The Social Dimensions of Adaptation to Climate Change in Bangladesh
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Iqbal Alam Khan, Zulfiqar Ali, M Asaduzzaman and M Harunur Rashid Bhuyan
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# ACRONYMS AND ABBREVIATIONS

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<th>Acronym</th>
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<tr>
<td>BIDS</td>
<td>Bangladesh Institute of Development Studies</td>
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<td>EACC</td>
<td>Economics of Adaptation to Climate Change</td>
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<td>FGD</td>
<td>Focus Group Discussion</td>
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<td>MOEF</td>
<td>Ministry of Environment and Forest</td>
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<td>NAPA</td>
<td>National Adaptation Program of Action</td>
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<td>NGOs</td>
<td>Nongovernmental Organizations</td>
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<td>NWMP</td>
<td>National Water Management Plan</td>
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<td>NWP</td>
<td>National Water Policy</td>
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<td>PSD</td>
<td>Participatory Scenario Development</td>
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<td>UNFCCC</td>
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ACKNOWLEDGMENTS

The social component of the Economics of Adaptation to Climate Change (EACC) study (hereafter ‘study’) was developed through the joint efforts of the World Bank Social Development (SDV) and Environment Departments (ENV) and LCR, AFR, EAP, and SAR Regions of the World Bank; ESSA Technologies Ltd and the International Institute for Sustainable Development (IISD), Canada; and research institutions in Bolivia, Bangladesh, Ethiopia, Ghana, Mozambique, and Vietnam. The study was undertaken by a core team led by Robin Mearns and comprising Anne Kuriakose, Carina Bachofen, Nilufar Ahmad and Minna Kononen (all SDV). An overall synthesis report of all six country reports is available at www.worldbank.org/eacc. The study was designed and implemented in close collaboration with the team leader for the overall EACC study (Sergio Margulis), and Ana Bucher, Laurent Cretegny, Urvashi Narain, Kiran Pandey, Robert Schneider (all ENV) and sector consultants.

The Bangladesh country study for the social component was led by Anne Kuriakose and Nilufar Ahmad (SDV), under the overall guidance of Robin Mearns, in collaboration with the EACC country team leader Kiran Pandey (ENV) and country office sector liaisons Shakil Ahmed Ferdausi (SASDI) and Khwaja Minnatullah (SASDI). Research partners in Bangladesh were the Bangladesh Institute of Development Studies (BIDS), where the study team was led by Zulfitar Ali and comprised lead researcher Iqbal Alam Khan, M. Azaduzzaman, and M. Harunur Rashid Bhuyan. Support in methodology and workshop design and for training of trainers for the Participatory Scenario Development (PSD) workshops was provided by Livia Bizikova (IISD), Samantha Boardley, Carol Murray (both ESSA), and Dale Rothman (IISD). A separate report is available summarizing this PSD work, along with a training of trainers manual at www.worldbank.org/eacc.

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EXECUTIVE SUMMARY

Bangladesh is one of the countries most vulnerable to climate change which also has a very high population density. The combination of a high level of poverty, and a depleted ecological system increase the country’s vulnerability to the impacts of climate change, which threatens the development achievements over the last decades. The increasing risks from climate change, sea level rise, and natural and man-made hazards—such as cyclones, storm surge, flooding, land erosion, water logging, and salinity intrusion in soil and water—already have adversely affected livelihoods of people living in environmentally fragile areas.

In 2005 the National Adaptation Program of Action (NAPA) for Bangladesh was prepared by the Ministry of Environment and Forest (MOEF) as a response to the decision of the Seventh Session of the Conference of the Parties (COP7) of the United Nations Framework Convention on Climate Change (UNFCCC). NAPA has prepared the adaptation measures as a set of actions complementary to national goals and objectives of other multilateral environmental agreements to which Bangladesh is one of the signatories.

The objectives of this study are to identify the social and livelihood groups vulnerable to climate change or climate variability; understand capital asset transformation capability of the villagers in potential hotspots; recognize and categorize climate change related hazards facing people in those hotspots; identify a range of adaptation measures in practice; and understand villagers’ aspirations and concerns regarding reduction of vulnerability and improvement of livelihoods.

To accomplish these objectives, the researchers identified eight villages, in various locations in Bangladesh, each of which is region that has faced and will continue to face natural (or in some cases man-made) disasters that likely will be worsened by the effects of climate change. These villages thus are known as “hotspots.” (A list of the hotspots is shown in Table 1). For the sake of simplicity, the hotspots are identified throughout the text by their predominant hazard characteristic, for example “drought prone” or “cyclone prone.”

One of the main purposes of the social component study is to understand the linkages between the adaptive capacity of the hotspot communities and the background of the communities in relation to their livelihood capital assets. This study focused more on the primary intervention of collecting data from the selected hotspots. To make the outcomes useful, this study combined both qualitative and quantitative approaches of field investigations. While quantitative data was collected via a household questionnaire survey, a focus also was given to the qualitative understanding of the livelihood strategies developed in the changing climate variability. This involved the use of various tools such as village mapping, village timelines, wealth ranking, focus group discussions (FGDs), Self-Assessments, Household Surveys, and Participatory Scenario Development (PSD) workshops.
FINDINGS

Although different hotspot areas are prone to different types of hazards, the above discussions highlight that the intensity and frequency of climatic events are increasing, thus bringing about greater impacts on the lives and livelihoods of people. Some devastating historical disasters have affected almost all places, although the degree of effect may be different. For instance, in respect to river floods, flash floods, waterlogged and drainage congestion-prone hotspots, all respondents highlighted the severe floods of 1988, 1998, and 2007, each of which had nationwide impacts. Similarly, the two consecutive cyclones Sidr and Aila (2007 and 2009, respectively) brought about huge miseries for people in hotspots close to the coast.

In all the hotspots, the most affected sector is usually agriculture because crop cultivation is highly depended on nature. While in cyclone prone area, crops are damaged by occasional cyclones, in salinity and tidal flood prone areas crop cultivation is gradually becoming difficult due to increased salinity. In other areas—such as river and flash flood hotspots—people can only grow crops in the Boro season, whereas in waterlogged areas farmers cannot grow crops in any season at all. Lack of crop production has direct impact on income as rural people are mostly depended on agriculture for their livelihoods.

The fisheries sector is highly affected in cyclone and waterlogged-prone hotspots, where cyclones and saline water have caused ghers to be damaged and fisheries to die. But in salinity and tidal flood prone hotspots, the same saline water created opportunities for shrimp farming. Even so, the poor are usually against shrimp cultivation because it leads to increased salinity and further damage to agricultural lands.

The impacts of natural disasters on livestock can be direct or indirect. In cyclone prone hotspots, livestock often die during cyclones when people fail to move them to safe shelters. In other areas—for example the waterlogged, drainage congested, and flash flood and river flood prone hotspots—livestock are occasionally affected by rises in water levels, during which they have to be moved to higher areas. However, in most areas people find in difficult to provide food for their cattle due to the absence of crop cultivation. Livestock always serve as important assets for the poor, and their products can either be consumed by the household or sold in the market.

Trees and vegetation are also severely affected in hotspots except for the drainage congestion-prone hotspots, because trees are not an integral part of urban life. In drought prone areas, people complained that they have no space for growing trees, while in waterlogged, river and flash flood prone areas, trees cannot be grown due to excess water. In cyclone, salinity and tidal flood prone hotspots, frequent cyclones cause trees to be uprooted and the soil salinity prevents homestead gardening.

Infrastructural damage is severe for the coastal hotspots, where cyclones lead to damage of roads, embankments, bridges, and houses, which need to be rebuilt completely. In the drainage congestion and flood prone areas, the damage is comparatively less, and minor repairs often can restore infrastructure to its original state. Problems occur when rising water level completely disrupts road communication for a few months, as in the case of a flash flood prone hotspot. Drought usually has no effect on infrastructure or household materials.

The health sector is mainly affected by waterborne and skin diseases resulting from floods, waterlogged and salinity. Long-term effects include malnutrition, stress, and increased physical labor arising out of poverty. Health problems create additional treatment expenditures and also lead to lack of productivity of labor. Severe consequences such as death tend to only occur in cyclone prone hotspots, although incidents such a drowning of children have also been recorded in flood prone areas.

The impacts on education can also be direct or indirect. Floods and cyclones often cause schools to remain closed for a few weeks and also create communication problems for children. In all hotspots, however, secondary effects are more severe, as when the lack of income compels parents to stop education of their children.

Due to various climatic hazards, landlessness is gradually increasing in almost all hotspots; this severely affects incomes since rural people mostly depend on
agro-based livelihoods. **Food insecurity** is a direct consequence of landlessness, because when people cannot grow crops, they cannot provide food for their families. In few hotspots, climatic hazards have led to new **social conflicts** or increased the previous ones. **Social insecurity** such as theft and harassment increases. Men do not want to leave their families and migrate to other places for work. However, in river flood and waterlogged prone areas, people mention that they have good social cohesion, and females feel confident to live alone in the absence of their husbands or sons. In cyclone prone area, social security is also good, and people can leave their assets and houses during cyclones without worrying that they could be stolen. But insecurity is a problem in the urban drainage congestion prone hotspots, where if people leave their houses unattended, everything would be stolen. **Poor health** and **poor education**, which are direct or indirect impacts of climate change, also increase vulnerability of people. **Poor communication** facilities increase vulnerability by reducing people’s mobility and livelihood options.

Coping mechanisms and adaptation vary according to the type of hazard in the different hotspots. Even when some of the coping mechanisms are similar for multiple hotspots, the extent of use and the time of usage vary. Temporary migration is most frequent for the working member of the hazard-affected households in the eight hotspots areas. About 37 percent households of the surveyed areas depend on temporal migration (rural and urban) to adapt with the natural hazards. In the hazard prone areas about one-third (32 percent) of respondents said they try to store food and drinking water, which they can use after the natural hazards. Livestock is the second most valuable asset, after land, for the farmers of rural Bangladesh, so they always try to take care of it. In the hotspots areas, about one in five households (24 percent) provide raised platforms for their livestock as an adaptation measure for climatic hazards. House repairing and rebuilding (39 percent) also are adaptation practices and options. The adaptive capacity of a community or household depends on its range of resources, which if sufficient can enable it to moderate potential damages and cope with the consequences of climate change.

None of the hotspots have a high adaptive capacity, which is understandable given their very poor asset base which prevents asset transformation in times of need. In tidal flood prone hotspots, the frequency and intensity of cyclones is quite lower than in cyclone and salinity prone hotspots, for which the impacts are comparatively less violent and the community has time to recover from the shocks. Moreover, people in the tidal flood prone hotspot have a wider range of livelihood opportunities as it is the most popular tourist spot in the country. Also nearby is the Bay of Bengal, where about 80 percent of the people are involved in fishing.

Although the cyclone and salinity prone hotspots are also part of two coastal districts, their access to the sea is restricted by the large expanse of mangrove forest. In the tidal flood prone area, comparatively rich businessmen carry out shrimp cultivation and salt production for which they can hire people as laborers. As a result, migration for work is less prominent in this area because even if people cannot cultivate crops or have fishing trawlers of their own, they can work as laborers. NGOs play an important role in post-disaster periods in cyclone prone hotspot, but this type of external support is absent in the salinity prone hotspot. In the latter, there are no cyclone shelters and no one has ever come to deliver warning signals, distribute relief materials, or reconstruct broken roads or houses. By contrast, NGOs for many years have rebuilt houses, provided radios, and delivered warnings in cyclone prone areas.

In both the river and flash flood prone hotspots, adaptive capacities are also low because there is little people can do to cope with the hazards. Like all other rural people, their incomes mainly depended on agricultural, but frequent floods destroy their crops and houses, further diminishing their financial prospects. Moreover, river erosion is diminishing the productivity of their lands, making their lives even more precarious and uncertain. In the waterlogged prone hotspot, people are rich in human capital and they have better education and skills compared to people in other areas. People are trying to diversify their livelihood options and move toward fishing, businesses, or services. They have better roads and access to safe water and electricity compared to other areas. Moreover, the presence of markets near the village allows people to sell the fish they catch, the handicrafts they make, and the livestock products they get. Social capital is also good in the area and the school headmaster uses his links to fight for the problems of...
this village. Their adaptive capacity is rated as medium, a little better than in the other hotspots. A similar situation prevails in the drought prone hotspot, where although people lack good human capital, their natural and physical assets are average. The proximity of the village to the upazilla (sub-district) town ensures that people have access to lot of services and opportunities. The village has numerous schools, mosques, shops, and basic institutions such as banks, health centers, government offices, and police stations.

Adaptive capacity is lowest in the urban drainage congestion prone hotspot, because people have few options to diversify their livelihoods. Here, they have no natural capital such as land or water bodies which they can use to make a living. Moreover, their education and skills are very low compared to other urban people, thus giving them little scope for moving up the income ladder. Social relations and health and hygienic conditions are also very poor.

The climate change-related hazards bring about multiple impacts on the communities which deteriorate their existing conditions and increase their vulnerabilities to further events. In order to cope and adapt to these recurring events, the local people have adopted a variety of mechanisms based on their indigenous knowledge and capacities. However, these practices are not enough to sustain their lives and livelihoods in the face of frequent and intense natural disasters. The government, together with assistance from local NGOs and international donor agencies, should take initiatives to increase the adaptive capacities of the people either by reducing their exposure to hazards and minimizing the damages or by strengthening their asset base and thus building their capacities.
1. INTRODUCTION AND OVERVIEW

SUMMARY OF EACC PROJECT AND THE SOCIAL COMPONENT

Current estimates of the costs of the likely impacts of climate change on developing countries and of the needed adaptation measures are in short supply, and the ones available are rather crude and simplistic. This is largely because the economics of adaptation to climate change (EACC) is relatively a new area of research. At the same time, an understanding of the full array of adaptation options, including institutional and policy changes, is crucial to prioritizing the most effective adaptation strategies. Better estimates of the overall budget implications of implementing “climate-resilient development” are needed both to enable developing countries to implement their national development strategies and to inform discussions concerning possible international assistance. In order to fill these gaps, a partnership has been formed between the World Bank and the governments of the United Kingdom, the Netherlands, and Switzerland, in which the World Bank has been tasked with leading the technical aspects of the EACC study to be funded by the three countries.

In particular, the study builds on learning from six country case studies covering a variety of environmental, social, cultural, and economic conditions, thus allowing for a degree of generalization and replication to most, if not all, developing-country contexts. These six countries are Bangladesh, Bolivia, Ethiopia, Ghana, Mozambique, and Vietnam.

STUDY RATIONALE AND APPROACH

The EACC study has two broad objectives. The first is to help decision makers in developing countries to better understand and assess the risks posed by climate change and to design strategies to adapt to it. This entails costing, prioritizing, sequencing, and integrating robust adaptation strategies into development plans and budgets. It also requires these strategies to deal explicitly with a high degree of uncertainty, potentially high future damages, and competing needs for investments in social and economic development.

The second objective of the study is to provide new and additional resources to help developing countries meet adaptation costs, especially in supporting their most vulnerable populations; in other words, to support country processes to develop climate-resilient development plans and budgets.

The Bangladesh Institute of Development Studies (BIDS) has been responsible for carrying out the research on the social component of the EACC study in Bangladesh. This report is based on the findings of the field work conducted in different climate change related vulnerable areas across the country. The rationale for this study was to understand the social dimensions of climate change adaptation and related elements of risk management, resilience, and social protection.

The Social Component study has two study objectives. The objective of the field study is to identify the social and livelihood groups vulnerable to climate change or climate variability; understand capital asset
transformation capability of the villagers in each hotspot; recognize and categorize climate change related hazards facing people in those hotspots, identify a range of adaptation measures in practice; and understand villagers’ aspirations and concerns regarding reduction of vulnerability and improvement of livelihoods.

The objective of the Participatory Scenario Development Workshop (PSD) at the local, regional, and national level was to help the local and national actors explore different climate futures and engage in structured debates around development priorities and relevant adaptation responses at the local, national, and regional levels. In other words, the purpose was to draw on both vulnerability and sustainable livelihoods conceptual frameworks to validate adaptation options and pathways through PSD workshops with stakeholders at each level. This also helped stakeholders to assess trade-offs and synergies between types of adaptation, development strategies, and enabling policies for future adaptation.

This research report thus put forward the study outputs describing the existing asset base of the hotspots and the future aspiration; livelihood practices; climatic hazards, impacts and vulnerabilities of the hotspots; coping mechanisms and adaptation practices; followed by recommendations from the stakeholders.

CONCEPTUAL FRAMEWORK

Bangladesh is one of the countries most vulnerable to climate change which also has a high population density. The combination of a high level of poverty and a depleted ecological system make the country more vulnerable to the impacts of climate change, which threatens the development achievements over the last decades. The increasing risks from climate change, sea level rise, natural and man-made hazards—such as cyclones, storm surge, flooding, land erosion, water logging and salinity intrusion in soil and water—have adversely affected livelihoods of people living in environmentally fragile areas. It has been estimated that a one meter rise in sea level would inundate 18 percent of the total land in Bangladesh, directly threatening about 11 percent of the population. Bangladesh experiences frequent natural disasters such as cyclones and floods as well as increasing soil salinity. These are projected to increase due to expected changes in precipitation, recession of Himalayan glaciers, and sea level rise (Watson et. al. 1998). Because large populations live in environmentally fragile areas such as coastal zones and islands that are devastated regularly by flash and riverine floods and are dependent on natural resources, they would become highly vulnerable to the impacts of climate change.

While significant progress has been made in Bangladesh over recent decades, women still predominate among the poorest because of their limited mobility and access to resources or information; this is reflected in the deaths of nearly five times more females than males in floods and cyclones (Aguilar 2008). Widespread poverty has made Bangladesh extremely vulnerable to the effects of tropical storms and flooding. Almost 50 percent of deaths from cyclones worldwide occur in Bangladesh, even though it experiences only 1 percent of all cyclones. (Amadore et al. 1996). This happens as thousands of people of Bangladesh live in climate vulnerable areas. As women’s participation in paid work outside home is low in South Asia, especially in Bangladesh, changes in crop, fishery, poultry and livestock production could severely impact the livelihoods and well-being of women and their children. Given the gender differential in vulnerability, it is important to have social assessments and institutional analyses that include gender-based experiences in collective actions and support from local institutions/networks when developing inclusive strategies for increased climate resilience. A gender-sensitive analysis is also important to direct aid and plan for full and equitable recovery in the case of frequent climatic events such as floods and cyclones, whose frequency and intensity are expected to rise with climate change. Furthermore, gender-sensitive analysis is important to ensure women’s participation in long term climate change adaptation strategies, which might have been constrained due to their traditional social norms in Bangladesh.

Figure 1 illustrates the generic links of climate change impacts with livelihood issues (Asaduzzaman et al 2005). Climate change is expected to have several impacts. Of these, above study pick out those which are likely to be of major importance in Bangladesh.
Climate Change – Poverty Nexus

Bangladesh’s high vulnerability to climate change is due to a number of hydro-geological and socio-economic factors that include: (a) its geographical location in South Asia; (b) its flat deltaic topography with very low elevation; (c) its extreme climate variability that is governed by monsoon patterns and which results in acute water distribution over space and time; (d) its high population density and poverty incidence; and (e) its majority of population being dependent on crop agriculture which is highly influenced by climate variability and change (Ahmed 2006).

The country faces too much water in monsoon season, causing floods, and receives too little water in dry season. This situation will be aggravated in a warmer climate, resulting in more severe droughts and increasing floods. It is projected that the possible sea level rise will inundate coastal areas of Bangladesh, thus forcing millions of people from their homes and livelihoods. Salinity has already increased in the coastal zones. This is caused by the low flow of fresh water from the Ganges and the ingress of salt water from Bay of Bengal. The climate change and the possible sea level rise is likely to inundate the coastal wetlands and lowlands, accentuate coastal erosion, increase the frequency and severity of floods, and create drainage and irrigation problems. Sea level rise from the south and enhanced Himalayan snow and glacial melt from the north will inundate large parts of Bangladesh in addition to today’s flood-affected areas.

The environment of Bangladesh contributes to the nation’s poverty, but it also is a mere victim of overexploitation and degradation. The frequently occurring hydro-geophysical hazards and extreme weather events have reduced streams of ecosystem services for the poor, which in turn has shrunk their livelihood opportunities. Subsistence-based agriculture has suffered the worst blow as a result of the proliferation of an input-dependent modern methods that constantly pushed the already marginalized farmers, who do not have the capacity to invest more to achieve for higher returns.
KEY AREAS OF INQUIRY

Asset and Livelihood Systems

Livelihoods

Various groups in society will experience the impacts of climate change in various degrees depending upon their initial economic conditions (poor or non-poor), location (coastal or non-coastal, rural or urban), and gender (NAPA 2005). Not only will subsistence agriculture be affected adversely; the food security of poor people in general will be at risk, leading to widespread malnutrition. Extensive water-logging, which is already being experienced, may worsen, causing adverse health effects due to outbreaks of pathogen-driven and water borne diseases.

Physical vulnerability varies across the coastal region. For example: in Khulna region waterlogging, soil salinity, and lack of cultivable land are significant; in Barisal region, tidal flooding, cyclone/tidal bore, salinity, siltation, and rat/insect infestation are problems; in Noakhali region, cyclone/tidal bores, river erosion, and drainage congestion are the most adverse physical or natural vulnerabilities; and in Chittagong region cyclone/tidal bore, different types of flood, and deterioration of soil fertility due to salinity are major physical vulnerabilities (Rahman et al. 2007).

Lack of employment opportunities and low wage rates seem to be the major vulnerability factors among the rural wage laborers. Physical vulnerabilities—such as lack of cultivable land and climate change stresses that have an effect on agriculture—ultimately convert into lack of employment opportunities for the wage laborers (Rahman et al. 2007).

Crop Agriculture and Food Security

The production of crops in Bangladesh is constrained by too much water during the wet season and too little during the dry season. The total irrigated area is 4.4 million ha, which is more than 50 percent of the potentially irrigable area of 7.12 million ha (NAPA 2005).

Together with the possible reduction in the Aman rice area (as a result of greater spread of flood waters, and longer duration of flooding) and a reduction in the Boro rice area (which will be limited due to constraints in irrigation), the total area suitable for rice production may in the future stagnate or possibly decrease. Of the three varieties of rice grown in Bangladesh, the aus rice (grown during the summer monsoon period under rain-fed conditions) seems to be the most vulnerable.

A GCM-coupled crop modeling exercise carried out by Karim et al. (1998) reported that Aus production would suffer by 27 per cent while wheat production would decline by 61 per cent under a moderate climate change scenario. Under a severe climate change scenario associated with 60 per cent moisture stress, the yield of Boro might decline by 55 to 62 per cent. It is interesting to note that, CO₂ fertilization would be able to prevent crop loss to a certain degree, but with increasing temperature the potential yield loss could not be completely offset by an increase in CO₂ concentration in the atmosphere (Ahmed, 2006).

Coastal Shrimp Culture

Stronger surge and tidal bores would increase the potential for saline water to overtop coastal embankments. Shrimp farms outside embankments create earthen mini-polders, locally known as ghers, to produce shrimp in captivity. Currently this is a big business in the coastal districts of Cox’s Bazaar, Satkhira, Khulna and Bagerhat. High tides would certainly threaten these ghers, both inside and outside embankments. On the other hand, salinity ingress in new areas to the north of current shrimp growing zones would facilitate shrimp business there.

A general rise in surface water temperature would also subject shrimp to heat-related stress. It is found that, if the temperature crosses a threshold of 32°C, the small shrimp fries would show very high rates of mortality. In April the temperature is already quite high. Simultaneously, warmer water might appear conducive for algal bloom, which would have detrimental effects on shrimp growth. (Ahmed 2006).

Livestock

Prolonged flood and cyclonic storm surges cause livestock death through a number of direct and indirect
mechanisms. During droughts, livestock in Bangladesh do not suffer death, but lack of water increases their vulnerability to diseases. Since climate change would increase susceptibility to natural disasters, the anticipated toll on livestock sector would be quite high.

The suffering of livestock in the coastal zone is much higher than in other parts of the country. Livestock density is relatively low in the coastal areas, particularly in the southwestern parts of the country. The gradual increase in salinity increases competition for freshwater resources. Animals used to have the least access to freshwater sources during the dry season. Due to drinking of poor quality water, these animals fell victim to diseases, which reduced their economic efficiency (draught power, milk production, etc.) (Ahmed 2006).

Forestry and Biodiversity

Bangladesh has a number of natural forest ecosystems including inland Sal forest (*Shorea Robusta*), dipterocarp forest, savanna, bamboo bushes in the hilly regions, and freshwater swamp forests. It also has littoral mangrove ecosystems and swamp forests. In addition to the forests the country also has a very rich aquatic biodiversity (with over 400 species) and bird and plant life. The biodiversity (both in the forested areas as well as elsewhere) is under threat due to human interventions, fragmenting of habitats, etc.

It was found that increased rainfall during the monsoon season would cause increased runoff in forest floors rather than infiltration into the soil. As a result, there would be enhanced soil erosion which would be more pronounced in sparse hill forest areas. Prolonged floods would severely affect growth of many timber species, while causing a high incidence of mortality for *Artocarpus* species. In contrast, enhanced evapo-transpiration in winter would cause increased moisture stress, especially in the Barind and Madhupur Tract areas, affecting the Sal forest ecosystem. The tea plantations in the north-east would also suffer due to moisture stress.

It was found that the Sundarbans mangrove forest (in southwestern Bangladesh) would be the most severely affected by climate change. Due to a combination of high evapo-transpiration and low-flow in winter, the salinity of the soil would increase. As a result the growth of freshwater loving species would be severely affected. Eventually the species offering dense canopy cover would be replaced by non-woody shrubs and bushes, while the overall forest productivity would decline significantly. The degradation of forest quality might cause a gradual depletion of rich diversity of the forest flora and fauna of the Sundarbans ecosystem. The forest floor may be experiencing a natural uplift due to sedimentation, but whether natural uplift is strong enough to counterbalance sea level rise is very uncertain. In a worst case scenario 32 cm of sea level rise may flood 84 percent of the Sundarbans, possibly by 2050; with an 88 cm sea level rise possible by 2100, the whole of Sundarbans would be lost (NAPA 2005).

Vulnerability and Climate Change

A wide range of social and economic factors has a direct and indirect bearing on human vulnerability to environmental change, including poverty, inequality, and the availability of natural resources. Poverty is generally recognized as one of the most important causes of vulnerability to environmental threats because the poor tend to have much lower coping capacities and thus bear a disproportionate burden of the impact of disasters, conflict, drought, desertification, and pollution.

Vulnerability is a subjective concept that includes three dimensions: exposure, sensitivity, and adaptive capacity of the affected system. The sensitivity and adaptive capacity in particular depend on a range of socio-economic characteristics. Several measures of social well-being, such as income and income inequality, nutritional status, access to lifelines such as insurance and social security, and so on, can affect baseline vulnerability to a range of climatic risks. Other factors might be risk-specific; for example, the proportion of rain-fed (as opposed to irrigated) agriculture might only be relevant for assessing vulnerability to drought (Agrawala et al. 2003).

Poor Hit Hardest

Poor people are the most susceptible members of society to the destruction caused by cyclones and flooding, and thus will be the primary victims of climate change, for a variety of reasons:
• Poverty exacerbates, and is exacerbated by, the impacts of climate change;
• Poor people’s livelihoods are highly dependent on natural resources, which are highly climate-sensitive; they also are the primary producers in our society.
• The poor are already struggling to cope with the extreme weather events;
• Poverty-stricken people often lack infrastructure for dwelling units or farms, which makes them vulnerable to natural disasters; and
• Their poverty makes it difficult to cope with even a small hike in production costs.

There are five categories of livelihood capital assets (human, social, natural, physical, and financial) and these play decisive roles in determining one’s contexts of vulnerability. It is important to develop socio-economic profiles for the major livelihood groups in an area to establish links between livelihood activities and climate-related risks. Application of the Sustainable Livelihoods Framework (SLF) can be of great help to this end.

Once the interaction between Livelihood Capital Assets and agents of change under altered climate conditions are superimposed, the effect of climate change on livelihood strategies and livelihood outcomes may easily be identified, as indicated in the SLF. A number of tools may be employed for such a participatory process. The use of SLF, involving a series of Focus Group Discussions and Key Informants’ Interviews or the much elaborated Participatory Vulnerability Assessment (PVA) technique of Action Aid International, may be utilized for these purposes (Oxfam, 2008).

Policy and Institutional Framework for Climate Resilience

Bangladesh has put in place a number of sectoral policies and plans (particularly during the 1990s) that bear upon its ability to cope with current climate risks, and to some extent the additional risks posed by climate change. The National Water Policy (NWP), promulgated in 1999 is the first ever policy document on water resources management for the country. NWP in its introductory section states, “Water resources management in Bangladesh faces immense challenges, the most critical of which are alternating flood and water scarcity during the wet and the dry seasons, ever-expanding water needs of a growing economy and population, and massive river sedimentation and bank erosion.” Delineation of flood risk zones, which will help minimize large-scale damages to assets is highlighted as a policy item under section 4.2 titled Planning and Management of Water Resources. Section 4.2j states the necessity of undertaking “… comprehensive development and management of the main rivers through a system of barrages and other structural and non-structural measures”. The policy calls for developing “… early warning and flood-proofing systems to manage… flood and drought.” The same thematic policy further mentions that “… the government will de-silt water courses to maintain proper drainage.” The policy theme titled Water Supply and Sanitation, under section 4.6, clearly states “salinity intrusions from sea water deep into the land in the south west are rendering groundwater unfit for consumption.” Unfortunately, no policy item was prescribed to tackle this issue. NWP also focuses on water use efficiency, regional cooperation for trans-boundary rivers and addresses water demands for Sundarban forest.

