14

ENVIRONMENT AND NATURAL RESOURCES MANAGEMENT SERIES

ENVIRONMENT [CLIMATE CHANGE] BIOENERGY MONITORING AND ASSESSMENT

Community Based Adaptation in Action

A case study from Bangladesh

Project Summary Report (Phase I)

Improved Adaptive Capacity to Climate Change for Sustainable Livelihoods in the Agriculture Sector

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FOREWORD

Climate change is happening and bringing with it alterations in climatic risk patterns. The impact of climate change has potential to undermine development achievements and threaten the food security of tens of millions of people, especially those living in Least Developed Countries (LDCs). The Intergovernmental Panel on Climate Change (IPCC) 4th Assessment report recognized a trend towards increasing climate variability associated with more extreme weather events that are likely to have direct affect on rural livelihoods, particularly in LDCs.

As one of the most climate-sensitive sectors, agriculture is under pressure to reduce greenhouse gas emissions and develop sustainable adaptation strategies to counterbalance future impacts of climate change. It is imperative to identify and institutionalize mechanisms that enable the most vulnerable farmers and local communities to cope with climate change impacts.

This means that farmers and local communities must be supported in preparing themselves for the changing situations and taking the steps that will improve their ability to protect their livelihoods. However, there is no one-size-fits-all solution. Awareness raising and capacity-building processes are urgently needed at all levels that will support long-term learning processes and, at the same time, take the broad range of eco-systems and socio-economic conditions into consideration.

Decentralized programmes seem most appropriate to promote local adaptation, within the framework of coherent national policies. With this in mind, specific attention should be given to the development of location-specific adaptation options that can manage future anticipated risks and take bio-physical, socio-economic and socio-cultural factors into consideration. A more systematic and consistent application of already known sustainable agricultural, forestry and fisheries practices may serve as suitable entry point to adapt to and mitigate the impacts of changing climates and environmental conditions.

Knowledge gaps remain as to how long these practices would be able to counteract the impacts of climate change, and how best to design and promote adaptation processes, in view of uncertainty in climate change scenarios and location-specific impacts. However, immediate action is needed to manage the existing and future risks within the framework of broader understanding on the most likely impacts of climate change. Case studies of adaptation processes are needed that will add to gathering, disseminating and replicating good practices, especially for the most vulnerable.

This report presents such a case study undertaken Bangladesh, implemented jointly by the Bangladesh Department of Agricultural Extension and FAO under the umbrella of the Comprehensive Disaster Management Programme (CDMP). It provides a summary of the approaches and processes undertaken to inform farmers about climate change and promote their local adaptation strategies. It also presents the lessons learned from the implementation process, as well as good practice options identified and valued by farmers for drought risk management in the context of climate change.

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ABSTRACT

Bangladesh, due to its geo-physical position and socio-economic context, is highly prone to regular natural hazards and the impacts of climate change. In 2005, the Food and Agriculture Organization of the United Nations (FAO) initiated a project at the request of the Bangladesh government that was designed to improve the adaptive capacities of rural populations and their resilience to drought and other climate change impacts. It also aimed to inform service providers and policy-makers of the learning and findings, in order to improve support to future adaptation processes. The project is implemented under the Comprehensive Disaster Risk Management Programme (CDMP), by the Department of Agricultural Extension (DAE), and in collaboration with the Departments of Fisheries, Livestock and Forestry and national research institutes such as Bangladesh Rice Research Institute (BRRI) and Bangladesh Agricultural Research Institute (BARI). (Community based actions started with: the characterization of livelihood systems; profiling of vulnerable groups; assessment of past and current climate impacts; understanding of local perceptions of climate impacts, local coping capacities and existing adaptation strategies. Based on those findings the project promotes institutional and technical capacity building within key agencies and among farmers associations/groups for demand responsive services needed by farmers to better adapt. The project has developed, and is constantly updating, a menu of diversified good practice adaptation options, which guides field testing of locally prioritized adaptation practices. Participatory extension is key and includes: demonstrations, orientation meetings, field days, farmer field schools, and community rallies.

This report provides a summary of the working approach developed and tested to promote community-based adaptation within agriculture. It presents lessons learned from the implementation process as well as the details of good practice options for drought risk management in the context of climate change.

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CONTENTS

ACRONYMS

ADPC	Asian Disaster Preparedness Center
BARI	Bangladesh Agricultural Research Institute
BMD	Bangladesh Meteorological Department
BMDA	Barind Multipurpose Development Agency
BRRI	Bangladesh Rice Research Institute
CDMP	Comprehensive Disaster Management Programme
CEGIS	Center for Environmental and Geographic Information Services
CFAB	Climate Forecast Applications in Bangladesh
CSR	Corporate social responsibility
DAE	Department of Agricultural Extension
DMC	Disaster Management Committee
DOE	Department of Environment
DRM	Disaster Risk Management
DRR	Disaster Risk Reduction
FAO	Food and Agriculture Organization of the United Nations
FMO	Field Monitoring Officer
GCM	General Circulation Model
LACC	Livelihood Adaptation to Climate Change
LFT	Local Facilitation Team
MIS	Management Information System
MoEF	Ministry of Environment and Forests
MoFDM	Ministry of Food and Disaster Management
N'TIWG	National Technical Implementation Working Group
PRECIS	Providing Regional Climates for Impacts Studies
SAAO	Sub-assistant Agricultural Officer
SAC	Subcomponent Advisory Committee
SPARRSO	Bangladesh Space Research and Remote Sensing Organization
SRI	system of rice intensification
SMS	Social Mobilization Strategy
TIWG	Technical Implementation Working Group
ToT	training of trainers
U'TIWG	*Upazilla* Technical Implementation Working Group
UNDP	United Nations Development Programme

GLOSSARY

aman	*a rice crop coinciding with the monsoon season*
aus	a rice crop coinciding with late dry and early monsoon season
Barind	undulating uplands with red/yellow clay soils of Northwest Bangladesh
bhiga	equals one third of an acre
boro	dry season rice, grown from December to April
ber	*English term for ziziphus jujubai*
jujubi	*ziziphus jujuba* fruit tree commonly known as *ber*
khari	traditional irrigation canals
kharif I	season typically from March to June
kharif II	season typically from July to October
monga	seasonal famine condition
pre-kharif	a season before *kharif* II typically from March to June
rabi	dry season, typically from November to February
t.*aman*	transplanted *aman* rice typically from July to October
t.*aus*	transplated *aus* rice, typically grown from March – June/July
upazilla	subdistrict

CHAPTER 1

PROJECT BACKGROUND

Bangladesh is particularly prone to natural disasters due to its geophysical position and socio-economic context. The territory expands through the delta, where the rivers Ganges, Brahmaputra, Meghna and their tributaries meet and drain into the Bay of Bengal. This wet environment has created arable land, conducive for agriculture. Its economy is highly agricultural, with 63 percent of its labor force in the agriculture sector. Agriculture is the single most important and the largest sector of Bangladesh's economy, accounting for about 35 percent of the GDP.

In spite of its delta characteristics, Bangladesh, in particular its northwestern region is drought-prone. Droughts are associated either with the late arrival or early withdrawal of monsoon rains. This phenomenon adversely affects rice crops, which account for more than 80 percent of the total cultivated land of the country, and causes regular damage to jute, the country's main cash crop.

Droughts in March-April prevent land preparation and ploughing activities from being conducted on time, delaying the broadcasting of *aman* and the planting of *aus* and jute. When droughts occur in May and June, they destroy the broadcast of *aman*, *aus* and jute. Inadequate rains in July and August delay transplantation of *aman*, while droughts in September and October reduce yields of both broadcast and transplanted *aman* and delay the sowing of pulses and potatoes.

Boro, wheat and other crops grown in the dry season are also affected by drought. Major droughts occurred in 1966, 1969, 1973, 1978, 1979, 1981, 1982, 1989, 1992, 1994, 1995, 1998 and 2000, causing substantial reduction in food production. The consecutive droughts of 1978 and 1979 directly affected 42 percent of cultivated land and reduced rice production by an estimated 2 million tonnes.[1] The losses due to drought in 1982 were more than double the losses caused by floods in the same year. The 1997 drought caused a reduction of around 1 million tonnes of food grain, of which about 0.6 million tonnes were transplanted *aman.*

Because of recurring droughts, farmers need to adapt their farming systems to the differing conditions caused by droughts from year to year. For most, however, these agricultural adjustments are a costly option, as investments are needed for re-sowing, crop replacement, intercropping or irrigation. Many farmers resort to disposal or mortgaging of

1 Brammer, H. 1987. Drought in Bangladesh: Lessons for Planners and Administrators; Ericksen, *et al.*, 1993. Socio-economic Implications of Climate Change for Bangladesh. In: R.A. Warrick and Q. K. Ahmad (Eds.). The implications of climate and sea-level change for Bangladesh: Kluwar Academic Publishers.

assets, borrowing or, eventually, to migration. This was particularly evident in 1994 and 1995, when 72 percent of households in a study community either sold or mortgaged their lands in order to cope with recurrent droughts, leading them into an inevitable debt trap.[2]

Increasing climate uncertainties are an additional threat in drought-prone environments and also one of the major factors for risk averseness. It forces farmers to depend on low input and low risk technologies. The inability to adopt improved technologies – to derive maximum gains during favorable seasons – often delays recovery after disasters. There is a risk that investments made for poverty reduction will be lost in high-risk areas, due to regular hazard impacts.

The expected impacts of climate change on food production and food security are global concerns, but they represent a particular threat for Bangladesh where agriculture is already under pressure, mainly due to increasing demand for food and depletion of land and water resources. Increasing climate risks, thus, have potential to undermine development efforts of Bangladesh further and aggravate poverty.

Higher temperatures and water stress due to heat could result in a decline in vegetation and agricultural production. By 2050, according to forecast scenarios, dry season rainfall may decrease by 37 percent, thus increasing the risk of droughts significantly.[3] Though monsoon rainfall is expected to increase by 28 percent, intermittent dry and wet spells cannot be ruled out. Intense rainfall would result in increased flooding and sedimentation in floodplains, making them less productive. Encroaching salinity due to sea level rise will further degrade agricultural areas.

Since the 1970s, several government programmes have sought to address climate risks. The development of irrigation systems in the 1970s increased potential for *Boro* rice and large areas were converted to *Boro* rice production. This, however, was at the cost of other pre-monsoon crops, including pulses and oil seeds, with the subsequent loss in diversity leading to reduced nutrition levels among the population. Although the government promoted crop diversification to reverse this trend and increase production of rice during the monsoon season and of other crops during dry season, farmers preferred to cultivate more rice during the less risky dry season.

This indicated that new ways and methods were needed to improve information access for farmers and assist them in identifying alternative, technically viable options for livelihood adaptation in the context of continuously changing socio-economic and climatic conditions. Better access to climate information is one option for encouraging farmers to adopt new risk or opportunity management practices under changing climatic conditions.

In 2004, the Ministry of Food and Disaster Management (MoFDM) officially launched the Comprehensive Disaster Management Programme (CDMP), a multi-hazard, multi-sector and multi-stakeholder programme. It recognizes the risks associated with climate variability and change, and the lack of sufficient capacities for assessing and managing

2 Paul, B.K. 1995. Farmers' and Public Responses to the 1994-95 Drought in Bangladesh: A Case Study

3 Ministry of Environment and Forest, 2002. Initial Communication under the United Nations Framework Convention on Climate Change.

long-term climate risks in Bangladesh. Component 4-b of the CDMP seeks to establish an integrated approach to managing climate risks at national and local levels. Under this component, the Food and Agriculture Organization of the United Nations (FAO) was requested to design and implement jointly with the Department of Agricultural Extension (DAE) a pilot project with the working title "Livelihood Adaptation to Climate Change" (LACC), to promote livelihood adaptation and reduce vulnerability to climate change, particularly among women and poor communities who have the lowest capacity to adapt.

Objectives of the pilot project were the following.

1) Develop a methodology to increase understanding of:
   - how results of climate change impact assessments, based on General Circulation Models (GCMs) and different climate change scenarios, can be translated into location specific agricultural impact outlooks and livelihood adaptation practices,
   - how such options can be tested and implemented in a participatory way with farmers,
   - how to feed results back to researchers and policy-makers in agriculture and the climate change community, in order to facilitate replication of success cases and avoid mal-adaptations.
2) Initiate and facilitate field testing with farmers of:
   - livelihood adaptation strategies to better respond to disaster and climate risks,
   - improved long-lead climate forecasting and responses to future climate change projections in agriculture.

Project outputs include:

- in-depth local situation assessment,
- identification of suitable project entry point activities,
- participatory project implementation strategy, suitable for replication elsewhere,
- required institutional mechanisms put in place or strengthened,
- technical capacity building and training,
- set of viable adaptation options that fit location-specific, agro-ecological and social settings of vulnerable groups,
- lessons learned from the community-based adaptation processes.

