Adaptive Crop Agriculture Including Innovative Farming Practices in Haor Basin

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Climate Change Cell
Department of Environment

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Foreword

The impacts of global warming and climate change are worldwide. For Bangladesh they are most critical because of its geographical location, high population density, high levels of poverty, and the reliance of many livelihoods on climate-sensitive sectors, such as agriculture, fisheries.

To address current impacts and manage future risks of climate change and variability towards development of a climate resilient Bangladesh, the government has established the Climate Change Cell (CCC) in the Department of Environment (DoE) under the Comprehensive Disaster Management Programme (CDMP). Climate change research, covering modeling and adaptation is one of the major activities of the Cell.

CCC in association with its Technical Advisory Group (TAG) and other stakeholders identified a set of research activities related to climate change in Bangladesh through a number of consultations. The activities have been prioritized and a number of projects have been commissioned in last few years.

Cell is facilitating adaptation research in order to, fill knowledge gaps in the arena of adaptation to climate change and its impacts on the life and livelihoods; explore options to adapt with the climate change; and contribute in better understanding of adaptation options. In this regard, a number of projects have been commissioned in the field of Crop agriculture, Crop insurance, Health, Gender and disadvantaged groups.

Flashflood is the major threat to thousands of rice farmers in the haor region over the years. Due to climate variability and change, increased precipitation early in the season make flashfloods more unpredictable and damaging, affecting livelihoods and food security of thousands of haor residents.

The study tested and demonstrated various rice crop and non-rice crops at the farmers' fields with encouraging results. Two varieties of winter rice (BR 29 with improved management of seedlings and BRRI dhan 45) with higher yields attained maturity by end of first week of April have high potential to avoid flashflood risks. Over a dozen of vegetables and spice crops performed satisfactorily and proved highly profitable which could be harvested at least a month before the current timing of flashfloods.

It is expected that the research will create a strong link between agriculture researchers and other stakeholders to share research results and needs. Dissemination of the study findings and replication and expansion of such initiatives at different locations of the haor basin will explore options to combat climate change impacts. Findings of such studies will facilitate policy makers and planners to formulate viable adaptation policies, strategies and action plan.

Zafar Ahmed Khan, PhD
Director General
Department of Environment

Acronyms and Abbreviations

ARAC	Adaptation Research Advisory Committee
BARC	Bangladesh Agricultural Research Council
BARI	Bangladesh Agricultural Research Institute
BAU	Bangladesh Agriculture University
BBS	Bangladesh Bureau of Statistics
BMD	Bangladesh Meteorological Department
BRRI	Bangladesh Rice Research Institute
CBRMP	Community Based Resource Management Project (of LGED)
CCC	Climate Change Cell
CDMP	Comprehensive Disaster Management Programme
CNRS	Center for Natural Resource Studies
CRA	Community Risk Assessment
DAE	Department of Agriculture Extension
DoE	Department of Environment
DFID	Department for International Development
FAO	Food and Agricultural Organization (of the United Nations)
FGD	Focus Group Discussion
GoB	Government of Bangladesh
HYV	High Yielding Variety
IPCC	Intergovernmental Panel on Climate Change
LEAF	Livelihood Empowerment and Agro-Forestry project
PLUS	Participatory Land Use Survey
UNDP	United Nations Development Programme

Table of Contents

List of Tables

List of figures

Executive Summary

The low lying northeastern basin of Bangladesh covers around 6,000 sq. km is subject to deep monsoon flooding supporting rich fisheries while drier winter yielding a bumper rice crop. While flooding enhances floodplain fisheries, the early flashfloods, unique to this region, caused due to sudden onrush of rainwater from adjacent Indian Hills poses a high risk of damage to the standing winter rice crop just 2/3 weeks before harvesting. Flashflood remains as the major climate risks to thousands of rice farmers in the region over years. Data reveal that rainfalls in Meghalaya, India have increase in March-April that intensifies the severity of flashfloods. Creating submergible dykes to delay or divert the entry of flashflood water into the crop fields is the only adaptation response from the government. However, there are incidents of failure of dykes almost every year and consequent losses of winter rice, the only crop in this vast basin covering 97% of the total cropped area. In 2003 over 80% of rice amounting to 0.6 million tons was completely damaged due to flashfloods.

Due to climate variability and change, increased precipitation early in the season, making flashfloods more unpredictable and damaging. Generally occurs during March-April that corresponds to peak rice harvesting time, the timing of flashfloods, in recent years, is changing, visiting earlier than usual, making the farmers more exposed to the impacts of extreme weather events affecting livelihoods and food security.

