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**Comprehensive Disaster Management Programme, CDMP**

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



**Summary Report  
Project Phase I**

**Community Based Adaptation in Action**

**December 2007**

**Submitted by:**



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**Food and Agriculture Organization of the United Nations**

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

## **Summary Report Project Phase I**

### **Community Based Adaptation in Action**

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Submitted by the

**Food and Agriculture Organization of the United Nations**

**December 2007**

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## 1. PROJECT BACKGROUND

Bangladesh is particularly prone to natural disasters due its geo-physical 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% 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% of the GDP.

Bangladesh, in particular its northwestern region, is drought-prone. Droughts are associated either with the late arrival or with an early withdrawal of monsoon rains. This phenomenon adversely affects rice crops, which account for more than 80% of the total cultivated land of the country, and also 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 broadcast *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% of cultivated land and reduced rice production by an estimated 2 million tons.<sup>1</sup> 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 tons of food-grain, of which about 0.6 million tons is transplanted *Aman*.

Because farmers are exposed to recurring droughts, they need to adapt their farming systems from year to year to the differing conditions caused by droughts. For most, however, agricultural adjustment is a costly option, as investment is needed in re-sowing, crop replacement, intercropping or irrigation. Most resort to disposal/mortgaging of assets, borrowing and eventually, to migration. This was particularly evident in 1994 and 1995, where 72% of households in a study community, sold and/or mortgaged their lands in order to cope with recurrent droughts, leading farmers into an inevitable debt trap<sup>2</sup>.

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. Non-adoption of new technologies to derive maximum gains during favorable seasons delays recovery after disasters. There is a risk even that investments made for poverty reduction are lost within the high-risk areas due to regular hazard impacts. Increasing climate risks, thus, further undermine development efforts of Bangladesh and aggravate poverty.

Impacts of climate change on food production and food security are global concerns, but they represent a particular threat for Bangladesh. Agriculture is already under pressure mainly due to an increase in demand for food, as well as to depletion of land and water resources. The prospects of global climate change make this problem a priority for Bangladesh.

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<sup>1</sup> Brammer, 1987. Drought in Bangladesh: Lessons for Planners and Administrators; Ericksen et al, 1993. Socio-economic Implications of Climate Change for Bangladesh.

<sup>2</sup> Paul, 1995. Farmers' and Public Responses to the 1994-95 Drought in Bangladesh: A Case Study

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

Several government programs since the 1970<sup>th</sup> have sought to address climate risks. The development of the irrigation system in the 70th led to increased *Boro* rice production in recent years. This, however, was at the cost of other pre-monsoon crops, including pulses and oil seeds, which led to lower nutrition levels in the population, as large areas were converted to *Boro* rice. To reverse this trend, the government promoted crop diversification thereafter to increase rice production during monsoon season and other crops during dry season. However, farmers preferred to cultivate more rice during the less risky dry season. New ways and methods are needed to better inform farmers to help them identify alternative, technically viable options for livelihood adaptation. Better access to climate information could encourage farmers to adopt new risk/opportunity management practices under changing climatic conditions.

The Comprehensive Disaster Management Programme (CDMP) recognizes the risks associated with climate variability and change and the current lack of capacity in assessing and managing long-term climate risks in Bangladesh. Component 4b of the CDMP seeks to establish an integrated approach to managing climate risks at national and local levels. Under this Component, efforts were undertaken in partnership with the Food and Agriculture Organization of the United Nations (FAO) to implement activities designed to promote livelihood adaptation and reduce vulnerability to climate change, particularly amongst women and poor communities who have the lowest capacity to adapt.

The **objectives** of the project are:

- 1) Develop a methodology to better understand:
  - 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 back results to researchers and policy makers in agriculture and the climate change “community of practice”, in order to facilitate replication of success cases and avoid mal-adaptations.
- 2) Initiate and facilitate the 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

The **outputs** and deliverables of this effort include:

- an in-depth local situation assessment;
- identification of suitable project entry point activities
- a participatory project implementation strategy, suitable for replication elsewhere
- required institutional mechanisms set- in place and/or strengthened ;
- technical capacity building and training;

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

- a set of viable adaptation options fitting into location specific agro-ecological and social settings of vulnerable groups;
- lessons learned from the community based adaptation processes

## **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 proved to be a major constraint in transforming global climate change modeling results into locally actionable adaptation practices. Therefore, the implementation of activities was initiated from a disaster risk management perspective as entry point with the aim to phase-in climate change issues and modeling results as soon as available. Utilization of past extreme climate event analogues and potentially available long-lead seasonal forecasts for managing climate risks were the starting point to develop methodologies to better understand how climate change impacts can be translated into agricultural response options and livelihood adaptation practices. The Subcomponent of CDMP was therefore based on the principle that adaptation to short-term climate variability and extreme events serves as a 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***

The availability of usable science-based climate prediction information needs to be tailored to match farmers' understanding and needs by suitably introducing it through discussions about its relevance and potential impacts on traditional practices and incorporating existing knowledge. Farming communities have considerable accumulated experiences to live with climate risks over time and have developed a range of adaptation strategies. In order to connect climate change modeling results with local realities, the understanding of farmers' traditional knowledge on climate risk management, local adaptation practices and their potential relevance to future climate impacts is an essential baseline. It is equally important is to establish better science-society integrators which help to orient climate modeling research to 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 to establish a link between the scientific *climate change modeling research community* and farmers is essential to induce the use of *climate change modeling results in a farmers needs-oriented way*. The DAE in Bangladesh, with its partner research institutions like BARI and BRRI, is a farmer service-oriented institution with a long history of linking farmers with frontier technologies and innovative farm practices. Therefore it provided a good entry point for taking a lead role in connecting climate change modeling research, with communities and farmers needs. On the other hand however, considerable structural innovations within the organization as well as skills building and attitudinal changes were required to capacitate DAE (Department of Agriculture Extension), and its national research partner institutions, for performing in close collaboration and coordination new tasks needed to (i) translate climate change modeling results into medium and long term agriculture impacts and (ii) transform these into concrete adaptation options relevant to farmers' current thinking and needs; while applying a 'language' and communication strategy which 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 work on the basis of day-to-day thinking rather than in view of long-term pro-active risk management. In that respect, there was a need to slowly encourage longer-term thinking and start working on issues that matter today, and then adding a longer term perspective. Therefore, the implementation process was initiated from a community level risk perception and disaster risk management perspective, and phased-in climate change issues and modeling results thereafter.

#### **2.5 Initiating field testing of adaptation options with 'no regret' technologies**

No reliable, downscaled data on potential future impacts of climate change are available yet. The best the project could do was using the PRECIS model for NW Bangladesh. Nevertheless, the project could not pretend to know how climate change impacts will be felt in the drought prone areas in NW BGD. Until better and more reliable data will be available about location-specific impacts of climate change, the project has chosen to experiment on small scale only, by focusing on 'no regret options' initially – options which are already known from as being environmentally and economically successful elsewhere, but which are not yet widely known in NW BGD. This strategy had a dual purpose: to establish field demonstrations to positively raise awareness on the one hand, but also to establish a pool of drought mitigating technologies known to farmers and DAE in NW BGD (with regard to advantages, benefits and costs) to 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 and the role of active intermediation within agriculture sector agencies, like the DAE, are hitherto familiar "only" with deterministic weather forecasts of 24-72 hours. This weather forecast information is used to react and respond to hazards just before or after their occurrence. Recent progress in long-lead climate forecasting makes it possible to better inform farmers on the probability of variations on the average seasonal rainfall, offering scope for risk/opportunity management in agriculture. Long-lead climate forecasts help to make strategic decisions well in advance, reducing the impact of dry and wet spells and associated secondary impacts. However, institutional rethinking is required in two ways: (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 (i) to get used the concept of probabilistic climate forecasting as compared to deterministic weather forecasting.

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

### **3. DESIGN OF PROJECT IMPLEMENTATION STRATEGY**

Designing and implementing livelihood adaptation to climate change in drought prone areas is consolidated within the policy of the Government of Bangladesh. The Comprehensive Disaster Management Programme (CDMP) recognizes the risks associated with climate variability and change. This Programme 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 who have the lowest capacity to adapt. After understanding the national policies related to climate change adaptation, the following working approach and processes were designed to guide the overall project implementation (Fig. 1).

**(i) Assessment of current vulnerability** – the following questions were addressed:

- 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 natural, socio-economic conditions,
- assessing current climate risks,
- assessing local perceptions about climate risks and impacts,
- documentation of livelihood profiles in pilot sites,
- assessing institutional frameworks.