The NWP was followed by the National Water Management Plan (NWMP) in 2001 that looked at implementation and investment responses to address the critical priorities identified in the NWP. The 25-year planning document emphasized the importance of management of recurring floods, instead of containment by erecting investment-intensive embankments. Given the criticality of climate change impacts on water resources, it is noteworthy that NWP does not explicitly mention this issue. NWMP, however, recognizes climate change as one of the factors determining future water supply and demand.

In assessing the Baseline Scenario, section 3.6.5 of NWMP briefly outlines the major impacts of climate change on rainfall, drainage congestion, sea level rise, and natural disasters. Stating that the impacts of climate change on Bangladesh are of great importance, section 3.8.1 also recognizes climate change issues as a major knowledge gap at the national level. This may have been true for year 2001; however, extensive researches on these issues have since filled this gap. NWMP has emphasized arresting in-stream salinity through scientific interventions. If planned and implemented early, the southward push of the isohaline line above threshold levels will not only help reduce in-stream salinity, it
will also facilitate lowering of soil salinity by increasing chances of flushing of crop lands with river water. Section 8.5.1 on Objectives of Agriculture and Water Management says “…climate change studies have indicated that by the middle of this century evaporation precipitation ratios may increase significantly during the pre-saturation and establishment phase of the Kharif I and Rabi rice crops.” While discussing management of water resources in coastal areas, the same section mentions, “… sea level rise and increased tidal ranges will bring about further hydrological and morphological changes.” However, in the context of water-related disaster management plans, NWMP does not mention climate change as a factor influencing the frequency and intensity of future catastrophes.

Bangladesh’s National Environmental Management Action Plan (NEMAP), which was published in 1995, does not explicitly discuss climate change. NEMAP does, however, add a cautionary note on the environmental damages that may result from structural flood control measures—which might highlight some conflicts with structural adaptation responses (such as the construction of barrages) highlighted under the NWP and NWMP, and other environmental consequences such as migration and breeding of fish-stock. Similar to NEMAP, the National Land Use Policy (NLUP) does not make direct reference to climate change. NLUP however aims to bring 25 percent of the land under forest cover and highlights mangrove plantations in char lands, and coastal green belts more generally as a priority. It also advocates conservation of existing forest lands, including the Sundarbans. These priorities of NLUP are also echoed the National Forest Policy (NFoP) that was initially formulated in 1979 and revised in 1994—although the goal of NFoP is to bring 20 percent (as opposed to 25 percent in NLUP) of the total land under forest cover. Forest conservation priorities in NFoP and NLUP could help reduce some of the other stresses on ecosystems such as the Sundarbans, thereby increasing their resilience to the impacts of climate change.

There is a plethora of policy/strategy documents relevant to broad agriculture and rural development in Bangladesh. These documents are generally compatible in terms of their avowed goals of rapid poverty reduction, increasing productivity and profitability of farming, and creating income and employment opportunities, especially for rural women. As expected, about a half of the policy documents deal with the crop sub-sector at large, although the contents of these documents deal mainly with cereal crops, especially rice. The Non-crop sub-sector, covering fishery, livestock and forestry, appears less prominently both in terms of coverage and focus. The National Agricultural Policy (NAP), 1999, emphasizes that the goal of food self-sufficiency and dependable food security can be achieved only through efficient delivery of inputs and support services. The policy is strongly biased toward the economic aspects, giving little emphasis to the social and the environmental aspects of agricultural development. Concretely, the government has adopted an approach to chemical agriculture and is focused on cropping systems rather than on integrated farming systems.

The main goal of the National Agricultural Extension Policy (NAEP), 1996, is to encourage the various partners and agencies within the national agricultural extension system to provide efficient and effective services which complement and reinforce each other in an effort to increase the efficiency and productivity of agriculture in Bangladesh. Other policies in this sector include National Fishery Policy, 1998; Seed Policy, 1993; Livestock Policy and Action Plan, 2005 and National Food Policy, 2004. However, none of these policies address the impacts of climate change on agriculture and livelihoods and hence, mentions no preparations in this regard. The Actionable Policy Brief (APB) 2004, the last in this series of policies, is also based on the overarching national goal of food security, which basically means sufficient cereal stock in the country. The APB is built on a solid conceptual framework, focused vision for the future, indicators of comparative advantages, competitive strength and profitability that will guide the development of each crop subsector, constraints to moving forward and key challenges that must be faced in achieving the overall objective of promoting food security for all in the country.

The coast of Bangladesh is known as a zone of vulnerabilities as well as opportunities. To reduce coastal vulnerabilities, improve the livelihood of the coastal people, ensure the optimum used of coastal resources and create an enabling institutional environment, the Ministry of Water Resources formulated the Coastal
Zone Policy (CZPo) in 2005. The coastal zone policy is unique in the sense that it is a harmonized policy that transcends sectoral perspectives. This policy explicitly identifies that the livelihoods and wellbeing of people in coastal areas have direct correlation with exogenous phenomena influencing them. “Section 4.3: Reduction of Vulnerabilities” mentions, "Disasters like cyclone, drainage congestion, land erosion and drought that take toll on life and property and depletion of natural resource base that supports particularly the poor. Majority households are vulnerable to climate change." In this regard, the policy focuses on comprehensive disaster management, which includes maintenance and construction of cyclone shelters and sea dykes and enhancing coping mechanisms. Impacts of salinity intrusion on coastal resources have been identified and development of salt-tolerant crop varieties, construction of freshwater reservoirs, and rainwater harvesting have been suggested. Measures will be taken for afforestation in the coastal areas including newly accreted chars. Section 4.5, 4.6 and 4.7 addresses issues of equitable distribution of benefits, human development of disadvantaged communities, women empowerment and a participatory approach in determining the needs of the coastal people. “Section 4.8.3: Climate Change,” a separate part dedicated to climate change, states, “Implementation of adaptive measures identified in relation to climate change for coastal zone and resources shall be gradually undertaken.”

The Comprehensive Disaster Management Programme (CDMP) was approved by GoB in 2003, bringing about a paradigm shift in disaster management from conventional response and relief practice to a more comprehensive risk reduction culture. Standing Orders have been prepared with the avowed objective of making the concerned persons understand their duties and responsibilities regarding disaster management at all levels, and accomplishing them. All Ministries, Divisions/Departments and Agencies shall prepare their own Action Plans in respect of their responsibilities under the Standing Orders for efficient implementation.

The draft National Plan for Disaster Management 2007–2015 is an outcome of the national and international commitments of GoB and the Ministry of Food and Disaster Management (MoFDM) for addressing the disaster risks comprehensively. It is indicative to what the relevant regional and sectoral plans would consider to address the key issues like risk reduction, capacity building, climate change adaptation, livelihood security, gender mainstreaming, community empowerment and response, and recovery management. The plan carries out detailed discussion on the causes, trends, and effects of important hazards such as flood, drought, cyclone, storm surge, arsenic contamination, salinity intrusion, riverbank erosion, and others. However, this section doesn't mention climate change as a dominating factor in altering disaster patterns. The Disaster Management Action Matrix outlines major strategic goals and key targets, of which one of the key targets is "Establish an Integrated Approach to disaster management including climate change and climate variability impacts". A number of Action Agendas for 2007–2015 have been mentioned under this target. These include: giving capacity to the Climate Change Cell within the Department of Environment (DoE); developing scenario and prediction models and conduct research to determine climate variability impacts for Bangladesh; identifying adaptation options through action research and incorporating this knowledge in disaster risk reduction program designs.

People in Places: Socio-Spatial Approaches to Adaptation

Spatial Variation

Levels of poverty vary substantially across the country and are strongly correlated with spatial distribution of food insecurity. The United Nations World Food Program (WFP) has reported that the poorest upazilas can be found in the north-west, the coastal belt, Mymensingh, Netrakona, Bandarban and Rangamati. In terms of absolute numbers, districts with more than one million people living in extreme poverty include Sirajganj, Naogaon, Bogra, Mymensingh, and Chittagong (NAPA 2005).

According to “The Bangladesh Rural Poverty Mapping Project,” the areas with highest incidence of poverty are the depressed basins in Sunamganj, Habiganj, and Netrokona districts in the greater Sylhet region; the northwestern districts of Jamalpur, Kurigram, Nilphamari, and Nawabganj; and, in the south, Cox’s Bazar and coastal islands of Bhola, Hatia, and Sandeep.
The areas with low levels of poverty are the greater Dhaka and Barisal regions, and Bogra, Pabna, and Jessore regions. This spatial pattern is similar with regard to incidence of extreme poverty.

Possible determinants contributing to this depressing state of poverty hotspots would be other aspects of human wellbeing and deprivation, including people’s assets (human, financial, and physical capital); their opportunities (natural resources endowment, accessibility, and migration); and their vulnerabilities or susceptibilities to environmental stresses.

The pockets of high poverty incidence generally coincide with the ecologically poor areas of Bangladesh:

1. The low-lying depression area, called *haor*, in the north-east;
2. The drought-prone area on relatively higher land in the north-west;
3. Several *upazilas* fringing the major rivers, particularly along the Jamuna River; and
4. Several of the south-eastern *upazilas*, including the Chittagong Hill Tract.

Despite the apparent geographical association of the poverty pockets with ecologically unfavourable areas, only few of the biophysical variables correlate significantly with the poverty indices. The significant ones include the prevalence of high land, low and very low-lying land, and heavy textured soil types. These partly explain the association of high poverty incidence with the *haor* and the hilly areas. Climatic variables such as rainfall availability emerge as insignificant, partly because of the non-linear relationship of rainfall with poverty. Other factors, particularly irrigation, mask the significance of associated climatic constraints, particularly drought, in explaining poverty over geographical space.

Among the coastal zones, poverty incidence is low in the western part toward Khulna (where livestock ownership, educational attainment, and prevalence of clayey soils are high) and is high in the eastern part toward Chittagong. The incidence of poverty and extreme poverty is generally lower in the western part, covering southern Rajshahi and northern Khulna Divisions. In fact, this part has more high land area and is more drought-prone but the higher irrigation coverage is key in achieving high productivity despite the biophysical constraints. The eastern part is relatively better endowed (with more extensive medium and low land, higher rainfall and educational attainment); yet these resources do not seem to have been effectively deployed for improving livelihoods (Pheng 2003).
2. SOCIAL DIMENSIONS OF CLIMATE CHANGE IN BANGLADESH

EXPECTED PHYSICAL IMPACTS OF CLIMATE CHANGE IN BANGLADESH

Water resources are ranked as the greatest concern because flooding is already an important issue for the country. Increased flooding will be significant in terms of damage to infrastructure and livelihoods at the present stage of development. The combination of increased glacial melt and increased monsoon intensity makes increased flooding more likely to occur.

Bangladesh’s coastal resources are ranked as next most vulnerable because the country exists mainly in a delta with most of its population and resources at low elevations. Sea level is likely to rise; and indeed it is more certain than increased flooding. However, the full impacts of sea level rise may not be realized for many decades, thus yielding it second place in the risk ranking.

Human health is ranked below these other sectors because of the significant uncertainty about many impacts, although it is likely that climate change will present increased health risks to Bangladesh. In particular, increased flooding could threaten human health through drowning and spread of disease.

Finally, agriculture is last because a number of studies estimate increased yields with small amounts of warming, but decreased yields with larger levels of warming. With the mixture of beneficial and initially adverse impacts, agriculture is consequently ranked as having less vulnerability than the other sectors.

Flood

The predicted increase in rainfall, changes in its timing, and melting of glaciers in the Himalayas will exacerbate the flood situation by increasing the frequency, duration, and extent of flooding. Rising sea levels will retard the flow velocities of the major rivers, particularly at their confluence points, resulting in sedimentation in river beds and decreasing river gradients.

A rise in sea level would not only inundate low-lying areas along the coast, it would also create a favorable condition for saline waters to overtop the flood protecting coastal embankments, especially when induced by strong winds. Breaching of existing coastal embankments will also inundate land with saline waters (Ahmed 2006).

In the short term, faster melting of glaciers is likely to increase water flowing down rivers like the Ganges/Padma in the spring and monsoon months, which already contributes (along with rainfall) to devastating river floods. However, in the long term the shrinking and thinning of Himalayan glaciers will lead to shortages of water in rivers, and rivers may even disappear permanently in some places once the glaciers have completely melted (Pender, 2008).

Drought

It is prognosticated that, under climate change scenario, evapo-transpiration will increase significantly, especially during the post-monsoon and pre-monsoon seasons, in
the backdrop of diminishing rainfall in winter and already erratic rainfall variability over time and space (Ahmed, 2006). About 12,220 km² will be transformed to very severe class against the existing 3,639 km² (a more than three-fold increase) under severe changes in climatic system during Rabi season. During Kharif four times more area will be changed to very severe class from the severe and moderate areas. The worst affected regions would be north-west, north-central, and south-west where both irrigated and rainfed crops would be affected (Rahman, et al. 2007).

Sea Level Rise

Processes not related to global warming in Bangladesh that are actively causing sea level rise include:

- Tectonic subsidence, which means that coastal Bangladesh is very gradually sinking due to the weight of the silt being deposited by its rivers and the continued rise of the Himalayas, which is slightly tipping Bangladesh seawards;
- Compaction of peat layers, which are soft layers of organic dead plant and animal material that are gradually being squeezed tightly together by the weight of the land above; and
- Human activities such as removal of water from the ground for irrigation, which speeds compaction, and the building of dams, dykes, embankments, and other measures to prevent floods, for these prevent new layers of silt raising the land level as older layers compact and sink (Pender 2008).

Bangladesh has been ranked as the third most vulnerable country in the world to sea level rise in terms of the number of people affected, and in the top ten in terms of percentage of population living in the low elevation coastal zone. Currently almost 40 million live in the coastal areas of Bangladesh, but depending on the rate of population growth, by 2080 when the situation begins to get more serious 51 to 97 million people could be living in this vulnerable area. In year 2050, assuming a sea level rise of 27 cm, around 26 million people will be at a low risk and almost 7 million will be at medium risk of flooding, of which 58 percent will be from Khulna, Satkhira, and Bagerhat most affected. As well as making household water supply problematic, salinity negatively affects agricultural production; a study in Khulna, Bagerhat, and Satkhira districts of southwest region of Bangladesh found that the suitable area for transplanted Aman rice cultivation will reduce from 88 percent to 60 percent with a 32 cm rise in sea level and 12 percent with an 88 cm rise in sea level (Pender 2008).

Salinity Intrusion

Changes in the surface water salinity pattern due to a 30 cm rise of sea level revealed that the present dry season saline front (2 dS/m) is expected to move 30 km to 50 km North, affecting most of Khulna, Jessore, Barisal, Patuakhali, and Noakhali (greater) districts and parts of Faridpur and Comilla districts. With a 1 m rise of sea level, the saline water front will move far North on the Northeastern side of Bangladesh. Most of Jessore, Faridpur, Comilla, and part of Dhaka (greater) districts will be affected by saline surface water intrusion. Most of Barisal, Patuakhali, Sundarbans, Bhola, Hatia, and Sandwip will be directly inundated by saline/brackish water or will have serious saline water logging problem. Salt water intrusion along the Meghna River valley may reach up to Mymensingh and Sylhet districts (Rahman, et al. 2007).

Currently, about 6 million people are already exposed to high salinity (>5 ppt), but due to climate change this is expected to increase to 13.6 million in 2050 and 14.8 million in 2080, with the population in Khulna, Satkhira, and Bagerhat most affected. As well as making household water supply problematic, salinity negatively affects agricultural production; a study in Khulna, Bagerhat, and Satkhira districts of southwest region of Bangladesh found that the suitable area for transplanted Aman rice cultivation will reduce from 88 percent to 60 percent with a 32 cm rise in sea level and 12 percent with an 88 cm rise in sea level (Pender 2008).

Drainage Congestion

Climate change will cause drainage congestion (resulting in waterlogging and localized flooding) due to a number of factors: Firstly, the higher sea water levels means the rivers gradients are reduced; in other words their slope from the mountains to the sea is not as steep, which will lead to higher river levels due to a backwater effect. Drainage congestion occurs mainly from July to October when cultivation of transplanted Aman rice is damaged if water depth is more than 30 cm for over three days (Pender 2008).
Coastal Erosion

The total length of the Bangladesh coastline is 710 km, and historically the coastline has undergone erosion and deposition. However, the balance between the two is being affected by climate change, such as more powerful cyclones and a higher sea level, with the result that more erosion is likely to occur but less deposition of sediments.

In terms of area this means that 5,800 hectares of land could be lost to sea erosion by 2030 and 11,200 hectares by 2075, together with 13,750 tons of foodgrain production by 2030 and 252,000 tons of foodgrain production by 2075. People will also be displaced, for example the island of Kutubdia, just off the coast of the southern district of Cox’s Bazar, has shrunk by half in less than 50 years and is expected to vanish completely in another 70 years due to erosion, partly caused by the 1991 cyclone (Pender 2008).

Cyclones and Storm Surges

As a result of climate change it is likely that future tropical cyclones will become stronger, with larger peak wind speeds and more heavy rainfall associated with ongoing increases of tropical sea surface temperatures. The increased wind speeds resulting from higher sea surface temperatures due to climate change means that storm surge heights will increase from 15% to 25% in the 2020s and 32% in the 2050s (Pender 2008).

River Bank Erosion and Vulnerability of Charlands

As most of the country is made up of soft silt soils, riverbanks are very eroded by river currents and wave action. River bank erosion includes channel shifting, the creation of new channels during floods, bank slumping due to undercutting, and local scour from turbulence caused by obstruction (Ahmed 2006).

An estimated 6.5 million people—around 5 percent of the Bangladeshi population—live on the Chars, and of the total land area of the country, 5 percent is Char, which comes to about a total area of approximately 7,200 square kilometers. The Char dwellers mainly depend on agriculture and agriculture-related activities. Opportunities for off-farm activities are marginal. As a result of river erosion, cultivable land, crops, and homesteads are often damaged or devoured by rivers regularly. The lack of basic services and governance representation, and dependence on limited and seasonally variable resource access, demands highly innovative and diversified livelihood strategies in the Chars—but this also leads to considerable social inequity. High food insecurity and low income results in the out migration of at least one household member (usually adult male) to find employment, leaving women and children to subsist (Chowdhury).

NATIONAL PLANNING FOR CLIMATE CHANGE: NAPA AND OTHER STRATEGIES

Bangladesh has been preparing its medium-term national development plan, known as the Five-Year Plan, since 1973. Along with the other sectoral development strategies, the Fourth Five Year Plan for the first time, and subsequently the Fifth Five-Year Plan (1997–2002) more urgently, tried to address the need for protection and conservation of the environment toward sustainable development of the economy. The major environmental issues identified and addressed in the Fifth Five-Year Plan are natural disasters, industrial pollution, health and sanitation, deforestation, desertification, changes in climatic condition, salinity, and deteriorating habitat of flora and fauna. Since the Fifth Five Year Plan, there has been no other.

In 2005, the government prepared a Poverty Reduction Strategy Paper (PRSP), which provides a comprehensive overview of the poverty situation in Bangladesh and opts for pro-poor economic growth. There are eight specific avenues—four strategic blocks and four supporting strategies—through which the goal of accelerated poverty reduction will be pursued. The “Strategic Block II: Critical Sectors for Pro-poor Economic Growth,” section of the PRSP emphasizes the agricultural and water development sectors and identifies that the country’s growth is highly dependent on natural resources and is affected by natural disasters and degradation of terrestrial and aquatic resources. The water resources management thus identifies the major issues of concern as floods, drainage congestion, droughts, cross-boundary flows, river erosion and accretion, cyclones, water quality and rights, surface water salinity, groundwater quality, climate change, and environmental management. The section on “Supporting Strategy IV: Caring for the
Environment and Sustainable Development,” mentions, ‘Human lives and livelihood in Bangladesh are intricately intertwined with nature. Consequently, no process of development and eradication of poverty can be conceived of without putting caring for environment and sustainable development at the centre-stage.’ The focus in this section is two-fold: conservation of natural resources such as agricultural land, forests, biodiversity, and combating pollution of air, and surface and ground water.

Of the 18 policy matrices outlined at the end of the PRSP, “Policy Matrix 7: Comprehensive Disaster Management Plan towards Poverty Reduction and Growth,” indicates mainstreaming disaster management into national policies, institutions, and development process; and strengthening capacity and enhancing knowledge on risk reductions. It recognizes the National Adaptation Program of Action (NAPA) as an ongoing activity to address some of the pertinent climate change issues. “Policy Matrix 18: Environment and Sustainable Development,” identified the integration of climate change adaptation in all policies, programs and projects as one of the key targets. Capacity building for integrating climate change into water and agriculture sectors and promotion of community based adaptation projects to address adverse effects of climate, have been mentioned as future priorities under this target.

Also in 2005, the National Adaptation Program of Action (NAPA) for Bangladesh was prepared by the Ministry of Environment and Forest (MOEF) as a response to the decision of the Seventh Session of the Conference of the Parties (COP7) of the United Nations Framework Convention on Climate Change (UNFCCC). NAPA has prepared the adaptation measures as a set of actions complementary to national goals and objectives of other multilateral environmental agreements to which Bangladesh is one of the signatories. NAPA provides detailed discussions of the historical climatic events in Bangladesh and how these will be exacerbated by climate change with specific focus on relevant sectors. Apart from mentioning the adaptation measures that have been undertaken till date by various government and non-government organizations in Bangladesh, NAPA suggested future coping strategies and mechanisms based on existing practices, keeping the main essence of adaptation science which is a process to adjust to the adverse situation of climate change. It outlines 15 large-scale projects divided into intervention and facilitating-type measures and based on certain pre-selected criteria.

In the aftermath of the COP13 at Bali, Indonesia, the GoB increasingly felt the need for a climate change strategy to carry forward and coordinate activities in support of the Bali Action Plan. Subsequently, in 2008 the Government developed the Bangladesh Climate Change Strategy and Action Plan (BCCSAP) through a fully consultative process involving government, civil society, and development partners.

The BCCSAP is presented in two parts. The first part provides the background based on physical and climatic contexts, core socio-economic realities and policies in the country, and the consequent rationale for a strategy on climate change. The thrust of the strategy is on sustainable development, poverty reduction, and increased well-being of all vulnerable groups in society with special emphasis on gender sensitivity. The second part elaborates a set of programs based upon six pillars or broad areas of intervention namely: food security; social protection and health; comprehensive disaster management; infrastructure; research and knowledge management; mitigation and low carbon development; and capacity building and institutional strengthening. The BCCSAP sums up Bangladesh’s current thinking on desirable activities to build climate resilience into the economy and society through adaptation to climate change as well as mitigation for a low carbon development path. The implementation of the BCCSAP will be financed through the Government’s own resources and external support that may be available from the development partners, as well as the specific international funds created for the purpose.

OVERVIEW OF SOCIAL VULNERABILITY IN BANGLADESH

Human Health

The combination of higher temperatures and potential increases in summer precipitation could create favorable conditions for greater intensity or spread of many infectious diseases. Still, the perceived risk to human health is low relative to those in other sectors (such as water resources) mainly because of the higher uncertainty about many of the possible health outcomes. Increased
risk to human health from increased flooding and cyclones seems most likely. Changes in infectious disease are less certain, as the causes of outbreaks of infectious disease are quite complex and often do not have a simple relationship with increasing temperature or change in precipitation. However, in general, climate change is expected to present increased risks to human health in Bangladesh, especially in light of the poor state of the country’s public health infrastructure. Life expectancy is only 61 years, and 61 percent of children are malnourished (NAPA 2005).

Gender Situation

Women are more vulnerable than men generally to all kinds of disasters and climate-related impacts due to gender inequalities in various social, economic, and political institutions. Women have limited access to and control over natural resources or money and, more importantly, are less mobile and have limited access to information. When a cyclone and floods hit Bangladesh in 1991, the death rate for women was almost five times higher than for men. Many women are not allowed to leave their homes without a male relative, and simply waited for their relatives to return home and take them to a safe place. Moreover, as in many Asian countries, most Bengali women have never learned to swim. In saline and drought prone areas where fresh water is in short supply, further stress is put on women who have responsibility to supply it to their families; they are often forced to walk long distances, risking their health and their safety in the process (Pender 2008).
3. RESEARCH METHODOLOGY

RESEARCH STRATEGY AND QUESTIONS

One of the main purposes of the social component study was to understand the linkages between the adaptive capacity of the hotspot communities and the background of the communities in relation to their livelihood capital assets. This study focused more on the primary intervention of collecting data from the selected hotspots. To make the outcomes useful, this study combined both qualitative and quantitative approaches of field investigations. Though quantitative data was collected via a household questionnaire survey, focus was made on the qualitative to understand the livelihood strategies developed in the changing climate variability.

SITE SELECTION AND SAMPLING

Site selection and sampling were done through literature review, key informant discussion, and preliminary field visits.

The literature review basically reviewed the existing research reports and policy documents to collect information on climate-related hazards and poverty in Bangladesh. The review was also important to identify the most vulnerable areas and the macro, sectoral, and donor policies that influence activities in different areas.

Key informants such as environmentalists, researchers, government officials, and NGO activists involved in relevant sectors were asked to deliver opinions based on their work experiences.

After primary selection of the hotspot sites through literature reviews and key informant interviews, a research officer from BIDS made a preliminary visit to each proposed hotspot to reconfirm the basis of selection and suggest changes where necessary.

METHODS: TOOLS EMPLOYED

This involved the use of various tools such as village mapping, village timeline, wealth ranking, FGDs, Self-Assessments, and Household Surveys.

Village Mapping: The village mapping was really helpful for building rapport with the villagers. The purpose of the village mapping was to understand the contextual reality as the villagers introduced their village by drawing its map. The participants, who were local men of various ages, were given markers of different colors and chart paper. They selected one person among themselves who could write Bangla and draw the map. He first marked “North” on the chart paper and then drew the map of the village accordingly, indicating locations of agricultural lands, infrastructure, institutions, settlements, water bodies, forests, etc., while other participants gave suggestions where necessary. The activity generated a rich map of the village with properly labeled legends and gave a visual understanding of the village’s livelihoods and possible sources of hazards from the village’s surroundings.

Village Timeline: The village timeline basically produced a listing of natural hazards that villagers had faced for the last 30 years or more. A timeline was drawn on a large sheet of paper and the years were marked, starting from 1970 to 2009. Villagers were
asked to recall the extreme natural hazards that took place in the area, starting from the most recent ones and moving backwards in time. In order to assist them to remember the events, the time periods were linked to political regimes. The participants were knowledgeable local people, school teachers, and general villagers. Once the events were marked on the timeline, the villagers were asked about the relative magnitudes of the events in terms of intensity and damages caused, and how each of the hazards affected the village. All the information was written down on the chart paper. This exercise helped the study team to understand the village’s history of climatic hazards and contextualize the present in relation to past events.

**Wealth Ranking:** In doing the Wealth Ranking, the villagers were asked to distinguish between existing wealth classes on the basis of important characteristics such as monthly income, assets, savings, livestock, education, utilities, housing, land ownership, etc. It was administered following the traditional PRA process. Four-to-six different classes were identified in different hotspot villages and they were written down on the chart paper with the characteristic of the classes. Names of the household heads of each class were asked and were written down on small cards and glued to the chart paper against the column of respective wealth class. The participants were then asked which class of the household move up and down the social ladder more quickly (or slowly) after a hazard, the reasons behind such mobility, migration situation and causes of it, where in ranking are the female-headed households, disabled persons, in-migrants, out-migrants, traditional leaders, and formal officeholders. This helped to identify the vulnerable groups or families on the basis of their adaptation history and trends. The wealth ranking was also used to select respondents for the Household Survey from among the wealth categories, so that the survey contained a fair percentage of respondents from each of the categories, and none were left out. The participants consisted of both local men and women from different age groups.

**FGDs on Livelihoods, Climatic Hazards and Adaptation Practices:** As mentioned earlier, a qualitative approach was the focus of the study, and a bottom-up participatory strategy was followed throughout the fieldwork. The FGDs were one such research tool used in the field. In each hotspot villages separate FGDs were done with men and women. They were asked some basic questions on livelihood options, socioeconomic scenario, climatic hazards, and adaptations of the villagers and the future adaptation needs. As the facilitator ran the session a note taker took written notes of everything the participants said in the FGD. The participants consisted of men and women of varying age and wealth class; from 18 years to 65 years and from extremely poor to the richest, with different occupations. Any disagreements among the participants that came up were also properly noted down. The facilitator, rather than asking direct questions, tried to present a clear sequence of issues and their logical explanations, in a natural village setting, in the context of local livelihood option available. The data obtained were analyzed by the participants of the FGD to reconfirm and at times they were crosschecked with other villagers who were not in the FGD. The FGDs were a key part of the data collection strategy.