With support of the Climate Change Cell and in collaboration with Bangladesh Rice Research Institute and Bangladesh Agriculture Research Institute, adaptive cropping has been tested at the farmers' fields demonstrated encouraging results. Two varieties of winter rice with higher yields attained maturity by end of first week of April have high potential to avoid flashflood risks. Over a dozen of vegetables and spice crops performed satisfactorily and proved highly profitable compared to rice harvested at least a month before the current timing of flashfloods. Research findings have opened up avenues for the farmers to adapt to the risks of flashfloods. However, more social and institutional work is needed to sensitize farmers to make a shift from their traditional preference over rice to other non-rice crops as well as for an enabling institutional mechanism that could facilitate extension of adaptive cropping to wider communities in Bangladesh exposed to flashflood hazards.

1. Introduction

The northeastern part of Bangladesh has a unique landscape, where natural pattern of flooding has created very productive fisheries in the wet season, and allowed rice to grow in the dry season. The productivity of this wetland (Haor) has contributed to be food surplus of this region, and there is a potentiality for further increases of land for agriculture. However, change of flood timing and pattern is probably one of the main reasons for changing local ecosystem and the livelihood of the local people. In Sunamgangj district, flashflood causes crop damage which is considered as a big threat to the people, especially who work as sharecroppers or landless laborers. Sometimes, the flashflood comes early, just before the rice harvesting and during that time the people of haor basin, do not even get the time to harvest their crops. In many cases, it has been found that this part of Bangladesh losses 100% of its crops.

Threats to local livelihoods are not solely confined to wet season catastrophes. During the dry season, the water-covered area is reduced by significant amount and turns individual small water bodies called beels and kuas as well as lakes and canals. These separated water bodies are vital for breeding and maintaining stocks of fish.

The Haor Basin is close to the Indian border and Meghalaya Hills where deforestation (natural & manmade) is happening everyday. Other climatic changes have also contributed in degrading the eco-system that causes severity of flash floods in the haor areas. Rainfalls in Megahalaya have increased in the recent years compared to 30 years back. This has an impact over the early flashflood in Jamalganj area. This report is to identify the major problems for the local people and also to find out a way to increase the options of their livelihood.

Upstream communities also contribute pollution loads in the basin, re-vegetating local areas have been critical to protect them. Trans-boundary issues to be addressed for better watershed management. The biodiversity will benefit establishing conservation areas to protect the threatened species.

1.1 Background

The hydrological regime of the haor basin has changed over years. Various factors are responsible for such changes; deforestation in both haor basin and in upstream of Meghalaya Hills in India is certainly one of the prime reasons in this regard. Changes of other climatic parameters may have contributed in the change of hydrological regime of the haor areas. The flash flood generally occurs after mid April due to heavy rainfall in the hills of Meghalaya, India. In recent years, flashflood hit Sunamganj district and other haor areas fifteen days earlier than thirty to forty years back. Thirty years before, flashflood used to hit border areas of Sunamganj and took three-five days to reach Tahirpur and seven-fifteen days to reach the haor of Jamalganj Upazilla while in the present situation, it takes one day and 3-5 days respectively (source: previous study of CNRS). Forest in the hilly areas and haor basin used to slow down the flow of water, and more water were seeped into local soils for storage. Now due to deforestation in Indian hills and haor basin flash flood hits Jamalganj ten to fifteen days earlier. Siltation in rivers, canals, and haors has raised the haor and riverbeds. As a result, the rivers and canals cannot hold much water, and severity of flood intensifies. Rivers also are unable to drain much water to Meghna river system. On the other hand, local farmer switched to cultivate HYV rice (BR 29) from local boro rice variety. BR 29 takes about 30

days more time to harvest compared to the local boro variety. The haor is a single crop area and the change of climate and agriculture practice results in damage of crop each and every year. To cope with this climate change situation, farmers need to adapt with the new technology and new variety of short duration rice and other winter/rabi crops for saving their crops from flash flood.