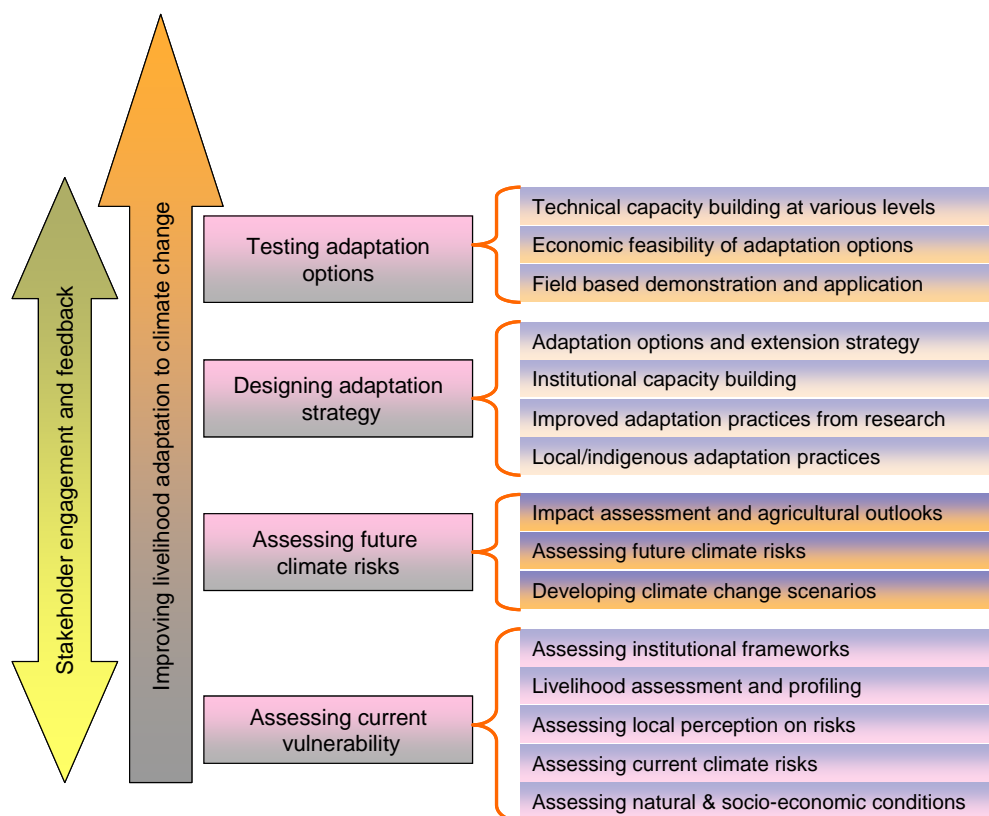


Fig.1. Operationalization strategy, project components and processes for livelihood adaptation to climate variability and change in drought prone areas of Bangladesh.

**(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:

- development of climate change scenarios for the pilot region,
- assessment of future climate risks,
- climate impact outlooks on agriculture.



**(iii) Design of an adaptation strategy** – responds 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:

- local/indigenous adaptation practices,
- improved adaptation practices,
- institutional capacity building,
- development of adaptation options and efficient extension strategy.

An adaptation options menu was developed to identify viable options for managing climate (in this case drought-related). It synthesized adaptation practices that could catalyze long-term adaptation processes. A set of prioritized adaptation options were validated against a set of key criteria, depending on the cropping season; seasonal adaptation option menus were consolidated before each cropping season.

**(iv) Testing of adaptation options:** This component was undertaken with the goal of adaptation options identified through stakeholder consultations. The major steps in this phase were:

- field-based demonstrations and application of adaptation options,
- undertaking economic feasibility studies,
- technical capacity building at different levels (national to local).

## **4. INSTITUTIONAL MECHANISMS FOR ADAPTATION IN ACTION**

### **4.1 Project management**

The pilot project was implemented by the DAE, with the institutional mechanisms indicated in the diagram below (Fig.2). The DAE, under the chairmanship of its Director General (DAE-DG) provided technical implementation support to the project. The National Sub-component Manager was appointed to oversee the implementation. The sub-component manager was responsible for execution of the project and reported to DoE, the DAE-DG through the Director of Field Services, DAE. The Deputy Director - Monitoring (Field Services, DAE) provided secretariat support to project implementation. A core group comprising of key staff was formed in DAE at the national level which provided, after training obtained from the project, day to day technical support for the project implementation. At the field level, the project was implemented through the existing DAE manpower. *Upazilla* and *block* level extension workers (SAAOs) of the project pilot areas were 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 component 4b of the CDMP. The representatives from the Ministry of Food and Disaster Management/ Disaster Relief and Rehabilitation (MoFDM/ DRR), DAE, CDMP and UNDP were drawn 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 the National and Upazila levels, capable of interpreting, translating and communicating climate change modeling and research results

for field application. The capacity building activities were taken up through training to ensure that TIWGs are capable of translating climate change modeling and research results into locally acceptable and achievable adaptation practices, and pilot testing of 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, DRR, SPARASO, BMD and BMDA. It acted as a link between the scientific community generating climate change information and the Upazila technical working groups, obtaining climate information and translating these into agriculture sector impacts. Crucially, the NTIWG transformed these impacts into locally relevant and acceptable adaptation options, in constant dialogue with the Upazila 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 technical clearing house for the selection of adaptation options to be applied and demonstrated through the extension service on seasonal basis at farmer's fields. The clearing house meetings also involved representatives from DAE, the Upazilla Technical working group as well as from national research institutes such as BARI and BIRRI and BMDA (see Fig 2).

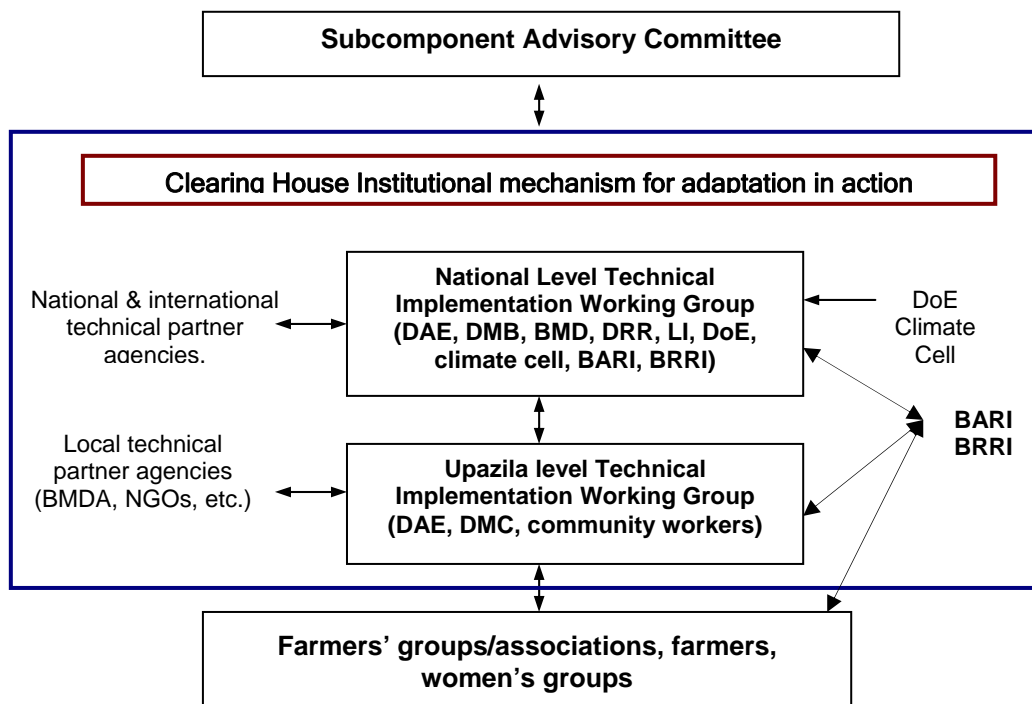


Fig.2. Institutional mechanisms for adaptation in action

The U'TIWGs are chaired by DAE and comprise representation from sectoral agencies of disaster management, agriculture, 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 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 vulnerability assessment skills, and in 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 local community levels and back by involving Bangladesh Meteorological Department (BMD) and Department of Agricultural Extension (DAE).