**Self-Assessments:** The Self-assessments were participatory exercise designed for the households to self-assess their own levels of adaptive capacity. They were shown a list of indicators under each capital assets (human, social, financial, natural, and physical) and asked to choose their most relevant three indicators which they consider to be most important in order to adapt to climatic hazards. The indicators were then ranked 1, 2, and 3 and the participants were asked to discuss and provide logic for choosing the indicators to represent each capital asset. Each indicator had a score from 1 to 5, where 1 = very poor, 2 = poor, 3 = average, 4 = good, 5 = very good. The participants were explained the scoring and they were asked to score their chosen indicators on the basis of its current adequacy for adaptation potential. They were correspondingly asked about the reasons for dedicating the particular score. The next question was what steps should be taken to improve the current situation of that particular indicator and who needs to do what. Lastly they were asked to give a future aspiration score to the indicators. All the discussions were written down on the large sheets of paper in Bangla so that the participants could see clearly and make any necessary changes or suggestions. A note taker wrote down all the discussions. Later the data was processed on an Excel spreadsheet and asset pentagon for each of the eight hotspots.
were prepared for comparison. The future aspiration scores were also plotted on the same axis of the pentagon to find out which capital asset the villagers aspired to the most.

**Quantitative Survey:** A semi-structured questionnaire was used to interview respondents from the eight hotspots (around 20 households per hotspot, totaling 170 households interviewed) to gain in-depth information about his/her family members, income sources, assets, impact of hazard, adaptation techniques, the costs involved, future plans and the role of local/government institutions in assisting the village community. The respondents were selected from range of vulnerability/livelihood profiles found from wealth rank techniques.
4. FIELDWORK RESULTS

OVERVIEW AND INTRODUCTION TO AREAS OF INVESTIGATION

Due to a number of hydro-geological and socio-economic factors, Bangladesh is one of the countries most vulnerable to the impacts of climate change. People in Bangladesh live precariously close to the risks of cyclones, floods, and droughts and more than 100 million people live in rural areas. Based on the geographical location within the country, different areas are exposed to different types and magnitudes of natural hazards. Taking all these various climatic events into account, a total of eight study sites or “hotspots” have been selected from the entire country. In the context of this study, the term “hotspots” refers to the regions most responsive to climate change that are already vulnerable and are likely to suffer substantial impacts as a result of climate change. Hence, they represent areas where climate change-related intervention activities might be concentrated.

Bangladesh is exposed to a wide variety of climate change hazards, which include drought, river floods, flash floods, cyclones and tidal surges, salinity intrusion, water-logging, and drainage congestion. Each of the selected hotspots has been tied to one of these major events so that the impacts of that particular hazard on the community can be assessed. While each “hotspot” clearly represents one specific hazard, it must be borne in mind that many areas are exposed to multiple hazards, each causing or reinforcing the others. The country shows extreme spatial and temporal climatic variability as well as unevenness in socio-economic development, all of which may lead to differentiated patterns of vulnerability to climate change.

The map of Bangladesh (Figure 2) marks the selected hotspots of this study which are distributed across different zones of the country, having variation in socio-economic development, resource availability, and exposure to natural hazards. Although a broad area or district has been pinpointed on the map, the field study has been conducted in a narrow area, which is a particular village or community settlement such as slum (Table 1). For each of these hotspots, detailed descriptions, encompassing the geographical context, natural setting, demographic characteristics, asset base, and livelihood options, have been given in the following paragraphs.

HOUSEHOLD ASSET BASE AND VULNERABILITY

Asset Base:

As defined by the Sustainable Livelihoods Framework, the capital assets owned by a community have been grouped into five categories (human, social, physical, natural, and financial). While there are differences in asset ownership or access between communities of different hotspots, there are also vast disparities between different wealth classes within the same community. Detailed description of these assets is provided below.

Human Capital

1. Education: Education opens up new horizons and provides better job opportunities so that people no longer have to depend on natural resources for
their livelihoods. Adult literacy rate is very low in most places because when the currently middle-aged people were young, there were few opportunities for schooling. Since the last decade, many NGOs have opened schools in many villages for which young children have chance to obtain a
good education. Today, although many young children go to school, the drop-out rate is high because the poor families cannot afford to continue education of their children. Even if tuition fees are waived, it is very difficult for the parents to afford books, stationeries, and uniforms. Moreover, the children have to leave school in order to work with their parents and help feed the family. However, there are still variations in this situation. In the drought prone hotspot, although there are many schools, literacy is very low because of poverty. Moreover, people believe that education has no use because even graduates stay unemployed. On the other hand, in the waterlogging prone hotspot, the situation is similar but education is highly valued. Parents work hard all day to meet the education expenses and women even carry their young children to school in times of high water levels. Unlike other areas, women in this village are also educated to the primary and secondary levels, and even beyond. In the river flood prone and flash flood prone areas, education is highly disrupted by floods, and schools remain closed in monsoon season. In the salinity prone hotspot, children have to walk across a canal carrying an extra uniform to reach school in the adjacent village. Hence, the lack of good schools coupled with the hostile natural environment as well as unfavorable household situation, are responsible for the poor level of education in most hotspots.

2. **Indigenous Knowledge/Experience:** Experience plays an important role in coping with problems, and traditional knowledge is useful in creating new livelihood opportunities. In waterlogged and flash flood prone hotspots, people have knowledge in making handicrafts such as fishing traps (charons) from bamboo and mats from murta trees. These have become an important secondary source of income when primary activities, like agriculture, are disrupted by hazards. In the river flood prone hotspot, elders can predict floods and erosion just by analyzing the flow of river water, and they can also judge which char will be sustainable. In the cyclone prone hotspot, experience from previous cyclones teaches people how to cope more efficiently.

3. **Health:** Good health is essential for being able to work and hence is related to an individual’s ability to earn. In the cyclone prone hotspot, good health is also necessary to move quickly to shelters. One of the main reasons for poor health is malnutrition, which is prevalent in all hotspots because poor families cannot even afford to eat two proper meals a day. In river and flash flood prone areas, water borne diseases are common because unhygienic situations arise when latrines are flooded. Skin diseases are present in cyclone, salinity, tidal flood and waterlogged prone hotspots due to exposure to saline water. In the latter hotspot, the health situation has improved in since the installation by BRAC about a decade ago of ring slabs in all households of the village, thus ensuring 100 percent sanitation coverage. In the drainage congestion prone hotspot, highly polluted water from urban sewerage systems exacerbate the health situation. Also poor access to health centers means people cannot obtain proper treatment when needed, as also is the case of flood prone

### Table 1. Eight Hotspots Selected for EACC – Social Study in Bangladesh.

<table>
<thead>
<tr>
<th>Hotspot Type</th>
<th>District</th>
<th>Upazila</th>
<th>Union</th>
<th>Village</th>
</tr>
</thead>
<tbody>
<tr>
<td>Drought prone</td>
<td>Naogaon</td>
<td>Porsha</td>
<td>Nilpur Sadar</td>
<td>Nilpur</td>
</tr>
<tr>
<td>Salinity prone</td>
<td>Satkhira</td>
<td>Assasuni</td>
<td>Protapnagar</td>
<td>Sonatankathi</td>
</tr>
<tr>
<td>Cyclone prone</td>
<td>Bagerhat</td>
<td>Shorankhola</td>
<td>Southkhali</td>
<td>Gabtala</td>
</tr>
<tr>
<td>River flood prone</td>
<td>Sirajganj</td>
<td>Kaziupur</td>
<td>Natuar Para</td>
<td>Ghora Gacha</td>
</tr>
<tr>
<td>Flash flood prone</td>
<td>Sunamganj</td>
<td>Tahirpur</td>
<td>Dakshin Sreepur</td>
<td>Janjail</td>
</tr>
<tr>
<td>Waterlogging prone</td>
<td>Jessore</td>
<td>Keshobpur</td>
<td>Safalakathi</td>
<td>Kalicharanpur</td>
</tr>
<tr>
<td>Tidal flood prone</td>
<td>Cox’s Bazar</td>
<td>Cox’s Bazar Sadar</td>
<td>Khurushkul</td>
<td>Rastarpur</td>
</tr>
<tr>
<td>Drainage congestion prone</td>
<td>Dhaka</td>
<td>Mohammedpur</td>
<td>Adabor</td>
<td>Comfort House</td>
</tr>
</tbody>
</table>
hotspots. In the drought prone and waterlogged prone hotspots, people even complained that doctors are not good and provide fake medicines in some cases they give the same medicine regardless of disease and never provide them free of cost.

4. New information/knowledge: In a changing world, new knowledge is needed to cope with new situations and use resources efficiently. But in most cases, villagers complained that no one ever came to give them any new information or training that could improve their conditions. In the drought prone and salinity prone hotspots, people want to learn about new varieties of rice which can adapt to dry and saline conditions, respectively. In the tidal flood prone hotspot, people never knew the adverse effects of catching shrimp fries and were also unable to interpret signals effectively. But now, they have learned through mistakes. In the flash flood prone hotspot, villagers were never involved in fishing due to restrictions in their caste system, but now due to poor income from agriculture, they are keen to learn about fishing techniques. According to most people, agricultural officers and NGO workers hardly ever helped them in acquiring this information.

Social Capital

1. Social Cohesion: Good relations among members of the society are necessary, especially in times of disaster when people can help one another. While some communities mentioned that they have relations of trust and cooperation, others blamed overall poverty for the poor level of trust and cohesion. When everyone is poor, people become desperate to meet their own needs and are not in a position to help others. In the cyclone prone hotspot, although there are no noticeable factions, people miss mutual cooperation which could have helped them in times of cyclones. They claimed that some people captured the relief materials which were meant for others. In the flash flood prone hotspot, a social conflict has existed for seven years due to unknown reason; it reached an extreme situation last year due to conflict over a bamboo bridge joining two blocks of the village. People of both sides hate each other so much that they didn’t even come to rescue a drowning child of the other side.

On the other hand, people in the waterlogging prone hotspot have good relations; women go to neighbors’ houses to cook when their kitchens are flooded, and if someone’s house is falling, everyone rushes to help.

2. Cooperative Societies: Cooperative societies can be helpful in coping with disasters because they initiate savings, can provide loans and take decisions for the community through a participatory process. But in most hotspots, such societies (shomites) are not present because establishing them requires a high level of trust and cooperation among the villagers as well as financial investment for start-up. In the salinity prone hotspot, some people think that co-ops are not important because they cannot provide employment and relieve them from their distressed conditions. In the tidal flood prone hotspot, a fishermen co-operative was set up which proved to be very useful as the members could get financial help to start a vegetable garden or to buy a net. People in the flash flood prone hotspot mentioned that a shomitee was once formed by the NGO CNRS and a representative used to collect Tk. 12 from each household per week. But as the higher authorities of this shomitee mostly belonged to one side of the village, they were biased and so the people from other side stopped saving. Thus the co-op was dissolved, and villagers believe that in order to make initiatives successful, the conflicts between the two sides must be resolved first.

3. Contact with NGOs: In the last couple of decades, NGO activities have spread to all parts of the country and have played a significant role, in terms of providing loans and relief materials. In the waterlogging prone hotspot, some NGOs have donated rice and money after floods or cyclones, while others have reconstructed the demolished houses. In the drought prone hotspot, almost every family has contact with one or more NGOs, which help them save or take loans. But people there believe that although NGOs seem to help them in the short run, they make them dependent in the long run. NGOs only give loans to those who can repay, and even takes away whatever assets they have if they fail to repay on time. In the cyclone prone hotspot,
the NGO Muslim Aid came as a blessing to people as it built *kacha*² houses for every family in the village after they lost their homes in cyclone.

Similarly, in the river flood prone hotspot, about 30 families received a cow and training under the Char Livelihood Program.

4. **Social Security:** Social security is needed to enable people lead a stress free life in a society. In the salinity prone hotspot, the security situation is very good and no one ever faced any harm or harassment. People can feel comfortable leaving their belongings back home when they move to the shelters because no one ever stole anything. Both in this village, as well as in the river flood prone hotspot, women mentioned that they feel safe alone at home when their husbands temporarily migrate to other places for work. However, people in the flash flood prone area blamed poverty and unemployment for the thefts that used to occur in their village even a couple of years ago. But two years back, when agricultural production increased a bit due to the embankment constructed by CNRS, the level of crime decreased in the area. But yet, due to conflicts between two groups of the village, women are sometimes harassed in public by men of the other group.

5. **Friends and Relatives:** If people have friends and relatives outside the village, they can get help from them in times of need. For instance, in the salinity prone hotspot, many people went to seek shelter in the adjacent village Nakna where many of their families lives. They can also send their livestock to their relatives’ houses, so that they can be saved during disaster. In the waterlogged prone hotspot, women mentioned that although they have their own parents in other villages, it is of no use, because no one wants to leave their own house and be a burden on others.

### Physical Capital

1. **Road networks:** People in most hotspots report that the conditions of roads and communications infrastructure determines the level of development of an area. In the cyclone prone hotspot, where roads have been damaged by frequent cyclones, people cannot reach cyclone shelters in time and also get relief materials that are distributed. In the salinity prone hotspot, people believe that high roads will resist entry of saline water and even provide temporary shelters during disasters. They will also allow students to go to school safely and enable young people to earn a livelihood by driving motorbikes and engine vans. But the only main road of this village is a narrow *kacha* (rough) path where two people cannot walk side-by-side. In the flash flood prone area, roads remain under water for four months, during which people have to wait for boats and spend an hour to reach the Upazilla town to purchase goods for their households. People have their own row boats but those are very risky and one woman even lost all her family members when the boat sank. Even when the roads are above water, they have to be traversed by foot because bicycles cannot be driven on the muddy paths.

Villagers of the drought prone area highlighted the necessity of roads for a different purpose. Many of them have their agricultural lands on the other side of the Punarbhaba River which can be crossed by foot during the dry season. But during May, when it’s time to harvest their *Boro* crops, they have to hire bullock carts to transport their paddy through a different route which highly increases their cost.

Hence, they mentioned that a bridge needs to be constructed over the river so that they can cross it by foot. In the waterlogged hotspot, the internal roads stay muddy and slippery in monsoon season, and people walk barefoot through the mud to go in and out of their houses.

2. **Electricity:** In a few hotspots, the villagers highlighted electricity as an important physical capital necessary to improve their lives and livelihoods. In the waterlogged hotspot, people have electricity in their homes, but load shedding in so high that they get no electricity in the evenings, which is the prime time for household work, handicraft making, and studying. Electricity comes at night when they are sleeping; as a result, they have to bear the cost of both grid connected electricity as well as kerosene to deal with load shedding. People in the drought prone hotspot mentioned that if they had electricity, it would greatly reduce their agricultural input costs as they would be able to avoid

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² Kacha – House made of mud and hay.
using diesel for running shallow machines. In the flash flood prone hotspot, Oxfam had provided three free solar panels, which are used by 18 households to light only six bulbs. This is not at all sufficient, because if they had a proper grid connection, they could use mobile phones, TV, and radios, which would increase their exposure to the rest of the world.

3. Housing: For poor families in rural places, a small kacha house with one or two rooms is all that they have. In the cyclone prone hotspot, Muslim Aid provided kacha houses for all families after they lost their houses in the cyclone. In the waterlogged hotspot, those who can afford it try to raise their houses by using mud. Villagers of the river flood prone hotspot are in the worst condition because they have to shift their houses every few years due to river erosion. In the drainage congestion prone hotspot, people have to live in crowded slums in which the houses are at a lower level than the roads, leading to water accumulation even after the slightest rainfalls. Landlords increase the house rent twice a year and do not even develop or repair the houses.

4. Equipment: In places where agriculture is the main source of income, most poor farmers have to rent large machineries, such as power tillers and shallow machines, which greatly increases their input costs, leaving very little for profit. In the drought prone hotspot, they have to pay Tk. 500 per bigha\(^3\) for borrowing a power tiller to plough their land and 2 mon\(^4\) of paddy per bigha \((\text{excluding the fuel cost})\) for renting a shallow machine for irrigation. The scenario is the same in the flash flood prone hotspot. In the waterlogged hotspot, people are involved mainly in fishing, and nearly every family has its own nets, which but they must replace every year as they get damaged. Some people have small boats called ‘dunga’ made from Tal trees, which can accommodate at best two people.

Asset ownership status of the surveyed households as obtained from the quantitative survey is presented below (Tables 2 and 3). Results show relatively poor asset base for the surveyed households. Most of the people of early flash flood, river flood, cyclone prone and salinity prone areas need boats for their daily communication to gain their livelihood. But it is clear from Table-1 that only 26.92 percent of the surveyed households have ownership of boat. Rests of the households have to depend on others in this respect.

<table>
<thead>
<tr>
<th>Types of asset</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bicycle/ Rickshaw/Van</td>
<td>19</td>
</tr>
<tr>
<td>Motorcycle</td>
<td>1.0</td>
</tr>
<tr>
<td>Boat</td>
<td>27</td>
</tr>
<tr>
<td>Ox cart</td>
<td>2</td>
</tr>
<tr>
<td>Sewing machine</td>
<td>3</td>
</tr>
<tr>
<td>Automobile</td>
<td>4</td>
</tr>
<tr>
<td>TV</td>
<td>18</td>
</tr>
<tr>
<td>Radio</td>
<td>24</td>
</tr>
<tr>
<td>Mobile phone</td>
<td>47</td>
</tr>
</tbody>
</table>

**TABLE 2. ASSET OWNED BY THE SURVEYED HOUSEHOLDS (MULTIPLE RESPONSES)**

<table>
<thead>
<tr>
<th>Types of equipment</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plough</td>
<td>27</td>
</tr>
<tr>
<td>Power-tiller</td>
<td>17</td>
</tr>
<tr>
<td>Fishing nets</td>
<td>25</td>
</tr>
<tr>
<td>Shallow tube-well</td>
<td>15</td>
</tr>
</tbody>
</table>

**TABLE 3. AGRICULTURAL AND NON-AGRICULTURAL EQUIPMENT**

3  Bigha – Unit of area (1 bigha = 33 decimals)
4  Mon – Unit of weight (1 mon = 40 kg)
6. **Access to safe water:** Lack of safe water supply increases water-borne diseases and places burdens on women, who are responsible for fetching water from distant sources. In places like the water-logged hotspot, safe water is not a problem because there is an adequate number of tube-wells. In the tidal flood prone hotspot, water is also not a problem for most people, except the Rakhain community who do not have safe water source in their territory; there, young women have to travel large distances every day to fetch water. But water is a problem in the river and flash flood prone hotspots, where tube-wells remain under water for a few months, during which residents must depend on river or flood water for daily use. The village in the flash flood prone zone has only three tube-wells, one of which is inactive. Tube-wells are the main source of drinking and cooking water, while river water is used for all other purposes. During floods, women cannot even boil the river water for consumption because of lack of fuel wood. In the cyclone and salinity prone hotspots, ponds and canals are filled with saline water, which causes skin irritation when used to wash clothes. People reported that some cattle also died after drinking this saline water.

**Natural Capital**

1. **Livestock:** Possession of cattle or poultry can serve as a secondary income source. Calves can be sold once grown, milk can be consumed or sold, and the money can be used for their daughter's marriage or to survive a financial hardship. Moreover, the cow dung can be used as fuel; otherwise it must be bought from the market. Poultry are important only for consumption, especially during festivals. Although every household has some poultry, only a few families own cattle. In the waterlogged hotspot, a poor person mentioned that his cow now is only hope of survival (‘Ami to shudhu oi ek gorur jonnoi beche asi ekkho’), adding that otherwise he would have had to take loans, like others (Nabole amar dena day kore khete bota). Cows provide five to six kgs of milk every day, which owners can sell for Tk. 20/kg, while ducks and hens lay eggs which can be consumed or sold by the household. In the salinity prone hotspot, most people cannot afford to buy livestock; those who do possess cattle always in fear of losing them to cyclones. In the flash flood prone hotspot, most households at least have one cow, either rented or owned, and a few have some ducks. During the dry season the cattle graze on government lands, and during flood periods they feed on stored hay, paddy, grass, soya seeds, paddy flakes, etc. In all these places, raising livestock is becoming expensive because all the feed for cattle must be bought from the market. In the waterlogged hotspot which has no grazing lands, men and women have to travel across the beel to gather grass for their cattle. If they earn Tk. 100 by selling milk, they have to spend Tk. 50 to buy feed for the cattle.

2. **Water bodies:** Common water bodies such as ponds are important because they can be used for fisheries and also for bathing and livestock. During droughts in the cyclone and waterlogged prone hotspots, people catch fish in the nearby river and beels as an important income source. In the cyclone prone hotspot, when the ponds become filled with saline water, they become unusable, making lives difficult for people. They have installed pond sand filters in these ponds to obtain fresh water. In the tidal flood prone hotspot, marine fishing in the sea is the main occupation. But people in the flash flood prone hotspot can fish only in the Tanguar Haor due to restrictions in the Ramsar Convention, which protects wetlands.

3. **Trees:** If people can grow fruits and vegetables, they do not have to purchase them for consumption. But in the drought prone hotspot, people cannot grow trees due to lack of space and in the waterlogged hotspot, trees cannot be grown due to excess water. In the latter, people had to cut and sell all the trees, for which they earned about Tk. 7000 per tree. In the river and flash flood prone hotspots, people mentioned that trees can hold on to soil and prevent erosion. But as the land gets flooded every year, it is not possible to grow enough trees. In the cyclone prone hotspot, people term trees as “God” because the mangrove forests of the south are essential to protect them from cyclones. Trees greatly reduce the wind speed, and

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5 Haor – Bengali word meaning wetland.
some people have even survived the storms by hugging or tying themselves to trees.

4. Agricultural Land: As rural people in Bangladesh are highly dependent on agriculture for their income, possession of land is very important. But most marginal farmers have only a small amount of land of their own and mainly lease land from landlords or work as laborers on someone else’s land. Those who have land are usually less affected by hazards because they earn a fixed annual rent regardless of crop yield. In the drought prone hotspot, the location of the land is also important because of availability of water. People who lease land have to pay Tk. 2000 per year for each bigha of land. In the river flood prone hotspot, people are becoming landless day-by-day due to river erosion. The same is true for the cyclone prone hotspot, where even though river erosion is less severe, salinity intrusion is destroying the fertility of the land. Soil salinity is also a major problem in the tidal flood and salinity prone hotspots, where crop cultivation is becoming almost impossible. In the flash flood prone hotspot, farmers can only cultivate Boro crops in winter because the lands are inundated in monsoon season, whereas in the waterlogged hotspot, agricultural activities have ceased completely because all their lands have been submerged for the last five years.

In rural Bangladesh, land is the primary source of livelihoods and represents future social security for the people. From the qualitative data of this study, it is clear that in the river erosion area people are losing their cultivable land every year. Quantitative data (Table 4) of the eight hotspots also shows that nearly three-fourths of the surveyed households are landless or nearly landless.

Financial Capital

1. Income: Having a steady income is the most important factor that determines the standard of living of the households. In all hotspots, the majority of the villagers are “hand to mouth” people who can hardly afford to provide three proper meals a day for their families. In the waterlogged hotspot, only service holders and couple of fish businessmen have good incomes. The poor mainly earn money by fishing, making handicrafts, and selling livestock products. In the drought prone area, where agriculture is the main occupation, profits from crops have been decreasing as the cost of diesel, fertilizers, and pesticides has increased in last couple of years, while the price of rice has decreased significantly. In the river flood prone hotspot, people stay idle for six months a year, and there are no industries or businesses where they can be hired. In the tidal flood prone area, only those people who have their own boats and nets have a regular monthly income; others have very few employment opportunities. Due to salinity, they have not been able to cultivate crops in recent years, and so their situation has been deteriorating. Day laborers in all hotspots earn as little as Tk. 80–100 per day depending upon the availability of work. Compared to rural hotspots, income is better in the drainage congestion prone urban hotspot, where people can work as maids, garment workers, drivers, shopkeepers, mechanics, and other jobs.

The above findings are also confirmed by the results obtained from the quantitative survey. An overwhelming majority of the surveyed households are dependent on jobs as agricultural day-laborers, fishing, small business/trading or petty professional activities (Table 5).

2. Loans: In the past decade NGOs have started giving loans to poor villagers who, in the absence of proper employment opportunities and due to frequent natural hazards, become compelled to

<table>
<thead>
<tr>
<th>Types of household</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Landless (0 decimal)</td>
<td>36</td>
</tr>
<tr>
<td>Functionally landless (1–49 decimals)</td>
<td>36</td>
</tr>
<tr>
<td>Small farmers (50–99 decimals)</td>
<td>9</td>
</tr>
<tr>
<td>Medium farmers (100–249 decimals)</td>
<td>10</td>
</tr>
<tr>
<td>Large farmers (250 decimals and above)</td>
<td>9</td>
</tr>
<tr>
<td>Total</td>
<td>100</td>
</tr>
</tbody>
</table>
borrow money. Villagers even take loans from local money lenders (Mohajons) who charge higher interest rates. In the drought prone hotspot, NGOs such as Asha, Reek, Grameen Bank, Thengamara (TMSS) and BRAC provide loans of Tk. 4000–20,000, at an interest rate of 10 percent. Loans are taken for various reasons, such as to meet household expenses, to buy livestock, to purchase agricultural inputs, and to marry off daughters. In the waterlogged hotspot, people have access to loans but do not want to take them because they cannot repay it. Big businessmen also take loans from banks of Tk. 40,000 or more to invest and expand their businesses.

3. Savings: Poor people in most hotspots have very little income and are highly dependent on loans, hence, having savings is out of question. In the drought prone hotspot, they have started the practice of depositing Tk. 20 every Saturday to the NGOs. If they do not withdraw this money for a long time they can save a good amount. People in the water-logged hotspot had little savings in the past, but due to lack of income in the last five years, they now have no savings. Only 1–2 percent of the people in the salinity prone hotspot have savings. After cyclones, people lose everything and in without work, house and livestock, it is impossible to save anything. Almost everyone has taken loans of a few thousand taka from shops or relatives. Richer people in the society usually have savings of up to Tk. 100,000 in the form of fixed deposits or insurance schemes.

Combined livelihood asset pentagons of all hotspots are presented below, which illustrates poor and imbalanced asset bases for the households living in the selected communities.

**EXISTING LIVELIHOOD SYSTEMS**

**Livelihood Practices:**

In the hotspots—except for the drainage congestion and the waterlogged prone areas—the majority of the people are engaged in agricultural activities, either on their own land or on land leased from owners. A small number of people who can afford to invest some money are engaged in small businesses, such as department stores, medicine shops, or grocery stores. Others who have neither land nor money work as day laborers, as skilled workers, or as service workers. In nearly all hotspots, people are less willing to migrate from their villages unless they must do so to earn a livelihood. Many people, both men and women, have never ever been outside their villages in their lifetimes. But now some parents aspire to send their children to better places for better lives, but their limited assets hinder them from doing so. In fact, it’s really the river around the proximity of each of the hotspots that plays the most dominant role in determining livelihood strategies. It acts as a blessing as well as a curse.

Due to lack of agriculture in their own land, people in the waterlogged prone hotspot move to work as day laborers or migrate out of the village to work in brick fields or on other’s agricultural lands. In rainy season, brick fields also are submerged, depriving people of work. Most of the poor people catch fish from the

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**TABLE 5. ANNUAL AVERAGE INCOME OF THE HOUSEHOLD BY SOURCES**

<table>
<thead>
<tr>
<th>Sources of income</th>
<th>Percentage of the households</th>
<th>Average annual income (Taka)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agriculture</td>
<td>34</td>
<td>12,706</td>
</tr>
<tr>
<td>Service related job</td>
<td>12</td>
<td>4,194</td>
</tr>
<tr>
<td>House rent</td>
<td>3</td>
<td>682</td>
</tr>
<tr>
<td>Fishing</td>
<td>22</td>
<td>8,425</td>
</tr>
<tr>
<td>Poultry</td>
<td>5</td>
<td>817</td>
</tr>
<tr>
<td>Vegetables</td>
<td>2</td>
<td>57</td>
</tr>
<tr>
<td>Remittance (from city and abroad)</td>
<td>4</td>
<td>2,519</td>
</tr>
<tr>
<td>Agricultural labor</td>
<td>30</td>
<td>6,936</td>
</tr>
<tr>
<td>Small business</td>
<td>26</td>
<td>8,684</td>
</tr>
<tr>
<td>Factory worker</td>
<td>1</td>
<td>115</td>
</tr>
<tr>
<td>Pension</td>
<td>2</td>
<td>83</td>
</tr>
<tr>
<td>NGO/Government job</td>
<td>4</td>
<td>1,451</td>
</tr>
<tr>
<td>Handicraft</td>
<td>18</td>
<td>3,440</td>
</tr>
<tr>
<td>Restaurants</td>
<td>1</td>
<td>384</td>
</tr>
<tr>
<td>Transport (road)</td>
<td>6</td>
<td>1,442</td>
</tr>
<tr>
<td>Transport (water)</td>
<td>1</td>
<td>28</td>
</tr>
<tr>
<td>Dairy farms</td>
<td>3</td>
<td>730</td>
</tr>
<tr>
<td>Others</td>
<td>17</td>
<td>5,422</td>
</tr>
</tbody>
</table>

---

Table 5. Annual Average Income of the Household by Sources
nearby *beels* using nets, fish lines, and traps. They earn more in the monsoon season, and people face difficulties in the dry season when the rivers and ponds become dry. During the dry season, they cut mud, excavate ponds, or build *ghers*; in the rainy season they make handicrafts, such as fishing equipment (*charons*). They sell these for Tk. 50–60/piece and then purchase food for their families. Some are involved in service work and have the most reliable and stable income source. In the drought prone area, too, the people rely on fishing, a separate community catches fish in the Punarbhava River. A large area of land becomes submerged in the rainy season, so the villagers can grow only one crop throughout the year. But in both the hotspots the income from fishing is decreasing rapidly due to dwindling fish population.