The main effect of the changed hydrological regime in haor agriculture is that farmers get ten to fifteen days less for cultivation than thirty years ago, again the high yielding rice varieties cultivated at present are of longer duration compared to the local varieties, predominantly cultivated earlier. To cope with the changed hydrological regime, farmers need to adapt diversified cropping pattern and new technologies. Adapt short duration rice variety for saving their only one crop from flash flood. The constrains of boro rice cultivation and important characteristics of rice varieties viz. short growth duration, relatively tall, lodging tolerance and non-shattering habits need to be identified. Another coping strategy could be cultivation of tall Aman variety or vegetable on floating beds (Baira) near the villages. There are many other cereals, vegetables, spices, pulses and tuber crops which could be cultivated successfully during rabi season in the haor basin and harvested much earlier than boro rice to avoid flash flood. Cropping on floating beds (Baira) is found potential to create opportunity of double cropping in a single year, which would increase the livelihood opportunity for farmers in haor areas. In a pilot form, the project activities have been implemented in Pagner Haor in Jamalganj Upazilla under Sunamganj District, one of the pilot districts of the Comprehensive Disaster Management Program (CDMP). Almost every crop losing farmers are found very enthusiastic by the successful demonstration and they would replicate the result of the field test.

The farmers of the above mentioned areas are in need of alternative cropping patterns to intensify crops and cropping in the region. Potential technologies identified have not been proven yet under the special biophysical and socio-economic environment of the project area. Therefore, these technologies have been tested under this research project through on farm research trials with the active participation of local farmers. This adaptive research was carried out with the assistance of BRRI and BARI. BRRI and BARI have the technical expertise and the project had adequate number of skilled manpower that strengthened implementation of research project for introducing rabi crops in the existing Rice-Fallow or Rice-Vegetables-Fallow cropping patterns. BRRI supported for introducing trials of some new varieties of winter rice which were short duration in character compared to the variety BR-29- which has been found very popular in the haor areas. BR-29 needs about 165 days from growing to harvesting which is usually treated as long duration variety and eventually damaged by the flash floods. Therefore, BRRI and BARI played a very important role in research by introduction of varieties of rabi crops (oilseeds, pulses, maize, wheat, vegetables etc) and short duration of rice varieties. It is anticipated that findings of this research activity would benefit the people of the project areas as well as the country as a whole through increased crop production.

1.2 Research Objectives

The overall objective of the research Project was to equip farmers in the haor regions (throw testing and demonstration) with appropriate rice varieties, other alternative crops and

agricultural technologies to achieve sustainability of their livelihood opportunities from adverse climate change situations.

- To test and demonstrate new crops variety, which have the potentials to help farmers to adapt climate change;
- To improve the livelihood of the people of haor basin by introducing short duration boro variety and hence protect the only crop from flash flood;
- Utilize the fallow land and increasing cropping intensity in comparatively high land.

1.3 Scope of Work

There are many scopes and opportunities to work, which can change the livelihood of the haor people in a positive way. Global warming has its impacts on the weather including the project area and probably that is why, climate change has impacted adversely in the haor area and intensifying severity of flash floods significantly in last few years. The pattern of rainfall, flash flood, drought etc. has changed in a noticeable way. For example, in recent years, flashflood hits Sunamganj District and other haor areas about fifteen days earlier than it used to do thirty to forty years before.