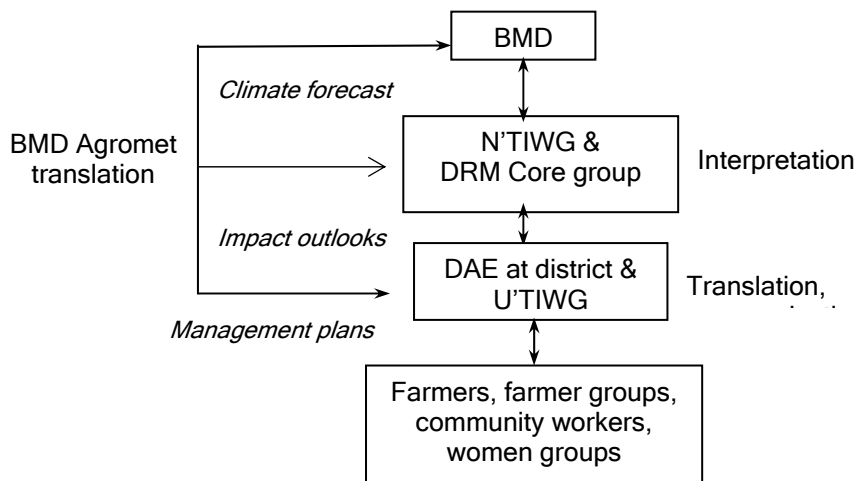


Fig. 3. End-to-end institutional system to facilitate climate information flow with feedback mechanism from national to local/community levels.

The National level Technical Implementation Working group 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 Bangladesh Meteorological Department (BMD) and the Department of Environment (DoE). The Climate Cell of DoE provides climate change scenarios by involving a network of national institutions. The National Level Technical Implementation Working Group (N'TIWG) and core group members are responsible for interpretation of climate information and to develop impact outlooks.

District level DAE staff and the Upazilla Technical Implementation Working Groups (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). The Upazilla level Technical Implementation Working Group (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 sub-component 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, regional to national. The forecast products developed at international forecasting centers were introduced to the sub-component 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 sub-component

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 Climate Cell unit of Department of Environment (DoE), 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 learnt, adoption of livelihood adaptation options, and to promote discussions of local requirements for climate change information.

### **5. CAPACITY BUILDING**

#### **5.1 Training need assessments**

Training need assessment sessions were organized with N'TIWG and DAE core group members in Dhaka, and another with about 50 Department of Agricultural Extension (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 divisional level training needs assessment was combined with a brief training on weather observations and instrument maintenance.

The findings from the training needs underlined the importance for 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; (g) Climate change and viable adaptation practices. The training needs assessment outcomes were quantified through participative discussions, brain storming 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 can be tailored to participants' needs. This flexible training strategy was recommended over 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,
- presenting principles and background information on individual topics, and

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
- 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 days national level training workshop on “climate risks and climate forecast applications in drought prone areas of Bangladesh” was organized for the National level Technical Implementation Working Group Members (N'TIWG) at DAE at Head Quarters, Dhaka on 14-15 August, 2005. Sixteen N'TIWG members as well as representatives from the Department of Environment (DoE) and FAO attended the training workshop. 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 schedule was designed based on the brief and well targeted training need assessment with the National level Technical Implementation Working Group (N'TIWG) members. The training program included presentations, discussions and exercises. Resources persons were also drawn from Department of Agricultural Extension (DAE) and also Bangladesh Meteorological Department (BMD) to discuss about 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 organized at FAO conference room, FAO, Dhaka on 22-23 February, 2006. The objectives of the training workshop were to:

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

Within the overall framework of project implementation, FAO partners had conducted before the workshop a climate change impact assessment and adaptation study which enabled 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 National Level Technical Implementation Group (N'TIWG) members through this training workshop.

During the training workshop it was emphasized that the proposed adaptation options are based on the detailed interaction held with local people in 12 pilot villages of drought prone districts (Chappai Nowobganj and Noagoan) and relevant project partners and local research organizations. The adaptation options served the basis for demand driven field demonstrations in the drought prone pilot villages of the project. Thirty two participants attended the training workshop representing following organization:

- 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 (SPARSO)
- Bangladesh Meteorological Department (BMD)
- North South University
- Food and Agriculture Organisation (FAO)
- Comprehensive Disaster Management Program (CDMP)
- United Nations Development Program (UNDP)
- Bangladesh Agricultural Research Institute (BARI)
- Bangladesh Rice Research Institute (BRRI)

Major recommendations and suggestions made during the training workshop are listed in the workshop proceedings (Summary of the national level training workshop on *"Livelihood Adaptation to Climate Change in Drought Prone Areas of Bangladesh"*).

#### **5.4 District and Upazilla level technical training workshops**

One day training cum feedback workshop were organized jointly by ADPC and CEGIS with the Upazilla level Technical Implementation Working Groups (UTIWG) members at Chapai Nawabgonj and in Noagoan in mid 2005. The participants included Upazilla level technical implementation working group members, 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 and the pilot locations in particular. The workshop included presentations, discussions and small group exercises. A particular interest to the workshop in Naoagoan was to discuss the necessity of judicious water resource management under changing climate conditions.

Four follow-up workshops at Upazilla level were conducted in all the pilot upazillas (Gomestapur, Natchole, Porsha and Sapahar) on 6-7 December, 2005. The Upazilla level technical implementation working group members attended the workshop. The participants were introduced to drought adaptation practices documented 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 on 22-23 February, 2006.

A one day training follow up program was carried out with 52 Department of Agricultural Extension Officers of the Rajshahi division. The training was organized based on the interest from the Deputy Directors and Agricultural Officers of DAE. The training curriculum included the following titles:

- site selection for meteorological observatory

- Instrumentation and maintenance
- Observation of each weather elements
- Time of observation
- Recording and data base maintenance



### 5.5 Introductory seminars with Research Institutions

Bangladesh Agricultural Research Institute (BARI): Scientists at Bangladesh Agricultural Research Institute (BARI) at Rajshahi were informed about the project activities, approaches and methods of livelihood adaptation to climate change. Research works carried out *targeting the drought prone areas of Barind tract documented in the reports were introduced.* 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 of Bangladesh Rice Research Institute (BRRI) sub-station 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*



The institute has evaluated SRI technique in the farmers' field 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. The project introduction seminars were organized on 8 December 2005. Subsequently the research institutes designed 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 farmer's field level.

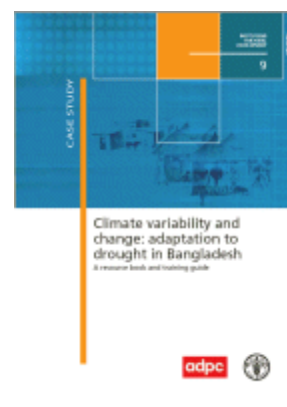
### **5.6 Newly Developed Training Materials**

Training modules incorporating all relevant training needs of the National level Technical Implementation Working Groups (NTIWG) and Upazilla level Technical Implementation Working Groups (UTIWG) were developed:

- 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 as a reference and guide for further training and capacity building of agricultural extension workers and development professionals to deal with climate change impacts and adaptation, using the example of drought-prone areas of Bangladesh. It also presents suggestions for a three-day training course that would be readily adaptable for 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](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](http://www.fao.org/sd/dim_pe4/pe4_060201_en.htm))

## **6. INITIATION AND IMPLEMENTATION OF FIELD WORK**

### **6.1 Baseline studies in the pilot site**

The basic situation analysis was conducted by CEGIS and 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 feedbacks to droughts,
- Local perception about the droughts and impacts, including of 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 in the region, showing however also that in recent years, over exploitation of water resources has led to rapid fall in the ground water table (Fig. 4 source; CEGIS)). The decadal average ground water depth from surface showed a steep decline during the past 25 years from 1981. The decline was steep during summer coinciding with boro season. Local adaptations to current climate variability are practiced to some extent among farmers in the study area and were categorized as: a) traditional, locally managed responses (e.g. pond and *dighi* excavation, retention of rainwater in *khari* and canals, shedding, tillage, breaking top soil), b) state supported responses (e.g. deep tube well facilitated irrigation), c) alternative innovative responses (e.g. adoption of mango farming, orchard developing, alternative livestock and poultry/birds rearing).