In the cyclone-prone areas, the burdens of high interest loans, river erosion, restricted Sundarban, and recent cyclones are the factors hindering economic activities. Previously, villagers were dependent on Sundarban for honey, wood, and fishing. But after it was declared as Reserved Forest, they had to change their occupation and became completely dependent on fishing. Saline water hinders cultivating fresh-water fish, and so they go for shrimp farming, unlike in the drought prone and

![Combined Livelihood Asset Pentagons (All Hotspots)](image-url)
waterlogged regions. Only 10 percent of adults are involved in agriculture, and the erosion of the Baleswar river is reducing dependence on agriculture. One of the common features in the livelihood patterns of the cyclone prone area is that people are moving away from one primary earning source and getting more involved in working as day laborers (such as carpenter), service workers (such as school teacher), skilled laborers (garment workers), and in some cases businesses. A few people drive vans or auto rickshaws and earn around Tk. 100–300 a day. Some have tailoring skills while others have small businesses of pharmacy, utensils, small tea and grocery stalls. Women usually do not work outside their households and are mainly engaged in cooking, raising children, looking after livestock, and helping their husbands. But a few women have started small scale handicrafts businesses, and some widowed women have even migrated out of the village to work as housemaids and cooks.

In the coastal hotspot regions fishing is the main occupation (80 percent), as agricultural lands are being lost or are losing fertility due to salinity. However, some still work as agricultural laborers in their neighboring village. Fishing, however, is getting difficult as the fish population is decreasing tremendously due to overfishing and the catching of fries. Now they catch fish worth 1–2 lakh taka, while in the past it used to be around 10–12 lakh. So, naturally, the wages of the fishermen have fallen tremendously. A good percentage of people have migrated out of the village to work as rickshaw pullers, garment workers, carpenters, construction workers, cooks, shrimp farm laborers, etc.

In the salinity prone area, specifically, the men now have a new income source by helping to rebuild the breached embankment and in return get 5 kg of rice every day. Some of the people cultivate shrimp. But others complain that due to the shrimp farms the agricultural lands are becoming useless as the shrimp farms illegally cut into the already weakened embankment to let in saline water. The majority of the people want to get back the land and live by farming as they believe only the rich are the ultimate profit earners from the ghers; not the poor laborers. In the river flood prone area, also, very few can get involved in agriculture due to fear of loss of land from river erosion and floods every year.

There are very few fishing activities, as well, and no option for shrimp farming. So, like the people in other regions they, too, migrate to urban or rural areas and work as skilled laborers. Given a good road communication, the people of the hotspots earn a living by working as drivers of vans, motorcycles, rickshaws, etc. But in the river flood prone area, where boats are the only mode of transportation, people work as boatmen.

Besides these, almost all the hotspots have cattle and poultry, which serve as important income sources for the rural households. Those who own cows can sell milk for Tk. 20/kg every day and also keep some for household consumption. When cows give birth, they raise the calves and sell the mother to earn a good amount of money. Cows also provide dung, which is wrapped around sticks to make “moshals” and used as a fuel for cooking. But cattle rearing becomes quite expensive without farming to provide hay and grains for the animals. Hens and ducks are present in almost all households; these are reared mainly for consumption of eggs or for selling the chickens. But the salinity prone area, at the present, is completely devoid of poultry, as some of them died in the cyclone Aila and others died drinking the saline water.

Unlike the other hotspots, the flash flood prone region is still heavily dependent on agriculture. Even the women help with the agricultural work. The young people migrate in the monsoon to other places to earn money as agricultural laborers and return in dry season to work at their own agricultural lands, cultivating Boro rice. Since flash floods inundate their agricultural lands for four-to-five months, they cannot cultivate paddy through the year. Most of the migratory people come back to the village at the time of sowing paddy. Women try planting some green vegetables in the government lands around the village. Women participate in agricultural work, especially after the harvesting they husk and stir paddy while it is being dried in the sun. Throughout the year, they generally make mats (pati) by using natural raw materials (murta tree), which is sold at local markets. Women do not migrate or work outside the home; they believe they are unskilled and unable to migrate to earn money.

The drainage congestion zone is different in that the migrants from the other seven hotspots migrate here.
People have migrated here for 20 years, looking for a reliable livelihood. Now they work as rickshaw pullers, garment workers, housemaids, day laborers, shopkeepers, construction workers, earth cutters, etc.

**EXPERIENCE WITH PAST CLIMATE VARIABILITY AND HAZARDS**

**Climatic Hazards:**

As mentioned in Section 3, the eight hotspots have been selected so that each represents one of the major climate change-related hazards that occur in Bangladesh. Although each hotspot has been identified as being vulnerable to one particular “primary” hazard, the field visits revealed that in most hotspots there are also some “secondary” hazards which exacerbate the situation. These secondary hazards are sometimes responsible for triggering the primary hazards, as in the case of the salinity prone hotspot, where frequent cyclones and tidal surges are leading to salinity intrusion. In other cases, such as the river flood prone hotspot, the secondary hazard of river erosion is actually the effect of the river floods which affect that area every monsoon. Sometimes the hazards may be mutually exclusive, but their synergistic effects magnify the level of impacts on the villagers. For instance, in the cyclone prone hotspot, river bank erosion is causing continuous loss of agriculture land, thus reducing people’s livelihood options and their ability to cope with frequent cyclones. Similarly, in the drought prone hotspot, while some land on the eastern side is left fallow during dry season due to lack of irrigation facilities, other lands adjacent to the Punarbhaba River are flooded during monsoon, thus preventing cultivation of Aus and Aman crops.

The following paragraphs contain detailed discussion on these different types of hazards in different hotspots.

According to the villagers of the drought prone hotspot, weather patterns have been changing gradually; summers are becoming warmer and rainfall is being delayed. In 2009, the monsoon precipitation started weeks after its traditional timing. This area is prone to drought from March to May, just a couple of months before the Boro crops are harvested. This increases the need for irrigation, which in turn, increases the cost of renting shallow machines and buying fuel. According to the villagers, drought has been a part of their lives for decades and it is not a major problem if they have enough money to spend for irrigation. In some places, where irrigation is not possible, even if someone has money, are left fallow during this season. Another major hazard is flood. Every monsoon, the Punarbhaha River overflows its banks and inundates the surrounding agricultural land, forcing many small farmers to abandon the cropping season. Although they can adapt to drought, there is no way to prevent the flooding. The biggest flood occurred in 1998, when the water level was so high that even the houses were inundated. People had to migrate to the school building for weeks and when they returned they found that all their assets had been damaged or stolen.

People in the salinity prone hotspot mentioned that about 30–40 years ago, this village was free from saline water and other types of disasters; but now it is vulnerable to multiple hazards including flood, river bank erosion, salinity intrusion, and cyclonic storm surges. An embankment was built around the village in the British Period which endured all the natural disasters since then. In the last 25 years the embankment has been breached five times and saline water entered the village, destroying agricultural lands. Once a land is flooded with saline water, it takes about two-to-three years to get back its original productivity. The 1988 flood was a devastating one and forced people to leave their homes as their assets and belongings all got washed away in the flood water. It breached the embankment for the first time and let in saline water. This was followed by a decrease in agriculture-based livelihood and an increase in temporary migration for other work. In 1998, the village was struck by a severe hail storm. The hailstones were so huge that they resembled meteorites. Though the people weren’t hurt the trees turned white as the big hailstones scraped the bark off the trees. Some of the trees in the village are still bearing the marks of the terrible hail storm. In 2001, the village suffered a flood coupled with river erosion. The embankment was breached and the lands were inundated with saline water. Fifty to sixty bighas of agricultural land were lost due to river erosion. Almost all the houses were completely destroyed in the flood water. In 2007, cyclone Sidr hit the village but didn’t cause many casualties. The village was flooded, but not severely.
The village was hardest hit by cyclone *Aila* in May 2009. The breached embankment brought in saline water from the sea, destroying the last remaining agricultural lands. The villagers now have no hope of survival if they cannot recover their lands. Along with this is the concern of river erosion that is now taking place more frequently. One midnight, the villagers woke up in fear as they heard the blunt sound of the river gobbling up a big chunk of land nearby. Luckily no harm was done, but it could affect any household.

Like the people of drought prone hotspot, these villagers also feel that the weather is changing very rapidly and unpredictably. The rains are coming late and it’s extremely hot in the summer. The storms are fierce and most damaging. They feel that the river course and flow has changed tremendously. In their childhoods, the river was very far away and they had to walk long distances to see it; but now it is just outside their homes. Apart from the erosion problem the strong winds and storms are of major concern now. The older people of the village never saw a cyclone as intense as *Aila*, which washed over their houses and left knee-deep water in their yards.

The tidal flood prone hotspot is vulnerable to cyclones, tidal surges, as well as river erosion. The great cyclone of 1991, crossed the village during the night with a maximum storm surge height of about 5 to 8m. Crops, livestock, fisheries, homesteads, roads, embankment, schools, and other infrastructure were affected. In addition, human lives were lost in storm surges and many people become homeless. A shortage of food and pure drinking water made people more vulnerable to diseases. Due to high winds and tidal waves, the total area was inundated for 10 days, and the villagers were unable to pump water into the sea. As the total area was surrounded by embankments, the people were surrounded by water because the sluice gates didn't function properly. In order to protect this area, the Water and Power Development Authority (WAPDA), built an embankment along the sea in 1991. After construction of the embankment, agricultural activities increased in this area. But gradually, the water level of the sea got higher and damaged the embankment. After the embankment was breached, more saline water came inside the village during high tides.

In 1994, 1997, and 1999 three devastating cyclones and tidal surges visited the area. Due to high winds and tidal surge, people had to leave their houses and take shelter in the nearest cyclone shelters, which were built in 1992. These cyclones destroyed the embankment further and damaged the agricultural land. Cyclone *Sidr* of November 2007 did not affect this village much. However, in 2008, Cyclone *Nargis* brought huge miseries for these people. Most of the *kacha* houses were destroyed by strong wind flow and at least two fishermen were missing in this village. In 2009, cyclone *Aila* destroyed the embankment and inundated 15,000 acres of agricultural land with saline water, destroying the standing crops. Apart from these extreme events, people here also complained that the weather pattern is changing. For instance, winters are not as cold as before, summers are much warmer, and rainfall has become very erratic. About 15–20 years ago the sea was much calmer, but nowadays it is very rough due to bad weather.

Apart from frequent cyclones, the **cyclone prone hotspot** is also suffering from river bank erosion. The Baleswar river has been eroding since 1950 and since then most of the families have lost 30–40 *bighas* agricultural land. Currently, 100 *bighas* of agricultural land are eroding each year. In the cyclone of 1970, 13 people, including many children, died in that village and about five members were lost from different families in Sarankhola union. No casualties occurred in 1991’s cyclone but houses, schools, roads, and other infrastructure were damaged. Huge numbers of trees were also uprooted. Cyclone *Sidr* hit at 8 pm in the evening of November 15, 2007, and took one minute to smash everything; 781 people died in the entire Sarankhola union, among whom 288 were from our study village. Roads, *madrasa*, bridges, culverts, and small shops were damaged due to this devastating tidal surge. Thousands of livestock died in *Sidr*. Tidal waves 20–25 feet high destroyed Aman crops in the fields. Due to lack of proper information about signal-10, very few people were able to rescue themselves by moving to cyclone-shelters.

Compared to cyclone *Sidr* it was expected that the effects of cyclone *Aila* in 2009 would be less because it occurred during the day time. But higher salinity and lack of fresh water made the situation even worse. Villagers who were living about 2–3 km away were unable to visit cyclone shelter. High speed winds and tidal surge sustained for one hour, whereas 15 minutes of prolonged attack was enough to demolish everything.
All the _ghers_ were damaged and the fish escaped. The saline water caused mass death of fish, which later led to extreme foul odors, making life intolerable for people.

In the **flash flood prone hotspot**, previously, flash flood was the main problem for the villagers because it damaged their only cultivated Boro crop. Year after year, they lost their crops due to flash flood, which had a severe impact on their livelihood earnings. Then CNRS built an embankment which reduced the impact of flash flood on croplands. Since then the local people have experienced good production from their agricultural fields, and agricultural labor work increased.

This village was affected by four major floods (1974, 1988, 1998, and 2007). In addition, several flash and rain-fed floods occur almost every year in this village, causing a great deal damage to the livelihoods of the villagers. The rain–fed floods of 1974 and 1998 were similar in their timing and severity. The hills of India are near this village and severe water runoff from the hills after heavy rainfall was responsible for the water level rise of river Surma and Tanguar Haor. Water started to rise at mid-June and stayed high for a month. It inundated all the houses and rose to chest high. Villagers said, "amader ostitto beleen hoye gesilo", meaning their existence was under severe threat due to those floods. People drowned and died in the flood but when the flood water started to recede, different water-related diseases like cholera, diarrhea, dysentery, etc., spread over the locality. The Government distributed aid to the affected villagers, but after one month that aid was insufficient. In 1988, a severe flash flood occurred in mid-March and destroyed their only crop Boro. Due to this sudden water flow, which the villagers term ‘Okhal Bonna,’ people became helpless because most of them lost their crops and homes. Water started to recede at the end of July. The effects were similar: People couldn't boil water for drinking purpose as they couldn't manage to collect enough dry wood, leaves, or branches for fuel. Many villagers lost their residential land due to river erosion. In 2007, another high intensity flood occurred in this area after heavy rainfall and led to severe river erosion. The flood started in July and the area remained waterlogged until the end of August.

The **river flood prone hotspot** is a newly risen _char_ island in Jamuna River, where floods and erosion are common natural hazards. After the floods of 1988 and 1989, this village was severely affected by river erosion which destroyed most of the houses. That year was a turning point for this village. At that time, Natuarpura union was close to Ghoragacha village, but every year the two frequently changed their positions because of river erosion. A large number of households were displaced to nearer _chars_ and other areas. But people relocate themselves once a new _char_ is rising, which was the case when our study area rose in 2004. In the meantime a number of households permanently migrated to nearby upazillas, districts, and other _chars_. In 2007, after three years, this village was further affected by riverine flood and river erosion, which inundated most of the agricultural lands. At least 150 households permanently migrated from this village in 2008. This village, which once had around 1,500 households, now consists of only 300.

The villagers of the **waterlogged hotspot** attribute their waterlogging situation to unplanned anthropogenic interventions, rather than to climate change. In order to protect this area from recurring river floods, the Water and Power Development Authority (WAPDA), funded by the US government, built an embankment in 1964 along the Bhogodowa River. After the building of embankment, agricultural activities increased in this area. But gradually, the river’s flow velocity decreased and siltation started to occur, as the tributaries and distributaries of the river were reduced by constructing embankments. The river channel was narrowed due to lack of enough water to ensure smooth flow. Gradually the river’s sinuosity decreased and water level of the river got higher than the nearby _beels_. The sluice gate, at that time, consisted of nine bands, which allowed a huge amount of water to pass from the _beels_ into the river.

In 1986 and 1998, two devastating floods occurred in this area. Due to high rainfall, the river overflowed its banks and submerged the surrounding areas. The total area was inundated for two weeks and the villagers were not able to pump water into the river. As the total area was surrounded by embankments and the river water level was higher than the _beels_, the water couldn't pass through the river. Also due to accumulation of silt in the sluice gate area, the gates didn't function properly. On November 29, 1988, there was a great storm in this region which caused severe damages. The devastating
flood of 1998 which affected the entire nation, also caused a lot of suffering for these villagers. The situation was similar to 1986. In the following years there were some minor floods but they were not as severe as the previous ones.

Meanwhile, due to low velocity flow in the river, siltation occurred in huge levels near the embankment areas. As a result, one side (Kalicharanpur) of the river was becoming higher and the other side was becoming lower. Thus, the specialists from WAPDA decided to take action to save the river and its other side. But before they could take any action, some powerful people from the other side of the river cut down the embankment in several places to pass the river water into this side of the river. WAPDA specialists recognized it as an effective process to solve the problem, thus they implemented Tidal River Management (TRM) process in 2005 in this area. They built another embankment through Kalicharanpur village and created many openings, so that in the dry season the river would get water from the beels to maintain normal flow. However, they only took beel Khukshia into consideration and overlooked the fact that another 26 beels were connected to this beel, and water from all these 27 beels would pass through the TRM area. Thus, the TRM exceeded its capacity and permanent water logged situation arose in this area since 2005. People in this village have agricultural lands, all of which have been under water during the past five years. The government has not taken any initiatives in these years to shift the TRM process to another village. They did not even compensate the local people for their sufferings, though they promised that they would give Tk. 4000 to each family every year.

Cyclone *Sidr* of November 2007, did not affect this village much. However, in May 2009, Cyclone *Aila* brought huge miseries for these people and exacerbated their already waterlogged situation. All the gbors were damaged and the fish escaped. The saline water caused mass death of fish which later led to extreme foul odors making life intolerable for people.

The drainage congestion prone hotspot is affected by floods every year, but very severe incidents occurred in 1996, 2004, and 2007. In these years, heavy rainfall accompanied by rising water level of the nearby water-bodies caused water to accumulate in the slum areas, which are at a lower level than the roads. Water level rose up to knee or waist level, and in 2004 it reached as high as the roofs. All the houses went under water and residents’ furniture, pillows, utensils, and clothes were all damaged by the dirty waters. Some things were usable after the water receded but most things rotted and had to be thrown away. People had to move to the nearby roads or construction sites and live in the open for weeks. Apart from these extreme events, every year during monsoon, overnight showers cause water to enter the houses, although the water drains away by afternoon.

**Summary**

Although different areas are prone to different types of hazards, the above discussions highlight that the intensity and frequency of climatic events are increasingly bringing about greater impacts on the lives and livelihoods of people. In some hotspots, where a single event such as cyclone can cause huge damages at one blow, in other area such as drought prone hotspots, the effects are gradual and less visible. Some devastating historical disasters have affected almost all places even though the degree of effect may be different. For instance, in the river flood, flash flood, waterlogged, and drainage congestion prone hotspots, all respondents have highlighted the severe floods of 1988, 1998 and 2007 which had nationwide impacts. Similarly, the two consecutive cyclones *Sidr* and *Aila* brought about huge miseries for people in hotspots close to the coast. While cyclones
usually occur in the pre- (April-May) or post- (October-November) monsoon periods, other disasters such as floods, river erosion, and drainage congestion take place in the monsoon season. Although these climatic hazards are results of climate change, in some hotspots, anthropogenic interventions have further aggravated the conditions. In the salinity prone hotspot, some influential people leased the Gorimahal canal from the government for shrimp farming and also inserted pipes through the embankment which is now the major cause of saline water entry. People in the drought prone hotspot complained that as India controls the flow of Punarbhaba River, it becomes dry in winter and overflows its banks in monsoon season. Similarly, deforestation in the hilly areas in north-east causes soil erosion after heavy rainfall, which coupled with blockage of distributaries of Surma River has led to sedimentation in the rivers and hence severe floods in monsoon. But the highest amount of anthropogenic influence is felt by people in the drainage congestion prone hotspot, where rapid real estate development, filling of canals and poor urban drainage system are the main causes of water accumulation.

Different communities faced different natural hazards. Flood is the most common hazard, affecting a large part of the country almost every year. Fifty percent of the surveyed households faced river flood in the last twenty years (Table 5). About 39 percent of the households were affected by storm surge. Cyclone is more common in the southern part and coastal regions of the country. Almost 219 rivers flow through the country. The people who live in the river bank areas have to face riverbank erosion. Likewise, those who live in the coastal region also face coastal erosion. Almost one-third of surveyed households faced river or coastal erosion in the last 20 years. People in some areas also faced multiple hazards (i.e., people of cyclone prone areas also faced water logging and salinity problem). So, the percentage of hazards affected households varies depending on location and hazard types. Table 6 below presents the hazards faced by the surveyed households over the last 20 years or so.

**Physical and Socio-economic Impacts:**

Each of the different types of hazards described in above has various physical and socio-economic impacts, both in the short and long run. Some hazards, like cyclones, are so intense that they destroy everything in few hours, while others, such as floods and waterlogging, take weeks to manifest their range of effects. While people have to live in hostile conditions during the disaster, the major hardships often arise in the post-disaster period when people are left with nothing. Some impacts are so devastating that they leave their marks forever as people can never restore their pre-disaster conditions, while others are comparatively mild giving people the chance to re-establish their lives and livelihoods. But when disasters are frequent, the impacts of one event build on those of the previous one, creating damages much greater than what could be inflicted by discrete events.

In the cyclone prone hotspot, each devastating cyclone like *Sidr* or *Aila*, has huge impacts on the lives and properties of the villages. During cyclone *Sidr*, which occurred at night, hundreds of people died, some became handicapped and families lost their earning members. Thousands of poultry and livestock were also killed, as people didn't have any time to move themselves or their animals to safe shelters. Infrastructures such as roads, schools, houses, bridges, culverts, and small shops were destroyed, and equipment such as boats, trawlers and power-tillers were also damaged. Due to high tidal surges, all the Aman crops in the fields were damaged and huge numbers of trees were uprooted. As cyclone *Aila* took place during the day,
more people were able to save their lives, but the high speed winds and tidal surges caused the ghers to be damaged and fish to escape. The water was highly saline which caused mass death of fish leading to extreme foul odors later on. The saline water mixed with fresh water of the ponds making them unusable. People described that saline water of Aila was worse than poison: “Bisher cheo ei pani kharap.” As a result, diarrhea, dysentery, fever, headaches and pneumonia occurred in large scale after the cyclone. Hatcheries, roads, bridges and houses which were repaired after Sidr have been damaged again by Aila. Besides these frequent cyclones, a continuous process of river erosion is also causing huge losses of agricultural lands. These immediate impacts have a lot of long term consequences. Villagers are being forced to abandon their traditional agricultural activities due to loss of land and increased salinity and shift to other livelihood options such as fishing, shrimp farming and small businesses. Men are compelled to migrate to urban areas for work as skilled or unskilled day laborers. Unemployment is increasing and people are slowly being engulfed by poverty.

In the salinity prone hotspot, frequent cyclones and the damage to the embankment are causing entry of saline water, which is destroying the agricultural lands. Once a land is flooded with saline water, it takes two- to-three years to recover it. Poor families are most-affected by saline water because they are solely depended on agriculture and homestead gardening for their livelihoods. The rich can earn profits from shrimp cultivation or other businesses. After cyclone Aila, severe freshwater crisis arose in this village and people have to bathe and wash their clothes and dishes in saline water. This has led to skin problems. Many poultry have also died because of drinking this saline water. Many livestock had to be released. About three people died in cyclone Aila. There is only one deep well (400 feet) in the village which is also shared by people from another village. The saline water is also killing many trees, which is in turn reducing their protection from strong winds. The latrines have been destroyed and the waters are now contaminated with human waste. All the houses and the only government primary school have completely been destroyed. Schools are closed for months and disruption of road communication hinder children from going to school. People, especially, women and children, now suffer from malnutrition as there is no fish and vegetables in their diet. Due to poverty, they cannot buy these from the market and because of salinity they cannot even grow vegetables in their yards. Even grass cannot be grown, and in absence of crops residues, it is not even possible to rear livestock.

Moreover, riverbank erosion has compelled more than 40 households to shift to other villages and at least five or six households migrated permanently to hilly areas of Chittagong. About 30–40 years ago, all the people used to depend on agriculture, but this scenario has changed in the last 10 years because of saline water intrusion. Young people no longer want to cultivate crops and are migrating to other places for work.

As the majority of the people in the tidal flood prone hotspot are involved in marine fishing, climate change has greatly affected their livelihoods. The sea has become rougher and fish are no longer found near the coast. Fishermen have to go deeper into the sea to catch fish, but as the fish population has been dwindling, they often return with empty baskets. The wages of fishermen have also decreased. The sea has become a much more dangerous place and trawlers have gone fishing causing death of fishermen. As the market price of shrimp fries is high, everyone wants to catch those, and in the process catch other fries as well, thus reducing the overall fish population. But awareness is now increasing. Due to frequent cyclones, increased height of tidal waves, and limited height of embankments, saline water gradually is entering the village and damaging agricultural lands. In the past they used to grow Aman and Boro crops as well as vegetables, but now they cannot grow anything due to salinity. This has greatly affected their incomes. Women also cannot grow chili, watermelon, and gourds in their home gardens. But salinity has also created opportunities for some people, especially the rich, who are now involved in shrimp cultivation and salt production. In the devastating cyclone of 1991, crops, livestock, fisheries, roads, embankment and schools were destroyed. Many people lost their lives and many became homeless. The total area was inundated for 10 days, and the fishermen became unemployed for a certain period. Although a cyclone shelter was built in 1992, it is not sufficient to accommodate all the people and livestock; so the livestock have to be released during cyclones so that they can find their own safe shelters. The three consecutive cyclones in 2007 (Sidr), 2008 (Nargis), and 2009 (Aila)
have also destroyed *kacha* houses, fish ghers and inundated agricultural lands. About 15,000 acres of land, which were full of matured crops, were flooded. Shortage of food and drinking water make the people vulnerable to diseases. Education of children is disrupted. Even when there is a harmless little rainfall, children cannot go to school as no one can afford to buy even an umbrella, and if the schoolbooks get wet, they will become unusable.

In the **river flood prone hotspot**, the water level rises every year in monsoon season, and during severe floods the houses and agricultural lands are inundated by water two-to-three feet deep. Few people die from floods, apart from a couple children who drown each year. As this area is a *charland*, the sandy soil does not allow crops to be grown unless the land is prepared for two-to-three years. But villagers do not want to invest much because due to river erosion, the sustainability of the *char* is uncertain. More and more agricultural lands are being lost to the river, decreasing livelihood options for the people. Life here is very mobile, as people have to shift their houses every few years to higher areas or other chars due to floods and erosion. Women cannot grow vegetables or trees because they are damaged by annual floods. The tube-wells and latrine remain flooded for six months, during which the people use river or flood water for drinking, cooking, washing, and bathing as well as defecation. As a result, there is high incidence of water-borne diseases, and children suffer from conjunctivitis, rashes, sores, and common cold.

In the **drought prone hotspot**, water stress arises in the dry season which increases irrigation requirements for Boro crops. This in turn raises input expenditures and decreases profits. For those who can afford to provide frequent irrigation, crop yield is not affected; but poor marginal farmers who find it difficult to rent shallow machines and provide fuel, end up with reduced yields. Moreover, drought causes tube-wells and ponds to become dry, which increases the burden on the women, as they are mainly responsible for fetching water. Some even go to distant places every day to fetch TW water for cooking and drinking, while they use river water for bathing and cleaning. The heat stress also makes their lives miserable. If production of crops decreases, they have less food available for livestock and household consumption. Apart from drought, this village is affected by river flood every monsoon, which prevents cultivation of Aus and Aman crops. Other than inundating croplands, these floods do not have any direct impact on people’s assets. But floods have one positive effect of increasing land fertility. Thus those lands which are adjacent to the river have higher productivity and do not suffer from drought in winter. The biggest flood occurred in 1998, when the water level was so high that even houses were inundated. People had to migrate to the school building for weeks and when they returned they found that all their assets have been damaged or stolen. But fortunately, no one dies directly
due to the flood or drought. There may be indirect effects, as when lack of income leads to death due to lack of treatment. Apart from the immediate effects of crop loss or water shortage, these hazards create a ripple effect leading to diminishing asset base. But the poor people fail to link their problems to the hazards in most cases and consider poverty and lack of financial capital as their major constraint.

In the waterlogged prone hotspot, due permanent water-logging situation since 2005, agricultural activities have completely stopped. As all the lands remain under water throughout the year, they cannot cultivate crops in any of the three seasons. This has led to serious decline in their incomes and living conditions. Previously they used to grow rice, vegetables, watermelon, and teel and never had food shortages for their families. Now in absence of agriculture they have been forced to choose fishing as their primary occupation. But due to overfishing, the fish population is dwindling day by day, reducing the income of fishermen. Some also make handicrafts and sell livestock products to earn money. When people find work, they tend to migrate temporarily to other rural or urban areas to give physical labor. But income from all these sources is very low, pushing people into extreme poverty. The situation becomes worse in monsoon season when the water level rises after heavy showers. Houses beside the beels get flooded up to knee level, making life difficult for people. Women cannot cook in their kitchens, livestock have to remain standing or be shifted to higher areas, and children cannot go to school. The schools themselves become waterlogged, often damaging the furniture and library books. In absence of agriculture, it is also difficult to rear cattle because all the food needs to be bought from the market. Women even have to travel large distance to cut grass for their livestock. Waterlogging also prevents growth of trees and vegetable plants in the area. Even if they plant vegetables in their yards, the roots rot away due to excess water. The roads of the village always remain muddy and slippery due to water. Poor income means people have difficulty affording good food, education, and health services as well.

In the drainage congestion prone hotspot, there is no permanent waterlogging but overnight heavy showers in monsoon season cause water to accumulate and flood the low lying slum area. The houses, being lower than the adjacent roads, become flooded with knee-level water. Slum dwellers face problems moving around, cooking, and living in their houses. Moreover, unlike in rural areas, these waters are polluted with urban waste which causes bad odor and carries disease-causing organisms. In times of extreme floods, water even rises up to the roofs and people are forced to leave their houses and take shelter in the roads or other higher areas. Furniture, clothes, pillows, and all household goods are damaged, and after the water recedes most things have to be thrown away. People suffer from waterborne disease, which leads to an extra burden in the form of treatment costs.