CHAPTER 2

PROJECT ENTRY POINTS

2.1 PROMOTING ADAPTATION TO CURRENT CLIMATE VARIABILITY AND EXTREME EVENTS

Effective climate risk management at the local level requires spatially and temporally differentiated climate information on different time scales. The uncertainties associated with climate change impacts at the local level have proven to be a major constraint in transforming global climate change modeling results into locally actionable adaptation practices. Therefore, activities were initiated with a disaster risk management perspective as the entry point, with the aim to phase-in climate change issues and modeling results as soon as available. The utilization of past extreme climate event analogues and, as they became available, long-lead seasonal forecasts for managing climate risks was the starting point for developing methodologies to increase understanding of how climate change impacts can be translated into agricultural response options and livelihood adaptation practices. The pilot project therefore applied the principle that adapting to short-term climate variability and extreme events can serve as the basis for reducing vulnerability to longer-term climate change.

2.2 LAUNCHING LOCAL INTERACTIONS ON THE BASIS OF TRADITIONAL KNOWLEDGE AND EXISTING LOCAL ADAPTATION PRACTICES TO CLIMATE RISK

Science-based climate prediction information needs to be tailored to farmers' perceptions and understanding. It requires careful introduction and discussions about potential climate impacts on traditional practices and the relevance of existing local knowledge. Farming communities have accumulated considerable experiences for living with climate risks over time and have developed a range of adaptation strategies. In order to connect climate change modeling results with local realities, it is essential to establish a baseline understanding of farmers' traditional knowledge about climate risk management, local adaptation practices and their potential to counterbalance future climate impacts. It is equally important to establish better science-society integrators that will help orient climate modeling research meet farmers' needs and provide feedback to the climate science community on the application value of their research.

2.3 BUILDING INSTITUTIONAL AND TECHNICAL CAPACITY

A sound institutional mechanism capable of establishing a link between the scientific community and farmers is essential to induce the use of climate change modeling results in a farmers' needs-oriented way. The Bangladesh DAE, with its partner research institutions such as the Bangladesh Agricultural Research Institute (BARI) and the Bangladesh Rice Research Institute (BRRI), is a service-oriented institution with a long history of supporting farmers with frontier technologies and innovative farm practices. Therefore, DAE is well positioned to take a leading role in connecting climate change modeling research with community's and farmers' needs. On the other hand, considerable structural innovations, skills building and attitudinal changes are required to build the capacity of the DAE and its national research partner institutions to collaborate on the new tasks needed to (i) translate climate change modeling results into medium- and long-term agriculture impacts, (ii) transform these into concrete adaptation options relevant to farmers' current thinking and needs and (iii) adapt a language and communication strategy farmers can understand easily.

2.4 ADDRESSING LONGER TERM ISSUES OF CLIMATE CHANGE THROUGH AWARENESS RAISING

A fundamental assumption underlying the project work at field level was that most farmers think in day-to-day terms, rather than long-term, pro-active risk management. This indicates the need to encourage longer term thinking by working on issues of immediate importance and then adding a longer term perspective. Therefore, the process was initiated with a community-level risk perception and disaster risk management perspective, and then climate change issues and modeling results were phased in.

2.5 INITIATING FIELD TESTING OF ADAPTATION OPTIONS WITH 'NO REGRET' TECHNOLOGIES

No reliable, downscaled data on potential impacts of climate change are currently available. Although the project used the PRECIS model for regional downscaling of climate change scenarios for northwest Bangladesh, it could not pretend to know exactly how climate change impacts will be felt in the drought-prone areas in northwest Bangladesh. Until better and more reliable data on location-specific impacts of climate change become available, the project has chosen to experiment on small scale only, focusing on options that already have proven environmentally and economically successful elsewhere, but are not widely known in northwest Bangladesh, i.e. "no regret" options. This strategy has a dual purpose: (i) to establish field demonstrations to raise awareness, but also (ii) to establish a pool of drought-mitigating technologies whose advantages, benefits and costs are known to farmers and DAE in northwest Bangladesh and can be implemented immediately or in the future. No broad-based replication strategy of adaptation options was promoted by the project in its early stage.

2.6 INTRODUCING THE CONCEPT OF PROBABILISTIC CLIMATE FORECASTING

The institutional system's capacity, including the role of active intermediation within agriculture sector agencies, such as through DAE, have been limited to 24-72 hour "deterministic" weather forecasts that enable communities to react and respond to hazards just before or after their occurrence. Recent progress in long-lead "probabilistic" climate forecasting makes it possible to improve information on the probability of variations in average seasonal rainfall, which gives farmers scope for risk/opportunity management in agriculture. Long-lead climate forecasts help farmers make strategic decisions well in advance, reducing the impact of dry and wet spells and associated secondary impacts. However, institutional rethinking is required for farmers: (i) to shift to proactive thinking and practices for addressing climate risks before their occurrence rather than continuing with the reactive mode of managing disasters and (ii) to get used the concept of probabilistic climate forecasting as compared to deterministic weather forecasting.

Long-lead climate forecast information and climate analogue information – as and when available – are presented in probabilistic terms, as are climate change modeling results. Communicating probabilistic climate information days or months in advance that is relevant to farmers' needs calls for evolving innovative translation and communication methodologies and processes, as well as appropriate institutional mechanisms.

CHAPTER 3

DESIGN OF PROJECT IMPLEMENTATION STRATEGY

The objective of designing and implementing livelihood adaptation to climate change in drought-prone areas is consolidated within the policy of the Government of Bangladesh. The CDMP recognizes the risks associated with climate variability and change. It advocates establishment of an integrated approach to manage climate risks at the national and local levels and implement activities to promote adaptation and reduce livelihood vulnerability, particularly among women and poor communities that have the lowest capacity to adapt. After identifying the national policies related to climate change adaptation, the following working approach was elaborated, which included the definition of specific activity needs. It was designed on the basis of an iterative planning-cum-testing process to guide the overall project implementation and replication thereafter in other districts. Figure 1 outlines the working approach, revised at the end of LACC 1 after two years of field testing (Fig. 1).

(i) **Assessment of current vulnerability** – addressed the following questions:
- Where does this society stand with respect to vulnerability to climate risks?
- What factors determine this society's current vulnerability?
- How successful are the efforts to adapt to current climate risks?

The working approaches developed by the project to assess vulnerability were:
- assessing local perceptions of climate risks and impacts,
- documenting livelihood profiles in pilot sites,
- assessing current climate risks,
- assessing natural, socio-economic conditions, institutional frameworks and existing local risk-coping strategies and technologies.

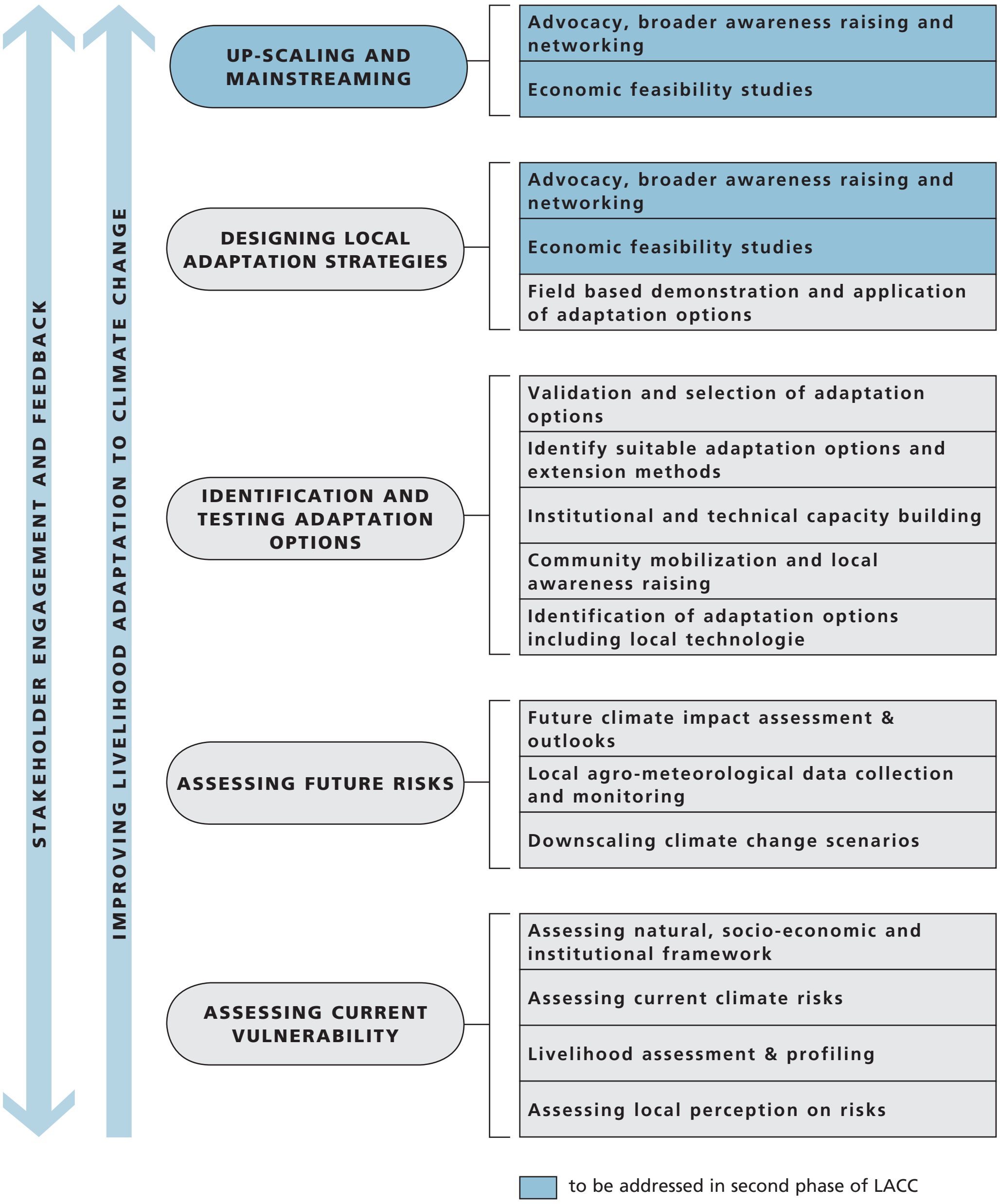
(ii) **Assessment of future climate risks –** focused on future climate change scenarios, vulnerability and environmental trends as a basis for considering future climate risks. The major activities to address the future risks were:
- downscaling of climate change scenarios,
- collecting and monitoring local agro-meteorological data,
- undertaking climate impact assessments and outlooks on agriculture.

(iii) **Identification and testing of adaptation options –** undertaken with the goal of establishing an adaptation option menu of good practices identified through stakeholder consultations. The major steps in this phase were:
- identifying adaptation options including local technologies and science-based knowledge,
- mobilizing communities and raising local awareness,

- building institutional and technical capacity,
- identifying the most suitable extension strategies to introduce and communicate adaptation options to farmers,
- validating selected adaptation options at local and national level and consolidating them into a menu of good practice options.

FIGURE 1

Operationalization strategy, project components and processes for livelihood adaptation to climate variability and change in drought-prone areas of Bangladesh



The adaptation options menu developed contained viable technologies for managing climate, in this case drought related. It synthesized adaptation practices that could catalyze long-term adaptation processes. The adaptation options were validated against a set of key criteria, depending on the cropping season, and seasonal adaptation option menus were consolidated before each cropping season.

(iv) **Design of location specific adaptation strategies –** responded to current vulnerability and future climate risks. It involved the identification and selection of viable adaptation options and measures, and the formulation of these options into farmer-friendly adaptation menus. The key components were:
- undertaking field-based demonstrations for applying adaptation options,
- undertaking economic feasibility studies,
- increasing advocacy, broader awareness raising and networking.

(v) **Mainstreaming and up-scaling good adaptation practices:** The pilot phase I of the project was considered too short to generate the knowledge needed to address these issues.[1] These steps will be inclusive aspects of the follow-up phase of LACC I.

1 The yellow under-laid parts in the graphic (Fig.1) indicate those activities that were not yet addressed in LACC 1 but are part of the overall strategy developed.

CHAPTER 4

INSTITUTIONAL MECHANISMS FOR ADAPTATION IN ACTION

4.1 PROJECT MANAGEMENT

The pilot project was implemented by the DAE (institutional mechanisms indicated in Fig. 2). The DAE, under the chairmanship of its Director General (DAE-DG) provided technical implementation support to the project. A National Subcomponent Manager appointed to oversee the implementation, was responsible for execution of the project and reported to Department of Environment (DoE) and the DAE-DG through the DAE Director of Field Services. The Deputy Director-Monitoring (Field Services, DAE) provided secretariat support to project implementation. A core group comprising key staff was formed in DAE at the national level which, after receiving training from the project, provided day-to-day technical support for the project implementation. At the field level, the project was implemented through existing DAE manpower. *Upazilla- a*nd *block*-level extension workers or sub-assistant agriculture officers (SAAOs) of the project pilot areas were thus another key target group of the project's institutional and technical capacity-building process.

4.2 SUBCOMPONENT ADVISORY COMMITTEE

A Subcomponent Advisory Committee (SAC), under the chairmanship of the DoE Climate Change National Component Manager, was constituted to provide a critical link between activities under this subcomponent and other complementary activities under CDMP Component 4-b. The representatives from the Ministry of Food and Disaster Management (MoFDM), DAE, CDMP and United Nations Development Programme (UNDP) were included, to ensure coordination of subcomponent activities with other components of the CDMP.