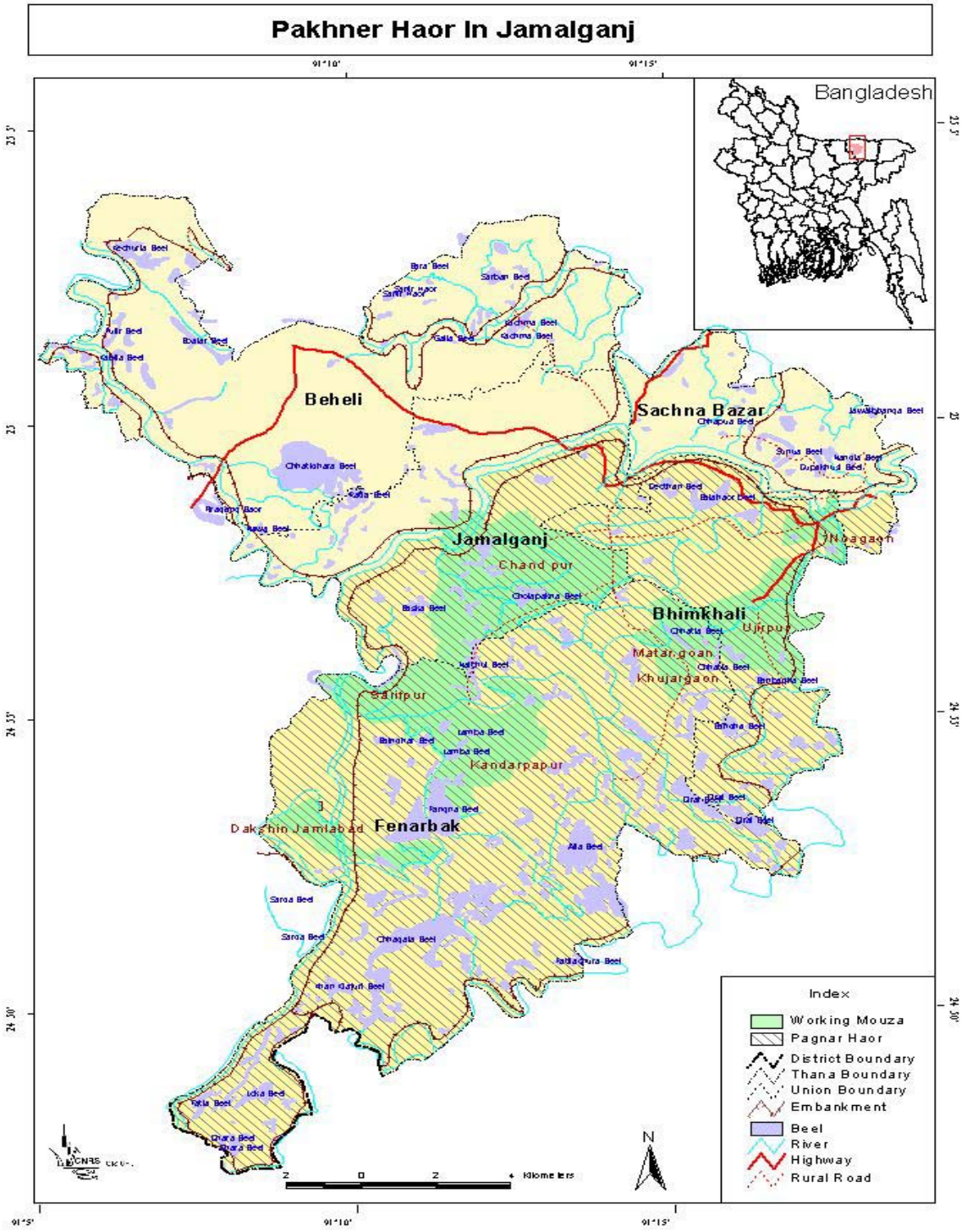
This flashflood damages the boro rice (only crop in haor basin) just before the harvesting time of the crop. It even does harm tremendously to the economy and livelihood of the region. To change the situation of locality's livelihood, the boro rice needs to be protected from the flashflood. Present practice of farmer's is to grow BR 29 HYV rice. It is a long duration rice variety highly susceptible to damage by flash floods. The research has targeted to identify either a short duration but high yielding rice variety or any suitable alternative crop which is found suitable in the context of economically viable and can address issues of climatic changes.

Another area of this region needs great attention. In the haor areas, there is land (10-40% of the haor area varies from haor to haor) which is comparatively higher and is usually fallow (locally know as *Kanda*). These lands are prospective for crop diversification and with many possible potentiality of crop intensification. Research suggests that an alternative Rabi Crop can be grown here, for example – pulses, oil seeds, cereals and vegetables etc. Moreover, there is also a great opportunity of increasing the yield of rice in haor region.

Lot of lands in haor areas remain inundated during winter season. And during wet season, the whole haor area remains inundated for about six months. Therefore, agriculture on the floating garden has been treated as a good and potential area of research.

2. Research Site

This project was implemented at *Pagner* haor in Jamalganj Upazila under Sunamganj District. The area covers 7 villages of 3 unions of the district. The villages are Fenarbak, Kandagoan, Mahmudpur, Gongadhorpur, Soyhara, Sonapur and Rajapur. Project villages are located in the map below:



3. Research Methodology

3.1 Mobilization of the research team

Agriculture graduates were employed at both the Headquarters and field levels to run the research activities smoothly. Both of the groups have working experience in the field of Agricultural research. Other staffs were also recruited according to the need.

CNRS has an office set up at Jamalganj under the District of Sunamganj since 1997. The Research Officer was provided with an office space within the CNRS set up and he started his activities at the field level. The Agriculturist attached to the HQ paid frequent visits to the project areas and maintained liaison with BRRI, BARI, DAE, CBRMP, CNRS-LEAF and other relevant projects, institutions and organizations.