Sector-Wise Impacts:

From the above discussions, it is evident that different types of hazards produce different degrees of impacts on different sectors. In all the hotspots, the most affected sector is usually agriculture because crop cultivation is highly dependent on nature. While in the cyclone prone area, crops are damaged occasionally by cyclones, in the salinity and tidal flood prone areas crop cultivation is gradually becoming difficult due to increased salinity. In other areas, such as the river and flash prone hotspots, people can grow crops only in the Boro season, whereas in waterlogged area, farmers cannot grow crops in any season at all. Lack of crop production has a direct impact on income as rural people mostly depend on agriculture for their livelihoods. Even when they shift to other occupations, the original income levels are not restored because of lack of work or resources.

The fisheries sector is highly affected in the cyclone and waterlogged prone hotspots, where cyclones and saline water have caused ghers to be damaged and fisheries to die. But in salinity and tidal flood prone hotspots, the same saline water created opportunities for shrimp farming. But the poor are usually against this shrimp cultivation because it leads to increased salinity and further damage of agricultural lands. In both tidal flood and waterlogged prone hotspots, people are now facing the effects of unsustainable overfishing which has led to dwindling fish populations.

The impacts on livestock can be direct or indirect. In the cyclone prone hotspot, livestock often die due to
cyclones as people fail to move them to safe shelters. In other areas, such as the waterlogged, drainage congestion, flash flood and river flood prone hotspots, livestock are occasionally affected by rising water levels and must be moved to higher areas. However, in most areas people find it difficult to provide food for their cattle due to absence of crop cultivation. In some places, like the salinity and river flood prone areas, grasses also cannot be grown, while in the flash flood prone area, the grazing lands are flooded in monsoon. Livestock always serve as an important asset for the poor and their products can either be consumed by the household or sold in the market. But due to poverty arising from lack of income opportunities, people cannot afford to purchase cattle or have to sell them to earn money.

**Trees** and vegetation are also severely affected in all hotspots, other than the drainage congestion prone hotspot, as trees are not an integral part of the urban life. In drought prone areas, people complained that they have no space to grow trees, while in the waterlogged, river and flash flood prone areas, trees cannot be grown due to excess water. In the cyclone, salinity and tidal flood prone hotspots, frequent cyclones cause trees to be uprooted, and the soil salinity prevents homestead gardening. Lack of vegetable and fruit plants lead to malnutrition as the poor cannot afford to buy these from the market.

**Infrastructure** damage is severe for the coastal hotspots, where cyclones lead to damage of roads, embankments, bridges and houses, which later need to be rebuilt completely. In the drainage congestion and flood prone areas, the damage is comparatively less and minor repairs after disaster can restore the original state. Although floods and water congestion do not destroy large structures, they do damage household physical assets such as furniture, equipment, utensils and clothing. Problem arises when rise in water level completely disrupts road communication for few months, as in the case of flash flood prone hotspot. Drought usually has no effect on infrastructure or household materials.

The **health** sector is mainly affected by waterborne and skin diseases, which the people face due to floods, waterlogging and salinity. Long term effects include malnutrition, stress, and increased physical labor arising out of poverty. While health problems create additional treatment expenditures, they also lead to lack of productivity of labor. Severe consequences such as death only occur in cyclone prone hotspot and a couple of events such as drowning of children have also been recorded in flood prone areas.

The impacts on **education** can also be direct or indirect. Floods and cyclones often cause schools to remain closed for weeks and also create communication problems for children. In the river flood prone hotspot, children have to sit on the teacher’s bed to take exams, and in the water-logged hotspot, young children have to be carried to school by their mothers so that they do not drown or damage their books. In all hotspots, however, secondary effects are more severe, as when lack of income compels parents to stop education of their children. Even if some can afford up to primary education, secondary education is out of bounds for most households, and the children drop out of school to work with their parents.

People of the hazard prone areas try to survive using different types of livelihood options which they can avail while they face them. Natural disaster affects their current income as well as savings which are observed from the qualitative survey. A majority of the surveyed households (55 percent) lost family income due to natural disaster (Table 7).

Storm surges, floods, and river bank/coastal erosion are major hazards that cause huge losses to crops and assets and on humans as well (Table 8).

### TABLE 7. COMMON REASONS FOR SUDDEN LOSS OF FAMILY INCOME

<table>
<thead>
<tr>
<th>Reasons</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Illness/Death</td>
<td>11</td>
</tr>
<tr>
<td>Loss of job</td>
<td>6</td>
</tr>
<tr>
<td>Poor harvesting</td>
<td>6</td>
</tr>
<tr>
<td>Natural disaster</td>
<td>55</td>
</tr>
<tr>
<td>Others</td>
<td>3</td>
</tr>
<tr>
<td>Not applicable</td>
<td>19</td>
</tr>
<tr>
<td>Total</td>
<td>100</td>
</tr>
</tbody>
</table>
Vulnerability in the context of study hotspots

Vulnerability is conceptualized in very different ways by scholars from different knowledge domains, and even within the same domain. Turner, et al. (2003) identify two classic approaches to viewing vulnerability across different disciplines.

- **Risk-hazard (RH) models** that aim “to understand the impact of hazard as a function of exposure to the hazard event and the dose-response (sensitivity) of the entity exposed.”
- **Pressure-and-release (PAR) models** in which “risk is explicitly defined as a function of the perturbation, stressor, or stress and the vulnerability of the exposed unit.”

The two different frameworks are both incomplete in their conceptualization of vulnerability with the former emphasizing biophysical processes but neglecting the factors that contribute to system sensitivity or the capacity to affect such sensitivity (Turner et al., 2003). Meanwhile, the latter places greater emphasis on social processes that contribute to vulnerability, but underemphasizes dynamic relationships and feedbacks among biophysical hazards and processes and social vulnerability processes.

Turner, et al. (2003) argue that these two concepts can be unified under a more integrated view of vulnerability, and the following Figure summarizes the relationship between the various components of vulnerability as well as some potentially relevant determinants of different aspects of vulnerability. This movement toward more integrated views regarding vulnerability is reflected within the IPCC’s definition of vulnerability that is specific to climate change (see also Adger, 2006):

“Vulnerability is the degree to which a system is susceptible to, or unable to cope with, adverse effects of climate change, including climate variability and extremes.”

(Carter et al., 2007)

Assessments commonly decompose climate change vulnerability into three constituent components: exposure, sensitivity and adaptive capacity, each capturing different elements of vulnerability.

- **Exposure:** The nature and degree to which a system is exposed to significant climatic variations.
- **Sensitivity:** The degree to which a system is affected, either adversely or beneficially, by climate-related stimuli. The effect may be direct or indirect.
- **Adaptive capacity:** The ability of a system to adjust to climate change (including climate variability and extremes) to moderate potential damages, to take advantage of opportunities, or to cope with the consequences.
Traditionally, the first two determinants (exposure and sensitivity) have been viewed as dictating the potential for adverse consequences to occur (or ‘gross’ vulnerability), thereby providing an indication of potential susceptibility to adverse impacts. Meanwhile, the third determinant (adaptive capacity) reflects the ability of the system to manage, and thereby reduce, ‘gross’ vulnerability.

**Scoring Inter-Hotspot Vulnerability**

Based on the concepts outlined in the above Figure, an attempt has been made to assess the vulnerability of the eight hotspots by assigning them scores on different indicators of social and biophysical vulnerabilities respectively. The scores have been given on a scale of 1–5, where 1 indicates a lower level and 5 depicts higher level of vulnerability. The aggregate scores calculated at the bottom of the table gives an indication of the difference in the level of vulnerability between different hazard prone hotspots. It should be noted that these scores are purely judgmental, based on the information collected and assessment of the researchers; hence, the relative variation between the scores is more important than the absolute value. The table below gives an indication of the methodological tools which provided data for each of the indicators mentioned.

**High Vulnerability:** From the above table it can be concluded that both the flood prone hotspots and the three coastal hotspots have the highest level of vulnerability compared to the others. This is because of the destructive nature of the hazards and the level of economic development of those areas.

In the flash flood, cyclone and tidal surge prone areas, the hazards are highly uncertain, giving people very less time to prepare themselves and save their lives and property. River floods are more or less predictable in the sense that people can get at least a week’s time before...
the flood water rises above threshold levels, yet there is little they can do to protect themselves. All four hazards cause massive destruction of crops, disrupt communication, damage houses and physical property, and also hamper normal lives of people to a great extent. In the flood prone areas, other than the hazard times, the soil is fertile and crops can be grown successfully in at least one season of the year. However, in the coastal regions, intrusion of saline water during the hazards also reduces soil fertility in the consecutive seasons, and as such hazards have become highly frequent, people are affected by another hazard before they can completely recover from the previous one.

Besides these biophysical vulnerabilities, these hotspots have also scored high in terms of socioeconomic vulnerabilities. Due to various climatic hazards, landlessness is gradually increasing in almost all hotspots, thus severely affecting the incomes of people, as rural people mostly depend on agro-based livelihoods. In the river flood,
flash flood, cyclone and salinity prone hotspots, river 
bank erosion is causing huge loss of agricultural lands, 
which is diminishing the natural assets of people, thus 
forcing them to adopt other livelihood options. In all 
these hotspots, even the richest people have as little as 
3–5 bigha of land, while the poor may possess 1–2 bigha 
or none at all. On the other hand, huge financial inequalities exist in drought and tidal flood prone hotspots,

### TABLE 10. VULNERABILITY ASSESSMENT OF THE EIGHT CLIMATE CHANGE-RELATED HOTSPOTS OF EACC STUDY.

<table>
<thead>
<tr>
<th>Indicators</th>
<th>Hotspots</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dependence on limited livelihood activities</td>
<td>Drought prone 4 River flood prone 2 Flash flood prone 5 Waterlogged prone 4 Salinity prone 4 Cyclone prone 5 Tidal surge prone 2 Drainage congestion prone 1</td>
</tr>
<tr>
<td>Financial inequality</td>
<td></td>
</tr>
<tr>
<td>Health problems</td>
<td></td>
</tr>
<tr>
<td>Lack of education</td>
<td></td>
</tr>
<tr>
<td>Inaccess to new information</td>
<td></td>
</tr>
<tr>
<td>Inaccess to electricity supply</td>
<td></td>
</tr>
<tr>
<td>Lack of proper communication</td>
<td></td>
</tr>
<tr>
<td>Inaccess of credit</td>
<td></td>
</tr>
<tr>
<td>Lack of women engagement in paid work</td>
<td></td>
</tr>
<tr>
<td>Inaccess to common property resources</td>
<td></td>
</tr>
<tr>
<td>Lack of GO / NGO activities</td>
<td></td>
</tr>
<tr>
<td>Landlessness</td>
<td></td>
</tr>
<tr>
<td>Unemployment</td>
<td></td>
</tr>
<tr>
<td>Food insecurity</td>
<td></td>
</tr>
<tr>
<td>Lack of hazard protection structure</td>
<td></td>
</tr>
<tr>
<td>Social conflicts / insecurity</td>
<td></td>
</tr>
<tr>
<td>Intensity of hazards</td>
<td></td>
</tr>
<tr>
<td>Frequency of hazards</td>
<td></td>
</tr>
<tr>
<td>Duration of hazard / Recovery time</td>
<td></td>
</tr>
<tr>
<td>Soil infertility</td>
<td></td>
</tr>
<tr>
<td>Unavailability of fresh water</td>
<td></td>
</tr>
<tr>
<td>Hazard uncertainty</td>
<td></td>
</tr>
<tr>
<td>Urgency of pre-hazard preparation</td>
<td></td>
</tr>
<tr>
<td>Overall vulnerability</td>
<td></td>
</tr>
<tr>
<td>Vulnerability level</td>
<td></td>
</tr>
<tr>
<td>High (above 80)</td>
<td>✓ ✓ ✓ ✓ ✓</td>
</tr>
<tr>
<td>Moderate (60–80)</td>
<td>✓ ✓ ✓ ✓ ✓</td>
</tr>
<tr>
<td>Low (below 60)</td>
<td>✓</td>
</tr>
</tbody>
</table>
where the rich are big landlords possessing as much as 50–100 *bigha* of land, while the poor have merely 1–2 *bigha*. In these areas, the poor are not prone to losing land due to erosion, but their original asset base is very limited. As a result, these people have to lease land from others or work as laborers on others’ lands.

Food insecurity is a direct consequence of landlessness, because when people cannot grow crops, they cannot provide food for their families. In rural cultures, a portion of the harvested crops are kept for the household while the rest are sold to the market to earn money. The stored grains sustain people for months while the money is used to buy other household goods and services. In the cyclone and flash flood prone hotspots, crops are occasionally damaged due to unpredictable events. Salinity also reduces yield or increases input expenditures, which means that the farmers have to reduce the fraction of grains they keep for their households. In flood prone hotspots, the lands can only be cultivated in any one season, for which enough crops are not produced to sustain the household for the whole year. Fishermen and day laborers are usually among the poorest in all the villages and their incomes are not sufficient to provide good meals for their families. Moreover, lack of homestead gardening in flood and salinity prone hotspots means that people are deprived of proteins such as milk and eggs. The market prices of all food items have also increased, resulting in more miseries for people.

Due to huge population growth, decreases in agricultural activities, and unsustainable fishing practices, people are gradually becoming unemployed or earning less than before. In the tidal flood prone hotspot, decreases in marine fish population means that wages of hired fishermen are decreasing. In the case of river and flash flood prone areas, work availability is also declining and people have no option but to stay idle for few months. Even educated young adults fail to find suitable jobs due to lack of industrialization and development in rural areas. The end results are increasing migration to urban areas, declining living status, and increase of poverty and crime.

In the tidal surge prone area, where people have access to common property resources such as the Bay of Bengal, declining crop production has forced people to shift to fisheries as their primary livelihood option. However, in the flash flood prone area as people are restricted to enter the protected wetland areas, fishing is not possible as an alternate income source.

In a few hotspots, climatic hazards have led to new social conflicts or increased the previous ones. In the salinity prone hotspot, there is conflict of interest between shrimp farmers and crop cultivators. While the former are taking advantage of the situation and even causing more salinity by bringing in more saline water, the latter are gradually losing fertility of their lands. Since the shrimp farmers are mainly rich and powerful people, the poor cannot fight back and at one point a situation arises when the poor are compelled to sell or lease away their lands to the shrimp cultivators. In the flash flood prone hotspot, social conflicts have long existed for unknown reasons, but lack of income and resources exacerbate the problem. Social insecurity such as theft and harassment increases. Men do not want to leave their families and migrate to other places for work. However, in the river flood and cyclone prone areas, people mention that they have good social cohesion and females feel confident to live alone in absence of their husbands or sons. In the cyclone prone area, social security is also good and people can leave their assets and houses during cyclones without worrying that they could be stolen.

Poor health and poor education, which are direct or indirect impacts of climate change, also increase vulnerability of people. Lack of education means new generations cannot deviate from the traditional natural resource-based livelihoods of their parents and work in service or manufacturing sectors. While some hazards such as cyclones may cause people to become physically disabled, all hazards such as floods and salinity lead to water-borne and skin diseases. However, long-term effects of malnutrition and poor childhood development make people more vulnerable to further diseases. Poor health translates to poor labor productivity and hence lower ability to cope with hazards. But sometimes, poor education and health are also results of non-climatic factors such as lack of educational or health centers in the villages and lack of awareness.

Poor communication facilities increase vulnerability by decreasing people’s mobility and livelihood options. In
the flash and river flood prone hotspots, a lot of time is required to travel by waterways to the nearest upazilla town to obtain basic goods and services. In the cyclone prone hotspot, poor communication means that people cannot travel to safe shelter easily and relief materials also do not reach them in time. If transportation is poor, an area becomes detached and suffers from lack of development activities by government and NGOs. People in these areas also do not have access to new information and cannot learn by replicating others’ successes.

Hazard protection structures, such as embankments and cyclone or flood shelters, are also not adequately present in these areas. In the coastal hotspots, the embankments have not been repaired since construction and currently they have been damaged at places making them incapable of restricting entry of sea water. In the flash flood prone area, a submergible embankment was constructed by a NGO, but it is not capable of protecting the crops adequately and is not strong enough to sustain for years. Cyclone shelters are present in the cyclone prone and tidal surge prone hotspots, but not in adequate quantities and they do not cater for the needs of women and livestock.

**Moderate Vulnerability:** The drought prone and waterlogged prone hotspots have been ranked as moderately vulnerable because the hazards affecting these areas are not as intense as those mentioned above. In the drought prone area, the hazard is highly predictable as it occurs every year in the dry season; and as it is a gradual process, the impacts are not realized in one day, as with cyclones and floods. The major impacts of drought are loss in crop yield, increased irrigation costs and decrease in ground water supply during the months of March–May. Unlike other hazards, drought does not destroy physical infrastructure or force people to leave their houses in search of shelters. In terms of socio-economic indicators, financial inequality is quiet high in this area as a few big landowners possess most of the land, while most families own very little land and work as sharecroppers or renters on others’ lands. Since people in this area are highly dependent on agriculture for their livelihoods, drought has a significant impact in their incomes. However, the drought prone hotspot selected for EACC study is quite developed compared to other hotspots, as it has good roads and transportation systems, lots of NGO-operated schools, government institutions including health care centers, agricultural bureaus. Yet the poor people cannot afford to use these services at times. The education level is quite low in this area, and unemployment is high even among those who are educated.

In the waterlogged prone hotspot, the hazard is anthropogenic rather than climate induced. The area scores quite high in terms of socio-economic indicators, as the education level is comparatively high, especially among women, and employment in service sectors is also relatively high. People were once highly dependent on agriculture for their livelihoods but now that their lands are completely submerged under water throughout the year, they have shifted to alternate livelihoods such as fishing, handicrafts, tailoring, van driving, etc. If the embankment had not been intentionally cut by relevant authorities as part of the TRM project, the village would not have suffered from these hardships. Community people reflected that once they were self sufficient as they could cultivate crops in all three seasons on their own lands but now they are trapped in extreme poverty due to this permanent waterlogging.

**Low Vulnerability:** Among the others, the least vulnerable hotspot is the drainage congestion prone area, as waterlogging only occurs for few days after persistent heavy monsoon showers. People have to live precariously for few days after which they can return to normal lives with comparatively fewer damages. As these slum dwellers are not dependent on natural resources such as land and water bodies for their livelihoods, drainage congestion does not have any long-term impact on their income generating activities. Moreover, unlike all other hotspots, women in the slum are also involved in paid work, and the economic diversification is higher. If compared to urban dwellers, huge financial inequalities exist with the slum people who are mostly migrants from different rural areas of the country. Living in an urban area, people have more access to information and services compared to those in rural hotspots.

**Explaining Variation in Intra-hotspot Vulnerability**

As discussed above, while the level of vulnerability varies from one hotspot to another, it is also different between different groups within the same hotspot. Based on the findings of field research, the following
three groups of people are considered as most vulnerable.

**Women:** In all the eight hotspots, women are generally more vulnerable than men to climate-related impacts due to their social status, cultural norms, lack of access to and control over resources, and lack of participation in decision-making processes. Women bear multiple responsibilities at home, including food preparation, provision of cooking fuel, health care, and caring for children and their education. It has been found that women living in poverty bear a disproportionate burden of consequences of climate change because of their marginalized status and dependence on local natural resources. Although it is found that women are in general more vulnerable to climate change impacts than men, there are significant differences in the vulnerabilities among the women based on location, age, education, wealth status, ethnic group, and overall asset base. Some of these socio-economic impacts observed in the EACC study are outlined below:

1. **Traditional division of labor resulting in increased workload:** In all hotspots, climate change related events increase the domestic burdens on women, as additional work needs to be done to deal with the adverse situation. However, these responsibilities do not increase in equal amounts in all hotspots. In some places while women have to spend on time and effort in performing their household chores, in others they have to get involved in additional activities which were previously not part of their normal works. Regarding the increase in workload, two types of vulnerabilities have been highlighted:
   a. **Investing more time and energy in usual household chores:** In the saline and drought prone areas where fresh water is in short supply, stress is put on women who have responsibility to supply it to their families, often being forced to walk long distances, risking their health and their personal safety in the process. In absence of agriculture, many people in the waterlogged hotspot cannot afford to buy fodder for their cattle, so it is the women who have to go to distant places to gather grass. Their usual job of cooking also becomes difficult when rising in water level compels them to raise their stoves or go to neighboring houses to cook. Women’s workload increases after a disaster as they have to help with house repairs, cleaning, and maintenance in addition to their routine work. When belonging to a minority ethnic group is superposed on women, their conditions are further exacerbated. For example, although all Bengali households in the tidal flood prone village have tube-wells, households of the Rakhaine tribal community of that village do have any source of safe water supply due to poor development of that area. As a result, Rakhaine girls have to travel long distances on foot to fetch water. Like age, wealth status also governs the impact on workload. However, the wealth status of the household sometimes determines the degree of impact on the women. For example, in the drought prone hotspot, women belonging to relatively wealthier families suffer less because their husbands can afford to employ servants or laborers to do many of the work like looking after cattle, repairing houses, post-harvest activities.
   b. **Engaging in additional activities outside regular domestic works:** In the waterlogged hotspot, where permanent waterlogging over the last five years have compelled people to shift from land-based to water-based livelihoods, women often have to accompany their husbands for catching fish at night. In both waterlogged and flash flood prone hotspot, women also help their male counterparts in making handicrafts such as mats or fishing traps, which are later sold in the market. However, the increased workload poses a greater impact on older women. In the waterlogged prone hotspot, older women have to look after themselves, as their sons or daughters cannot afford to bear the costs. They roam around the village all day, fish on their own using their own dilapidated boats and nets, and sleep in someone else’s house at night. They went into tears while narrating how waterlogging has submerged all their lands, obliging them to live in such a helpless condition.

2. **Social positions and limited access to resources creating deterioration of health, hygiene, and sanitation:** Conditions of health and hygiene may deteriorate due to a number of reasons such as lack of food,
increased incidence to diseases, poor sanitation facilities, and decreased financial capability to pay for medical treatment. With respect to health and hygiene, five main types of vulnerabilities have been identified by the EACC study:

a. **Women's position in the household and innate nurturing characteristics leading to malnutrition:** Natural hazards such as flood, drought, cyclone, and waterlogging reduce agricultural production and cause food insecurity of the household because poor people cannot afford to purchase food from the market. Under this circumstance, a skewed intra-household food distribution arises because it is usually the women who consume less to preserve enough food their children and family members. For instance, in the flash flood prone hotspot, some mothers mentioned that they sometimes willingly go unfed to ensure that their children are not starving. While malnutrition may cause physical weakness and reduced immunity, it also can result in low birth weight and poor health status of new-born babies. For example, in the drainage congestion prone urban hotspot, the child mortality rate is quite high, which may be due to poor growth of the children during pregnancy.

b. **Lack of access to safe water, resulting in waterborne and skin diseases:** Floods, waterlogging, drainage congestion, and cyclones all increase the incidence of water borne diseases such as diarrhoea, cholera, typhoid. These diseases mainly spread as sanitation systems collapse and people start defecating in open places. In the urban hotspot, the situation becomes worse as water gets polluted with sewage and garbage from the nearby drains and canals. A couple of women in the water-logging, flood and salinity prone hotspots showed that they have skin infections due to prolonged submergence in water or using saline water for household activities. In the river and flash flood prone areas, women mentioned that during floods they are compelled to drink flood water because all the tube-wells get flooded, and it is not possible to boil the water every time.

c. **Poor quality of physical capital leading to poor hygiene and sanitation:** During floods, waterlogging or drainage congestion, women face difficulties in conducting their personal sanitary tasks because toilets get flooded and they have to wait till night to ensure their privacy. In drought prone areas, scarcity of water means that women cannot bathe frequently. They go to some distant river or pond and bathe there in the afternoon hours while men are resting at home.

d. **Limited financial resources and less mobility reduce access to medical services:** Women do not leave home to visit doctors unless there is a serious disease, so their problems are usually overlooked. In most hotspots, when climatic impacts decreased household income, the families cannot afford to spend money on medical treatment, and the women are the first ones to sacrifice. In the villages of the flash and river flood prone hotspots, there are no hospitals or medical centers, and people have to go to the nearest upazilla town by boat for treatment. This additional transportation cost and time required often hinder women from enjoying proper and timely treatment. One woman in the drought prone hotspot complained that she is reluctant to visit the local doctors because they give the same medicine regardless of the problem—and also do not behave well.

e. **Lack of access to information and lower mobility leading to greater injury or death:** During extreme events such as cyclones and storm surges, women are more susceptible to injuries and death than men because they do not get information in time or cannot leave the household until everyone else has evacuated. In the cyclone prone hotspot, it was found that of the 341 victims of cyclone Aila, most casualties were women. Some women also suffered injuries and were disabled when their sarees got entangled with tree branches on their way to cyclone shelters. Death of husbands or the male earning member of the family also has a significant effect on women. If a woman's husband dies or becomes disabled, she is left on her own in the quest for survival either as a female-headed or female-managed household.
3. **Social status of women leading to increased social insecurity:** The EACC study reflects that women’s safety is jeopardized mainly due to four circumstances, which are:
   
a. **Increased male out-migration creating insecurity of female-managed households:** In some areas, climate change generates resource shortages and unreliable job markets, which lead to increased male-out migration and more women left behind with additional agricultural and households duties. Temporary migration for work is common for men in most hotspots, when lack of income-generating activities compels them to move to neighboring villages or towns in search of work. In the tidal flood prone hotspot, men usually stay at sea for months, and the women are left in the villages to look after the house and the children on their own. Social insecurity is high as theft increases and women become susceptible to harassment by other men. An interesting finding in this hotspot is that, in order to ensure that their wives do not become disloyal to them behind their backs, the men usually feel more comfortable leaving their wives behind when they are pregnant.

   b. **Segregation from kinship ties leading to insecurity in new environments:** Climate change-related hazards often push widowed or divorced women, as well as young girls, to move to urban areas in search of work. When females migrate to new areas on their own, they primarily have to face the hostile situation of their destination and adjust to the new culture. They are highly insecure in the new environment, for instance, in urban slums where many of these women end up.

   c. **Limited gender-sensitive institutional support leading to insecurity on the way to and at the shelters:** In the cyclone prone hotspot, it is common that young girls and even adult women are harassed on their way to cyclone shelters. Women complained that the cyclone shelter themselves are not gender sensitive, as they do not have separate rooms and toilets for men and women, especially for pregnant and lactating mothers. Moreover, women mentioned that all the volunteers who disseminate warning signals during cyclones are males, for which they feel quite left out. Female volunteers could help them to move to shelters properly and take some last-minute preparations. In the drainage congestion and flood prone areas, when women have to stay on the roads or cyclone shelters during disaster times, they feel quite uncomfortable sharing the space with strange men.

   d. **Higher demand for limited resources leading to post-disaster conflicts:** After a cyclone, it is usually the women who have to stand in long queues all day to get relief materials. Overcrowding, quarrels, and fights are common in these situations, and women often have to go through these conflicts to get a minor share of the relief materials.

4. **Cultural norms leading to volatile marriage and family life:** In terms of impacts on marriage and family life, the EACC study has produced two main observations:
   
a. **Early marriage:** When climatic hazards deteriorate the livelihood status of a household, marrying off any young girls seems to be a means of shedding some burden. A respondent in the water-logged hotspot reflected that she dropped out of school so she could be married. The trend of early marriage is relatively high in the drought prone hotspot, where there is chronic poverty due to crop loss and generally low level of education. A girl’s marriage is also dependent on the amount of dowry her father can pay to the groom; frequent hazards diminish a family’s ability to give a substantial amount of dowry, which affects the daughter’s subsequent marital life.

   b. **Intra-household conflicts:** Resource scarcity and poverty arising from climate change impacts can also translate to conflicts within the household. It was found that one woman in the salinity prone hotspot was abandoned by her husband when her parents failed to provide the dowry demanded. When a family is displaced from a rural area to an urban slum, the dynamics of the urban culture often influence intra-family conflicts resulting in separation and re-partnering.

5. **Cultural norms and limited access to educational institutions hampering proper education:** In terms of
impacts on education, the EACC study has produced two main observations:

a. Age old tradition of undermining importance of female education leading to high drop-outs in general: Generally it has been observed that school dropout rates are high and women in all hotspots have less education than men. Natural disasters like cyclones significantly reduce the asset base of a household, and one of the impacts is that poor families can longer afford to send their children to school. When there is a choice, it is the girls who are first dropped out of school because their education is considered less important than their brothers’. For instance, in a family with three sons and three daughters in the drought prone hotspot, it was found that two of the sons have moved to the town for higher education, while one of the daughters slightly younger than her brothers stopped education after she failed in SSC once.

b. Social structure and access to institutions creating variation between hotspots: Although female education is low in all areas, there exists significant variation among the hotspots. For example, in the waterlogged prone hotspot, females are much more educated compared to those in other areas. One of the reasons can be presence of good quality primary and secondary schools within close vicinity. And as most young mothers are educated at least up to primary level, they are quite passionate about ensuring proper education for their children. In contrast, in the drainage congestion prone hotspot, although there are many schools in the area, slum girls do not have much access to educational institutions because of financial inabilities. One interesting observation is that cultural norms in the slum also expect that girls should go to religious schools (madrassas) for their education.

Poor and Marginal Farmers: In rural areas of Bangladesh most people are involved in crop production as their primary livelihood activity. However, as population is increasing and the same amount of land is divided among children of the next generation, individual land ownership is declining significantly. As a result, most farmers these days have an insignificant amount of land and mainly work as sharecroppers or renters on others’ lands. When crop productivity decreases due to climate change-induced natural hazards, it brings about adverse impacts on employment and incomes. Poor farmers usually store a significant portion of their agricultural produce for household consumption, which sustains the whole family for months. If crop yield falls, household food security is at stake; to afford basic food items, the families have to forgo other expenses such as on health, education, clothing, etc. Rich farmers, on the other hand, are more resilient to climatic hazards because they often get fixed rents for their leased-out lands regardless of production or have diversified livelihood options which are not always natural resource based.