4.3 TECHNICAL IMPLEMENTATION WORKING GROUPS AND IMPLEMENTATION MODALITIES

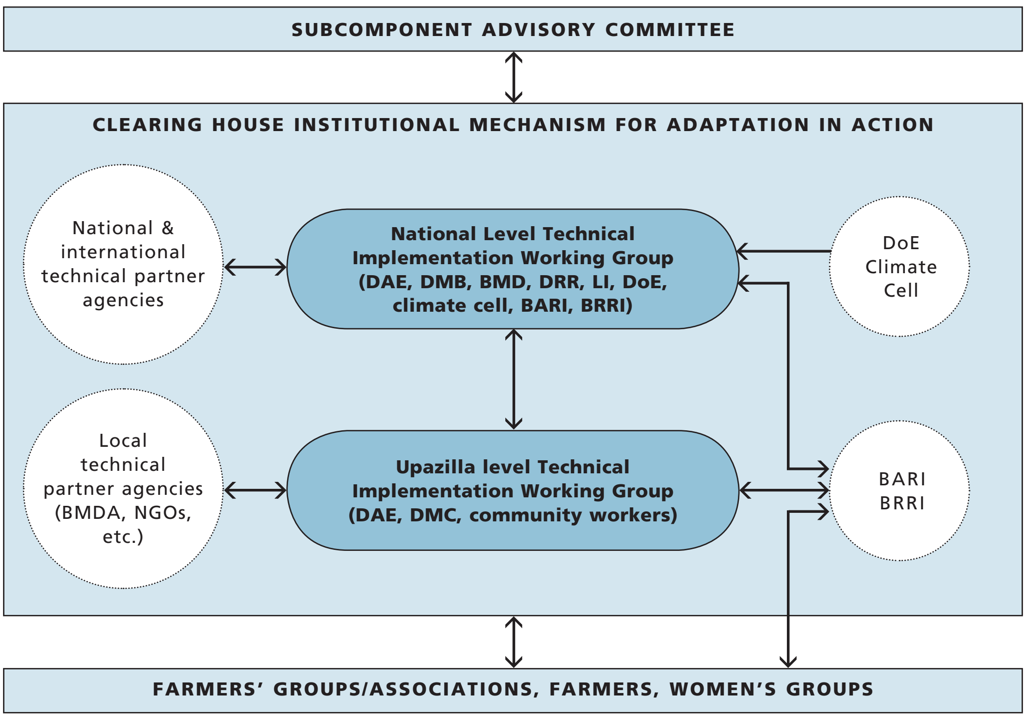
Technical Implementation Working Groups (TIWGs) were established for implementation of activities under the subcomponent, both at national and *upazilla* levels. This meant that members would need to be able to interpret, translate and communicate climate change modeling and research results for field application. Thus, capacity-building activities were initiated through training to ensure that TIWGs could translate climate change modeling and research results into locally acceptable and achievable adaptation practices, and pilot test livelihood adaptation options at the pilot sites with farmers.

The National Technical Implementation Working Group (N'TIWG) was formed by involving key participants from DAE, BARI, BARI, DoE Climate Cell, DMB, Space

Research and Remote Sensing Organisation (SPARRSO), Bangladesh Meteorological Department (BMD) and Barind Multipurpose Development Agency (BMDA). It acted as a link between the scientific community generating climate change information and the U'TIWGs, obtaining climate information and translating these into agriculture sector impacts. Crucially, the N'TIWG transformed these impacts into locally relevant and acceptable adaptation options, in constant dialogue with the *Upazilla* Technical Implementation Working Group (U'TIWG). The N'TIWG also transformed project methodologies and procedures and adaptation options into an ongoing agriculture sector adaptation process. This group also took the lead in coordinating meetings as the technical clearing house for the selection of adaptation options to be applied and demonstrated seasonally through the extension service at farmer's fields. The clearing house meetings also involved representatives from DAE, the U'TIWG as well as from national research institutes such as BARI and BRRI and BMDA (see Fig. 2).

FIGURE 2

Institutional mechanisms for adaptation in action



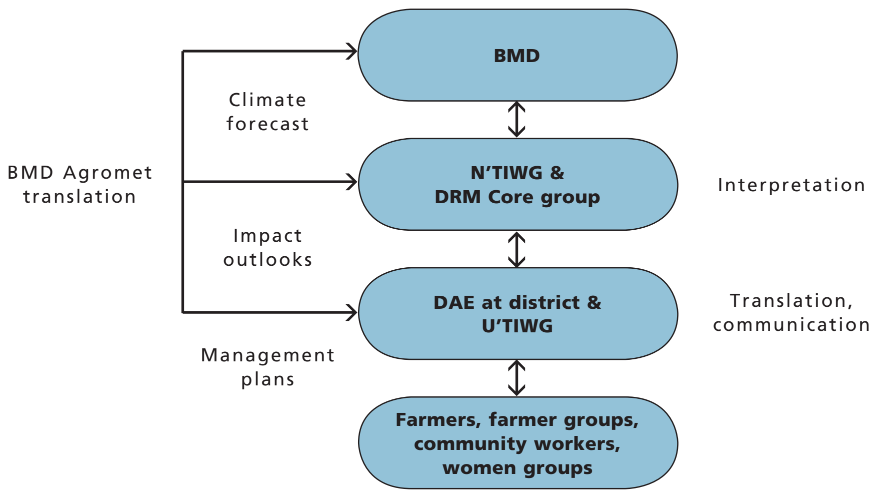
The U'TIWGs are chaired by DAE with representation from sectoral agencies of disaster management, agriculture and water resources management, and from selected grassroots groups such as local farmers associations. Non-governmental organizations were invited to collaborate with these groups. In addition, local field monitoring officers (FMOs) were hired to facilitate working group activities and social mobilization processes in all selected *upazillas*. The inclusion of district-level authorities in the U'TIWG ensured their active participation during the implementation process. The U'TIWG training to build technical capacity emphasized skills for vulnerability assessments and for interpreting, translating and communicating downscaled climate information on methodologies for transforming adaptation options into locally relevant and usable formats. They acted as a crucial link between local communities and the N'TIWG to facilitate the exchange of external and internal knowledge streams relevant for project implementation.

4.4 ESTABLISHMENT OF END-TO-END INSTITUTIONAL SYSTEM FOR FORECAST APPLICATION

An end-to-end institutional system (Fig.3) was established to facilitate climate information flow from the national level to district and community levels and back by involving the Bangladesh Meteorological Department (BMD) and DAE.

FIGURE 3

End-to-end institutional system to facilitate climate information flow with feedback mechanism from national to local/community levels



The N'TIWG and the core group established at DAE headquarters in Dhaka are the focal points for receiving climate information and climate change scenarios directly from the BMD and DoE. The Climate Cell of DoE provides climate change scenarios by involving a network of national institutions. The N'TIWG and core group members are responsible for interpreting climate information and developing impact outlooks.

District-level DAE staff and U'TIWG are responsible for the translation and communication of impact outlooks to the farmer groups and community workers, and the *upazilla*-level project implementation network under the Ministry of Food and Disaster Management (MoFDM). U'TIWG members were trained to develop location specific alternative management plans responsive to climate forecasts in general and impact outlooks in particular. The system is already in place and will be made functional during the second phase of the project.

The subcomponent implementation working group members and the DAE-DRM core group members at Dhaka were introduced to various climate information providers at different scales ranging from global and regional to national. The forecast products developed at international forecasting centres were introduced to the subcomponent implementation working groups and national disaster risk management core group members. Strategic linkages were established between the regional/national initiatives carried out through Climate Forecast Applications in Bangladesh (CFAB). All the products and scientific background of the forecasting systems were introduced to the subcomponent implementation working group members during the training workshops. Efforts were also made to introduce the climate change scenarios developed by a network of national institutions coordinated by the DoE Climate Cell Unit, which has close linkages with CDMP.

4.5 MANAGEMENT INFORMATION SYSTEM

A management information system (MIS) will be devised in the second phase of the LACC project, to ensure a constant flow of information among various stakeholders. Throughout the process cycle, an information flow system with feedback mechanisms was established to exchange experiences and monitor project implementation. It was proposed to have information dissemination materials and annual feedback workshops to inform CDMP, the research community, civil society and policy makers about lessons learned, adoption of livelihood adaptation options, and to promote discussions of local requirements for climate change information.

CHAPTER 5
CAPACITY BUILDING

5.1 TRAINING NEED ASSESSMENTS

Training needs assessment sessions were organized with N'TIWG and DAE core group members in Dhaka, and another with about 50 DAE staff at Rajshahi in August 2005. In addition to the Director of the Rajshahi Division, the Deputy Directors of Chapai Nowobganj and Naogaon Districts participated in the sessions. The division-level training needs assessment was combined with a brief training on weather observations and instrument maintenance.

The findings from the training needs assessment underlined the importance of capacity building in the following areas: (a) drought, drought types, drought impacts; (b) climate variability and change; (c) climate and climate change impacts in agriculture; (d) climate forecast applications; (e) existing and improved localized forecast products; (f) preparation of impact outlooks and management plans; and (g) climate change and viable adaptation practices. The training needs assessment outcomes were quantified through participative discussions, brainstorming sessions and group exercises.

5.2 TRAINING STRATEGY

The training programme strategy was embedded into the processes of the DAE's regular capacity building and extension works. The training approach was designed to be flexible so base information could be tailored to participants' needs. This flexible training strategy was recommended instead of a step-by-step prescribed approach. The overall format consists of sections on:

- setting goals and learning objectives,
- defining and highlighting key words and terminology, and
- presenting principles and background information on individual topics.

The approach also contains training activities with learning units (LUs) and exercises based on that module's content. The exercises exposed the participants to new concepts and skills, current risk management practices and future adaptation practices. The training materials include supplementary handouts as well as guidance for preparing:

- interactive lectures,
- review sessions,
- individual exercises, and
- group exercises and presentations.

The training processes at various levels were initiated as a training-of-trainers (ToT) approach and started with a series of formal training events at all levels. The capacity building activities included formal training workshops, on-the-job training and regular back- stopping missions. The local community-level (union-level) training workshops were organized after ensuring community mobilization processes.

5.3 NATIONAL-LEVEL TRAINING WORKSHOPS

5.3.1 Climate risks and climate forecast applications

A two-day national-level training workshop on “Climate risks and climate forecast applications in drought-prone areas of Bangladesh” was organized for the N’TIWG members at DAE headquarters in Dhaka, on 14-15 August 2005. Sixteen N’TIWG members as well as representatives of DoE and FAO attended. The training curriculum included the following topics:

- climate risk analysis tools and methods in pilot drought-prone regions,
- climate and weather forecast products available with Bangladesh Meteorological Department,
- interpretation, translation and communication of probabilistic and uncertain climate information products available at national, regional and international forecasting organizations,
- inter-relationship of forecast products and locally available climate data,
- disaster calendars and local cropping systems in drought-prone areas,
- preparation of agricultural sector impacts in response to forecasts.

The training programme, based on the brief and well targeted training need assessment with the N’TIWG members, included presentations, discussions and exercises. Resource persons were also drawn from DAE and BMD to discuss existing cropping systems and forecast products, respectively.

5.3.2 Options for livelihood adaptation to climate change in drought-prone areas

The overall aim of the training workshop on “Livelihood Adaptation to Climate Change in Drought-Prone Areas” was to improve the adaptive capacity to climate change for sustainable livelihoods in the agricultural sector through targeted capacity building for DAE, N’TIWG and other stakeholders. The training-cum-validation workshop was held at the FAO Dhaka office, 22-23 February 2006. The specific objectives of the training workshop were to:

- introduce the project activities to the participants and getting feedback,
- discuss the climate change impacts in agriculture sector and to translate climate change model outputs into agricultural impacts,
- demonstrate climate risk analysis for pilot locations and introduce probabilistic climate forecast information products,
- introduce livelihood adaptation practices and evaluate them based on their relevance, economic feasibility and environmental friendliness.

Within the overall framework of project implementation, FAO partners had conducted a climate change impact assessment and adaptation study before the workshop. This provided documentation of viable local and improved adaptation practices to enhance the adaptive capacity of rural households against future climate change impacts. The adaptation options were evaluated at the workshop for their relevance, economic feasibility and environmental friendliness by the experts, representatives of research organizations and N'TIWG members.

During the training workshop it was emphasized that the proposed adaptation options were based on the detailed conversations held with local people in 12 pilot villages of drought-prone districts (Chappai Nowobganj and Noagoan) as well as relevant project partners and local research organizations. The adaptation options served as the basis for demand-driven field demonstrations in the drought-prone pilot villages of the project. The 32 participants who attended the training workshop represented:

- Department of Agricultural Extension (DAE)
- Department of Livestock
- Department of Fisheries
- Department of Relief
- Department of Environment (DoE)
- Bangladesh Space Research and Remote Sensing Organisation (SPARRSO)
- Bangladesh Meteorological Department (BMD)
- North South University
- Food and Agriculture Organization of the United Nations (FAO)
- Comprehensive Disaster Management Programme (CDMP)
- United Nations Development Programme (UNDP)
- Bangladesh Agricultural Research Institute (BARI)
- Bangladesh Rice Research Institute (BRRI)

The major recommendations and suggestions made during the training workshop have been incorporated into a list of adaptation options approved by the technical implementation working group members.