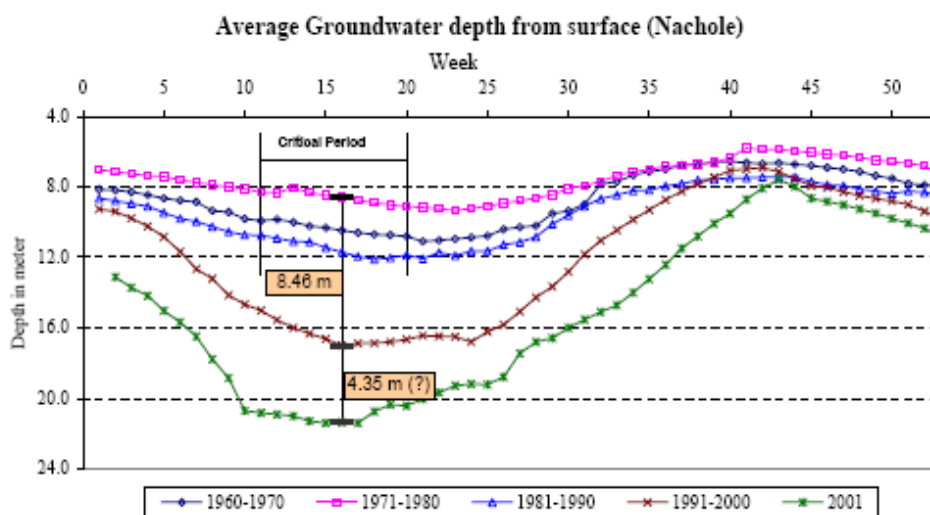


Fig.4. Average ground water depth from the surface

Several institutions including government agencies, NGOs, social, informal and private institutions as well as farmers/water user groups are operating in the area. The different agent's roles, capacities and know-how for dealing with climatic risks differ largely. With its formal mandates to provide deep tube well irrigation the Barind Multipurpose Development Agency (BMDA) is playing a lead role but pays little attention to areas where ground water is not accessible. Local-level disaster management committees officially existed, but their capacity was limited and thus local capacity building activities were carried out.

The main rural livelihood groups in the project are: wage laborers (41%); small and marginal farmers (32.4%); petty traders/businessmen (7%); large farmers (6.9%); fishers (0.4 %) and



others. Wage laborer face unemployment and crises of failed migration, 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 under [http://www.fao.org/sd/dim\\_pe4/pe4\\_060701\\_en.htm](http://www.fao.org/sd/dim_pe4/pe4_060701_en.htm)

**BOX 1. Vulnerable groups profiling and livelihood system assessment**

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

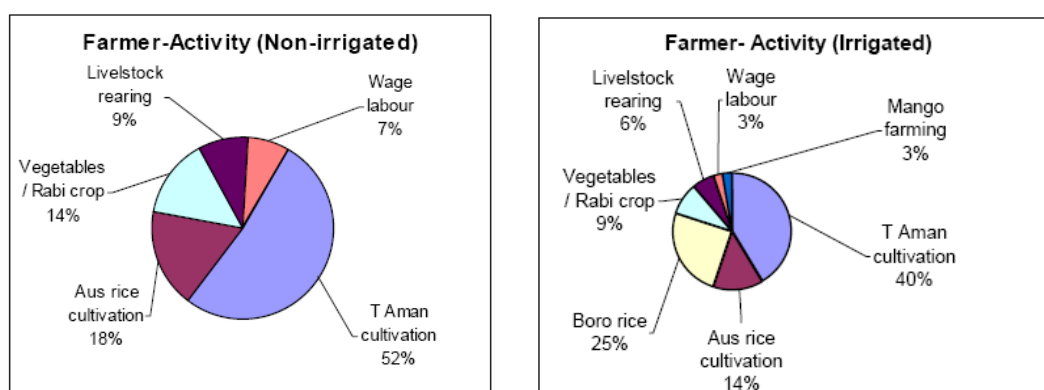


Fig. 4. Proportion of livelihood activities among the farmers in non-irrigated and irrigated areas in the drought prone areas.

The study found that both, the climatic conditions and the anthropogenic factors are contributing 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 most important 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 has identified some local practices and perceptions towards risk management in the pilot areas.

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

After consulting with the local people and professionals it was decided for the purpose of project interventions that the farmer category would not be broken down into various sub-groups since in the study area all the farmers 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 of current vulnerability, local perceptions of risks, future vulnerability and climate change impacts was conducted by ADPC, which highlighted among other factors the following findings.

**Current risks and local perceptions:** Understanding current risks and local community perception are the crucial pre-requisite for integrating climate change adaptation with DRM. Local people in the study area perceive current climate as being different to 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 (rice), winter vegetable and fruit (mangoes) production are affected by increased rainfall variations, temperature and drought. The observed data also showed higher variability in rainfall pattern and increased temperature trends over the last 5 decades (Fig.6 & 7; Data source: BMD, 2007).

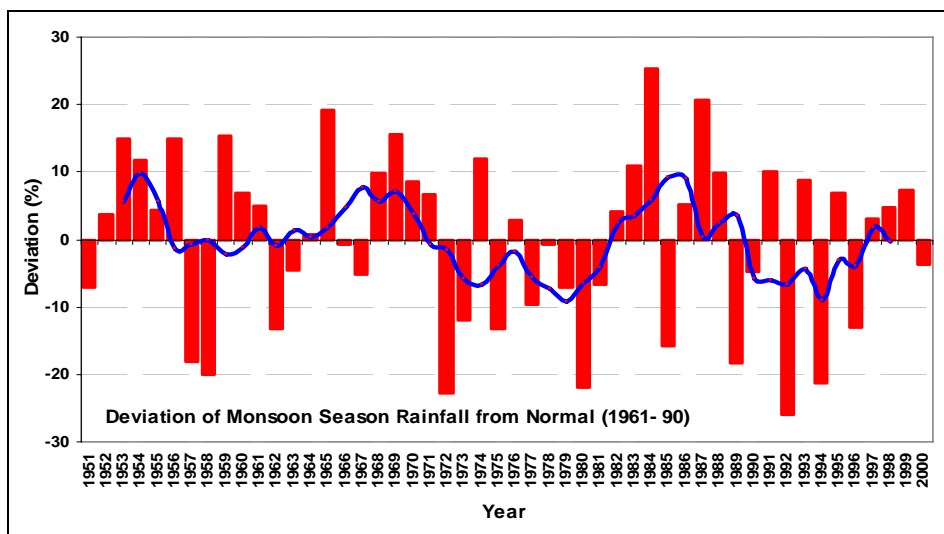


Fig.6. Deviation of monsoon season rainfall from normal (1961 – 90)

**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% until 2070,

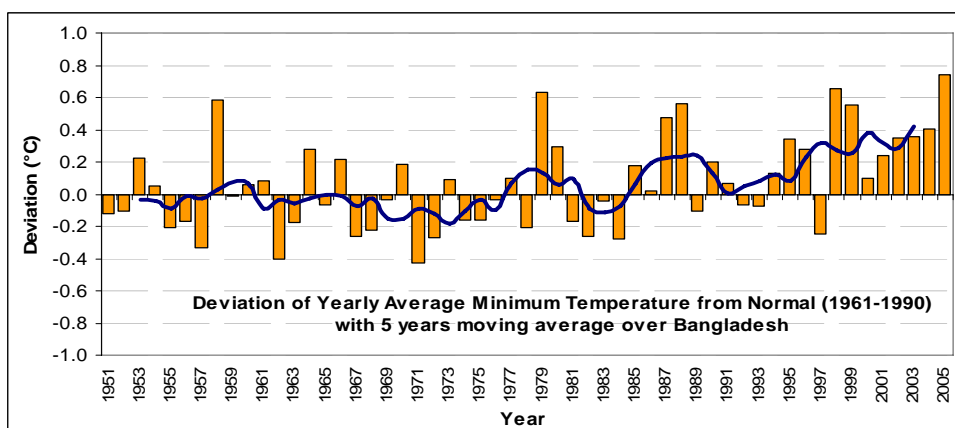


Fig. 7. Deviation of yearly average minimum temperature from normal (1961 - 1990)

precipitation distribution patterns over 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 is increasing since the early eighties, 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 tube well 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 both that the climatic conditions and anthropogenic factors mutually reinforce the chronic vulnerability of livelihoods in rural areas. Successful local level adaptation to climate variability and change required multiple pathways of well-planned and interrelated short-term and long-term measures including:

- ◇ physical adaptive measures (e.g. link canals, irrigation, storage facilities for retaining water; drainage);
- ◇ adjustment of existing agricultural practices (e.g. adjustment of cropping pattern, selection of adapted varieties of crops; better storage of seeds and fodder; floating seed beds; switch to alternative crops (e.g. adoption of mango as cash crop),
- ◇ socio-economic adjustments (livelihood diversification, migration, market facilitation);
- ◇ strengthening of community resilience including local institutions and self help capacities;
- ◇ strengthening formal institutional structures and environment;
- ◇ policy formulation to catalyze enhancement of adaptive livelihood opportunities;
- ◇ awareness creation and advocacy on climate change and adaptation issues;
- ◇ 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 and/or respond to risk situations in any case and long before any outside assistance may come or not. Having experienced damage and loss, they are interested in protecting themselves from climate risks through community based disaster preparedness and mitigation. However, community empowerment towards the use of technologies and viable adaptation practices for better managing climate change risks are essential components for further improvements of livelihood adaptation and enhanced community resilience. The project encouraged local communities to establish their own learning and action platforms to better understand and diagnose social issues that play a catalytic role for mainstreaming and up-scaling of climate risk management and potential adaptation options.