Crop loss due to flash floods often brings food insecurity to a poor farmer’s household. Since Boro cropping requires modern inputs and considerable investments, crop loss due to flash floods devastates the hopes of poor and marginal farmers who often become loan defaulters following such a disaster. Flash floods also destroy houses built of mud, which often belong to poor farmers. Loss of crops and houses sometimes put poor farmers in extreme economic hardships.

In the river flood prone hotspot, once a prolonged flood continues past mid-August, it becomes a nightmare for poor and marginal farmers because they cannot transplant Aman paddy in time. Even before transplantation, they accept certain levels of crop loss. If the flood event continues up to September, as it happened in the deluge of 1998, the farmers lose as much as 40 percent of projected yield; this is a huge blow to micro-scale food security and a macro-scale (i.e., national) economic catastrophe. In such a case, it becomes almost impossible to cope with the aftermath of the flood, especially in terms of food insecurity and hunger.

Salinity in the dry season appears to be a major concern for poor farmers. Since input-intensive high yielding Boro paddy is grown during the dry season, poor farmers need to borrow money from wealthy money lenders. With diminishing profitability, crop production does not facilitate economic emancipation. Economic hardship of the poor and marginal farmers therefore remains unabated. Moreover, in all these three hotspots, river bank erosion is also increasing landlessness among
marginal farmers, who are forced to migrate temporarily to other areas to work as day laborers.

Drought affects Boro crops profusely, especially during March and April. Lack of irrigation during the peak drought period can result in chita formation and reduce yield significantly. And occasional lack of appreciable rainfall in late July and August can jeopardize land preparation for Aman transplantation. Livestock also suffers, with many farmers having to sell their cattle at very low prices because they lack both fodder and drinking water.

In the tidal flood prone hotspot, standing crops, especially vegetables and Aman seedlings often are ruined by strong reverse osmosis caused by salinity. Loss of the Aman season is often translated into food insecurity and hunger for poor and marginal farmers. Once seedlings are ruined, it becomes a costly affair on the part of the poor farmers to replace them.

In the waterlogged prone hotspot, it appears that most of the lands are inundated year round. However, the intensity of waterlogging varies seasonally: all the lands undergo deep water during peak monsoon, while in the dry season the water column on the lands are generally knee high and the roads and other notable infrastructure become inundation-free. Farmers who had been involved in crop production for generations are now either unemployed or work as migratory day laborers in nearby villages.

Poor and marginal farmers are usually hand-to-mouth people with no cash savings or fixed assets which can be used to recover from disasters. In the absence of education, all they have is the ability to provide physical labor. As there are few employment opportunities in the village, these men have to move to towns and cities to work as mud cutters, rickshaw pullers, factory workers, etc., leaving their families behind.

Fishermen: In most areas, fishermen are the poorest ones, and as their livelihoods are based on natural resources, their incomes are also greatly affected by climatic hazards. In the drought prone hotspot, fishermen complained that in the past the adjacent Punarbhaba River used to have some water even in the dry season, enabling them to obtain some fish for their subsistence. Nowadays, the river becomes completely dry during winter months, and even in the monsoon when water levels rise, the fish population is too small to allow a significant catch. Fish culture is also possible in the ponds as well due to water shortage. Moreover, most ponds are privately owned and common people do not have access to them. In the waterlogged prone hotspot, in the absence of agricultural activities, many people have started fishing in the Beel area and this overfishing is causing the fish population to dwindle very fast. As a result, the fishermen have to stay awake all night standing in the waters to get enough of a catch to be sold in the market the following day.

In the tidal surge prone area, unsustainale fishing in the sea has also led to decline in fish population, and fishermen now have to go into deeper waters. The fishermen often defy cyclone warnings, especially when successive warnings are issued and they apprehend loss of fishing season by spending time on shore. Sometimes rough weather on the open sea capsizes their fishing boats and they drown. The owners of these trawlers are usually rich fish businessmen who hire labor at cheaper wages to catch fish from the deep sea. Fishermen are among the most vulnerable groups because they completely depend on naturally bred fisheries without any input from themselves. If they could breed fish in enclosed ponds or ghers, their yield would have been higher. Only in salinity prone hotspot, shrimp cultivation is conducted by rich people in enclosed ghers where intrusion of saline water has created new opportunities for them while causing hardships for marginal farmers.

Vulnerability is conceptualized as a function of exposure, sensitivity, and adaptive capacity. In this section an attempt has been made to assess the relative vulnerabilities of the eight hotspots by assigning arbitrary scores to various indicators of socioeconomic and biophysical vulnerabilities. It has been observed that vulnerability is relatively high in the three coastal and two flood prone hotspots, moderate in case of the drought and waterlogged prone areas, and low in the urban drainage congestion prone hotspot. Yet within individual hotspots, not all groups are subject to equal degrees of vulnerability. In most hotspots it has been found that women, marginal farmers, and fishermen are among the most vulnerable groups because of their social positions, asset bases or livelihood practices.
CROSS-CUTTING OBSERVATIONS: COPING STRATEGIES VERSUS ADAPTATION

Existing Coping Mechanisms

Coping mechanisms vary according to the type of hazard in the different hotspots. Even when some of the coping mechanisms are similar for multiple hotspots, the extent of use and the time of usage vary. The following matrix (Matrix 1) and paragraphs describe the various steps people take to cope with hazards and the factors which constraint them in certain cases.

Moving to safe shelter: Moving to a safe shelter during a hazard is the first step that people take to save their lives and personal properties from damage. Before cyclone shelters were built, people in the tidal surge prone hotspot used to move to paved high roads or other highlands. Although today there are a few cyclone shelters, the nearest one is at least 1 km away, and they are not spacious enough to accommodate all the people. People normally do not move to these shelters until it is signal 6 or 7. In the salinity prone hotspot, there are no cyclone shelters, and when people get warnings about impending cyclones, they move their children to other houses which are stronger and located in relatively higher areas. When their houses are damaged by cyclones or inundated with water, people move to nearby roads or newly created highlands. Some also use the school building as temporary residence.

People in the cyclone prone hotspot move to cyclone shelters during hazards, but as these shelters are overcrowded with poor latrine or drinking water facilities, people have to face numerous difficulties. Women do not like these shelters because there are no separate rooms for men and women. In order to keep warm, people often burn papers or wood in the cyclone shelters. Some who fail to reach shelters in time take shelter in tree tops or tie themselves to trees so that they are not blown away. In the river flood prone hotspot, people migrate to higher charlands during floods. They have to rent the land for the period of their stay, which is not possible for everyone due to lack of money. This form of migration is becoming even more difficult as all the charlands are getting smaller due to erosion and as the migrating population is increasing.

People in the waterlogged and drainage congestion prone hotspots migrate to the nearby paved high roads. In the waterlogged prone hotspot, villagers have to temporarily live under the open sky on the only paved high road of the village along with their livestock or move to Union Council, which is further away. In the drainage congestion prone hotspot the slum dwellers also take temporary shelter in construction sites nearby. People in the flash flood prone area cannot go anywhere and so stay in their houses amidst the flood water. Very few people who have relatives in other villages move to their houses during floods. In the drought prone area, people do not have to leave their houses due to any disasters. It was only during the devastating flood of 1998, which inundated the whole village, that people temporarily moved to the school building.

Temporary Structures, Cooking and Food Storage:

Sometimes during hazards, people build temporary structures to protect themselves and their belongings. In the tidal flood prone hotspot, people build machas to keep their important documents or belongings safe. Along with this, people in the flash flood prone hotspot make raised platforms with bamboo for living, rice storage, and cooking. In the river flood prone area, people plan ahead and make high ceilings with planks of wood to store their goods. In the waterlogged or drainage congestion prone hotspots, people do not build machas but in the latter they hang their utensils with ropes from the ceilings. Women in the waterlogged and flash flood prone hotspots use tin containers to raise their cooking apparatus, while in the river flood and drainage congestion prone hotspots, they cook on their beds. Sometimes women in the waterlogged, drainage congestion and tidal flood prone areas have to go to their neighbors' houses to cook or share stoves when they all are forced to shift to the roads.

People in the urban slum said that whenever they feel that water level is going to rise, they try to finish their cooking the day beforehand, or at least keep boiled water for their families. They usually eat dry food like Chira, molasses, and bread when they cannot cook. The poor in the tidal flood prone area store dry food beforehand in portable earthen ovens, whereas the rich have enough savings to live on bought food during hazards. But in waterlogged hotspots, people mentioned that they hardly have enough rice to eat every day so making dry food such as chira, muri out of rice is out of
### Matrix 1. Existing Coping Mechanisms

<table>
<thead>
<tr>
<th>Coping mechanisms / Hotspots</th>
<th>Salinity prone</th>
<th>Cyclone prone / Tidal Flood</th>
<th>River flood prone</th>
<th>Water logging</th>
<th>Drainage congestion</th>
<th>Flash flood prone</th>
<th>Drought prone</th>
<th>Riverbank / Coastal erosion</th>
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<tbody>
<tr>
<td><strong>Moving to safe shelter</strong></td>
<td>In salinity prone hotspots, there are no cyclone shelters and when people get warnings about impending cyclones, they move their children to other houses which are stronger and located in relatively higher areas.</td>
<td>People in cyclone prone hotspots move to cyclone shelters during hazards, but as these shelters are overcrowded with poor latrine or drinking water facilities, people have to face lot of difficulties. Women do not prefer these shelters because there are no separate rooms for men and women.</td>
<td>People migrate to higher charland during floods.</td>
<td>Villagers have to temporarily live under the open sky on the only paved high road of the village along with their livestock or move to Union Council which is further away.</td>
<td>Slum dwellers also take temporary shelter in construction sites nearby.</td>
<td>People in flash flood prone area do not have any scope to go anywhere and so stay in their houses amidst the flood water. Very few people who have relatives in other villages, move to their houses during floods.</td>
<td>In drought prone area, people do not have to leave their houses due to any disasters.</td>
<td>People migrate with the whole family.</td>
</tr>
<tr>
<td><strong>Temporary structures, cooking and food storage</strong></td>
<td>People store biscuits, molasses, candles, dry food, life saving medicines, oral saline under the earth or inside the bamboo.</td>
<td>People store biscuits, molasses, candles, dry food, life saving medicines, oral saline under the earth or inside the bamboo. They carry dry food with them to the cyclone shelters.</td>
<td>People plan ahead and make high ceilings of wood to store their goods.</td>
<td>People do not build machas but in the latter they hang their utensils with ropes from the ceilings. Sometimes women in the waterlogged, drainage congestion and tidal flood prone areas have to go to their neighbors' houses to cook or share stoves when they all are forced to shift to the roads.</td>
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<td>People raise platforms with bamboo for living, rice storage and cooking.</td>
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### Coping mechanisms / Salinity prone

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<tr>
<td>Dealing with livestock</td>
<td>In cyclone, salinity and tidal flood prone areas, where cyclone shelters cannot accommodate all people, taking livestock to shelters is not possible. As a result, they are released so that they can find a safe shelter for themselves.</td>
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<td>Livestock take shelter on the roads along with people.</td>
<td>Livestock take shelter on the roads along with people.</td>
<td>People often build floating platforms for their cattle or shift them to adjacent villages when possible.</td>
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| Safe water                  | In waterlogged areas, when death of fish caused extreme bad odors after Aila, the chairman employed laborers to retrieve the dead fish and also apply bleaching powders to the water. | Pond-Sand Filter (PSF) is the main source of drinking water after hazards in cyclone prone area when all the ponds and canals become filled with saline water. Local NGOs (e.g. Muslim Aid UK, Rupantor) provide such facilities. | People ultimately use the flood waters for household purposes. | People ultimately use the flood waters for household purposes. |

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**Notes:**
- **Coping mechanisms / Salinity prone**
  - In cyclone, salinity and tidal flood prone areas, where cyclone shelters cannot accommodate all people, taking livestock to shelters is not possible. As a result, they are released so that they can find a safe shelter for themselves.

- **Safe water**
  - In waterlogged areas, when death of fish caused extreme bad odors after Aila, the chairman employed laborers to retrieve the dead fish and also apply bleaching powders to the water.
  - Pond-Sand Filter (PSF) is the main source of drinking water after hazards in cyclone prone area when all the ponds and canals become filled with saline water. Local NGOs (e.g. Muslim Aid UK, Rupantor) provide such facilities.
  - People ultimately use the flood waters for household purposes.
question. In the flash flood prone area, dry foods are sometimes donated by the government or NGOs, but the amount is never sufficient. People in the salinity prone hotspot mentioned that when they face food crisis during cyclones, the rich often give them some food and sometimes their relatives from adjacent villages also come to help. In the cyclone prone hotspot, people store biscuits, molasses, candles, dry food, life-saving medicines, and oral salines under the earth or inside the bamboo. They carry dry food with them to the cyclone shelters. When relief is provided they have to stand in queues for long periods just for a fist full of rice, and they sometimes have to come home empty-handed.

Schools and education: In the cyclone prone hotspot, schools are kept closed during disasters because they are used as cyclone shelters or temporary residences for homeless people. In other places like the river and flash flood prone areas, children face difficulty in going to school and so attendance remains very low. In the river flood prone area, students often take exams sitting on the teacher’s bed. In the waterlogged area, parents do not want their children to miss school and so carry the young children to school so that they do not get drowned or damage their books on the way. When water level rises in the school campus, the headmaster, along with the older students, stacks the school furniture one over another, so that they do not get damaged. They also move the library books to a higher place. In the salinity prone hotspot, children have to cross a canal by foot to reach their schools, and so they carry an extra uniform with them.

Dealing with livestock: Shifting livestock to safe shelters becomes a burden during hazard time. In cyclone, salinity and tidal flood prone areas, children face difficulty in going to school and so attendance remains very low. In the river flood prone area, students often take exams sitting on the teacher’s bed. In the waterlogged area, parents do not want their children to miss school and so carry the young children to school so that they do not get drowned or damage their books on the way. When water level rises in the school campus, the headmaster, along with the older students, stacks the school furniture one over another, so that they do not get damaged. They also move the library books to a higher place. In the salinity prone hotspot, children have to cross a canal by foot to reach their schools, and so they carry an extra uniform with them.

Access to safe water: Getting safe water is a huge problem during hazards and people adopt different ways to cope with this problem. In the tidal flood and drought prone areas, people go to distant places or other villages to get fresh water from tube-wells for drinking and cooking. Where this is not possible, as in the case of river and flash flood prone areas, people ultimately use the flood waters for household purposes. In the latter they try to boil it, but lack of fuel wood hinders them. One time NGOs provided them with water purifying tablets. Pond-Sand Filter (PSF) is the main source of drinking water after hazards in cyclone prone area when all the ponds and canals become filled with saline water. Local NGOs (e.g., Muslim Aid UK, Rupantor) provide such facilities. Some of the households install rainwater harvesting tanks, for pure and portable water supply. In waterlogged hotspot, when dead fish caused extremely bad odors after Aila, the chairman employed laborers to retrieve the dead fish and also apply bleaching powders to the water. Reduction in food consumption occurs automatically during or after any hazards as people cannot afford to purchase enough food for their families. In such cases, they stay hungry, eating only very little per day.

Change irrigation practices: In the drought prone hotspot, people have to provide extra water during March–May so that the crops are not affected by water stress. People who do not have their own shallow machines have to pay 2.5 mon of rice for irrigating each bigha of land and the fuel cost as well. The opposite situation prevails in the waterlogged hotspot. Although most people cannot cultivate in any season due to water-logging, some people whose lands are relatively higher can grow Boro crops in the winter. In this case, they perform reverse irrigation, i.e., they pump water out of their lands.

Temporary migration: Migrating temporarily to other rural or urban areas during hazards is a common practice in most hotspots. In the salinity prone hotspot, men often migrate to their neighboring village (Nakna).
where they work in the agricultural lands as laborers during monsoon. Others move to Rangamati, Bandarban, or Barisal where they earn money by felling trees or working in the saw mills. Some work as rickshaw pullers in Dhaka and Barisal for a month or two and come back to the village as soon as they find rickshaw pulling very strenuous. Not many women migrate for work, but two widowed women who have no one to look after or earn for them went to work as cook and housemaid in Khulna, but after a year or so one of them had to come back as she had two minor children with no one to look after them.

In the flash flood prone hotspot, young people, especially men, migrate to other districts (Munshiganj, Sylhet and Chittagong) for work as day laborers during floods. Women do not migrate or work outside home; they believe they are unskilled and unable to migrate for earning money. Men who cannot leave their houses and go for work elsewhere usually stay idle or help the women to make handicrafts (mats). In the waterlogged hotspot, whenever there is a working man in the family, he migrates to other places in search of work. They work in brick fields or other's agricultural lands, and live away from their houses for 15 to 30 days. Their food is sent from their homes to their working places. One person carries food for 30 people by bicycle. During October/November (Kartik), they sow seeds of Boro crops, cut soil in crop fields and work in brick fields also. In March–May (Chaitro, Boishak) they harvest the Boro crops from the fields. In the drought prone hotspot, migration numbers are low compared to other villages, because people do not want to leave their homes for work. Sometimes people go to nearby brick kilns or other agricultural land in adjacent villages to work as day laborers. Women never leave their homes for work. Most men in the cyclone prone hotspot migrate to other villages to work as day laborers. They mainly go to other districts of greater Khulna, Barisal, or even to Dhaka, while their families stay in the village.

Interpretation of signals: In the cyclone prone hotspot, people’s survival is completely dependent on the access to immediate warning facilities and its adequate interpretation. Volunteers of Red Crescent wave flags and announce through miking after signal 3. But during cyclone Sidr there was a misinterpretation of signal 10, which led to huge casualties. After Sidr, Muslim-Aid UK (an NGO) provided a radio to almost all the households so they can get signals on time. In the saline prone hotspot, people complained that no one ever came in their village to deliver any signals, but they learn about upcoming hazards through TV and radios. They can also predict cyclones by looking at the wind speed and water currents. In the tidal flood prone hotspot, people stay home when the signal is 2 or signal 3, but when it is 6 or 7 everyone moves to the cyclone shelters with their belongings. If the fishermen are home during a low signal they can decide whether to go to the sea or not, but those who are already out in the sea have little option. In the river flood prone area, people also rely on experience to predict disasters by looking at river flow and rainfall patterns.

Taking Loans: Taking loans is also one of the common coping mechanisms of the hazard-affected people. In the drought prone hotspot, few households are not indebted to any bank or NGOs because when they cannot make profits from a single season, they have to take loans to buy inputs for the next season. In the cyclone prone hotspot, local NGOs provide loans for handicrafts, raising poultry, livestock, vegetable or homestead gardening. When repaying loans, females tend to be more serious compared to males. However, they gather the money—sometimes by borrowing from friends or relatives—the women repay the loans as soon as possible. But in the river flood prone hotspot, people cannot get loans because they do have any documents to provide as security; also, the interest rate is very high. People in the waterlogged hotspot said that they do not have to show any proof while taking loans but they usually avoid it because they know they cannot repay. Similarly, the villagers of the flash flood prone hotspot are reluctant to take loans, but they do borrow money from relatives and neighbors. They buy goods in installments from the shops. Some household heads took loans from non-governmental organizations like LGED, CNRS, and IRA for repairing their houses.

Selling livestock products or assets: Poor people have very few assets to sell, other than livestock products such as milk and eggs. During hazards, some people increase sales of these products to get money to purchase other necessities, while others reduce their sales and keep more for household consumption. In the drought prone
hotspot, people often sell their cows to get enough money to meet household expenses. In the water-logged hotspot, people sold trees that were about to rot away in the water. In salinity and cyclone prone hotspots, people also sometimes sell their lands to earn money or because they know they cannot afford to desalinize their agricultural lands.

Temporary migration is most frequent for the working member of the hazard-affected households in the eight hotspots areas. About 36 percent (Table–9) of households of the surveyed areas depend on temporal migration (rural and urban) to adapt with the natural hazards. They mainly migrate for getting working opportunities. In the hazard prone areas about one-third said they try to store food and drinking water, which they can use after the natural hazards. Livestock is the second most valuable asset, after land, for the farmers of rural Bangladesh, so they always try to take care of it. In the hotspots areas people (24 percent) raised platform for their livestock as an adaptation measure for climatic hazards. House repairing and rebuilding (39 percent) also are adaptation practices and options. In the cyclone prone south hotspots, after cyclone Sidr and Ila, the people are still struggling to repair their houses, and they want external assistance to do that.

**TABLE 11. ADAPTATION STRATEGIES OF THE SURVEYED HOUSEHOLDS WHILE FACE HAZARDS**

<table>
<thead>
<tr>
<th>Adaptation strategies</th>
<th>Percentage of households</th>
</tr>
</thead>
<tbody>
<tr>
<td>Crop selection (saline/drought/flood tolerant)</td>
<td>7</td>
</tr>
<tr>
<td>Adapt planting dates</td>
<td>11</td>
</tr>
<tr>
<td>Adapt cropping densities</td>
<td>1</td>
</tr>
<tr>
<td>Adapt fertilizer / Pesticide application</td>
<td>7</td>
</tr>
<tr>
<td>Adapt tillage practices / Ploughing techniques</td>
<td>2</td>
</tr>
<tr>
<td>Change the pastoral system</td>
<td>1</td>
</tr>
<tr>
<td>Change the herd composition</td>
<td>1</td>
</tr>
<tr>
<td>Seed storage facilities</td>
<td>9</td>
</tr>
<tr>
<td>Build dwarf embankment around field</td>
<td>5</td>
</tr>
<tr>
<td>Use water harvesting techniques</td>
<td>9</td>
</tr>
<tr>
<td>Temporal migration to urban areas</td>
<td>10</td>
</tr>
<tr>
<td>Temporal migration to other rural areas</td>
<td>27</td>
</tr>
<tr>
<td>Permanent migration</td>
<td>3</td>
</tr>
<tr>
<td>Non timber forest product commercialization</td>
<td>1</td>
</tr>
<tr>
<td>Home garden agriculture</td>
<td>10</td>
</tr>
<tr>
<td>Increase market sales</td>
<td>3</td>
</tr>
<tr>
<td>Handicrafts</td>
<td>14</td>
</tr>
<tr>
<td>Start fisheries / Poultry</td>
<td>6</td>
</tr>
<tr>
<td>Reduce expenses by changing consumption</td>
<td>17</td>
</tr>
<tr>
<td>Draw down on livestock surpluses or saving</td>
<td>8</td>
</tr>
<tr>
<td>Restore and preserve homestead forest to reduce erosion</td>
<td>7</td>
</tr>
<tr>
<td>Soil erosion prevention</td>
<td>1</td>
</tr>
<tr>
<td>Food storage (dry food, safe water etc.)</td>
<td>33</td>
</tr>
<tr>
<td>Construction of storage areas</td>
<td>17</td>
</tr>
<tr>
<td>Preservation of fuel wood</td>
<td>28</td>
</tr>
<tr>
<td>Raised platform for livestock / Cooking</td>
<td>24</td>
</tr>
<tr>
<td>Raised houses to prepare for season change</td>
<td>20</td>
</tr>
<tr>
<td>Repair house to prepare for seasons change</td>
<td>19</td>
</tr>
<tr>
<td>Access and interpretation of warning signals</td>
<td>4</td>
</tr>
<tr>
<td>Sell assets</td>
<td>11</td>
</tr>
</tbody>
</table>

KEY CONCLUSIONS FROM FIELDWORK

Livelihoods and Climate Change Adaptation

**Existing Adaptation Practices**

*Permanent Migration*: Permanent migration from the hazard prone area seems to be the only solution when people lose everything due to hazards and have no hope of any livelihood opportunity in that area. But this is a big decision and involves high costs, so it cannot be taken by many people. Moreover, even in very hostile conditions, people are reluctant to leave the land of their ancestors and move to an unknown place. In the salinity prone hotspot, riverbank erosion caused more than 40 households, mostly fishermen, to move to the neighboring village. After cyclone Aila, about five-to-six households, who were living outside the embankment, moved to the hilly areas of the south-east (Rangamati and Bandarban) where they have bought lands and settled. There they earn money by felling trees or working in the saw mills. In the river flood prone hotspot, where riverbank erosion is severe, the number of households in the village dropped from 1,500 to 300 in the last 20 years. At least 150 households migrated because of severe river erosion in 2007. Similarly, in the cyclone prone hotspot, people mentioned that some of their relatives have migrated to Dhaka, Khulna, Patuakhali, or Barisal as they had lost everything in prolonged river erosion and
unpredictable recent cyclones. Some of these migrated people are working as wage-laborers, garments workers, rickshaw pullers, or van-drivers. In the tidal flood and waterlogged prone hotspots, very few people can afford to migrate permanently to cities and other villages because of the cost. Only the rich people have managed to leave the village and settle down in the town.

**Shift or diversify livelihood options:** As discussed in section 4, climate change-related hazards have huge impacts on people’s livelihoods, especially for those who are involved in agriculture or fishing. As these sectors are highly depended on nature, they are becoming very unreliable and so people are trying to explore other livelihood options for survival. In the salinity prone hotspot, where agriculture is becoming unsuitable due to increasing salinity, members of the younger generation do not want to follow the traditional occupations of their ancestors and so are migrating to other places for wood-related work, rickshaw pulling, day labor, etc. The same is true in the river flood prone area, where in the last 10 years, more and more people are getting involved in carpentry work, small businesses, or migrating to work in garment factories. In the flash flood prone hotspot, women make bamboo mats (pati) throughout the year to sell at the local markets. Even though the villagers are prohibited to fish by their Hindu caste system, they have now started fishing due to scarcity of food. Similarly, in the waterlogged hotspot, people are now making fishing traps (charons) as one of their alternate sources of income. The majority of the people have also shifted their occupations from agriculture to fisheries because of this waterlogging. While a few better-off people who possess their own ponds can grow fish, others catch fish in common property resources such as beels. In the tidal flood prone area, salinity has created new livelihood opportunities for some people who are now involved in shrimp cultivation and salt production. In the cyclone prone hotspot, river bank erosion and restricted entry to Sundarbans are also compelling people to change their occupations gradually. Farmers are becoming shop-keepers, small businessmen, or shrimp cultivators. All of them have access to community ponds and the river, and are so taking up fishing as their main occupation.

Literate females are also interested to make handicrafts in their leisure time, after the household chores. A few of them already started this by borrowing capital from cooperative societies.

**Changing crop varieties and cropping pattern:** In areas, where agriculture is still possible, people are trying to change their crop varieties so that the plants can adapt to the water shortage or saline conditions. In the tidal flood prone hotspot, farmers prefer cultivating Boro crops in winter rather than growing Aus and Aman in summer and monsoon, as the main hazards occur during these seasons. However since Boro cultivation is costly because of its requirement for inputs like irrigation, fertilizer, etc., some of the small farmers still like to cultivate Aman rice. Some of the farmers used to grow watermelon and gourds in their fields due to the aridity of the soil. In the drought prone hotspot, replacing traditional hybrid Boro varieties by Parija and Irri-29 helped farmers cope with drought. According to them, these varieties mature one month earlier and so the farmers can avoid the water-stressed conditions which arise during March–May.

**Adapt fertilizer and pesticide applications:** In the salinity prone hotspot, farmers wait for some months or years for the salinity to decrease from the agricultural land. They apply sugar and gypsum fertilizer to decrease salinity and use tobacco and cow dung as pesticides. Similarly, in the tidal flood prone area, most of the lands are not suitable for cultivation due to salinity and aridity. But the peasants are putting fertilizer and manure there. They usually use gypsum and potash to reduce the salinity. They are also growing early maturing varieties of vegetable in addition to seasonal crops. In the river flood prone hotspot, when any land emerges from the flood waters, it needs to be prepared for agriculture by plowing it. As the soil is highly sandy in the charlands, people initially need to make it suitable for growing crops. The marginal farmers in the drought prone area have been cropping for generations and do everything based on trial and error. None have any proper education or training. When Boro crops are infected by pests in winter, they apply more and more pesticides to kill the insects. The amount of fertilizers and pesticides required is increasing day by day.

**Repair or rebuild houses:** In villages most houses are kacha which are easily destroyed after any cyclone or flood and so need to be repaired or rebuilt. In the salinity prone hotspot, the better-off people in the village often raise their houses or make them paka after a sudden disaster. They also put fences around
the house and make the house stronger by supporting it with more bamboo poles. For protecting yards and residential land, people in the flash flood prone hotspot build fences around the edge of their residential lands using bamboo and *murta*. In order to prevent water from entering their houses, people in the water-logged hotspot are trying to raise their houses by mud and bricks. For this they have to purchase mud from the Bhogodowa River, which makes the process quite expensive. Richer people can afford it and those who are building new homes now are making them higher. Most people do not have money to repair their existing homes. In the river flood prone area, people also have to repair the damaged parts of the houses after floods. Houses are completely destroyed after cyclones in the cyclone prone hotspot, and people become completely homeless. As none of them had the capability to rebuild their houses, an NGO (Muslim Aid) built one room kacha houses for each family. In the drainage congestion prone hotspot, people complained that landlords never raise or repair their houses, but one of the landlords mentioned that she spent Tk. 40,000 to raise the floor of her own house with cement.