5.4 DISTRICT- AND *UPAZILLA*-LEVEL TECHNICAL TRAINING WORKSHOPS

One-day training-cum-feedback workshops were organized jointly by Asian Disaster Preparedness Center (ADPC) and Center for Environmental and Geographic Information Services (CEGIS) with the U'TIWG members at Chapai Nawabgonj and in Noagoan in mid-2005.The participants also included district-level agricultural officers, Disaster Management Committee (DMC) members and farmer representatives. The purpose of the training workshops were to introduce the impacts of climate variability and future climate change in drought-prone areas of Bangladesh, particularly in the pilot. The workshop included presentations, discussions and small group exercises. A particular objective of the Naoagoan workshop was to discuss the necessity of judicious water resource management under changing climate conditions.

Follow-up *upazilla*-level workshops were conducted in the four pilot *upazilla*s (Gomestapur, Natchole, Porsha and Sapahar) during December 2005. The U'TIWG members attended the workshop. The participants were introduced to drought adaptation practices collected and documented on the basis of inputs from local farmers, government organizations and research institutions. The participants gave their feedback about the suitability of adaptation practices for their pilot villages. Based on the discussions, adaptation options were screened and presented later at the national-level validation workshop held 22-23 February 2006.

A one-day training follow-up programme was carried out with 52 DAE officers from the Rajshahi division. Based on the interest of the Deputy Directors and Agricultural Officers of DAE, the curriculum included:

- criteria for selection of site for an observatory,
- instrumentation and maintenance,
- observation of each weather elements,
- time of observation,
- recording and database maintenance.

5.5 INTRODUCTORY SEMINARS WITH RESEARCH INSTITUTIONS

Bangladesh Agricultural Research Institute (BARI): BARI scientists at Rajshahi were informed about the project activities, approaches and methods of livelihood adaptation to climate change and introduced to the research that had targeted the drought-prone areas of

Barind tract. The viable adaptation options were carefully selected in consultation with the scientists of BARI. The following technologies were found most suitable for Barind tracts for demonstration in *kharif II* and *rabi* seasons:

- alternate rice-based cropping systems incorporating pulses, oilseeds and vegetable,
- technologies and varieties suitable for Chickpea cultivation during winter after harvest of *T. aman* rice,
- homestead gardening as a risk management strategy.

Bangladesh Rice Research Institute (BRRI): Scientists at the BRRI substation at Rajshahi were contacted and briefed about the project activities. The introductory seminar outlined the relevance of technologies developed in BRRI for livelihood adaptation to climate change. Based on the discussion, the local researchers come up with a list of viable technologies to manage future climate risks in drought-prone areas. The following technologies were jointly selected by the project team and BRRI scientists:

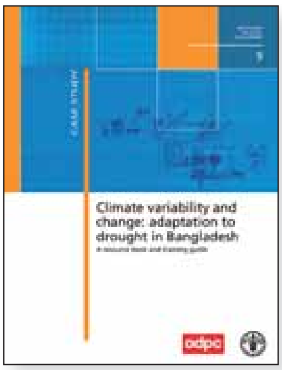
- short-duration, high-temperature-tolerant rice varieties for kharif II,
- intercropping rice in Mulberry for kharif II,
- direct-sown, wet-seeded rice for rabi (boro),
- system of rice intensification (SRI) for *boro*.

BRRI evaluated SRI technique in the farmers' fields and found it suitable for *boro* season. However, it was advised to introduce the technology to the farmers as an adaptation option only after additional analysis. After the introduction seminars held 8 December 2005, the research institutes subsequently designed and implemented technical training sessions on their own with farmers and extension workers, in the context of introducing and monitoring the implementation of selected good adaptation practices at field level.

5.6 NEWLY DEVELOPED TRAINING MATERIALS

Six training modules incorporating all relevant training needs of the N'TIWGs and U'TIWGs were developed. These included:

- Module 1: Understanding climate variability and change
- Module 2: Drought and its impacts
- Module 3: Impacts of climate variability and change in drought-prone areas
- Module 4: Climate risk assessment at community level in the agriculture sector
- Module 5: Agricultural adaptation options to climate variability and climate change
- Module 6: Climate forecast application to improve adaptive capacity



The training curriculum was evaluated during the structured training sessions with both national- and *upazilla*-level technical working groups in Bangladesh.

The resource book, *Climate variability and change: adaptation to drought in Bangladesh*, has been tested and prepared to serve as a reference and guide for further training and capacity building of agricultural extension workers and development professionals in dealing with climate change impacts and adaptation. Although it uses the example of drought-prone areas of Bangladesh, it presents suggestions for a three-day training course readily adaptable to any areas of Bangladesh affected by climate-related risks. The information presented on climate change adaptation would enable participants to prepare, demonstrate and implement location-specific adaptation practices and, thus, to improve the adaptive capacity of rural livelihoods to climate change in agriculture and allied sectors (http://www.fao.org/nr/clim/abst/clim_070901_en.htm).

The training modules developed under the FAO-TCP project "Strengthening Support to Disaster Preparedness in Agriculture Sector" in Bangladesh were also used. (http://www.fao.org/sd/dim_pe4/pe4_060201_en.htm).

CHAPTER 6

INITIATION AND IMPLEMENTATION OF FIELD WORK

6.1 BASELINE STUDIES IN THE PILOT SITE

The basic situation analysis, conducted by CEGIS, included the following major areas of study:

- natural resource endowment including land, soils water and climatic parameters in the pilot areas,
- socio-economic situation in the pilot areas (including asset position and social networks),
- main livelihood strategies in the area and of vulnerable groups,
- presence and role of formal and informal institutions and their services for rural development in general and climate risk management in particular (if any),
- livelihood profiling of vulnerable groups,
- local household-level coping strategies of livelihood groups, and coping ranges of livelihood groups to climate impacts,
- socio-economic system response and feedback to droughts,
- local perception about droughts and impacts, including past droughts,
- adaptation practices followed in the recent period under changed cropping patterns, and socio-economic characteristics,
- local adaptation practices in the drought-prone areas and societal acceptability to new ideas for adaptation practices.

Findings in the study highlighted the good agricultural potential of the region, while also showing thatover-exploitation of water resources in recent years has led to rapid fall in the groundwater table (Fig. 4 source: CEGIS).

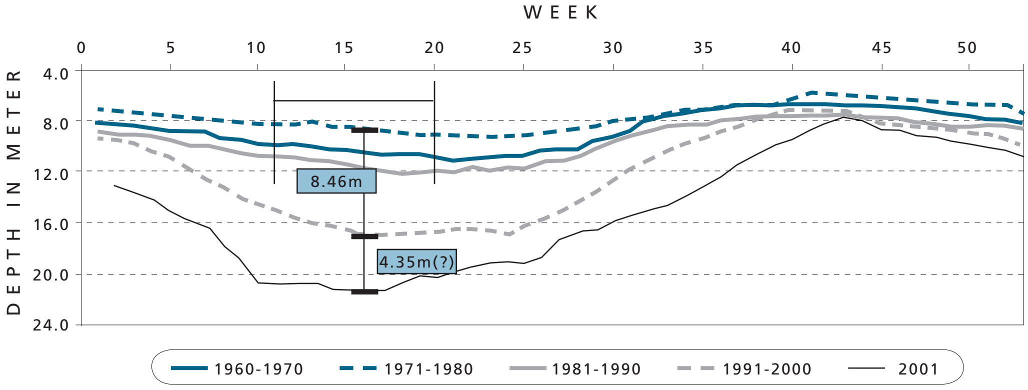
The decadal average groundwater depth from surface has shown a steep decline since 1981. The steepest decline was during the summer which coincided with *boro* season. Local adaptations to current climate variability, practiced to some extent among farmers in the study area, were categorized as:

- traditional, locally managed responses – e.g. pond and *dighi* excavation, retention of rainwater in *khari* and canals, shedding, tillage, breaking top soil,
- state-supported responses – e.g. deep tubewell facilitated irrigation, and
- alternative innovative responses – adoption of mango farming, orchard development, and alternative livestock and poultry/bird rearing.

The variety of government agencies, NGOs, social, informal and private institutions, farmers' groups and water-user groups operating in the area have brought widely differing roles, capacities and know-how for dealing with climatic risks. The BMDA, with its formal

FIGURE 4

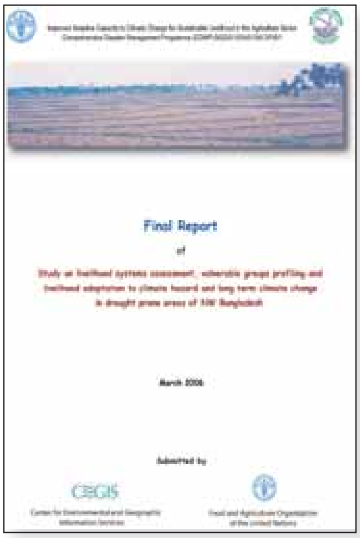
Average groundwater depth from the surface



mandate to provide deep tubewell irrigation, has played a lead role but pays little attention to areas where groundwater is not accessible. Although local-level disaster management committees officially exist, their capacity has been limited and thus local capacity-building activities have been carried out.

The main rural livelihood groups in the project are: wage laborers (41 percent); small and marginal farmers (32.4 percent); petty traders and businessmen (7 percent); large farmers (6.9 percent); fishers (0.4 percent) and others. Wage laborers face unemployment and crises of failed migration and petty traders lack regular customers. Large businessmen and large farmers were found to be less vulnerable due to better access to financial, social and physical assets. The relative proportion of the livelihood activities of the farmers differed between non-irrigated and irrigated areas (Fig.5). In general, cropping was a major livelihood activity among farmers, irrespective of their category. The full study is available at:

http://www.fao.org/sd/dim_pe4/pe4_060701_en.htm



After consulting with local people and professionals, it was decided that the project interventions would not break the farmer category into subgroups since all farmers in the study area are vulnerable to the climatic and non-climatic risks. The fishers in the area were not included as a separate target group since the number of fishing households is very limited in the project area. However, fishing was a complementary activity to cropping within other livelihood groups.

A second in-depth baseline study to assess current vulnerability, local perceptions of risks, future vulnerability and climate change impacts was conducted by ADPC which highlighted, among other factors, the following findings.

BOX 1

VULNERABLE GROUPS PROFILING AND LIVELIHOOD SYSTEM ASSESSMENT

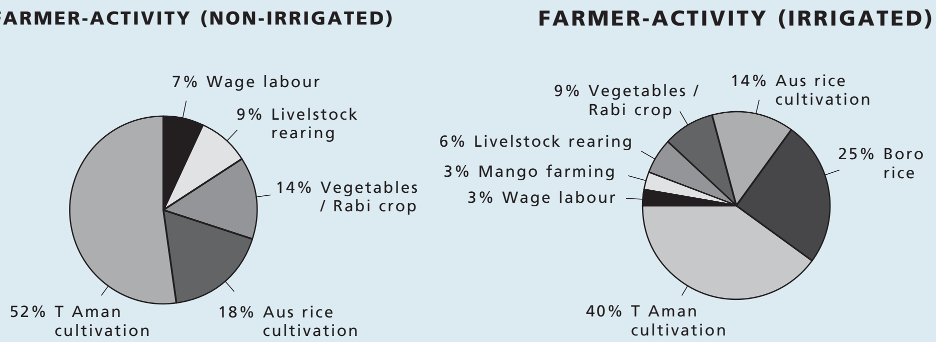
The study was carried out in the pilot *upazillas* of two districts – Chapai Nawabganj and Naogaon – of northern Bangladesh. Geophysically, the area is highly vulnerable to drought, and excessive evapo-transpiration has been an added phenomenon.

The study found that both climatic conditions and anthropogenic factors contribute towards the vulnerability of livelihoods. Climatic factors are unfavorable and natural hazards strike regularly, but limited local capacities and capabilities and the (non)-access to various forms of livelihood assets represent major threats. The dominant vulnerable groups are small and marginal farmers as well as wage labourers. The state-oriented adaptive responses help in reducing vulnerabilities, but it is the local settings and physio-graphic situation that do not allow for recovery from climatic hazards. The state supported supplementary irrigation facilities to reduce the impact of drought to some extent. The study identified some local practices and perceptions towards risk management in the pilot areas.

Additionally, it was also observed that lack of awareness and knowledge of alternative adaptive responses led to vulnerability. While several adaptive practices or coping measures are regularly considered by the farmers, the relative success to overcome drought has been limited. In this situation, the adaptive capacities of the people have improved through identification of effective adaptation measures.

FIGURE 5

Proportion of livelihood activities among the farmers in non-irrigated and irrigated areas in the drought-prone areas



Current risks and local perceptions: Understanding current risks and local community perception is a crucial pre-requisite for integrating climate change adaptation with DRM. Local people in the study area perceive that current climate is different from the past. The seasonal cycle has changed, droughts have become more frequent, pest and disease incidences increased, average temperature has increased in the summer while winter has shortened. Local people in the study area also perceive that their *boro*, *aus,* winter vegetable and fruit (mango) production are affected by increased rainfall variations, temperature and drought. The observed data also showed higher variability in rainfall patterns and increased temperature trends over the last five decades (Source: Fig.6 - Fig.7, BMD, 2007).