The entry point for discussion with communities was the consensus that a broader range of adaptation options offers value added to the existing coping strategies at the community level. The process of social mobilization appeared as essential and effective to motivate farmers and farmer's groups to collaborate in a more organized way, catalyzing interest and awareness about climate variability and change and their impact on agriculture, as well as to mobilize 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 location specific Social Mobilization (SM) processes at community level. It proposed the formation of a social mobilization group with the purpose to provide an institutional entry point for Social Mobilization at community level. Informal local groups were formed in response by local communities in each pilot site to coordinate local action with the project and implement the adaptation options at community level.

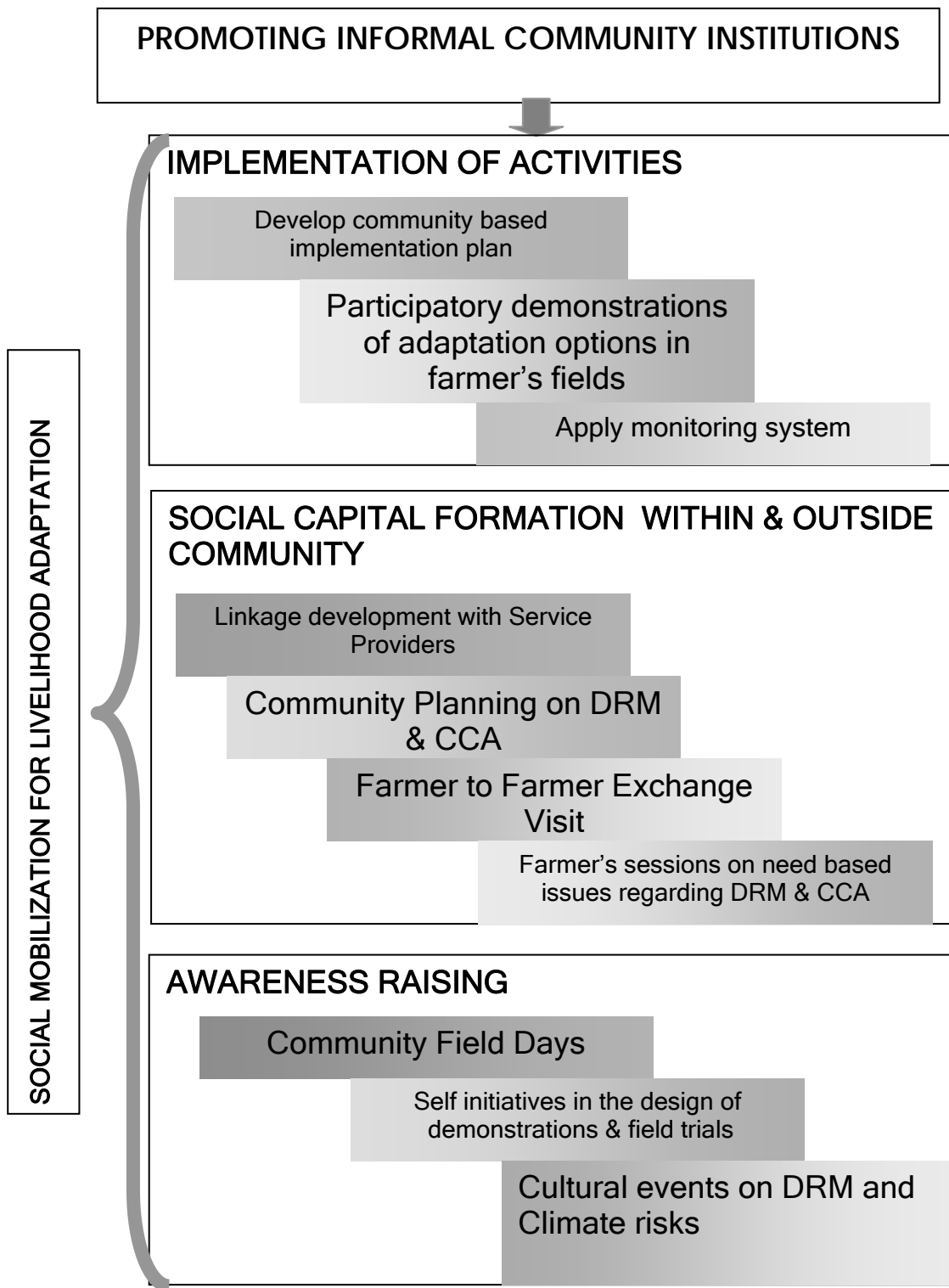


Fig.8 Community level Social Mobilization Strategy (SMS) Framework use by the project

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 Local facilitation Team at village level are School Teacher, Imam, Farmer’s representatives, village level DMC members and union level sub-assistant agriculture officers (SAAOs). During project implementation in some cases the role of the LFT was taken care of by the village committee. In practical terms, the LFTs participated in the process of selecting adaptation options considered useful for their respective village. It is important to highlight in this context that the project promoted the idea that communities, who are the end users of any option, would take decision on any options they preferred to sequentially test at field level through demonstrations. In practice however, it was observed during implementation that the decision making process was often much 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 session organized at local level. The Social Mobilization Framework for improving livelihood adaptation to climate change as applied in the project is presented in Fig.8.

### 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: a) traditional, locally managed responses (e.g. pond excavation, retention of rainwater in canals), b) state supported responses (e.g. deep tube well irrigation) c) 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.

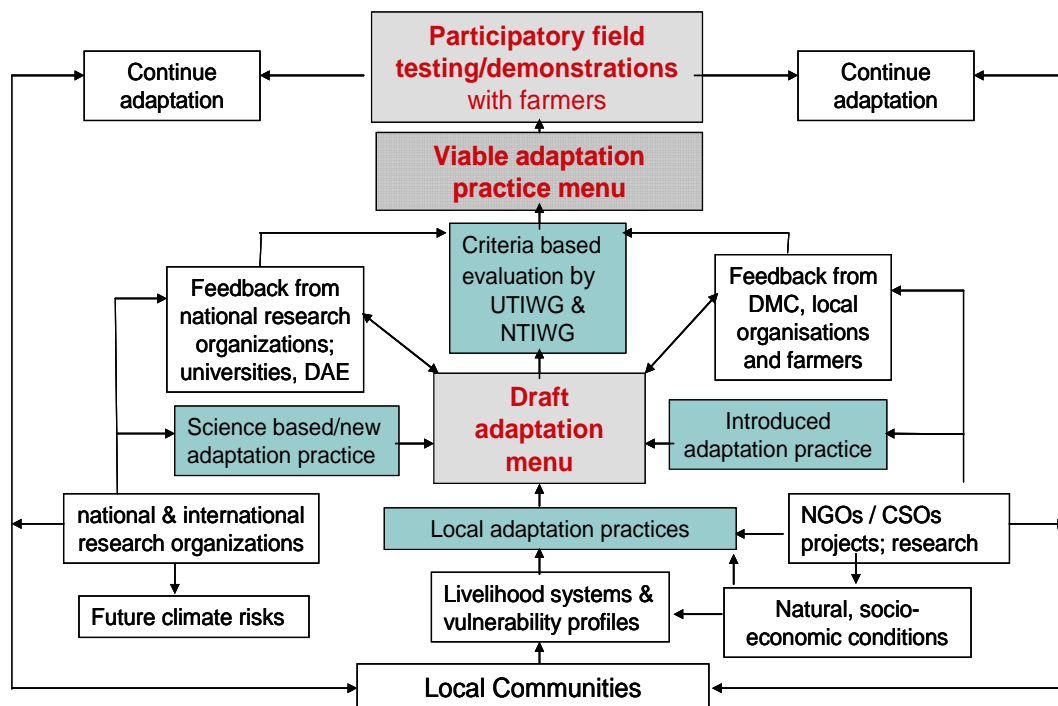


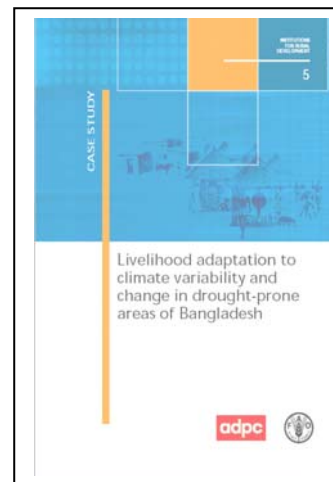
Fig 9. Overall framework and institutional structure describing activities and process of selection, evaluation and prioritization of adaptation practices for drought-prone areas in Bangladesh.