*Repair Tube-wells:* In some areas, the tube-wells occasionally go under water, posing problems for people. But sometimes raising tube-wells is not possible due to lack of funds. In the river flood prone area, if a villager has to do the work of raising the bed around the TW himself with the help of some community men, then he also has to worry about feeding the laborers at least but he lacks that money to do so. So government needs to help. In the tidal flood prone area, the well-off family raised their tube wells and can drink safe water easily. Poor people then try to collect drinking water generally from tube-wells which are still in order.

*Preserve fuel wood:* In most rural areas, people use natural substances as fuel for cooking. In both drought and water-logged hotspots, people use cow dung but in different ways. In the former, they make circular disks by drying cow dung in the sun, and in the latter they wrap the dung around sticks to make *moshal*. People usually make these in large quantities and store them. In the cyclone prone hotspot, when the weather is good and the season is dry, the men go to the Sundarbans by boat to collect fuel wood. When these are brought home, the fuel woods are tied in a bundle and put up on a raised ceiling inside the house.

*Start homestead gardening:* In most places, women try to grow some trees or vegetables in their yards to provide food as well as prevent soil erosion. In the river flood prone hotspot, some people plant trees like bamboo, *kolmi* to reduce soil erosion. Similarly, in the flash flood prone area, women plant green vegetables in the government lands around the village, but not every household can do this. The villagers in the tidal flood prone hotspot have started homestead forestry to reduce coastal erosion or the effects of cyclones. They have planted mahogany, teak, and coconut trees. Generally, the saplings are available in the nearest nursery. As the area is also cyclone-prone, people build houses that are not so high and if they can, plant trees on the southern side of their homes.

*Prepare seed beds:* This adaptation practice is unique to the salinity prone hotspot where the farmers get help from the farmers of the adjacent village (*Nakna*) to produce seed for their crops. Nakna being at a higher land than Shonatankathi is good for agriculture and seed production. It costs around 500 taka. After the land is ready and free from water and salinity, the seeds are sowed.

The *vulnerability* of a socio-economic and environmental system to climate change is conceptualized as a function of a system’s *exposure* to climate change effects and its *adaptive capacity* to deal with those effects. The more exposed a system is to a particular climate stimulus, the greater the system’s vulnerability; conversely, the greater the adaptive capacity of the system to a given climate event, the lower its vulnerability. The adaptive capacity of a community or household depends on its range of resources, which enable it to moderate potential damages and cope with consequences of climate change. These assets are human, social, physical, natural, and financial, the existing status of which in each hotspot have been discussed in section 3. The following table (table 12) outlines the importance of each of these assets in determining the adaptive capacity of a community.

As discussed in section 2, the focus group discussions involved a self-assessment exercise in which the participants were asked to score the indicators of each of the
### MATRIX 2. EXISTING ADAPTATION PRACTICES

<table>
<thead>
<tr>
<th>Hotspots / Adaptations</th>
<th>Salinity prone</th>
<th>Cyclone prone / Tidal flood</th>
<th>River flood prone</th>
<th>Waterlogging</th>
<th>Drainage congestion</th>
<th>Flash flood prone</th>
<th>Drought prone</th>
<th>Riverbank / Coastal erosion</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Permanent migration</strong></td>
<td>In salinity prone hotspot, riverbank erosion caused more than 40 households, mostly fishermen, to move to the neighboring village.</td>
<td>After cyclone Aila, about 5-6 households, who were living outside the embankment, moved to the hilly areas of the south-east (Rangamati and Bandarban) where they have bought lands and settled. In tidal flood and water-logging prone hotspots, very few people can afford to migrate permanently to cities and other villages as huge cost is required. Only the rich people have managed to leave the village and settle down in the town.</td>
<td>In river flood prone hotspot, where riverbank erosion is severe, the number of households in the village dropped from 1500 to 300 in the last 20 years. Villagers have to temporarily live under the open sky on the only paved road of the village along with their livestock or move to Union Council which is further away. In tidal flood and water-logging prone hotspots, very few people can afford to migrate permanently to cities and other villages as huge cost is required. Only the rich people have managed to leave the village and settle down in the town.</td>
<td>In drought prone area, people do not have to leave their houses due to any disasters. At least 150 households have migrated because of severe river erosion in 2007.</td>
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<td></td>
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</tr>
<tr>
<td><strong>Shift or diversify livelihood options</strong></td>
<td>As agriculture is becoming unsuitable due to increasing salinity, young generation do not want to follow the traditional occupations of their ancestors and so are migrating to other places for wood related work, rickshaw pulling, day labour etc.</td>
<td>In tidal flood prone area, salinity has created new livelihood opportunities for some people who are now involved in shrimp cultivation and salt production. In cyclone prone hotspot, river bank erosion and restricted entry to Sundarbans are also compelling people to change their occupations gradually. Farmers are becoming shop-keepers, small businessmen or shrimp cultivators.</td>
<td>In the last 10 years, more and more people are getting involved in carpentry works, small businesses and migrating to work in garment factories. People are now making fishing traps (charons) as one of their alternate sources of income. Majority of the people have also shifted their occupations from agricultural works to fisheries because of this water logging.</td>
<td>Women make bamboo mats (pati) throughout the year to sell at the local markets. Even though the villagers are prohibited to fish by their Hindu caste system, they have now started fishing due to scarcity of food.</td>
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### MATRIX 2. EXISTING ADAPTATION PRACTICES (continued)

<table>
<thead>
<tr>
<th>Hotspots / Adaptations</th>
<th>Salinity prone</th>
<th>Cyclone prone / Tidal flood</th>
<th>River flood prone</th>
<th>Waterlogging</th>
<th>Drainage congestion</th>
<th>Flash flood prone</th>
<th>Drought prone</th>
<th>Riverbank / Coastal erosion</th>
</tr>
</thead>
<tbody>
<tr>
<td>Changing crop varieties and cropping pattern</td>
<td>In tidal flood prone hotspot, farmers prefer cultivating Boro crops in winter rather than growing Aus and Aman in summer and monsoon, as the main hazards occur during these seasons. However since Boro cultivation is costly because of its requirement of inputs like irrigation, fertilizer, some of the small farmers still like to cultivate Aman rice. Some of the farmers used to grow watermelon and gourds in their field due to the aridity the soil.</td>
<td>In drought prone hotspot, replacing traditional hybrid Boro varieties by Parja and Irri-29 helped them to cope with drought. According to them these varieties mature one month earlier and so the farmers can avoid the water-stressed conditions which arise during March-May.</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Fertilizer and pesticide applications</td>
<td>Farmers wait for some months or years for the salinity to decrease from the agricultural land. They apply sugar and gypsum fertilizer to decrease salinity and use tobacco and cow dung as pesticides. Most of the lands are not suitable for cultivation due to salinity and aridity. But the peasants are putting fertilizer and manure there. They usually use gypsum and potash to reduce the salinity. They are also growing early maturing varieties of vegetable besides to seasonal crops. When any land emerges from the river waters, it needs to be prepared for agriculture by plowing it. As the soil is highly sandy in the charlands people initially need to make it suitable for growing crops.</td>
<td>The marginal farmers in the drought prone area have been cropping for generations and do everything based on trial and error. None have any proper education or training. When Boro crops are infected by pests in winter, they apply more and more pesticides to kill the insects. The amount of fertilizers and pesticides required is increasing day by day.</td>
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<table>
<thead>
<tr>
<th>Hotspots / Adaptations</th>
<th>Salinity prone</th>
<th>Cyclone prone / Tidal flood</th>
<th>River flood prone</th>
<th>Waterlogging</th>
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<th>Flash flood prone</th>
<th>Drought prone</th>
<th>Riverbank / Coastal erosion</th>
</tr>
</thead>
<tbody>
<tr>
<td>Repair or rebuild houses</td>
<td>The better-off people in the village often raise their houses or make them paka after a sudden disaster. They also put fences around the house and make the house stronger by supporting it with more bamboo poles.</td>
<td>Houses are completely destroyed after cyclones in cyclone prone hotspot and people become completely homeless. As none of them had the capability to rebuild their houses, an NGO (Muslim Aid) built one room kacha houses for each family.</td>
<td>In river flood prone area, people also have to repair the damaged part of the houses after floods.</td>
<td>In order to prevent water from entering their houses, people in the waterlogged hotspot are trying to raise their houses by mud and bricks.</td>
<td>People complained that land lords never raise or repair their houses, but one of the landlords mentioned that she spent Tk. 40,000 to raise the floor of her own house with cement.</td>
<td>For protecting yard and residential land, people in the flash flood prone hotspot, build fences around the edge of their residential lands using bamboo and mursa.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
The total score in each hotspot provides a good reflection of the current adaptive capacities of the communities, although the values should not be used very strictly. These scores have been obtained through the qualitative judgment of the participants rather than by quantitative measurements. Moreover, the scores were assigned by different participants in different hotspots whose judgment depended on their respective perspectives. If they had been provided by the same group of

five capital assets. This tool thus helped to assign a quantitative value to the current conditions of each of the indicators so that they can easily be compared with those of other hotspots. The following table (table 13) shows the scores of each of the five assets in all the hotspots. These values have been obtained by calculating the average of the scores of all the indicators in both male and female FGDs in each hotspot.

The Social Dimensions of Adaptation to Climate Change in Bangladesh

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### Table 12. Determinants of Adaptive Capacity

<table>
<thead>
<tr>
<th>Capital asset</th>
<th>Rationale</th>
<th>Indicator</th>
</tr>
</thead>
<tbody>
<tr>
<td>Human</td>
<td>Response to climate impacts is enhanced with residents who have:</td>
<td>• Level of Education</td>
</tr>
<tr>
<td></td>
<td>• strong skills and ingenuity; and</td>
<td>• Health Status</td>
</tr>
<tr>
<td></td>
<td>• good physical and mental health</td>
<td>• Access to new information</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Indigenous knowledge/Experience</td>
</tr>
<tr>
<td>Social</td>
<td>• Fewer people left stranded or without care</td>
<td>• Social Cohesion</td>
</tr>
<tr>
<td></td>
<td>• Networks between communities get the word out and assistance in</td>
<td>• Social Security</td>
</tr>
<tr>
<td></td>
<td>• People who care about their community will ensure it recovers</td>
<td>• Friends and Relatives</td>
</tr>
<tr>
<td></td>
<td>• Political connections may enhance community access to assistance</td>
<td>• Co-operative Societies</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Contact with NGOs</td>
</tr>
<tr>
<td>Physical</td>
<td>• The quality of utilities affects severity of impact.</td>
<td>• Road Networks</td>
</tr>
<tr>
<td></td>
<td>• Effective communications services guarantee faster response from within</td>
<td>• Access to Safe Water</td>
</tr>
<tr>
<td></td>
<td>and without.</td>
<td>• Access to Electricity</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Possession of Equipments</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Housing</td>
</tr>
<tr>
<td>Natural</td>
<td>• Better quality/higher quantity of affected resources mean greater ability</td>
<td>• Agricultural Land</td>
</tr>
<tr>
<td></td>
<td>to withstand climate impacts.</td>
<td>• Water Bodies</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Trees</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Friends and Relatives</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Co-operative Societies</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Contact with NGOs</td>
</tr>
<tr>
<td>Financial</td>
<td>• Greater financial assets mean greater ability to recover from material</td>
<td>• Income</td>
</tr>
<tr>
<td></td>
<td>loss</td>
<td>• Loans</td>
</tr>
<tr>
<td></td>
<td>• Diverse employment opportunities provide more options if climate affects</td>
<td>• Savings</td>
</tr>
<tr>
<td></td>
<td>particular type of occupation</td>
<td></td>
</tr>
</tbody>
</table>

Source: Wall and Marzal, 2004

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### Table 13. Livelihood Capital Asset Scores of Hotspots

<table>
<thead>
<tr>
<th>Hotspots</th>
<th>Livelihood capital assets (Scores out of 5)</th>
<th>Total score (Out of 25)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Drought prone</td>
<td>Human 2.5  Social 2.16  Physical 2.33  Natural 2.16  Financial 2</td>
<td>11.15</td>
</tr>
<tr>
<td>Salinity prone</td>
<td>Human 2.16  Social 3.33  Physical 1.16  Natural 1.83  Financial 1.67</td>
<td>10.15</td>
</tr>
<tr>
<td>Cyclone prone</td>
<td>Human 2.33  Social 2.5  Physical 1.16  Natural 1.5  Financial 1</td>
<td>8.49</td>
</tr>
<tr>
<td>River flood prone</td>
<td>Human 1.83  Social 3.16  Physical 1.83  Natural 1.83  Financial 1.67</td>
<td>10.32</td>
</tr>
<tr>
<td>Flash flood prone</td>
<td>Human 2.29  Social 1.67  Physical 2  Natural 2.4  Financial 1.5</td>
<td>9.86</td>
</tr>
<tr>
<td>Waterlogged prone</td>
<td>Human 3.33  Social 3.25  Physical 2.33  Natural 2  Financial 1.67</td>
<td>12.58</td>
</tr>
<tr>
<td>Tidal flood prone</td>
<td>Human 2.2  Social 3.2  Physical 2.5  Natural 1.83  Financial 2.16</td>
<td>11.89</td>
</tr>
<tr>
<td>Drainage congestion prone</td>
<td>Human 1.9  Social 2.17  Physical 1.7  Natural 1  Financial 1.7</td>
<td>8.47</td>
</tr>
</tbody>
</table>
respondents in similar socio-economic settings, then the values could have been easily compared. For example, although the infrastructure in urban areas is more improved than in rural areas, the people in the drainage congestion prone hotspot assigned one of the lowest scores to physical capital, perhaps, because they compared their conditions to other areas of the city. Similarly, although the urban slum dwellers have higher absolute incomes compared to the villagers, they gave low scores to their incomes, which are low compared to other urban people. On the other hand, the aim of this self-assessment exercise was to evaluate the asset base in the context of the individual hotspots. Thus, in analyzing the adaptive capacities, we have based our judgment both on the qualitative data as well as the above scores. To interpret the above scores, the following criteria have been used (table 14).

<table>
<thead>
<tr>
<th>Total score (out of 25)</th>
<th>Adaptive capacity</th>
</tr>
</thead>
<tbody>
<tr>
<td>20–25</td>
<td>Very High</td>
</tr>
<tr>
<td>15–20</td>
<td>High</td>
</tr>
<tr>
<td>10–15</td>
<td>Medium</td>
</tr>
<tr>
<td>05–10</td>
<td>Low</td>
</tr>
<tr>
<td>0–05</td>
<td>Very Low</td>
</tr>
</tbody>
</table>

Based on these criteria, the eight hotspots have the following levels of adaptive capacity (table 15).

As illustrated by the above table, none of the hotspots have a high adaptive capacity, which is understandable given their very poor asset base which prevents asset transformation in times of need. In the tidal flood prone hotspot, the frequency and intensity of cyclones is quite a bit lower than in cyclone and salinity prone hotspots, for which the impacts are comparatively less violent and the community gets time to recover from the shocks. Moreover, people in the tidal flood prone area have a wider range of livelihood opportunities because it is the most popular tourist spot in the country. Based on this tourism, shops, businesses, and hotels provide opportunities for people to shift from their natural resource-based livelihoods. The Bay of Bengal is also very near, and about 80 percent of the people are involved in fishing.

Although the cyclone and salinity prone hotspots are also part of two coastal districts, they have less access to the sea because of the large expanse of mangrove forest in between. In the tidal flood prone area, wealthy businessmen carry out shrimp cultivation and salt production, hiring local people as laborers. As a result, migration for work is less prominent in this area because even if people cannot cultivate crops or have fishing trawlers of their own, they can work as laborers. This is not the case for the cyclone or salinity prone hotspots, where frequent cyclones and saline water intrusion destroy their assets to such an extent that their adaptive capacity is diminished. In these areas, adaptive capacity is low because the impacts of hazards are so grave that people not only lose their income options but also their houses, livestock, and everything else. People in these areas also have low levels of education or skills, so working as day laborers remains the only option when crops and fisheries are damaged. But as there are no big businesses or farms in the area, little work is available. Moreover, they do not have much access to loans, preventing them from investing in new sectors. Supply of utilities such as water and electricity is also poor, along with damaged infrastructure such as roads and bridges. NGOs play an important role in post-disaster periods in the cyclone prone hotspot, but this type of external support is absent in the salinity prone hotspot. In the latter, there are no cyclone shelters and no one delivers warning signals, distributes relief materials or reconstructs broken roads or houses. However, NGOs
have long operated in the cyclone prone area in terms of rebuilding houses, providing radios, and delivering warnings.

In both the river and flash flood prone hotspots, adaptive capacities are also low because residents can do little to cope with the hazards. Like all other rural people, their incomes are mainly dependent on agricultural, but frequent floods destroy their crops and houses. Moreover, river erosion is diminishing their lands, making their lives more precarious and uncertain. Neither villages has health centers or markets, and all goods and services must be purchased from the nearest upazilla town. Due to absence of road communication, boats serve as the only mode of transportation, making the villages quite isolated from the main towns. NGO activities started only recently in these areas and are still insufficient to meet their needs. Loans are of little use if people do not have the ability to repay. People in these areas have to stay idle for months. Education is also very poor, so there is little hope that the next generations can explore other livelihood options. Although people in both these areas live amidst water half of the time, fishing activity is insignificant. In the flash flood prone area, people are prohibited to fish in the Tanguar Haor due to the Ramsar Convention and moreover, their religion also does not allow their particular caste to fish. In most other hotspots people are moving from agriculture to fishing, but people in these two flood prone areas still seem to follow their traditional occupations.

In the waterlogged prone hotspot, people are rich in human capital and they have better education and skills than people in the other areas. People are trying to diversify their livelihood options and move toward fishing, businesses, or services. They have better roads, access to safe water and electricity, unlike the other areas. Moreover, the presence of markets near the village allows people to sell the fish they catch, the handicrafts they make and the livestock products they get. Social capital is also good in the area, and the school headmaster uses his links to fight for the problems of this village. Their adaptive capacity is medium, a little better than the other hotspots. A similar situation prevails in the drought prone hotspot, where although people lack good human capital, their natural and physical assets are average. The proximity of the village to the upazilla town ensures that people have access to services and opportunities. The village has schools, mosques, shops, and basic institutions such as banks, health centers, government offices, and police stations. Moreover, the impacts of the hazards are not as intense as the cyclones or floods which destroy everything from houses to crops. Even if crop yields are reduced, people’s daily lives are not disrupted.

According to the scores, adaptive capacity is least in the urban drainage congestion prone hotspot, because people have few options to diversify their livelihoods. People who currently live in slums have already been pushed from rural to urban area due to poverty and lack of resources. Here, they have no natural capital such as land or water bodies which they can use to make a living. Moreover, their education and skills are very low compared to other urban people, so they have little hope of moving up the income ladder. There are a few NGO schools but these are quite expensive, and parents prefer to make their children work to earn some extra money for the family. Social relations and health and hygienic conditions are also very poor. Although they live in rented houses, they cannot move to other areas free from drainage congestion because house rents are higher in better places.

ENHANCING FUTURE ADAPTIVE CAPACITIES:

In order to increase the adaptive capacities of each of the communities, it is essential that their asset base is increased to an adequate level. During the self-assessment exercise, the participants pinpointed some of the major actions that should be taken by the government, NGOs, or the community itself to enhance their current conditions. Regardless of the hazard, some future suggestions were common in all hotspots, while some were only specific to that particular area. Some recommended actions, such as building embankments, are meant to reduce the exposure of the community to hazards, while others, such as increasing livelihood opportunities, are meant to enable the people to cope better with the hazard situation.

1. **Construction or repair of embankments:** Although embankments already exist in certain places, they have either been damaged or are not functioning properly. In the tidal flood prone hotspot, the
height of the embankment needs to be raised so that high tidal waves cannot enter the village. In the flash flood prone hotspot, a submersible embankment exists but during excessive floods, the water that enters cannot drain out in time; hence, the villagers suggested the need for a better embankment with sluice gates. The embankment in the salinity prone hotspot has been breached at many places, requiring immediate repairs to stop inflow of saline water. It should also be monitored that people do not breach the embankment intentionally to promote shrimp farming. A similar condition exists in the waterlogged hotspot, where the embankments have been cut in places intentionally by the authorities so that sedimentation occurs on the lands adjacent to the rivers. But as described in section 4, this has brought about permanent waterlogging in the area for the last five years. The only way to improve the situation is to fix the embankment again or shift the cut places to another area. In the drainage congestion prone hotspot, the slum dwellers suggested that a box culvert needs to be installed to pass the water into the channels. However, in some places, there are no embankments at present, but people highlighted the need for these structures to prevent river bank erosion. In both cyclone and river flood prone hotspots, people mentioned that an embankment needs to be constructed along Baleswar and Jamuna rivers, respectively.

2. Better education facilities: In almost all hotspots, the children are deprived of proper education facilities either due to lack of schools in the village or high cost. In the river and flash flood prone areas, there are currently no government schools and children go to the only NGO-operated school in the area. More government primary and secondary schools need to be built in these areas. In the drought and drainage congestion prone hotspots, people mentioned the need for free primary schools which would provide books as well as uniforms. In the former, people also mentioned the idea of night school for secondary education so that these children can work with their parents during the day and study at night. As cyclone and tidal flood prone areas are frequently affected by cyclones, using a primary school as a cyclone shelter would be the best option.

3. Provide more employment opportunities: People in all areas are willing to shift from natural resource-based livelihood to the manufacturing or service sectors. But in order to do so there needs to be more industries, businesses, schools, and NGOs in the hotspots where people can work, thus avoiding the need for migration. In the river flood prone hotspot, villagers envisioned that dairy farms have good potential for employment. There needs to be more opportunities for graduates so that they can find jobs after completing their education. People can also be trained to explore new livelihood opportunities and improve their existing ones. In the water-logged and flash flood prone areas, where people are skilled in making handicrafts, there needs to be greater market access so that people can sell their products not only to the local markets but also to urban areas. In the drainage congestion prone area, women mentioned that they should also be given the chance to work so that they can contribute to supporting their families.

4. Construction of roads and bridges: Road communication leads to development of an area in the long run. In some places, such as the river and flash flood prone areas, road communication is non-existent and people have to use boats to travel long distances to reach their nearest upazilla towns. Road construction is not possible in the former area, as it is a char land which shifts continuously. However, in the latter, construction of concrete roads will allow the villagers to use them in the dry season. In the salinity prone hotspot, cyclones have damaged all the roads and bridges which need to be repaired immediately. Farmers in the drought prone area also mentioned the need for a bridge over Punarbhaba River, which would allow them to transport their harvested paddy easily. In the waterlogged hotspot, the internal roads need to be layered with bricks so that they do not become muddy and slippery. Better road networks will lead to faster communication, lower transportation costs, and more livelihood opportunities. In the cyclone prone hotspot, this will enable people to move to shelters quickly, and in the waterlogged and drainage congestion prone hotspots, the roads will also be able to provide shelter when houses are flooded.

5. Good local governance: If the local government is devoted to the development of the area and the
betterment of the people, then more investments will be made in the area by the central government and NGOs. In the river and flash flood prone hotspots, people complained that they have always been neglected by the government, and whatever development have taken place are due to the actions of various NGOs. In the salinity prone hotspot, the elected chairman is from Jamat-e-Islam Party, so none of the relief materials come to that village after cyclones; rather they are distributed in the adjacent village, where the chairman is from the current Awami League government. Villagers in the waterlogged hotspot also complained that the government is not concerned about their vulnerable conditions and is doing nothing to improve their situations.

6. *River dredging:* River dredging will solve the problems of floods and waterlogging as the river will be able to hold more water during the monsoon. In the river, flash flood and waterlogged hotspots, the river beds have risen due to sedimentation and cutting off distributaries. People in these areas mentioned that the Jamuna, Surma and Bhogodawa rivers need to be dredged. In the drought prone area, villagers also highlighted the need for dredging the Punarabhaba River so that it does not become dry during winter; this would minimize the impacts of drought.

7. *Afforestation:* Planting trees is necessary for different purposes in different areas. In the cyclone and tidal flood prone hotspots, a coastal greenbelt can greatly reduce the wind speed and minimize the impacts of cyclones. On the other hand, in the river and flash flood prone hotspots, afforestation along the river banks can prevent bank erosion by holding the soil. Tree plantation is also needed in the hilly areas to reduce soil erosion and runoff from the hills after heavy showers. In the drought prone hotspot, more trees will make the environment cooler and reduce loss of soil moisture.

8. *Cyclone shelters:* Although cyclone shelters are present in the cyclone prone hotspot, they are not adequate to meet the needs of the people. The shelters are usually far away and do not have enough space to accommodate everyone. Thus, people mentioned the need for mini cyclone shelters after every 10–12 houses which can be used for emergency purposes. Moreover, the shelters should have safe water supply and sanitation facilities. Separate rooms for women and provision for bringing in livestock will also help people greatly. In the salinity and tidal flood prone hotspots, more cyclone shelters need to be constructed that could also be used as school during normal times.

9. *More access to common property resources:* Common property resources such as forests and water bodies often supply raw materials for people. But in the flash flood prone hotspot, the Ramsar Convention has prohibited fishing in the Tanguar Haor and prevented villagers from even collecting twigs. Similar complaints were heard from people in the cyclone prone hotspot, where villagers are prohibited to enter the Sundarban mangrove forest for fishing, fuelwood or honey collection. They are harassed by pirates who fine them for entering the forest areas.

10. *Electricity supply:* Electricity can improve the living standards of people and also help in their income generating activities. People in the waterlogged and flash flood prone hotspots, mentioned that electricity is necessary at night so that the children can study and they can make handicrafts and perform other household activities. In the drought prone hotspot, farmers said electricity will allow them to use shallow machines for irrigation and thus avoid the high fuel cost. In all hotspots, electricity will allow people to watch TV or charge mobile phones so that they can get entertainment and also learn about the changing world.

11. *Access to safe water supply:* Rural people in Bangladesh are highly dependent on groundwater for drinking and cooking purposes and on surface water for bathing and washing. But in the drought prone area, the groundwater level is decreasing day-by-day, and so people need a central piped water supply. Although piped water supply is already in place in that hotspot, its coverage needs to be increased. In the flood prone areas, where tube-wells become flooded every year, other safe water sources need to be ensured. In the cyclone and salinity prone hotspots, surface water is becoming unusable due to salinity, and so water purification or treatment systems need to be installed. In the former, use of Pond Sand Filters has already started but is still not adequate.
12. Development of warning systems: In the case of some hazards such as cyclones, timely warning is essential and people should also be trained to interpret signals accurately. In the cyclone prone hotspot, volunteers of Red Crescent deliver the signals, whereas in salinity prone area there is no warning system at all. Some women mentioned that there should be female volunteers to help them. People need to be trained about the steps they should take when different signals are disseminated. False warnings should be avoided, otherwise the people lose trust in the reliability of the signals.

Sharing Responsibility:

Most of the actions suggested in section 6 are the responsibility of the government and its relevant ministries; however, NGOs and international donor agencies can also play a major role. A huge amount of funding is required for constructing the infrastructures; this could be provided from government funds as well as by donor agencies who can channel their aid through the government or local NGOs. Construction of embankments and roads and river dredging require government initiative, especially the involvement of the Ministry of Water Resources.

Education and employment facilities can be developed both by the public and private sector. NGOs can set up schools and private entrepreneurs can set up factories, but these need to be monitored by government policies so the poor are benefitted. Although NGOs can help supply electricity and water at small scale by setting up solar panels or tube-wells, large centralized water and grid electricity supply should be ensured by the government. Through donor-funded projects, NGOs can also promote tree plantation in relevant areas. Weather forecasts are made by Bangladesh Meteorological Department, and warnings are disseminated by government as well as NGO volunteers. Training of these volunteers is also needed to make the system more effective. Community people have little role to play in enhancing their adaptive capacities because they have few assets. If they are empowered by the government or NGOs, they can play a significant role.
5. PARTICIPATORY SCENARIO DEVELOPMENT (PSD) WORKSHOP RESULTS

Participatory Scenario Development (PSD) is a tool for scanning the future in a rigorous, creative, and policy-relevant way to explore the effects of different actions for future challenges through participation of multiple stakeholders. Given the complex and uncertain climate futures which require varied forms of analysis and communication at multiple scales, these workshops aim to help local and national actors explore different climate futures and engage in a structured debates around development priorities and relevant adaptation responses at the local and national levels.

Bangladesh is one of the six developing countries where the EACC study is being conducted, and Bangladesh Institute of Development Studies (BIDS) is the organization responsible for carrying out the Social component of the study. For this purpose, national, local, and regional level PSD workshops were carried out throughout six hotspots; and victims, professionals and experts from various sectors were invited to these events (see List of Participants in the Appendix).

PSD WORKSHOPS: DESIGN OVERVIEW

Objectives of the PSD Workshop:

The objectives were drawn from the National PSD workshop conducted in June 2009 in Dhaka, Bangladesh. They were to:

- Identify options for adaptation to the impacts of climate change that also reflect participant’s preferences;
- Expose relationships, including synergies and trade-offs, between adaptation actions that need to be undertaken at national, regional and local levels;
- Develop an adaptation pathway that is relevant for the workshop participants in the context of their desired future development priorities; and
- Identify potential sectoral and institutional adaptation options to cope with or alleviate the impacts of climate change and socio-economic changes;

Methods: Process & Participants

The workshop followed a step-by-step process. Each new session was preceded by a presentation by the facilitator in order to put the exercise into perspective. Before each exercise began, an explanation was demonstrated to the participants after which, they carried out the task with supervision from the BIDS facilitation team.