Research team conducted a CRA at first in order to identify and analyze the risks of the project sites (A separate document: Community Risk Assessment, CRA). The team has facilitated a participatory land use survey (PLUS) in the project area to know about the land use pattern of the haor areas (Another separate document: Participatory Land Use Survey, PLUS).

3.2 Set up the modalities with other organizations

Research project has been conducted at Jamalganj under Sunamganj district. To run the project smoothly CNRS made collaborations with some other organizations namely BARI, BRRI, DAE, CBRMP and CNRS-LEAF and signed a MOU with the institutions.

BARI: CNRS worked with BARI from the beginning of the project and a MoA between CNRS and BARI was signed on 18 December 2006.

BRRI: CNRS worked with BRRI Habiganj regional station under MOA of CNRS-LEAF project.

CNRS-LEAF/IC: CNRS worked very closely with LEAF/IC (Livelihood Empowerment and Agroforestry Project, funded by SDC) and signed an internal MoA.

DAE, CBRMP: CNRS developed functional relationship with the DAE and CBRMP (community based resource Management Project of LGED) to share ideas and to disseminate the findings among greater audience.

3.3 Climate risk assessment

A climate risk assessment (CRA) activity was carried out in the targeted communities of Jamalganj upazila. The process of CRA followed participatory approach and came up with a climate risk reduction action plan. The process included the following activities viz. collection of general information on socio-economic, demographic, physical parameter by union. Project team facilitated participatory workshop and group exercises and came up with hazard census, hazard calendar, livelihood calendar, risk analysis, ranking of hazards in the context of risks, prepared risk reduction action plan, prioritized the interventions, impact analysis of interventions and identification of ongoing risk reduction activities. Based on the plan, implementation of adaptive cropping to address flashfloods has been taken care of under this research. A separate document on CRA has been produced.

3.4 Participatory Land Use Survey (PLUS)

Participatory land use survey was undertaken to identify the existing land use pattern of the haor areas. The survey was conducted on the basis of mouza as a primary unit and use of all plots of the mouza was identified. PLUS was conducted in five mouzas in Jamalganj upazila which are Kandarbapur, Gongadharpu, Chhoyhara, Latifpur and Chanpur Survey information revealed that about half of the mouzas are not under cultivation. Haor dwellers are mainly dependent on surface water for their winter rice and kanda land (a bit raised land) are found not suit`able for rice cultivation (due to irrigation problem) remain fallow. As per the land use survey, about 20% of total lands are kanda which remain fallow or used for grazing land, seed bed, play ground and crop processing area. Study reveals that 53% of total mouza areas are not used for agriculture purposes. A separate document on PLUS has been produced.

3.5 Farmer Selection

Four types of farmers were involved in this project for pilot demonstration. They were, land less farmer (sharecropper), marginal, medium and rich farmer. CNRS selected 37 farmers from seven villages. Farmers were selected based on the following criteria:

- Must be an advanced farmer;
- Able to understand new technology easily;
- Long experience in crop production;
- Able to understand adverse effect of climate change on crop production;
- Inventive.

3.6 Land Selection

Four types of land were considered for demonstration, namely - homestead and adjacent, comparative high (*kanda*,) comparative low (*kanda*,) and haor basin (low lying areas for rice cultivation). Forty-seven plots were selected in different areas; average plot size was 4.7 decimals. The plot size ranges from 2 to 12 decimals and modal of size of the plots was 5 decimal.

The criteria followed in land selection are:

- Alleviation of the land
- Water availability of the land
- Distance from road.
- Previous usage of the land.
- Texture of the land

3.7 Crop Selection

Seventeen types of crops under five broader categories were selected for the research:

1. Cereal crop (Rice),
2. Pulse crop (Mugh Bean, Lentil),
3. Oil seed (Mustard),
4. Vegetables (Radish, Spinach, French bean, Garden Pea, Sweet guard, Red Amaranth, Steam Amaranth, Bitter gourd, Potato, Ash gourd, Ariod),
5. Spices (Onion, Garlic).

Criteria followed for selection of the crops are:

- Performance (both vegetative growth and yield) of the crops in previous years;
- Following the BARI and BRRI recommendation;
- Sharing experience of crop production with other related organizations, who are working in the haor areas;
- Using previous working experience of CNRS.

3.8 Data Collection Method

Following methods were adopted for data collection

- Survey (survey tools, land and farmer selection, crop selection)
- FGD (finalizing the farming modalities, crop selection in a group discussion)
- Recall method (previous data)
- Monitoring (monitoring format, observation)

3.9 Data analysis

All the data presented in the report were processed. In case of plant growth (height, tiller number, panicle length etc), 10 plants were selected randomly from each plot at a certain interval. Data were collected and analyzed from these plants and the mean of those 10 records has been presented in the report.