FIGURE 6

Deviation of monsoon season rainfall from normal (1961 – 1990)

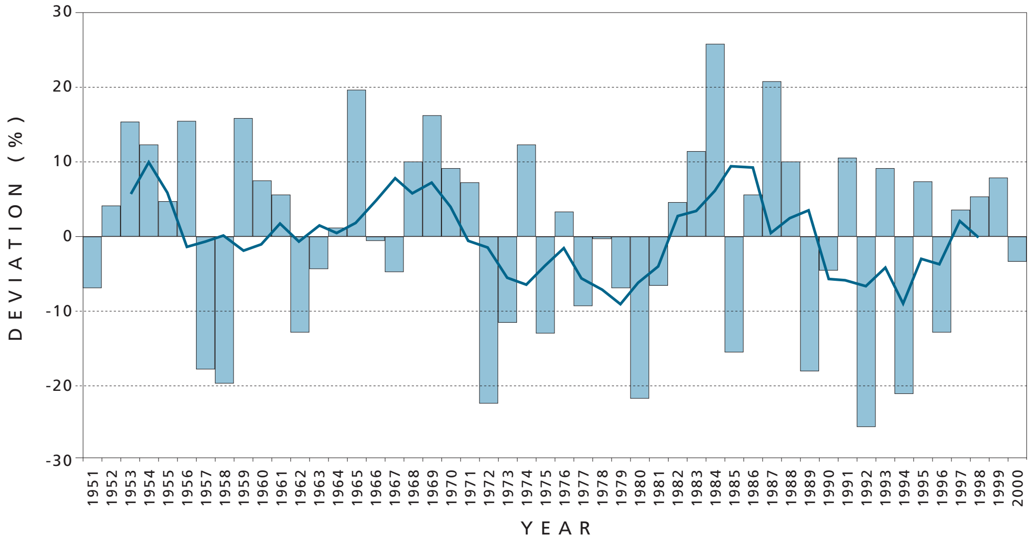
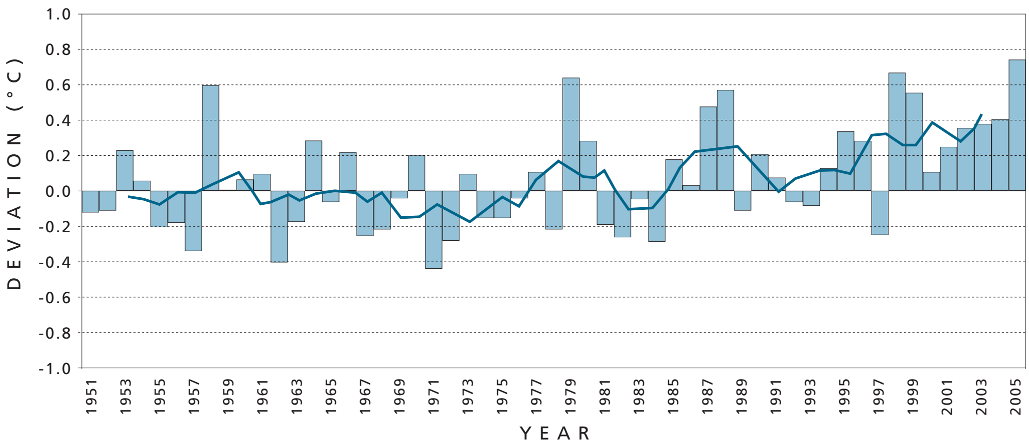


FIGURE 7

Deviation of yearly average minimum temperature from normal (1961 – 1990) with five-year moving average over Bangladesh



Future risks and vulnerabilities: Global Circulation Model (GCM) projections for Bangladesh indicate an average temperature increase of 1.3°C and 2.6°C by 2030 and 2070, respectively. Though monsoon precipitation is likely to increase by 27 percent until 2070, precipitation distribution patterns during the plant growing period, higher temperature and higher rates of evapotranspiration would create further water stress conditions and declines in vegetation and agricultural production in the drought-prone areas. A continued trend towards more frequent and intensive natural hazards is expected as result of increasing climate variability and climate change. Water deficits of around 400-500 mm may occur during the dry months of the year. Groundwater depletion has been increasing since the early 1980s, corresponding with large-scale exploitation for irrigation. The study confirmed the assumption that the livelihood groups with more livelihood assets and institutional support are less vulnerable to climate risks. Limited access to deep tubewell water in the non-irrigated areas and the occurrence of several anthropogenic factors (e.g. electricity failure, high price of agricultural input) are the main forms of perceived vulnerability of farmers.

The two studies conducted by CEGIS and ADPC indicated that both climatic conditions and anthropogenic factors mutually reinforce the chronic vulnerability of livelihoods in rural areas. Successful local-level adaptation to climate variability and change require multiple pathways of well-planned and interrelated short-term and long-term measures including:

- undertaking physical adaptive measures (e.g. link canals, irrigation, storage facilities for retaining water; drainage);
- adjusting existing agricultural practices (e.g. cropping pattern adjustment, selection of adapted crop varieties, better seed and fodder storage, floating seed beds, switching to alternative crops such as mango as a cash crop),
- making socio-economic adjustments (livelihood diversification, migration, market facilitation);
- strengthening community resilience including local institutions and self-help capacities;
- strengthening formal institutional structures and environment;
- formulating policy to catalyze enhancement of adaptive livelihood opportunities;
- creating awareness and advocacy on climate change and adaptation issues;
- improving better research, on-farm links to test new/improved crops (e.g. drought-tolerant and low-irrigation varieties/crops selection), and other conducive and adaptive technologies.

Adaptation to reduce the vulnerability of agriculture and allied sectors to the impacts of climate change requires coordinated actions, proper planning, financial resources and community involvement.

6.2 SOCIAL MOBILIZATION AND COMMUNITY EMPOWERMENT

Local communities adopt coping and survival strategies to prepare for or respond to risk situations long before any outside assistance would (or would not) arrive.

Having experienced damage and loss, they are interested in protecting themselves from climate risks through community-based disaster preparedness and mitigation. However, empowering communities toward the use of technologies and viable adaptation practices for better management of climate change risks is essential for further improving livelihood adaptation and enhanced community resilience. The project encouraged local communities to establish their own learning and action platforms to increase their understanding and ability to diagnose social issues that play a catalytic role in mainstreaming and up-scaling climate risk management and potential adaptation options.

The entry point for discussion with communities was the consensus that a broader range of adaptation options adds value to existing coping strategies at the community level. The process of social mobilization appeared essential and effective for (i) motivating farmers and farmer's groups to collaborate in a more organized way, (ii) catalyzing interest and awareness of climate variability and change and their impact on agriculture, and (iii) mobilizing self initiative to find out and implement adaptation options locally. The process encourages community groups to develop relations with other stakeholders in order to gain technological assistance, administrative backup and other need-based supports.

Local Facilitation Team (LFT): The project team developed a strategy for community-level, location-specific social mobilization (SM). LFTs were formed by local communities to provide an institutional entry point for social mobilization at community level. Formed in each pilot site, they coordinate local action with the project and implement the adaptation options at community level.

The importance of LFTs and their role was discussed during the training sessions organized for community representatives, sub-assistant agriculture officers (SAAOs) and disaster management committee members. The local stakeholders and members of the village-level facilitation team included a school teacher, imam, farmer's representatives, village-level DMC members and union-level SAAOs. In some cases, the role of the LFT was taken care of by the village committee during project implementation. In practical terms, the LFTs participated in the process of selecting adaptation options considered useful for their respective village. It is important to highlight that, in this context, the project promoted the idea that communities are the end users of any option. Thus, they would decide which options they preferred to test sequentially at field level through demonstrations. In practice, however, it was observed during implementation that the decision-making process often was influenced by the views of the extension workers – a challenge to work on in the second project phase. The community groups took an active role in all informal learning and awareness-building sessions organized at local level. The SMS framework for improving livelihood adaptation to climate change as applied in the project is presented in Fig.8.

FIGURE 8

Community-level Social Mobilization Strategy (SMS) Framework use by the project

PROMOTING INFORMAL COMMUNITY INSTITUTIONS

↓

SOCIAL MOBILIZATION FOR LIVELIHOOD ADAPTATION

IMPLEMENTATION OF ACTIVITIES

Develop community based implementation plan

Participatory demonstrations of adaptation options in farmer's fields

Apply monitoring system

SOCIAL CAPITAL FORMATION WITHIN & OUTSIDE COMMUNITY

Linkage development with service providers

Community planning on DRM & CCA

Farmer to farmer exchange visit

Farmer's sessions on need based issues regarding DRM & CCA

AWARENESS RAISING

Community field days

Self initiatives in the design of demonstrations & field trials

Cultural events on DRM and climate risks

6.3 IDENTIFICATION OF ADAPTATION OPTIONS

6.3.1 Selection and validation process

Local adaptations to climate variability practiced to some extent among farmers in the study area can be categorized as:

- traditional, locally managed responses – e.g. pond excavation, retention of rainwater in canals,
- state supported responses – e.g. deep tubewell irrigation,
- alternative innovative responses – e.g. mango farming, livestock and poultry/birds rearing, exist in the study area.

The adaptation practices applied locally and introduced by national development, research and extension organizations were collected and documented.

Viable adaptation options were selected through a sequence of evaluation processes at different levels starting from *upazilla*-level DMC members, U'TIWGs and N'TIWGs (Fig.9). Consultative meetings and brief feedback workshops were also organized with the local research institutions (BARI and BRRI) and developmental organizations.

6.3.2 Selection of good practice options menu

The adaptation options were evaluated with the U'TIWG and N'TIWG for their technical suitability in drought-prone areas. The outcome of the stakeholder evaluation was integrated into the multi-criteria analysis and a good practice option menu of 26 potentially good techniques was prepared. Adaptation practices suitable for *kharif I*, *kharif II* and *rabi* seasons were recommended for field demonstrations (rabi 2005, *kharif I*, *kharif II* and *rabi* 2006, *kharif I*, *kharif II* and *rab*i 2007). The list of demonstrations finally selected for field demonstrations after validation are given in Table 1.

The techniques and details of selection criteria and the good practice menu are presented in the summary project report "*Livelihood adaptation to climate variability and change in drought-prone areas of Bangladesh – Developing institutions and options: A case study*". This case study can be downloaded under: http://www.fao.org/sd/dim_pe4/pe4_061103_en.htm.

FIGURE 9

Overall framework and institutional structure describing activities and process of selection, evaluation and prioritization of adaptation practices for drought-prone areas in Bangladesh