The PSD workshops took half a day in each of the areas. It started by outlining the key elements of the workshop agenda, followed by introducing the objectives of the workshop to the participants. The purpose was to acquaint the participants with what the PSD workshop sought to achieve. Exercises included: developing a vision of the future, subjecting the vision to climate and socio-economic impacts, identifying adaptation options, spelling out adaptation pathways, and establishing short-, medium- and long-term priorities.

At the national level workshops, the country was divided into four broad regions: Northwest, Northeast,
Coastal, and Urban. Each of the regions was differentiated by its geography, climatic scenarios, economic opportunities, and potential threats from climate change. Residents, professionals, and experts from various sectors were invited to participate based on the workshop design and goals.

After the introductory session, the participants were divided into groups based on their interest and knowledge of the issues to be explored. Each group was constituted such that it represented the diverse stakeholders who were in attendance. At the local and regional level three groups were formed: gender, professional, and civil society. Each of the groups was asked to represent their area from their perspective. Local chairman, members, school teachers, journalists, and local elites formed the civil-society group (1). Women of different age groups represented the gender group (2). Their main concern were women oriented vision in near future, affect on health, security during disasters, improvement of women education and women empowerment. Farmers, fishermen, natural resource-oriented livelihood earners, and small businessman comprised the professional group (3). They mainly emphasized how natural hazards affect their livelihood options, changes in their occupations, and probable adaptation techniques to overcome the curse of occurring hazards.

The facilitator introduced the vision exercise. Participants were asked to vision along the...
issues identified, including but not limited to, energy, education, health, land management, local governance, food security, and social cohesion. This exercise ended with presentations from the various groups.

We introduced the first presentation on climate change impact and vulnerability with reference to disaster prone areas of Bangladesh at national, local and regional level workshops. These presentations were meant to characterize the climate change discussions within the context of current development challenges in the zones. This presentation was followed by group work, where participants subjected their visions to climate change scenarios.

At the local and regional level workshops after the first exercise (vision), we continued with a video documentary based on potential climate change impacts and adaptation strategy in Bangladesh. The documentary is based on different ongoing natural and man-made hazards such as drought, floods, river erosion, salinity intrusion, tidal surge, and cyclones. The cruelty and brutality of these disasters was showed visually. At the end, a few adaptation techniques, such as modern agriculture practices, fishing, floating vegetable gardening, raising poultry, and homestead gardening, were suggested. This provided the context for the groups to continue their work and identify impacts and corresponding probable adaptation options that will mitigate the adverse impacts of climate change focusing on vulnerable groups.

One thing that came out with this exercise was that while some of the coping options can be classified as short-term actions, and hence unsustainable, others can be classified as sustainable because they extend into the long term. Clusters of adaptation options were further developed into adaptation pathways prioritized into short (five years), medium (about 10 years) and long term (30 years and more). This final exercise took the participants into plenary session, where each group reported back on its findings, thus concluding the workshop.
OVERVIEW OF RESULTS FROM LOCAL AND NATIONAL WORKSHOPS

Prevailing climatic conditions and people’s vision 2050

All the hazards in Bangladesh such as cyclones, drought, salinity, flash flood, waterlogging, river flood, river erosion, and drainage congestion result in loss of life, economic loss, and damage to communications and infrastructure. A wide range of issues were explored by the participants. After the group formation, all participants were encouraged to discuss the issues by relating both the past and the present so as to give a vivid picture of the prevailing climatic conditions.

The next activity was aimed at developing ideal vision of the future. In order to remain focus both the facilitator and the participants identified some of the key elements of vision namely: long term, positive outlook, and an ideal situation. Again, to set the exercise into context, participants were presented with a number of issues (i.e., food security, land management, water resources, and health) around which they should formulate their visions. However participants were also encouraged to explore beyond the issues presented to them and also vision in the long term (up to 2050).

Other issues that came up during the vision exercise included: temporary or permanent migration, electricity facilities, social conflicts regarding equitable distribution of relief, poor carrying capacity without basic amenities of cyclone and flood shelters. Whereas major issues like environment management, water resource management, economic and gender issues, also came up in all national, local, and regional workshops.

However, the local workshop at the drainage congestion area raised issues that were divergent from other local workshops. For instance, agricultural and fishing issues were absent at drainage congestion area’s workshop, whereas they were prioritized in other local workshops. Establishment of day-care centers in each and every workplace, price reduction of basic goods, and permanent housing facilities with adequate water supply and sanitation facilities issues were brought up by urban participants in their workshop.

Climate change Impacts, existing adaptation practices and future options

Following the vision exercise the participants subjected the visions to possible climate and socio-economic impacts that will make achieving the visions difficult. For instance, at the national level workshops sustainable livelihood options, water resource management, protection and perfect utilization of natural resources, construction of adequate infrastructures, and planned urbanization were identified as possible future adaptation options to mitigate natural as well as anthropogenic impacts throughout Bangladesh.

MATRIX 3. PREVAILING CLIMATIC CONDITIONS:

<table>
<thead>
<tr>
<th>1st National</th>
<th>2nd National</th>
<th>Local</th>
<th>Regional</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cyclone, drought, salinity, flash flood, water logging, river flood, river erosion—leading to life loss, economic loss, communication &amp; infrastructure damage.</td>
<td>Cyclone, drought, salinity, flash flood, water logging, river flood, river erosion—leading to casualties, socio-economic and physical loss.</td>
<td>Unpredictable cyclone or tidal surge resulting massive casualties; agricultural loss, damage infrastructure &amp; communication system.</td>
<td>Drainage congestion created by unplanned urbanization leads to improper housing, water &amp; sanitation facilities, health problems, and social conflicts.</td>
</tr>
<tr>
<td>Sarankhola (Cyclone)</td>
<td>Kazipur (Riverflood)</td>
<td>Mohammadpur (Drainage congestion)</td>
<td>Cox’s bazaar (Tidal flood)</td>
</tr>
<tr>
<td>Khulna</td>
<td>Unexpected cyclone affects agriculture sector &amp; shrimp culture and thus leads to migration for better income scope.</td>
<td>Cyclone and tidal flooding hamper mainly economic sectors such as tourism, agriculture, salt and fisheries.</td>
<td>Along with these affect communication system and health.</td>
</tr>
</tbody>
</table>
### MATRIX 4. VISION 2050

<table>
<thead>
<tr>
<th>Sector</th>
<th>1st National</th>
<th>2nd National</th>
<th>Kozjpur (River flood)</th>
<th>Mohammadpur (Drainage congestion)</th>
<th>Cox’s Bazaar (Tidal flood)</th>
<th>Khulna</th>
</tr>
</thead>
<tbody>
<tr>
<td>Land zoning; no river erosion; promote ecotourism &amp; forestry.</td>
<td>Green Belt</td>
<td>Free of river erosion within 2050.</td>
<td>Permanent solution of drainage system.</td>
<td>Proper waste management.</td>
<td>Make a green belt using indigenous species of plants.</td>
<td>Protection of Sundarban</td>
</tr>
<tr>
<td>Environment management</td>
<td>Ensure water conservation &amp; flood security.</td>
<td>Installation of more PSF &amp; Rainwater harvesting system.</td>
<td>Availability of pure drinking water.</td>
<td>Canal dredging.</td>
<td>Extraction of salt water from deep tube well in order to get fresh drinking water.</td>
<td>Improve navigation facilities through river dredging.</td>
</tr>
<tr>
<td>Income &amp; livelihood</td>
<td>Full free women education up to SSC.</td>
<td>100% educated people.</td>
<td>Establishment of educational institution in Char areas.</td>
<td>Special education and training for abnormal people.</td>
<td>Adequate number of government higher education centre.</td>
<td>100% literacy.</td>
</tr>
</tbody>
</table>

*Continued on next page*
At local level workshops, such as in cyclone prone areas, massive casualties, drinking water scarcity, income loss, salinity intrusion, and gender problems were raised as impacts. To overcome these prevailing climatic conditions participants identified water harvesting and changing their occupations as existing adaptation techniques. They also suggested construction of embankments, mini cyclone shelters, and improvement of early warning systems as suitable future options for minimizing losses. On the other hand, participants from river flood areas suggested alternative livelihood options, construction of embankments, development of communication systems, and establishment of clustered village as probable future adaptations. Moreover, issues such as strict enforcement of rules and regulations, establishment of day-care centers and prohibition of polygamy, were also raised in the urban workshop at local level.

At the regional level workshop in Khulna representing the cyclone and salinity prone areas of Bangladesh, improvement of early warning systems to minimize losses, innovation of salt-tolerant agricultural practices to reduce food insecurity, and planned industrialization to ensure income scopes were discussed as adaptation options.

**ADAPTATION PATHWAYS**

**Issues and Adaptation Pathways:**

Adaptation pathways were developed by emphasizing several issues based on the time horizon. Some issues such as policy and governance, social policy, and natural resource management are long term projects, while developments regarding information, services, alternative income generation, education and training can be achieved during short or mid-term. For instance, at the national level workshop participants raised the issue that land reformation, decentralization of administration, academic and institutional authorities, or innovation of climatic hazard tolerant crop varieties (salt tolerant for coastal areas, early maturing verities for flash flood areas and less water demanding verities for drought prone parts) are expensive and time-consuming and involve policy considerations. Whereas, issues regarding river dredging, construction of embankments, green belts, and better communication systems at local and regional level workshops involves government husbandry. On the other hand, at local level workshops participants gave more emphasis to social policies such as restriction of early marriage and polygamy, empowering women, female education, ensuring social security, establishing clustered villages, etc.
### MATRIX 5. CLIMATE IMPACTS AND ADAPTATION MEASURES

<table>
<thead>
<tr>
<th>Areas</th>
<th>Impacts</th>
<th>Adaptation measures</th>
</tr>
</thead>
</table>
| 1st National | • Income loss  
• Displacement of mass people  
• Conflict over resource use  
• Crop loss  
• Biodiversity loss  
• Water scarcity  
• Damage to existing roads and communication system  
• Loss of crop production.  
• Unemployment.  
• Social insecurity.  
• Water scarcity  
• Disruption of education system.  
• Migration towards capital city. | • Sustainable livelihood options  
• Early warning systems; multipurpose shelters.  
• Protection of mangrove forest.  
• Innovation of climate resilient crops.  
• Rainwater harvesting.  
• Construction of effective infrastructures.  
• Green belt  
• Inclusion of chapters on climate change in text-books.  
• River management and dredging.  
• Construction of reservoirs.  
• Change schools calendar by following hazards occurrence period.  
• Following building codes. |
| 2nd National | • Income loss.  
• Loss of agricultural land due to river erosion  
• Migration  
• Scarcity of drinking water  
• Salinity intrusion  
• Occurrence of accidents of women while moving to shelters.  
• Inadequate carrying capacity of cyclone-shelters.  
• Massive casualties. | • Alternative livelihood options  
• Construction of durable embankment.  
• Green-belt  
• Installation of adequate number of PSF & rainwater harvesting system.  
• Plumbing of saline water or application of lime.  
• Construction of Mini cyclone shelters with basic facilities.  
• Improvement of warning system and make people aware about its meaning. |
| Sarankhola (Cyclone) | • Income loss.  
• Loss of agricultural land due to river erosion  
• Migration  
• Scarcity of drinking water  
• Salinity intrusion  
• Occurrence of accidents of women while moving to shelters.  
• Inadequate carrying capacity of cyclone-shelters.  
• Massive casualties. | • Alternative livelihood options  
• Construction of durable embankment.  
• Green-belt  
• Installation of adequate number of PSF & rainwater harvesting system.  
• Plumbing of saline water or application of lime.  
• Construction of Mini cyclone shelters with basic facilities.  
• Improvement of warning system and make people aware about its meaning. |
| Kazipur (River flood) | • Income loss.  
• Loss of agricultural land due to river erosion  
• Migration  
• Scarcity of drinking water  
• Salinity intrusion  
• Occurrence of accidents of women while moving to shelters.  
• Inadequate carrying capacity of cyclone-shelters.  
• Massive casualties. | • Alternative livelihood options  
• Construction of durable embankment.  
• Green-belt  
• Installation of adequate number of PSF & rainwater harvesting system.  
• Plumbing of saline water or application of lime.  
• Construction of Mini cyclone shelters with basic facilities.  
• Improvement of warning system and make people aware about its meaning. |
| Mohammadpur (Drainage congestion) | • Drainage congestion due to rainwater & unplanned urbanization  
• Unavailability of pure and portable water.  
• Spread of mosquitoes.  
• Child malnutrition.  
• Inequitable & improper wage distribution despite of laws.  
• Wages snatch by Hijackers or offenders.  
• Social insecurity.  
• Increase of poly-marriages among slum-dwellers.  
• Rise of child-labor or offenses. | • Take shelter on roads, high-rise or under construction buildings.  
• Made Macha (shelves made of bamboo) to keep necessary goods.  
• Store water for longer time or use purifier to reduce odor.  
• Monitoring and cleaning of small water bodies and drains.  
• Spraying of insecticides regularly.  
• Better health care facilities by government or local NGOs.  
• Government initiatives regarding equitable and deserving wage distribution among the workers.  
• Enforcement of strict rules by police force.  
• Prohibition of polygamy.  
• Ensure adequate schooling.  
• Establishment of day-care centers. |
### MATRIX 5. CLIMATE IMPACTS AND ADAPTATION MEASURES (continued)

<table>
<thead>
<tr>
<th>Areas</th>
<th>Impacts</th>
<th>Adaptation measures</th>
</tr>
</thead>
</table>
| Local | • Casualties and health disorder.  
• Destruction of School, college and Madrasa hamper education system.  
• Salinity intrusion in croplands.  
• Disrupt communication system.  
• Scarcity of portable water supply.  
• Tourism suffers  
• Dry fish industry suffers  
• Salt industry suffers | • Broadcasting of warning system in local language  
• Establishment of rescue team in each community.  
• Education centers remain close during disaster.  
• Construction of polders to protect agricultural lands.  
• Need to increase the road level considering the future hazards.  
• Installation of community base deep tube-well is needed.  
• Improve tourist facilities and provide better protection, like provision of life jackets, etc.  
• Use green house technology, where fishes can receive enough heat even in the rainy conditions and will be protected from insects.  
• Use modern technologies that can produce salt even in rainy conditions. |
| Regional | • Poor Crop production due to salinity.  
• Loss of biodiversity of mangrove forest by tidal surge.  
• Unemployment  
• Migration  
• Poor social cohesion | • Innovation of salt-tolerant as well as cyclone-tolerant crops.  
• Greenbelt.  
• Rainwater-harvesting.  
• Industrialization.  
• Construction of cyclone-tolerant houses.  
• Improvement of warning system. |
Some issues were discussed in all three levels (national, local, and regional), such as land zoning, innovation of disaster tolerant crop verities, alternative livelihood options, green belts along the river or sea, and improvement of educational system. This suggests that these developments or improvement are needed in all selected sites of Bangladesh. Construction of embankments (as in The Netherlands), reduction of carbon emissions, and population growth were exceptional issues raised only at the regional level workshop in Khulna.

CONCLUSIONS FROM THE WORKSHOP TRACK

After each of the PSD workshops at the national, local and regional levels, there was a wrap-up session where views of participants about the overall improvement of their territory were discussed. These lessons were given a very critical consideration and it became evident as issues from different groups (such as, civil society, professional, and gender group) conferred, positive and negative possibilities around those points were identified by the participants. The part most liked by the participants was the participatory and friendly atmosphere under which the exercises took place. There were initial fears that participants representing communities and livelihood groups might feel reluctant to take part in the exercises, having found themselves in the midst of local government officials. But at the local and regional level workshops, participants from different economic and professional groups talked in a friendly way with their group members. However, at national level workshops, participants from rural areas were more reluctant to speak up in front of experts, even though the facilitator engaged them in the exercise and sought their opinion on critical issues; they finally found themselves in line.

All participants indicated having either gained or expanded climate change knowledge, and some local government officials said that they were going to use what they have learned at the workshop in their development plans. Community participants also offered to disseminate information about what they learned at the workshop, especially with regards to fashioning sustainable adaptation strategies to cope with climate change impacts. At the local and regional level, representative of BIDS concluded the workshops by reviewing the participants’ vision, problems they face in their life, the existing strategies they adopt, and recommendations about future adaptation pathways. The organizers of the workshops at local and regional level (basically the local NGOs) were also cordially thanked by the representative for their participation. Apart from these, the task on Adaptation Pathways should be explained more explicitly, showing appropriate samples rather than blank flow charts. As this is the most important output of the workshop, so more time should be allotted for this exercise in all levels.
### MATRIX 6. ISSUES AND ADAPTATION PATHWAYS

<table>
<thead>
<tr>
<th>Issues</th>
<th>1(^{st}) National</th>
<th>2(^{nd}) National</th>
<th>Local</th>
<th>Regional</th>
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</thead>
<tbody>
<tr>
<td><strong>Policy &amp; governance</strong></td>
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<tr>
<td>• Land Pattern Reforms</td>
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<td>• Formulation of a new integrated master plan for urban management.</td>
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<td>• Decentralization of administrative, academic and institutional authorities.</td>
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<td>• Land Zoning, Following building codes.</td>
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<td>• Exploration of tourism.</td>
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<td>• Land Reform</td>
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<td>• Legal Aid</td>
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<td>• Price reduction of basic goods.</td>
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<td>• Land zoning</td>
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<td>• Transparency and accountability of governing authorities.</td>
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<td><strong>Information &amp; services</strong></td>
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<tr>
<td>• Increase in public awareness through media</td>
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<td>• Development of early warning system.</td>
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<td>• Inclusion of chapters on climate change in text-books.</td>
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<td>• Ensure telemedicine facilities.</td>
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<td>• Road Transport</td>
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<tr>
<td>• Improvement of roads and communication system.</td>
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<tr>
<td>• Broadcasting of warning system in local language</td>
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<tr>
<td>• Powerful radio station</td>
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<td>• Providing trainings to volunteer</td>
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<tr>
<td><strong>Energy</strong></td>
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<tr>
<td>• Increase Energy Capacity.</td>
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<td>• Solar panel facilities in Shelters.</td>
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<tr>
<td>• Electricity facilities</td>
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<tr>
<td>• Electricity access to all households</td>
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<tr>
<td>• Supply of gas, water and electricity</td>
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<tr>
<td>• Cooking gas facilities.</td>
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<tr>
<td><strong>Agriculture &amp; natural resource management</strong></td>
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<tr>
<td>• Awareness on New Crop Varieties.</td>
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<tr>
<td>• Improved Water Governance</td>
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<tr>
<td>• Water Harvesting</td>
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<tr>
<td>• Pond/Canal excavation</td>
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<td>• Innovation of hazard tolerant crop varieties.</td>
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<td>• Saline tolerant varieties</td>
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<td>• Plantation of indigenous species as green belt and preservation of existing flora.</td>
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<td>• Stop hill cutting.</td>
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<tr>
<td>• Modern technologies for dry fish and salt industries.</td>
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<tr>
<td>• Innovation of salt tolerant varieties in agriculture</td>
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<tr>
<td>• Construction of embankment like Netherlands</td>
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<tr>
<td>• Construction of houses resilient to cyclones</td>
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<td>• Protection of Sundarban and biodiversity.</td>
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<td>• Coastal greenbelt</td>
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<td>• Aflorestation along the embankments.</td>
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<tr>
<td>• Protect Green belt</td>
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<td>• Long term river dredging.</td>
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<td>• Separated place for garbage.</td>
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<td>• Planting trees at both side of road.</td>
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<td>• Green-belt and Spa construction</td>
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<tr>
<td>• Maintaining the stability of mangrove forestry.</td>
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<td>• Using silt come from high tide.</td>
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<tr>
<td>• Reduction of Carbon emission.</td>
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Continued on next page
### MATRIX 6. ISSUES AND ADAPTATION PATHWAYS (continued)

<table>
<thead>
<tr>
<th>Issues</th>
<th>1st National</th>
<th>2nd National</th>
<th>Local</th>
<th>Regional</th>
</tr>
</thead>
<tbody>
<tr>
<td>Economic diversification</td>
<td>• Resource mobilization.</td>
<td>• Employment opportunities.</td>
<td>• -Construction of strong &amp; durable embankment.</td>
<td>• -Construction of adequate number of cyclone shelters with basic amenities.</td>
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<td></td>
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<td></td>
<td>• -Establishment of industries</td>
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<tr>
<td>Social policy</td>
<td>• Subsidize on Social Scheme (Health, Education, Employment, Climatic Hazard etc.)</td>
<td>• Prevention of early marriage.</td>
<td>• -Establishment of Clustered (Guccho) villages.</td>
<td>• -Birth-registration by free of cost.</td>
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<td></td>
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<td></td>
<td>• -Women Empowerment.</td>
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<td></td>
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<td></td>
<td>• - Ensuring female education</td>
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<td></td>
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<td></td>
<td>• -Ensure social security.</td>
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<tr>
<td>Education and training</td>
<td>• Educated and Skilled Human Resources</td>
<td>• Change schools calendar by following hazards occurrence period.</td>
<td>• -Establishment of schools and colleges</td>
<td>• -Establishment of government secondary and higher education centers.</td>
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<tr>
<td></td>
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<td></td>
<td>• -Vocational Training Institute in each Upacilla</td>
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</tbody>
</table>
6. CONCLUSIONS AND RECOMMENDATIONS

The findings of this study provide a detailed overview of the various types and intensities of climatic hazards faced by different communities across the country, as represented by the eight selected hotspots. There are wide differences in the socio-economic conditions and geographical settings of each of the hotspots, which lead to differences in possession of capital assets and livelihood options. The climate change-related hazards bring about multiple impacts on the communities which deteriorate their existing conditions and increase their vulnerabilities to further events. In order to cope and adapt to these recurring events, the local people have adopted a variety of mechanisms based on their indigenous knowledge and capacities. However, these practices are not enough to sustain their lives and livelihoods in the face of frequent and intense natural disasters. The government, together with assistance from local NGOs and international donor agencies, should take initiatives to increase the adaptive capacities of the people either by reducing their exposure to hazards and minimizing their damages or by strengthening their asset base and thus building their capacities.

The situation in each of the eight hotspots portrays the spatially differentiated patterns of vulnerability to climatic variability and climate change. By analyzing the impacts of various event, the study demonstrates the inter-linkages between the different sectors and identifies the vulnerable groups within a particular community. It also focuses on the institutional and economical factors that facilitate or undermine people’s ability to cope, thus identifying the priorities for each community and hence, the country as a whole.

MAJOR FINDINGS AND RECOMMENDATIONS

1. Synergistic Effects of Multiple Hazards: The eight hotspots have been selected such that each represents one of the major climate change-related hazards that occur in Bangladesh. Although each hotspot has been identified as being vulnerable to one particular “primary” hazard, the field visits revealed that in most hotspots there are also some “secondary” hazards which exacerbate the situation further. The hazards which have been termed “secondary” are sometimes responsible for triggering the primary hazards, as in the case of salinity prone hotspot, where frequent cyclones and tidal surges are leading to salinity intrusion. In other cases, such as the river flood prone hotspot, the secondary hazard or river erosion is actually the effect of the river floods which occur in that area every monsoon season. Sometimes the hazards may be mutually exclusive, but their synergistic effects magnify the level of impacts on the villagers. For instance, in the cyclone prone hotspot, river bank erosion is causing continuous loss of agriculture land, which reduces people’s livelihood options and hence, their ability to cope with frequent cyclones. Similarly, in the drought prone hotspot, while some lands on the eastern side are left fallow during dry season due to lack of irrigation facilities, other lands adjacent to the Punarbhaba River are flooded during monsoon, thus preventing cultivation of Aus and Aman crops.

2. Poor Asset Base Resulting in Limited Livelihood Options: In rural areas of
Bangladesh, traditionally people have depended on natural resources for earning their living, for which possession of agricultural land and/or access to water bodies play a significant role. Poor people and marginal farmers, who constitute the major portion of most communities, often have insignificant amounts of land and agricultural machineries, for which they can hardly earn a profit or store enough grains to sustain their families. In the waterlogged, cyclone and tidal flood prone hotspots, where loss of land and soil fertility have compelled many people to change their livelihoods from cropping to fishing, earnings from fishing are also poor as overfishing has been leading to dwindling fish populations. Due to lack of proper education and employment opportunities, people cannot move to service or manufacturing sectors, which would have provided a fixed income source. Under these circumstances, people are temporarily migrating to other rural or urban areas to work as day laborers, earning Tk. 80–100/day. Those who have indigenous knowledge in handicraft making, as in the case of the waterlogged and flash flood prone hotspots, are trying to earn some money by making fishing traps or mats. Livestock products are often used for household consumption or sold in the market, but in many areas, lack of agricultural bi-products leads to food shortage and makes livestock rearing quite expensive. Thus, in the absence of adequate income, poor people are gradually getting trapped under the burden of loans.

3. Impacts of multiple hazards leading to additional vulnerability: Each of the different types of hazards has various physical and socio-economic impacts, both in the short- and long-run. Some hazards, like cyclones, are so intense that they destroy everything in few hours, while others such as floods and waterlogging take weeks to manifest their range of effects. While people have to live in hostile conditions during the disaster, the major hardships often arise in the post-disaster period when people are left with nothing. Some impacts are so devastating that they leave their marks forever as people can never restore their pre-disaster conditions, while others are comparatively mild and give people the chance to re-establish their lives and livelihoods. But when disasters are frequent, the impacts of one event build on those of the previous one, creating damages much greater than that could be inflicted by discrete events. In the cyclone, salinity and tidal flood prone areas, frequent cyclones cause massive destruction of embankments, houses, roads, bridges, trees, crops, and fisheries and loss of human and animal lives. Entry of tidal water due to high waves and breached embankments leads to inundation and salinization of agricultural lands and water bodies, severely affecting the livelihoods of the already homeless people. These physical losses also lead to social problems such as conflicts, financial inequalities, social insecurities, family tensions, and unemployment. In salinity prone hotspots, conflicts exist between poor crop cultivators and rich shrimp farmers because the latter intentionally breach the embankment to allow entry of saline water. In the tidal flood prone area, on one hand, the poor fishermen are suffering from decreasing wages and lower catches, whereas on the other hand, the rich landlords and fish businessmen who hire them are so wealthy that they live in towns in multi-storied buildings. When the male members of a family migrate to other areas for work or remain at sea for months, the families are separated and women living on their own often feel insecure. In the river flood, flash flood, cyclone, and salinity prone areas, riverbank erosion makes life highly uncertain and risky for people who are compelled to shift their houses every few years. Absence of crop production due to floods, waterlogging, or salinity—coupled with high population growth and poor development—lead to high unemployment. These translate into diminished capacity to afford good education, food, and health, which deteriorates their situation further. Thus, the impacts of these multiple hazards create a ripple effect making the communities further vulnerable to climatic events.

4. People practice various adaptation measures available to them: Given the limited asset base, people in these eight hotspots do whatever they can to protect their lives and properties from the hazards. Adaptation strategies can be hard, involving structural measures or soft, encompassing non-structural practices and these can be
undertaken at the community or household level. The immediate actions involve moving to safe shelters such as high roads or cyclone shelters when their homes are damaged by floods or cyclones. In flood and waterlogged prone areas, people often build temporary structures such as false ceilings or raised platforms for cooking, living, or keeping important goods. When livelihood options are constrained, people migrate temporarily to other areas in search of work as day laborers. Those who can afford also migrate permanently with their families to other districts or urban areas. Where agriculture is still possible, farmers adapt fertilizer and pesticide application, cropping dates, irrigation patterns, or crop varieties. People also try to diversify their income sources by starting handicrafts, fisheries, homestead gardening, or selling livestock products. Water management techniques such as installation of pond sand filters, and rainwater harvesting are present only in the cyclone prone hotspot. People in other areas either use the contaminated flood waters or travel long distances to fetch fresh water. Gender-specific coping mechanisms have been observed in the waterlogged hotspot, where women wear sarees up to knee level and in the cyclone prone hotspot, where they change from sarees to salwar kameez when signals are disseminated. Although a variety of practices have been identified, none are sufficient to significantly reduce the extent of impacts on the communities; instead, they are merely survival efforts.

5. **Need to enhance adaptive capacities of the vulnerable**: In order to increase the adaptive capacities of each of the communities, it is essential that their asset base is increased to an adequate level. Regardless of the hazard, some future suggestions were common in all hotspots, while some were only specific to a particular area. Some recommended actions, such as building embankments, are meant to reduce the exposure of the community to hazards (protection), while others such as increasing livelihood opportunities are meant to enable the people to cope better with the hazard situation (accommodation). Although embankments already exist in certain places, they have either been damaged or are not functioning properly due to inadequate height or absence of sluice gates. In areas affected by cyclones or riverbank erosion, people highlighted the necessity of afforestation or construction of coastal greenbelts. River dredging is also a long-term solution to reduce impacts of floods, drought, and waterlogging. Cyclone shelters are essential in coastal areas; although they already exist, their numbers and facilities are highly inadequate to meet the needs of the people. Other physical capital such as roads, electricity supply, and access to safe water are also essential to improve the lives of people. Human capital needs to be enhanced through better education and training. Overall development of the areas through more businesses, industrialization, and offices is essential to promote employment. People do not need loans, but they need to build their own capacity to earn and save. Decentralization of administrative, academic, and institutional authorities is needed to promote good governance, and proper resource management plans should be developed. Better flow of information and services through media, awareness campaigns, training and education should be ensured.