Viable adaptation options were selected through a sequence of evaluation processes (Fig.9) at different levels starting from upazilla-level DMC members, Upazilla level Technical Implementation Groups (UTIWG) and National level Technical Implementation Working

Groups (NTIWG). Consultative meetings and brief feed back 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 UTIWG and NTIWG 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 was prepared. The details of selection criteria and descriptions of the good practice menu are presented in the summary project report entitled “Livelihood adaptation to climate variability and change in drought prone areas of Bangladesh – Developing institutions and options: A case study”. Lists of adaptation practices suitable for different seasons (*kharif I*, *kharif II* and *rabi*) were recommended for field demonstrations (*rabi* 2005, *kharif I*, *kharif II* and *rabi* 2006, *kharif I*, *kharif II* and *rabi* 2007). The list of demonstrations selected after validation were given in Table 1.



[http://www.fao.org/sd/dim\\_pe4/pe4\\_061103\\_en.htm](http://www.fao.org/sd/dim_pe4/pe4_061103_en.htm)

Table 1. Categories of good practices recommended for demonstration after validation

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



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**

With the active participation and involvement of the National level and Upazila level working groups, the existing field based extension approaches and methods were used and enriched with climate risk related information to transform the project concepts into concrete field based action. In the absence of farmers field schools in the project region field 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 institutes and/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.



Orientation meetings



Field days



Folk songs and dramas



Demonstration rally



Awareness raising



Exchange visits

Awareness raising and communication strategies suitable to inform and transfer climate change-related knowledge and interventions were identified through orientation workshops. Farmers and extension workers and local/district level decision makers were key audiences



of this activity. During the course of orientation workshops, volunteer farmers, farmers groups, local task force were identified to collaborate in pilot experiments, ensuring representative participation by women and women's groups.

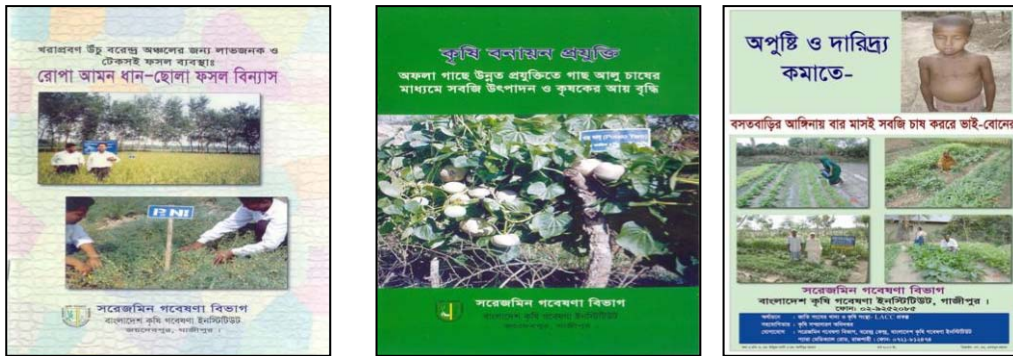


Fig. 10. Publications on viable adaptation practices for awareness rising (Source: BARI, 2006)

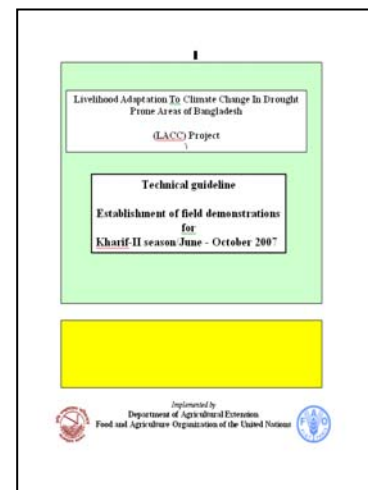
The awareness raising strategies included orientation meetings, field days, folk songs and drama plays, demonstration rallies. Also exchange visits to near by villages were organized by the project team for the local facilitation teams. Leaflets and small information bulletins (Fig.8) were prepared by BARI and disseminated during the field demonstrations.

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

Before each season the technical implementation group at national and upazilla level prepared a list of suitable demonstrations and detailed implementation guidelines for each available option. The guidelines contained step-by-step procedures on each demonstration, materials and resources requirements activity table with responsibility. A monitoring sheet has been prepared in consultation with the upazilla level technical implementation groups. The monitoring sheet consists of details on seasons, name of village, list of farmers, date of start, date of sowing/planting, input use (quantity and timing), schedule of operations, cost of cultivation, 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 Upazilla level technical implementation working groups.



## 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 were selected based on the feedback from the farmers and acceptance rating for these practices was rather very high.

(1) In farmlands with no irrigation source, rainwater harvesting was done through the mini-ponds for supplemental irrigation. Mini-ponds of 5m x 5m x 2m (length x breadth x depth) size was preferred in small farms. However, some farmers proposed to excavate larger ponds (10m x 10m x 2m) as per requirement. Some preferred to have these mini-ponds in a corner of the field. Adequate awareness about the utility of ponds was provided during demonstrations. The method requires limited family labour and non-climatic benefit include opportunity for growing short duration vegetables along the pond.



(2) *Jujubi* (*Ziziphus jujuba*) was considered as a potential option to existing autonomous mango cultivation. Mango plantation is an autonomous adaptation spreading rapidly. However, 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 aggravate *monga* (seasonal famine conditions). Rice is the only crop grown during monsoon season. Food security of the Barind tract depends on the monsoon season rice. Introduction of *Jujubi* offers scope for diversification, risk reduction at the same time crop is high temperature tolerant, offers less shade effect on the rice crop beneath. Hence rice may not be completely replaced by *Jujubi* cultivation.





(3) Dry seed bed for *T. Aman* rice is one of the preferred adaptation options to manage the risk of delayed on-set 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 delays, seedlings will not be available to ensure timely transplanting in July.



Dry seedbed practice with minimal supplemental irrigation helps the farmers to keep the seedlings ready for transplanting immediately after on-set of monsoon rains. This option was suggested by the farmers, but needed some improvement on easy pull out of seedlings with out damage and suitability of the practice for heavy textured soils in the Barind tract. The local research institutions improved the procedure.

(4) Homestead gardening is one of the practices which was already suggested by the Bangladesh Agricultural Research Institute in the early 1980s. However at that stage it was not successful due to non availability of drought resistant vegetables. The current efforts helped to identify the drought resistant vegetable crops involving farmers themselves. This practice ensures year round income, nutritional security, gender involvement. The practice was considered as a better alternative to manage seasonal famine like situations called 'Monga' in north western Bangladesh. Similarly direct sowing and less water rice cultivation has been successfully demonstrated in the farmers' fields. However, the acceptance right now is low as the water availability.



**Box 2. Case study on homestead vegetable production in the Drought Prone High Barind Tract of Bangladesh (BARI, 2007)**

BARI has conducted demonstrations in four different locations viz. 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. A total of 12 households (three household from each location) were selected mostly from small, marginal and landless group of farmers. Round the year, 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 freely distributed to initiate the program and all other inputs and labors were provided by the farmers.