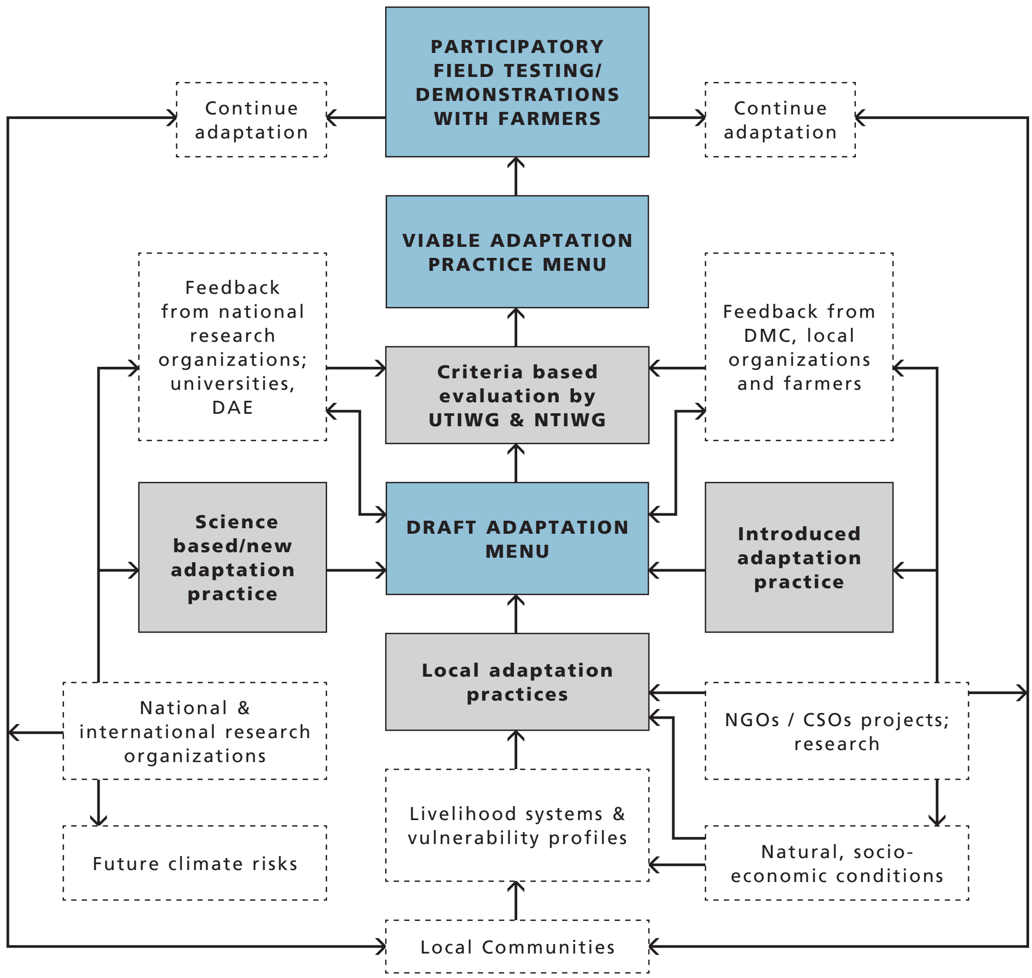


TABLE 1

Categories of good practices recommended for demonstration after validation

Sl. No	Categories	Adaptation practice	Season
1	Agronomic management	Seedbed method for *T.aman* rice	*Kharif – II*
2		Manures and composting	*All*
3		Depth of transplanting for *T. aman*	*Kharif – II*
4		Strengthening field bunds (Ail lifting)	*Kharif – II*
5	Water harvesting	Re-excavation of traditional ponds	*All*
6		Re-excavation of khari canals	*All*
7		Mini-ponds	*All*
8		Supplemental irrigation	*Kharif – II*
9	Water use efficiency	System of Rice Intensification	*Rabi*
10		Direct sown rice (drum seeder)	*Rabi*
11		Drought resistant rice varieties	*Kharif – II*
12	Crop intensification	Green Manure – *T. aman* system	*Kharif – I*
		T. aus – Chini atap system	*Kharif - II*
		T. aman – Mustard/linseed system	*Kharif - II*
		T. aman – Chickpea	*Kharif - II*
		T. aman – Mung bean	*Kharif - II*
13	Alternate enterprise	Mango cultivation	*All*
		Jujubi cultivation	*All*
14		Homestead gardens	*All*
15		Mulberry intercropping in rice	*Kharif - II*
16	Alternative energy source	Community based biogas and tree planting	All
17	Household-level energy efficiency	Improved stove	All
18	Post harvest practices	Seed storage for higher viability	All

Selection criteria included (a) drought mitigation potential, (b) suitability for future climate scenarios, (c) environmental friendliness, (d) economic viability, (e) increased productivity, (f) sustainability (f) social acceptability, (g) gender integration, (h) household income, (i) employment opportunity, (j) relevance to vulnerable community, (k) applicability to multiple sectors, (l) seasonal relevance, (m) immediate need, (n) institutional support and (o) expert acceptance. The criteria-based evaluation was followed by a selection and prioritization based on (i) effectiveness in reducing key risks, (ii) potential technical as well as costs, social acceptance and manageability, and (iii) current state of implementation and additional requirements.

6.4 EXTENSION METHODS AND AWARENESS RAISING

Existing field-based extension approaches and methods were used with the active participation of the National- and Upazilla-level Working Groups. The training was enriched with use of climate risk-related information that transformed the project concepts into concrete field-based action. In the absence of farmers' field schools in the project region, participatory field demonstrations on farmer's own fields were seen as the most appropriate extension method to introduce, guide and monitor the field testing of selected adaptation options. Field orientation meetings were organized before the start of any field demonstration. Frequent field visits of the research institute staff or the extension workers to advise farmers, as well as on-the-spot technical training sessions were held during the implementation cycle of various options. Field days were organized at the end of each season to share the results and learning experiences among the farmers.

Awareness-raising and communication strategies suitable to inform and transfer climate change-related knowledge and interventions were identified through orientation workshops at which farmers, extension workers and local/district-level decision-makers were key audiences (Fig.10). During the course of workshops, volunteer farmers, farmers groups and local task forces were identified to collaborate in pilot experiments, ensuring representative participation by women and women's groups.

The awareness raising strategies included orientation meetings, field days, folk songs and dramas, and demonstration rallies. Also, exchange visits for local facilitation teams to nearby villages were organized by the project team. Leaflets and small information bulletins (Fig.11) were prepared by BARI and disseminated during the field demonstrations.

FIGURE 10.

Extension methods and awareness rising strategies followed during the field demonstrations.

ORIENTATION MEETINGS

FIELD DAYS

FOLK SONGS AND DRAMAS

DEMONSTRATION RALLY

AWARENESS RAISING

EXCHANGE VISITS

FIGURE 11

Publications on viable adaptation practices for awareness rising (Source: BARI, 2006)

CHAPTER 7

PARTICIPATORY FIELD DEMONSTRATIONS OF ADAPTATION OPTIONS

7.1 IMPLEMENTATION PROCESSES

Field demonstrations were carried out by the farmer groups during *rabi* 2005, *kharif I and II* 2006, *rabi* 2006, *kharif* I and II 2007, facilitated by Field Monitoring Officers (FMOs) and U'TIWG members. The list of viable adaptation options was presented to the local farmer groups who had chosen the suitable adaptation options for their localities. Demonstrations were initiated thereafter by the farmers themselves, who also had been identified by the local groups. Where possible, demonstration fields were selected close to a road so that other farmers could visit them. Interestingly, the farmer groups selected poor marginal farmers. Preparatory works were carried out by the farmers to the extent possible. Farmer-to-farmer learning was motivated through several extension approaches including orientation meetings, field days, folk songs and dramas, demonstration rallies and exchange visits.


Livelihood Adaptation to Climate Change in Drought Prone Areas of Bangladesh

(LACC) Project

Technical guideline

Establishment of field demonstrations for Kharif-II season/June - October 2007

Department of Agricultural Extension
Food and Agriculture Organization of the United Nations

Before each season, the technical implementation groups at national and *upazilla* levels prepared a list of suitable demonstrations and detailed implementation guidelines for each available option. The guidelines contained step-by-step procedures on each demonstration, material and resource requirements, and an activity table with responsibility. A monitoring sheet was prepared in consultation with the U'TIWGs, consisting of details on seasons, village name, list of farmers, start date, sowing/planting date, input use (quantity and timing), operations schedule, cultivation cost, yield, economics (net profit) and farmers acceptance rating. The monitoring sheets were maintained by Field Monitoring Officers (FMOs) in consultation with the *Upazilla* Agriculture Officer and in close collaboration with U'TIWGs.

7.2 SELECTED GOOD PRACTICE SAMPLES

The interim results showed that there are many good practices capable of reducing the risks associated with climate change. The good practices, selected based on the feedback from the farmers, had high acceptance ratings.

(1) In farmlands with no irrigation source, rainwater harvesting was done through the mini-ponds for supplemental irrigation. Small farms preferred mini-ponds of 5m x 5m x 2m (length x breadth x depth). However, some large farmers proposed excavating larger ponds (10m x 10m x 2m) as per requirement. Demonstrations included information as to the utility of the pond which were often placed in a corner of the field, using as little space as possible and in the lowest part of the field. The method requires limited family labour. They provide non-climatic benefits such as opportunities for growing short-duration vegetables near the pond.

(2) *Jujubi* (*Ziziphus jujuba*) was considered a potential option to existing autonomous mango cultivation. Although mango plantation as an autonomous adaptation is spreading rapidly, the project anticipated that under changing climatic conditions, high temperature-induced synchronized maturity may lead to price drop. Further, it threatens to replace rice completely, causing food insecurity and aggravating *monga* (seasonal famine conditions). The food security of the Barind tract depends on rice which is the only crop grown in the monsoon season. Introduction of *jujubi,* which is drought and high temperature tolerant and makes less shade on the rice crop beneath, offers scope for both diversification and risk reduction. Hence, rice or seasonal vegetable cropping may not be completely abandoned in a field when cultivating *jujubi.*

(3) Dry seed bed for *T. aman* rice is one of the preferred adaptation options for managing the risk of delayed onset of monsoon rains and early season dry spells. Normally farmers wait until the first monsoon shower in June/July to start seedbed activities. If the monsoon rain is late, seedlings will not be available to ensure timely transplanting in July.

Dry seedbed practice with minimal supplemental irrigation helps farmers keep seedlings ready for transplanting immediately after onset of monsoon rains. This option was suggested by the farmers, but needed some improvement to ensure that seedlings could be pulled out easily, without damage, and to improve the suitability of the practice for heavy textured soils in the Barind tract. The local research institutions improved the procedure.

(4) Homestead gardening already had been suggested by BARI in the early 1980s. However at that stage, it was not successful due to non-availability of drought-resistant vegetables. The current efforts involve having the farmers themselves identify the drought-resistant vegetable crops. Homestead gardening ensures year-round income, nutritional security and involvement of women, as home gardens are managed by women. The practice was considered a better alternative to manage monga (seasonal famine) conditions in northwestern Bangladesh. Similarly, direct sowing and less water rice cultivation (seedlings grown for transplantation in watered fields) have been demonstrated successfully in the farmers' fields. However, where water availability is low, so is acceptance.

BOX 2:

CASE STUDY ON HOMESTEAD VEGETABLE PRODUCTION IN THE DROUGHT-PRONE HIGH BARIND TRACT OF BANGLADESH (BARI, 2007)

BARI conducted demonstrations in four different locations (Nachole, Gomastapur, Porsha and Shapahar) during the *kharif-I, kharif-II* and *rabi* seasons of 2006 to intensify the use of homestead spaces for increased vegetable production and to meet the demand of family nutrition. Twelve households (three from each location) were selected for demonstrations, mostly small, marginal or landless farmers. Year-round vegetable patterns were selected for different niches (such as open sunny land) based on farmers options/agreement. Only vegetable seeds and some critical inputs were distributed free to initiate the programme, with all other inputs and labors provided by the farmers.

The demonstration plots helped farmers reduce their daily expenditures for vegetables and, at the same time, increased their intake of vegetable significantly (from 40 g/h/day on average to 136 g/h/day). However, the intake remained below the recommended daily vegetable consumption (200g/h/day). The vegetable yield was reduced in *rabi* 2006 due to a serious water crisis/drought and because farmers were engaged in T.aman rice harvesting and processing. Several farmers used water from mini-ponds to reduce the drought impact. They also earned a small amount of cash income selling vegetables that they had left after meeting their own daily requirements and those of their relatives and neighbors. A house-to-house enquiry found that most of the activities were carried out by women and women used this money for children education and for meeting small needs.

In the homestead/market, new leafy vegetables such as *kangkong* and *batisak* (Chinese cabbages) were introduced. These two crops produce good amounts of biomass and are considered water efficient. For drought-prone areas, high-water use efficiency is crucial for adapting to local conditions. Locally adapted, sweet tasting stem amaranth (*Katora danta*) was also grown, because it adapted well to low soil moisture and high temperature. Most of the other vegetables were also adapted to Barind conditions, as these were selected after long trials in another area of High Barind Tract (Godagari Upzilla of Rajshahi district). It was observed that except for land preparation and marketing, work was done by women and children. This created employment for women, as well as empowering and giving them a sense of satisfaction, as they had cooperated for the benefit of the family. Moreover, they were consuming fresh, nutritious and poison-free vegetables on a daily basis. Although farmers are keeping vegetable seeds for the next year's production, seed production and preservation in high temperature and high humid conditions is a highly technical operations, and there is need for training. In general, seed quality in the local markets is very low. For sustainability and up-scaling of the pilot work, continued assistance will be needed including hands-on training, more demonstrations, field days, nutrition education, consumption fares and backup research.

7.3 INTERIM ACHIEVEMENT AND RESULTS

More than 225 demonstrations of 15 viable adaptation practices were conducted for five seasons (*Rabi* 2005 to *Kharif II* 2007) in four *upazilla*s of drought-prone Barind areas. Among the several adaptation practices, farmers groups considered mini-ponds, growing of *jujubi* (local name *ber*), dry seedbeds for rice, and homestead gardens as the most important adaptation options. In total there were about 36 mini pond demonstrations initiated in four *upazilla*s that had no deep tubewell irrigation facilities during 2006. The monsoon season during 2006 was below normal rainfall and many farmers used the water from mini-ponds for supplemental irrigation. The acceptance rating for various demonstrations and the feedback on each demonstration is presented in Table 2.

TABLE 2

Preference of livelihood adaptation options by the farmers

Adaptation practice	Seasons	Acceptance	Remarks/reasons
Homestead gardening	All	Very high	Additional household income, employment and nutritional security
Drought-tolerant fruit tree gardening	All	Very high	Drought tolerance and crop diversification
Water saving irrigation for rice	*Rabi (boro)*	Low	Controlled irrigation not possible due to non availability of electricity in time
Mini-nursery for fruit trees	All	Very high	Community initiative and income generation
Dry seed bed to manage early dry spell risk	*Karif-II*	Moderate	Lack of technical capacity
Improved stove for household use	All	Very high	Fuel and time saving
Cultivation of non-conventional oilseeds	*Rabi*	Moderate	Pest and disease infestation
Use of compost and organic manures for water conservation	*Karif-II*	Moderate	Inadequate training and long time required for decomposition
Alternative cereals, e.g. maize	*Kharif-II*	High	Drought tolerance and income stabilization
Rain water harvesting	*Kharif-II*	Very high	Economic benefits and stable income

A detailed summary of all demonstration trails is presented in Annex 1.