The demonstrations revealed that intake of vegetable by farmers increased to a significant level (on the average 136 g/h/day instead of 40 g/h/day), which helped the farmers to meet the demand of vegetables and to reduce the daily expenditure of vegetable purchase. However, the intake was below the recommended daily vegetable consumption (200g/h/day). The yield of vegetable was reduced in rabi 2006 due to serious water crisis/drought and farmers engagement for T.aman rice harvesting and processing. Several farmers used water from mini-ponds to reduce the impact of drought. Farmers also earned a small amount of cash income from vegetable selling after meeting their daily requirement and free distribution among the relatives and neighbors. From house to house enquiry it was 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 like Kangkong and Batisak (Chinese cabbage) were introduced. These two crops produced good amount of biomass and are considered “water efficient”. For drought prone areas, high water use efficiency is crucial in order to adapt with local conditions. Moreover, locally adapted stem amaranth (Katora danta, taste sweet) was also grown, because it also 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 Upzila of Rajshahi district). It was observed that except land preparation and marketing, most of other works were done by women and children. Thus, it created employment for women, as well as empowerment and 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. Farmers are keeping vegetable seeds for the next year production. However seed production and preservation in high temperature and high humid conditions are a highly technical job, and there is a need for training. In general, quality of seeds 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 back-up research.

**7.3 Interim achievement and results**

More than 225 demonstrations of 15 viable adaptation practices were conducted for 5 seasons (Rabi 2005 to Kharif II 2007) in 4 upazillas of drought prone Barind areas. Among the several adaptation practices, farmers groups considered mini-ponds, growing of Jujubi

(ber), dry seedbed for rice and homestead gardens as the most important adaptation options. In total there were about 36 mini pond demonstrations initiated in four Upazillas, where irrigation facilities through deep tube well was not existent during 2006. The monsoon season during 2006 was a below normal rainfall season 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	<i>Rabi (boro)</i>	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	<i>Karif-II</i>	Moderate	Lack of technical capacity
Improved stove for household use	All	Very high	Fuel and time saving
Cultivation of non-conventional oilseeds	<i>Rabi</i>	Moderate	Pest and disease infestation
Use of compost and organic manures for water conservation	<i>Karif-II</i>	Moderate	Inadequate training and long time required for decomposition
Alternative cereals (eg. Maize)	<i>Kharif-II</i>	High	Drought tolerance and income stabilization
Rain water harvesting	<i>Kharif-II</i>	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.



## 8. LESSONS LEARNED AND CONCLUSIONS

Given the high population density and vulnerability to climate shocks, recent history of famine and past experiences and dependency of agriculture for livelihoods, Bangladesh is further threatened by the impacts of future climate change. Already half of the population live below the upper poverty line (2 122 k cal/day) and a third below the lower poverty line (1 805 kcal/day). Poverty alleviation and ensuring household level food security under changing climate conditions is a major challenge. Ensuring community participation in climate change adaptation, in addition to top down institutional development and policy support is crucial to manage the 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:

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 and or services. Regardless of its underlying causes, climate change is changing disaster risk profiles, environmental and socioeconomic vulnerabilities and 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 is what 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 had helped to identify locally relevant adaptation practices for current and future drought risks, and this project demonstrated their availability for possible replication under changing climatic conditions in the future.

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 climate impacts in the future and particularly not at local scale, the project suggests that the intermediate goal of climate change adaptation programmes should be to empower communities to be able to adapt well given the impacts on 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 transfer, innovations and development pathways. This process of adaptation needs to explicitly address 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 need 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,<sup>4</sup> is at best a partial solution to climate change and 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

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<sup>4</sup> Example: *We successfully tested water savings technologies in irrigated rice production. 20 % water savings, same yields. But Farmers tell us they are not going to adopt these practices at present, because water supply for irrigation depends on electricity and there are too frequent electricity failures. The risk for them to loose the crop with less time flexibility for watering - which the techniques imply- is too high. It shows that our improved AG technologies **alone** are not sufficient*

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 anticipated risks expected by climate change. Short-term and long-term adaptive measures in agriculture, linked with clear focus on possible future risks, must be integrated into cross sectoral planning including:

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

Adaptation to climate change is a location specific issue. There will be no “one fits all” solutions at local level. Decentralized ways of working are needed, within the framework of coherent national policies. Project demonstrations such as mini-ponds show that it is a good adaptation practice for a farmer who is operating on a clayey soil, but not suitable for a farmer who is operating on a sandy soil. Specific attention is required to develop location specific adaptation options to manage future anticipated risks considering bio-physical, socio-economic and socio-cultural factors.

Institutional capacity building and organisational networking with clear definitions of roles and responsibilities are essential: In order to make adaptation work, institutional capacity building and strengthening of organizational networks across all levels and sectors is a basic precondition. Since adaptation (to climate change) is a new field of work, the institutional responsibilities are not yet well defined. When doing so, there will be the need to carefully integrate top-down and bottom-up perspectives and capacities, and to establish ‘functional coordination’ mechanisms between various agency activities, planning, communication, and operations at field level. Furthermore, it will be crucial to better link and factor-in adaptation to other on-going development activities, and to determine clear roles, who should do what in order to make community based adaptation effective. The experiences clearly showed that provision of a comprehensive approach with concrete roles for action is necessary to motivate change in local perceptions and ensuring meaningful interventions through local service providers including government institutions. The project implementation process showed that a lot can actually be achieved if we get the full buy in, and can work through the 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 from the household to the national level and in all spheres, from private to public, determine access to assets, livelihood strategies and vulnerability to climate change. To add climate change adaptation through a livelihood perspective helped

improving the adaptive capacity of farmers by increasing household access to assets and services. The creation of broad awareness of climate variability at grassroots level, through government and non-governmental interventions and the 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, as well as dissemination of all awareness messages in local language need to become an integral part of the livelihood adaptation process. The livelihood perspective was strengthened by the initial scoping studies and the better 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 we can reach pretty far in terms of awareness raising and capacity building for adaptation, if we would succeed first of all in doing better what we already know about sustainable natural resource management and agricultural development. There is already wealth of knowledge on sustainable technologies and innovative methods of technology transfer to manage current risks. Tuning these risk management techniques towards future anticipated risks could address the future risks to a significant extent. By taking this first step we can gain a time window urgently needed to get better. Locally down-scaled predictions of climate change impacts and new location specific adaptation options will 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 practical learning and action research and development platforms to jointly develop and replicate with farmers, Departments of Agriculture and international and national research institutions innovative adaptive technologies. Emphasis should be given on demand driven, interactive research based on mutual learning between farmers such as through farmers field schools. project helped to identify the current weaknesses in the institutional set-up, networking and information sharing. The weaknesses had been partially addressed through strengthening existing institution's technical capacity and by promoting new structural coordination and collaboration mechanisms..

There is a need to monitor ongoing adaptation practices, alert on risks of mal-adaptation, and establish links with policy making. Farmers do take action anyway on their own if they can, irrespective of external interventions. It was observed in North West Bangladesh that many land owners started planting Mango trees in their rice fields, mainly for economic gain but also because the mango is well adapted to the increasingly dry conditions . This autonomous adaptation is taking place in an unplanned and uncoordinated manner. However, this is likely to have a negative impact due to shading on the rice crop underneath in 2-3 years time. Once the land is not suitable for rice production, local food production and availability will then go down, the landless laborers will lose their work. This may lead to internal migration in search of employment, which is considered very critical in densely populated areas and towns like they exist in Bangladesh. The project tried to present with *Jujubi* and alternative crop to mango, which would not cause the same loss of rice. In general terms however, it is required to start thinking about such developments and need to give answers to questions such as if we can leave adaptation uncontrolled to the market or should governments be more actively involved in analyzing, testing and promoting good adaptation options, with incentives and regulatory frameworks as necessary to prevent mal adaptations?

Assess the value of indigenous knowledge in the context of managing future risks: There are a lot of valuable local practices and indigenous knowledge among the farmers on drought risk management, but it is necessary to assess the real value of these practices in the context of managing future risks. It is required to better assess and promote their



dissemination and integrate them with value added knowledge which may not be locally available. The project-based experience related to involvement of the local research institutions has provided insight into the whole range of issues related to adaptation to drought and designing management alternatives. There are many “domains” like land use planning, watershed management, plant production, farming systems research, developing drought tolerant varieties and small scale water harvesting practices already in place. It is a good entry point to put the existing knowledge about climate risks and working approaches into the new context of climate change adaptation.

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 improve the adaptive capacity of community in general and farmers in particular. Precise documentation and monitoring of all coping and adaptation strategies followed by farmers is necessary to provide a basis for the future.