BOX 3

ECONOMIC ASPECTS OF SELECTED, PRIORITIZED ADAPTATION OPTIONS

- The adoption of rain water harvesting and supplemental irrigation during drought in *Kharif* 2006 improved the rice yield by 23% and net profit by 75%.
- Water saving irrigation practice increases the water use efficiency of rice by 20%, but yield and economic advantage is marginal due low cost of water.
- Adoption of improved stove at household level requires an investment of US$10/household, while it saves 30% fuel use and reduces 35% time for cooking.

CHAPTER 8

LESSONS LEARNED AND CONCLUSIONS

Given the high population density, vulnerability to climate shocks, recent history of famine and dependency on agriculture for livelihoods, Bangladesh is further threatened by the potential impacts of climate change. Already half of the population lives below the upper poverty line (2 122 kcal/day) and a third live below the lower poverty line (1 805 kcal/day). Alleviating poverty and ensuring household-level food security under changing climate conditions is a major challenge. Ensuring community participation in climate change adaptation as well as top-down institutional development and policy support is crucial for managing future risks at community level in general and for the agriculture sector in particular. The key lessons and conclusions drawn from the project implemented by FAO to promote livelihood adaptation to climate change in drought-prone areas of Bangladesh are the following.

Launch adaptation with a focus on current variability and factor in climate change. Where climatic factors are unfavorable and natural disasters strike regularly, livelihoods are increasingly vulnerable, especially due to the inadequate local capacities and limited access to various livelihood assets or services. Regardless of its underlying causes, climate change is changing disaster risk profiles, environmental and socio-economic vulnerabilities, and it induces new environmental hazards that further impact development processes. Impacts caused by altered frequencies and intensities of extreme weather and climate phenomena are very likely to change. However, the experiences of the recent past, current living conditions and natural hazard threats prevails in peoples' memory, thus making present natural hazard threats and climate variability the best entry points for community-level interventions, awareness raising and advocacy towards climate change issues. The initiatives of integrating climate change adaptation into the DRM operational frameworks helped identify locally relevant adaptation practices for current and future drought risks. This project demonstrated their availability for possible replication under future changing climatic conditions.

Climate adaptation is a social learning process that creates the capacity to cope with climate change-related impacts. Since we are not yet able to anticipate exact future impacts of climate change, particularly at local scale, the project suggests that climate change adaptation programmes should have an intermediate goal of empowering communities to adapt to the impacts in a broader ecosystem perspective. In pursuing this goal, climate adaptation should focus on support for the decision-making and capacity-building processes that shape social learning, technology transfers, innovations and development pathways. This process of adaptation needs to address explicitly the needs of marginalized groups that are most vulnerable to the types of climatic and socio-economic changes that are likely under perturbed climates. The social learning process needs to identify the best practices through participatory processes for community-based adaptation. A key message is that the current uncertainty regarding the precise impacts of climate change should not be used to justify inaction.

Multiple and integrated adaptation measures across sectors are essential. Project findings confirm that climatic conditions and anthropogenic factors mutually reinforce chronic vulnerability to climate variability and natural disasters. Technology, on its own,[1] is at best a partial solution to climate change. Technological solutions should be embedded in the relevant social and environmental contexts. The project confirms the need for multiple but integrated pathways across sectors to improve adaptive responses of local communities, especially the poorest sectors of the community. Neither an agricultural nor any other single sectoral intervention alone can provide sufficient scope to manage the future climate change risks. Short-term and long-term adaptive measures in agriculture, linked with clear focus on possible future risks, must be integrated into cross sectoral planning. These include, for example:

- undertaking physical adaptive measures, such as link canals, irrigation, storage facilities for retaining water and drainage;
- adjusting existing agricultural practices to match future anticipated risks, such as adjustment of cropping pattern, selection of adapted crops varieties, diversification of cropping and/or farming systems, better storage of seeds and fodder, dry seed beds, more efficient use of irrigation water on rice paddies, more efficient use of nitrogen application on cultivated fields, and improved water management including water harvesting;
- introducing alternative enterprises and farming systems such as adoption of mango or *jujubi* as cash crops, goat rearing and poultry production, pulses as an additional crop after monsoon season, and more agroforestry;
- making socio-economic adjustments, e.g. livelihood diversification or market facilitation;
- strengthening community resilience, including local institutions and self-help capacities;
- strengthening formal institutional structures and environment;
- formulating policy to catalyze enhancement of adaptive livelihood opportunities;
- creating awareness and advocating DRM, linking it with climate change and adaptation issues.

Adaptation to climate change is a location-specific issue. Decentralized ways of working are needed within the framework of coherent national policies. There cannot be one-size-fits-all solutions at local level. For example, project demonstrations found that

1 Example: The water saving technologies the project introduced in irrigated rice production led to a 20 percent water savings with the same yields. However, farmers reported they would not adopt these practices at present, because water supply for irrigation depends on electricity and there are frequent electricity failures. The risk is too high that they would loose the crop because they would have less time flexibility for watering – which the techniques imply. This illustrates that improved agricultural technologies alone are not sufficient.

mini-ponds are a good adaptation practice for clay soil but not suitable for sandy soil. Managing anticipated risks requires developing location-specific adaptation options that consider bio-physical, socio-economic and socio-cultural factors.

Institutional capacity building and organizational networking with clear definitions of roles and responsibilities are essential. Institutional capacity building and strengthening of organizational networks across all levels and sectors are basic preconditions to making adaptation work. Since adaptation to climate change is a new field of work, the institutional responsibilities are not yet well defined. However, as the field develops, there will be need to integrate top-down and bottom-up perspectives and capacities, and to establish mechanisms to coordinate the functions of various agency activities such as planning, communication and operations at field level. Furthermore, it will be crucial to improve links and factor adaptation into other on-going development activities, and to determine clear roles such as who should do what in order to make community-based adaptation effective. The experiences clearly illustrate that provision of a comprehensive approach with concrete roles for action is necessary to motivate change in local perceptions and ensure meaningful interventions through local service providers, including government institutions. The project implementation process found that a great deal can be achieved if there is full buy-in and the work can be done through existing institutions.

Applying a livelihoods perspective is helpful to understand and promote local-level adaptation to climate change. Community and household assets are influenced by the institutions, organizations, policies and legislation that shape livelihoods. The institutions and processes operating in both public and private spheres and from household to national levels determine access to assets, livelihood strategies and vulnerability to climate change. Adding climate change adaptation through a livelihood perspective improves the adaptive capacity of farmers by increasing household access to assets and services. Increasing awareness of climate variability at grassroots level – through government and non-governmental interventions, provision of essential support such as information, technology, technical know-how, alternative sources of income and employment, credit facilities, insurance mechanisms, health facilities and information on markets, and dissemination of all awareness messages in local languages –needs to become an integral part of the livelihood adaptation process. The livelihood perspective has been strengthened by the initial scoping studies and increased understanding of local community perceptions on risks and local coping and adaptation practices.

Need to better promote sustainable natural resource management practices in the context of future risks. The project shows that activities to address climate change adaptation will go further if they build upon what is already known about sustainable natural resource management (SNRM) and agricultural development. There is no need to reinvent the wheel – it is best to use exiting knowledge on SNRM as an entry point, adapting or adopting successful, tested practices and working approaches. There is already a wealth of knowledge on sustainable technologies and innovative methods of technology transfer to manage current risks. These risk management techniques could be fine-tuned to address also future risks to a significant extent. By taking this first step, it is possible to gain an urgently needed window that would allow time to improve the techniques. Locally downscaled predictions of climate change impacts and new location-specific adaptation options could then build on what is already practiced by the farmers or existing at the technology transfer mode.

Need to revitalize and strengthen research and development links. The project experience argues in favor of establishing more and better participatory and practical learning and action research and development platforms to develop and replicate innovative adaptive technologies jointly with farmers, ministries of agriculture and international and national research institutions. Emphasis should be on demand-driven, interactive and research-based and focus on mutual learning among farmers, such as through farmers field schools. The project also helped identify the current weaknesses in the institutional set-up, networking and information sharing. The weaknesses have been partially addressed through strengthening existing institutional technical capacity and by promoting new coordination and collaboration mechanisms.

There is a need to monitor ongoing adaptation practices and potential risks of mal-adaptation, and to establish links with policy making. Farmers will take action on their own if they can, irrespective of external interventions. It was observed in northwest Bangladesh that many land owners planted mango trees in their rice fields, mainly for economic gain but also because the mango is well adapted to the increasingly dry conditions. However, this autonomous adaptation is taking place in an unplanned and uncoordinated manner and, in two or three years, it will have a negative impact when the trees are large enough to shade the rice crop beneath. Once the land is not suitable for rice production, local food production and availability will decrease, and landless laborers will lose their work. This may lead to internal migration in search of employment, which is critical in densely populated areas and towns such as those in Bangladesh. The project presented *jujubi* as an alternative crop to mango that would not cause the same shading and loss of rice. In general, however, it is necessary to recognize the impact of these autonomous developments and to consider whether adaptation should be left to the control of the market or if governments should be more actively involved in analyzing, testing and promoting good adaptation options, including incentives and regulatory frameworks as necessary to prevent mal-adaptations.

Assess the value of indigenous knowledge in the context of managing future risks. Although farmers often rely on proven local practices and indigenous knowledge for drought risk management, it is necessary to assess the real value of these practices in the context of managing future risks. This requires viewing them in terms of disseminating them but also adding value to them with knowledge, for example, from research institutions that may not be locally available. The project experience with local research institutions provided insight into a range of drought adaptation issues and potential design of drought management alternatives. Many practices such as land-use planning, watershed management, plant production, farming systems research, development of drought-tolerant varieties and small-scale water harvesting practices are already in place. Factoring existing knowledge about climate risks into new approaches in the context of climate change adaptation is a good entry point.

The establishment of an institutional framework through which local adaptation strategies can be reviewed, validated and integrated into the mainstream of resource management, however, is essential to improving the adaptive capacity of communities in general and farmers in particular. Precise documentation and monitoring of all coping and adaptation strategies followed by farmers is necessary to provide a baseline for future development.

Adaptation practices related to crop diversification and income generation are preferred at community level. Field demonstrations confirmed that farmers' acceptance of alternative crop diversification (mango and ber) and income generation practices (fruit tree nurseries and homestead gardening) is very high. Similarly, acceptance of drought-tolerant rice and pulse production was high, due to the fact that it led to higher income levels and crop intensification. Water-saving rice cultivation, less preferred by farmers in areas where irrigation water is supplied through deep tubewells – requires awareness-raising efforts and policy interventions on pricing of water in the future. There was moderate adoption of dry seed bed and compost, because these practices require substantial training at community level. Adaptation practices involving community actions such as mini-nurseries were highly preferred, as the practice provided substantial income throughout the year. Without net financial benefits for farmers, there seems to be little scope for local adaptation of any new technology at this stage.

Promoting public-private partnerships in climate change adaptation. Vulnerable agricultural systems face huge environmental and social challenges, in view of potentially harmful effects of climate change. Corporate social responsibility (CSR) is a new concept in northwest Bangladesh whereby organizations, including private entrepreneurs, are taking responsibility for the impacts of their activities on communities and environment. CSR is perceived as going beyond the statutory obligations to comply with legislation, with organizations voluntarily taking further steps to improve livelihood assets of their local community and society at large. During the initial project phase, the private entrepreneurs developed adaptation practices meant to increase resilience to impacts of climate change and maximize the benefits for overall sustainable development. Awareness has been created among the local seedling producers about the advantage of drought-resistant species and the project team facilitated the interaction between DAE, local research institutes and private seed/seedling producers.