Adaptation practices related to crop diversification and income generation are preferred at community level: The results of field demonstrations confirmed that farmers’ acceptance of alternative crop diversification (Mango and Ber) and income generation practices (fruit tree nurseries and homestead gardening) are very high. Similarly, acceptance of drought tolerant rice and pulse production was high due to a higher income level and crop intensification. Water saving rice cultivation was less preferred by farmers in areas where irrigation water was supplied through deep tube wells – requires awareness rising efforts and policy interventions on pricing of water in the future. Adoption of dry seed bed and compost was moderate as adoption of these practices requires substantial training at community level. Adaptation practices involving community actions like mini-nursery 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: The vulnerable agricultural systems are facing huge environmental and social challenges, in view of potentially harmful effects of climate change. Corporate Social Responsibility (CSR) is a new concept in NW Bangladesh whereby organisations including private entrepreneurs are taking responsibility vis a vis the society for the impacts of their activities on communities and the environment. This obligation is perceived to go beyond the statutory obligation to comply with legislation. Organizations are voluntarily taking further steps to improve livelihood assets of their local community and society at large. During the initial project phase, the private entrepreneurs were engaged in the process of developing adaptation practices that increase resilience against impacts of climate change and maximise 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 Department of Agricultural Extension (DAE), local research institutes and private seed/seedling producers.

**ANNEX 1. SUMMARY OF FIELD DEMONSTRATIONS 2005/2007**

**District: Chapai Nawabganj; Upazilla: Gomestapur**

Name of the demonstration	Name of the villages	Seasons	Number of demonstrations	Net adaptation benefit over existing practice	Farmers acceptance	Remarks/feedback
Water saving rice cultivation	Parasadpur	Rabi 2005	2	- Net profit of 102% compared to existing practice - Water saving to an extent of 40% compared to flooding	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	Kharif – 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 tradition 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				
Dry seedbed nursery for T. Aman rice	Malpur	Kharif – I 2006	3			
	Borodapur	Kharif – I 2006	6			
Short duration T. Aman rice (Block demonstration)	Malpur	Kharif – II 2006	3			
	Borodadpur	Kharif – II 2006	3			
Short duration chickpea cultivation	Malpur	Rabi 2006	7			
	Borodadpur	Rabi 2006	3			
Short duration linseed cultivation	Malpur	Rabi 2006	3		Moderate	Pest infestation reduced the yield and requires additional investment
	Borodadpur	Rabi 2006	1			
Drought resistant maize	Parasadpur	Rabi 2006	3	Drought tolerant	High	High yielder but water stagnation

cultivation				compared		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			
FYM preparation	Parasadpur	Kharif – I 2007	2			
	Malpur	Kharif – I 2007	2			
	Borodapur	Kharif – I 2007	2			
Mini Nursery for sapling production	Parasadpur	Kharif – I 2007	3			
	Malpur	Kharif – I 2007	1			
	Borodapur	Kharif – I 2007	2			
Mango orchard management	Parasadpur	Kharif – I 2007	3		Very 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		
	Malpur	Kharif – I 2007	2			
	Borodapur	Kharif – I 2007	2			

Summary of field demonstrations

District: Chapai Nawabganj; Upazilla: Nachole

Name of the demonstration	Name of the villages	Seasons	Number of demonstrations	Net adaptation benefit over existing practice	Farmers 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 upto 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	- Investment cost of Taka.9000 is required - The crop is able to withstand drought conditions & leaves opportunity for intercropping with rice - An 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
Mini pond excavation and supplemental irrigation for T. aman rice		Kharif – II 2006	4	- An investment cost of Taka. 3425 is required - 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
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	Very 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	<ul style="list-style-type: none"> <li>- Crop diversification with Maize reduces the impact of drought</li> <li>- Net profit of Taka.5900/bigha was achieved</li> </ul>	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	<ul style="list-style-type: none"> <li>- Additional net profit of Taka.200/bigha was achieved</li> </ul>	Moderate	The profit is very low
Crop intensification with Chickpea		Rabi 2006	8	<ul style="list-style-type: none"> <li>- Additional net profit of Taka.3350/Bigha was achieved</li> </ul>	Very high	Very well accepted by the farmers, but recommended to supply drought tolerant varieties
Homestead vegetable gardens		Kharif – I 2007	6	<ul style="list-style-type: none"> <li>- Year around income generation at household level</li> </ul>	Very 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	<ul style="list-style-type: none"> <li>- Cost of cultivation of Taka.15000 is required for 1000 m<sup>2</sup></li> <li>- Additional income to the farmers during dry years</li> </ul>	Very 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	<ul style="list-style-type: none"> <li>- The practice improves soil fertility status and water holding capacity</li> </ul>	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	<ul style="list-style-type: none"> <li>- 30% fuel and 35% time saving</li> <li>- Improves the energy use efficiency and reduces health hazards to the women and children</li> </ul>	Very high	An investment of Taka.800 is required per stove
Papaya cultivation		Kharif – I 2007	4	<ul style="list-style-type: none"> <li>- Additional income and nutritional contribution</li> </ul>	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

Summary of field demonstrations

District: Naogaon; Upazilla: Sapahar

Name of the demonstration	Name of the villages	Seasons	Number of demonstrations	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 <sup>2</sup> 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
	Basuldanga	Kharif – I 2007	2	- Additional income generation of Taka. 20330 from 400 m <sup>2</sup> area	Very high	-
	Chachahar	Kharif – I 2007	2	- Additional income of Taka 21705 from 400 m <sup>2</sup> area	Very high	Availability of required saplings locally
Mango orchard management	Bahapur	Kharif – I 2007	2	- Reduced impact of drought in Mango compared to rice	Very 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	High to very high	Initial investment cost of Taka.2900 for 20 trees is required.
	Chachahar	Kharif – I 2007	2	- Drought tolerance compared to rice	High to very high	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	-	Very high	
	Chachahar	Kharif – I 2007	2	-	Very high	

Homestead gardening	Bahapur	Kharif – I 2007	2	-		
	Basuldanga	Kharif – I 2007	2	-		
	Chachahar	Kharif – I 2007	2	-		
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	Very high	
	Chachahar	Kharif – I 2007	2	- Used for subsequent Rabi season for high yielding boro crop	Very high	
Papaya cultivation to manage drought	Bahapur	Kharif – I 2007	2	-		
	Basuldanga	Kharif – I 2007	2	-		
	Chachahar	Kharif – I 2007	2	-		

### Summary of field demonstrations

**District: Naogaon; Upazilla: Porsha**

Name of the demonstration	Name of the villages	Seasons	Number of demonstrations	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 <sup>2</sup> 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
	Saharandha	Kharif – I 2007	2	-	Very high	-
	Chhaor	Kharif – I 2007	3	-	Very high	Availability of required saplings locally
Mango orchard management	Shavapur	Kharif – I 2007	2	- Reduced impact of drought in Mango compared to rice	Very high	Autonomous adaptation and replication takes place every season. Cost of cultivation was Taka 2023 for 20 trees (includes pit, planting and establishment)

	Saharandha	Kharif – I 2007	2	- Reduced impact due to drought	High to very high	Initial investment cost of Taka.2900 for 20 trees is required.
	Chhaor	Kharif – I 2007	2	- Drought tolerance compared to rice	High to very high	Initial investment cost of Taka 2880 is required.
Improved stove	Shavapur	Kharif – I 2007	2	- Saving of fuel (30%) and time (35%) - Improved energy use efficiency	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	- Six members family require 6 kg of fuel wood. Introduction of improved stove could save 2 kg of fuel every day.	Very high	
	Chhaor	Kharif – I 2007	2	-	Very high	
Homestead gardening	Shavapur	Kharif – I 2007	2	- Each farmer could harvest vegetables worth of Taka.715 and return would be for every month	Very high	Households need not purchase vegetables from the local market
	Saharandha	Kharif – I 2007	2	-		
	Chhaor	Kharif – I 2007	2	-		
Double chambered FYM preparation	Shavapur	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.
	Saharandha	Kharif – I 2007	2	- Used for subsequent Rabi season for high yielding boro crop	Very high	
	Chhaor	Kharif – I 2007	2	- Used for subsequent Rabi season for high yielding boro crop	Very high	
Papaya cultivation to manage drought	Shavapur	Kharif – I 2007	2	-	Moderate	Papaya production was not satisfactory in all the pilot villages
	Saharandha	Kharif – I 2007	1	-	Moderate	
	Chhaor	Kharif – I 2007	2	-	Moderate	