ANNEX 1

SUMMARY OF FIELD DEMONSTRATIONS BY DISTRICT 2005/2007

District: Chapai Nawabganj; Upazilla: Gomestapur

Name of the demonstration	Name of the villages	Seasons	No. of dem.	Net adaptation benefit over existing practice	Farmers acceptance	Remarks/Feedback
Water saving rice cultivation	Parasadpur	Rabi 2005	2	■ Economic profit is marginal (plus 2%) compared to existing practice ■ 40% water savings compared to conventional irrigation	Moderate	Frequent electricity failures and non-availability of fuel restricts the farmers to adopt water saving irrigation methods
Homestead vegetable garden	Malpur	Kharif – I 2006	3	■ Rural diet diversification ensured	Very high	Household requirement of vegetable are fully met
	Malpur	Kahrif – I 2007	2			
	Prasadpur	Kharif – I 2007	2			
	Borodadpur	Kharif – I 2007	2			
Mini-pond excavation for supplemental irrigation	Malpur	Kharif – II 2006	3	■ Net profit of 81.5% increase over traditional rainfed rice cultivation.	Very high	Initial investment needs to be supported through local institutional systems and pond size needs to be designed according to the holding size.
	Borodopur	Kharif - II 2006	4			
	Nachole	Kharif - II 2006	2			
Dry seedbed nursery for T. Aman rice	Malpur	Kharif – I 2006	3	■ Additional testing required	-	The techniques needs to be improved further
	Borodapur	Kharif – I 2006	6			
Short duration *T. aman* rice (Block demonstration	Malpur	Kharif – II 2006	3	■ Additional yield of 400 kg/ha	-	Improved seeds should be available in time
	Borodadpur	Kharif – II 2006	3			
Short duration chickpea cultivation	Malpur	Rabi 2006	7	■ Additional yield of 60 kg/ha over control	Moderate	-
	Borodadpur	Rabi 2006	3			

Name of the demonstration	Name of the villages	Seasons	No. of dem.	Net adaptation benefit over existing practice	Farmers acceptance	Remarks/Feedback
Short duration linseed cultivation	Malpur	Rabi 2006	3	-	Moderate	Pest infestation reduced the yield and requires additional investment
	Borodadpur	Rabi 2006	1			
Drought tolerant maize cultivation	Parasadpur	Rabi 2006	3	Higher drought tolerance as compared to locally existing crops	High	High yielder but water stagnation during active monsoon rainfall reduces the yield and sufficient drainage facilities are required. Institutional support for marketing is required.
Fruit tree cultivation (Papaya)	Parasadpur	Kharif – I 2007	2	■ Household diet diversification ■ Suitable for homestead fruit tree cultivation	Low	Soils of the barind tract are not highly suitable for papaya cultivation. Papaya in homestead garden may be advocated.
	Borodapur	Kharif – I 2007	4			
Farm Yard Manure preparation	Parasadpur	Kharif – I 2007	2	-	-	Control plot was not maintained
	Malpur	Kharif – I 2007	2			
	Borodapur	Kahrif – I 2007	2			
Mini Nursery for drought resistant fruit tree sapling production	Parasadpur	Kharif – I 2007	3	-	-	Control plot was not maintained
	Malpur	Kharif – I 2007	1			
	Borodapur	Kharif – I 2007	2			
Mango orchard management	Parasadpur	Kharif – I 2007	3	-	High	Autonomous adaptation taking place in the barind areas, requires institutional support especially for supply of drought tolerant mango varieties
	Malpur	Kharif – I 2007	1			
	Borodapur	Kharif – I 2007	2			
Improved stove	Parasadpur	Kharif – I 2007	2	■ Fuel saving of 30-35% and time saving upto 25% could be achieved ■ Improved fuel efficiency and reduced fire risk	Very high	-
	Malpur	Kharif – I 2007	2			
	Borodapur	Kharif – I 2007	2			

District: Chapai Nawabganj; Upazilla: Nachole

Name of the demonstration	Seasons	No. of dem.	Adaptation benefits as compared to existing practice	Farmer's acceptance	Remarks/feedback
Water saving rice cultivation	Rabi 2005	2	■ Net profit of 28.2% compared to existing practice	Moderate	Recommended to replicate the practice for wider adoption
	Rabi 2006	2	■ Water saving up to 30% in high Barind areas	Moderate	Non-availability of electricity to run the water pumps restricted the adoption of practice successfully
Dry seed bed method for *T.aman* rice cultivation	Kharif – I 2006	4	■ Managing late receipt of rainfall during kharif II season	Moderate	Timely transplanting of *T.aman* rice achieved during kharif - II season of 2006
Apple Kul (Jujube) gardening	Kharif – II 2006	3	■ The crop is able to withstand drought conditions; ■ Opportunity for intercropping with rice ■ Extra benefit of approximately Taka.10000/ bigha is ensured	Very high	Well accepted by the farmers and were highly motivated to replicate themselves. The practice is extended in barind areas within a short period of time. Investment cost of Taka.9000 is required
Mini pond excavation and supplemental irrigation for *T. aman* rice	Kharif – II 2006	4	■ The water harvesting helped to provide two supplemental irrigation during drought ■ Yield increased by 15% over existing practice (around 100 kg/bigha)	High	Farmers suggested to double the size of the mini pond. However, the size increase depend on availability of land and land holding size among the farmers in the region Investment cost of Taka. 3425 is required
Block demonstration of short duration *T.aman* rice followed by Chick Pea	Kharif – II 2006	4	■ Crop intensification with rice followed by pulse increases soil fertility status ■ Productivity increase due to additional chick pea crop	High	Well accepted by the farmers and suggested to improve the seed distribution system through local support institutions
Drought tolerant maize cultivation	Rabi 2006	2	■ Crop diversification with Maize reduces the impact of drought ■ Net profit of Taka.5900/ bigha was achieved	Very high	Well accepted and farmers are highly motivated as the crop is new to the region. Recommended to improve the market facilities
Crop intensification with linseed	Rabi 2006	3	■ Additional net profit of Taka.200/bigha was achieved	Moderate	The profit is very low
Crop intensification with Chickpea	Rabi 2006	8	■ Additional net profit of Taka.3350/Bigha was achieved	High	Very well accepted by the farmers, but recommended to supply drought tolerant varieties

Name of the demonstration	Seasons	No. of dem.	Adaptation benefits as compared to existing practice	Farmer's acceptance	Remarks/feedback
Homestead vegetable gardens	Kharif – I 2007	6	■ Year around income generation at household level	High	Farmers are interested to engage themselves in homestead vegetable cultivation and additional family earning were assured by selling excess vegetables
Mini nursery for fruit tree seedling production	Kharif – I 2007	4	■ Cost of cultivation of Taka.15000 is required for 1000 m^2 ■ Additional income to the farmers during dry years	High	Availability of fruit tree saplings encourages farmers in the project area to go for fruit gardens. The practice creates additional source of income during dry periods. Farmers can sell the saplings 2-3 months after sowing/grafting/ budding
Two chamber Farm Yard Manure	Kharif – I 2007	5	■ The practice improves soil fertility status and water holding capacity	High	A pit size of 1.5 m x 1.5 m x 1.0 m is required and need to incur an investment of Taka.1250/ pit. The FYM prepared during Kharif I can be used during subsequent Rabi season
Improved stove	Kharif – I 2007	6	■ 30% fuel and 35% time saving ■ Improves the energy use efficiency and reduces health hazards to the women and children	Very high	An investment of Taka.800 is required per stove
Papaya cultivation	Kharif – I 2007	4	■ Additional income and nutritional contribution	Low	The soil conditions are not suitable for higher production and an initial investment of Taka.13000 is required and which restricts wide spread adoption of the practice

District: Naogaon; Upazilla: Sapahar

Name of the demonstration	Village name	Seasons	No. of dem.	Net adaptation benefit over existing practice	Farmers acceptance	Remarks/ feedback
Mini nursery for fruit tree saplings	Bahapur	Kharif – I 2007	2	■ Additional income of Taka.39900 from 400 m^2 area ■ Additional employment generation during drought years	High	Farmers are interested to replicate the practice. Timely availability of saplings is an advantage and cost of saplings will be cheaper Availability of required saplings locally
	Basuldanga	Kharif – I 2007	2	■ Additional income generation of Taka. 20330 from 400 m^2 area		
	Chachahar	Kharif – I 2007	2	■ Additional income of Taka 21705 from 400 m^2 area		
Mango orchard management	Bahapur	Kharif – I 2007	2	■ Reduced impact of drought in Mango compared to rice	High	Autonomous adaptation and replication takes place every season. Cost of cultivation was Taka 2023 for 20 trees (includes pit, planting and establishment)
	Basuldanga	Kharif – I 2007	2	■ Reduced impact due to drought		Initial investment cost of Taka.2900 for 20 trees is required.
	Chachahar	Kharif – I 2007	2	■ Drought tolerance compared to rice		Initial investment cost of Taka 2880 is required.
Improved stove	Bahapur	Kharif – I 2007	2	■ Saving of fuel (40%) and time (35%) ■ Improved energy use efficiency ■ Animal fodder and manure will not be used as fuel	Very high	Very high level of acceptance in all the villages as it could save fuel and time. However, large families require some modifications
	Basuldanga	Kharif – I 2007	2			
	Chachahar	Kharif – I 2007	2			
Homestead gardening	Bahapur	Kharif – I 2007	2	■ Year around income generation at household level		
	Basuldanga	Kharif – I 2007	2			
	Chachahar	Kharif – I 2007	2			

Name of the demonstration	Village name	Seasons	No. of dem.	Net adaptation benefit over existing practice	Farmers acceptance	Remarks/ feedback
Double chambered FYM preparation	Bahapur	Kharif – I 2007	2	■ Improved soil fertility management ■ Wastage of FYM is reduced ■ Improved water retention of the soil	Very high	Initial investment cost of Taka 1500 is required.
	Basuldanga	Kharif – I 2007	2	■ Used for subsequent Rabi season for high yielding boro crop		
	Chachahar	Kharif – I 2007	2	■ Used for subsequent Rabi season for high yielding boro crop		
Papaya cultivation to manage drought	Bahapur	Kharif – I 2007	2	-	Low	Not preferred by farmers
	Basuldanga	Kharif – I 2007	2			
	Chachahar	Kharif – I 2007	2			

District: Naogaon; Upazilla: Porsha

Name of the demonstration	Village name	Seasons	No. of dem.	Net adaptation benefit over existing practice	Farmers acceptance	Remarks/feedback
Mini nursery for fruit tree saplings	Shavapur	Kharif – I 2007	1	■ Additional income of Taka.40000 from 400 m^2 area ■ Additional employment generation during drought years	Very high	Farmers are interested to replicate the practice. Timely availability of saplings is an advantage and cost of saplings will be cheaper Availability of required saplings locally
	Saharandha	Kharif – I 2007	2			
	Chhaor	Kharif – I 2007	3			
Mango orchard management	Shavapur	Kharif – I 2007	2	■ Reduced impact of drought in Mango compared to rice ■ Reduced impact due to drought ■ Drought tolerance compared to rice	High	Autonomous adaptation and replication takes place every season. Cost of cultivation was Taka 2023 for 20 trees (includes pit, planting and establishment); Initial investment cost of Taka.2900 for 20 trees is required; Initial investment cost of Taka 2880 is required.
	Saharandha	Kharif – I 2007	2			
	Chhaor	Kharif – I 2007	2			
Improved stove	Shavapur	Kharif – I 2007	2	■ Saving of fuel (30%) and time (35%) ■ Improved energy use efficiency ■ Six members family require 6 kg of fuel wood. Introduction of improved stove could save 2 kg of fuel every day	Very high	Very high level of acceptance in all the villages as it could save fuel and time. However, large families require some modifications
	Saharandha	Kharif – I 2007	2			
	Chhaor	Kharif – I 2007	2			
Homestead gardening	Shavapur	Kharif – I 2007	2	■ Each farmer could harvest vegetables worth of Taka 715 return every month	Very high	Households need not purchase vegetables from the local market
	Saharandha	Kharif – I 2007	2			
	Chhaor	Kharif – I 2007	2			

Name of the demonstration	Village name	Seasons	No. of dem.	Net adaptation benefit over existing practice	Farmers acceptance	Remarks/feedback
Double chambered farm yard manure preparation	Shavapur	Kharif – I 2007	2	■ Improved soil fertility management ■ Wastage of FYM is reduced ■ Improved water retention of the soil ■ Used for subsequent Rabi season for high yielding boro crop ■ Used for subsequent Rabi season for high yielding boro crop	Very high	Initial investment cost of Taka 1500 is required.
	Saharandha	Kharif – I 2007	2			
	Chhaor	Kharif – I 2007	2			
Papaya cultivation to manage drought	Shavapur	Kharif – I 2007	2	■ Not preferred by the farmers	Low	Papaya production was not satisfactory in all the pilot villages
	Saharandha	Kharif – I 2007	1			
	Chhaor	Kharif – I 2007	2			

ANNEX 2

NUMBER OF FIELD DEMONSTRATIONS AND BENEFICIARIES

More than 292 demonstrations of 17 viable adaptation technologies were implemented and monitored during 5 seasons (Rabi 2005 to Kharif II 2007) in the 4 project upazilas, on almost 100 ha (in total) of farmers' own fields. The results of the feedback analysis showed that about 370 farming families benefited directly from implementation of the technologies in their own fields. In addition to the direct beneficiary families, 4170 other farm families participated in the demonstrations of the technologies; among them 212 farmers replicated the selected good practices in their fields on their own cost. The summary of the overall impact of the field demonstrations are presented in the following table.

Number of demonstrations, direct and indirect beneficiaries

Sl. No.	Name of the practice	No. of demos implemented	Families with direct benefit	Farmers participating in demos	Number of farmer initiated replications
1	Excavation of Mini pond (5mX5mX2m) or (10mX10mX2m)	36	36	425	11
2	Establishment of Jujube garden	31	31	215	8
4	Homestead vegetable gardening	44	44	112	57
5	Establishment of Mini nursery	24	24	9	3
6	Water saving rice cultivation	8	8	420	0
7	Dry seed bed method for raising rice seedlings	24	24	200	0
8	Cultivation of T. Aman as a Block Demonstration	8	64	1370	46
9	Cultivation of Chickpea as a Block Demonstration	4	28	350	22
10	Cultivation of Maize	6	6	270	25
11	Cultivation of Linseed	7	7	400	25
12	Cultivation of Papaya	22	22	49	0
13	Farm yard manure	24	24	65	0
14	Management of Mango orchard	18	18	65	0
15	Mango gardening	8	8	55	0
16	Improved stove	28	28	165	15
	Total	292	372	4170	212

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