Soil sampling and soil analysis

The soil samples were collected randomly from 15 different spots of each research area at a depth of 0-15 cm. Fragmented stones and weeds were removed from the samples. The samples were mixed together. The samples were then air-dried, grinded and sieved. Soils were kept in polythene bags and sent to SRDI for laboratory analysis. The organic matter pH, N, P, K and S were analyzed and estimated from the soil sample.

4. Results and discussion

4.1 Technical aspect

The research related activities were started from July 2006 and completed in June 2007. During this period several information and data were collected in a regular interval. Performance and adaptability of each of the crops are discussed in the following sections.

4.1.1 Cereal crops (Rice)

Rice is the main crop of the haor basin which is cultivated widely by the local farmers. A previous study revealed almost 90% of the land used for rice cultivation (CNRS study in 2001). Crops (especially rice) damaged by the Flash flood is the main climate change related challenge in the haor area. As a result, adaptation of new short duration variety rice was found very important for ensuring livelihood of the people of this area. For testing the rice verities, low lands were selected where medium farmers used to cultivate rice (detail in Annex A). Six different rice varieties were tested, among those there were some new varieties (e.g. CH 45, BRRI Dhan 45 which are not yet been released by BRRI as variety) were tested with some old and popular HYVs. Different methods of cultivation were followed for some popular varieties to reduce duration of life span.

Duration

Performance of the verities was found excellent in all the stages of life cycle and vegetative growth was up to the mark. Germination of all the varieties of rice was quite excellent. Average yield was very high than the national average yield. BRRI dhan 45 requires minimum time to cultivate and found highly suitable for haor areas in the context of addressing flash floods and economic feasibility. It was found that a short duration winter rice variety need about 25 days less compared to the popular BR 29 (traditional practice) variety and can be harvested end of March, before visiting flash floods in the haor.

BRRI dhan 29 (new technology) is a long duration variety, and most popular in haor region. Its life duration has been manipulated by crop management and resulted reduction of about 15-20 days.

Table 1: Lifespan of different rice variety

Plot No.	Date of Sowing	Date of transplanting	Date of harvesting	Lifespan (days)
BRRI dhan 28	18 .11.06	25.12.07	15.04.07	147
BRRI dhan 45	**22 .11.06**	**25.12.07**	**10.04.07**	**139**
CH 45	18 .11.06	25.12.07	12.04.07	145
Hobiganj boro 6	18 .11.06	25.12.07	18.04.07	151
BRRI dhan 29 (traditional practice)	18.11.06	24.12.07	30.04.07	163
BRRI dhan 29 (with new management/technology)	**04.12.06**	**24.12.07**	**30.04.07**	**149**

However, harvesting (in winter season, November 2006 to March 2007) of rice (all varieties) was delayed by 10-5 days due to cold injury. In normal weather condition, harvesting dates can be reduced about 2 weeks. Keeping this in mind, this can be assumed that if farmers are able to maintain proper seeding time, they can harvest some of the recommended rice

varieties before flash flood. It is worthwhile to mention here that this kind of action research needs a continuation for at least three to four years to have a generic result.

Market price

In case of BRRI dhan 45 and BRRI dhan 29 market prices was found higher than the other varieties (Table 2), production cost was also lower than other varieties. Table 2 shows that production of BRRI dhan 45, BRRI 29 (popular) and BRRI 29 (research) is higher (about 6 ton/ha) than the other varieties (5.5 tons/ha). Cost of production was found lower in case of the above mentioned three varieties (average costs Tk.6,700/ton) while it was found above Tk.7,000 for other varieties.

Table 2: Cost-market price comparison of different crops

Rice variety	Yield (Ton/ha)	Cost/ ton (Tk)	Market price/ton
BRRI dhan 28	5.37	7,692	12,000
BRRI dhan 45	**5.98**	**6,908**	**12,500**
C H 45	5.55	7,443	12,000
Hobiganj boro 6	4.56	9,059	11,500
BRRI dhan 29 (pop)	6.10	6,611	13,000
BRRI dhan 29 (res)	**6.18**	**6,526**	**13,000**

Based on the overall performance of the research crops (rice) it is recommended that for addressing the risk of flash flood BRRI dhan 45 and BRRI dhan 29 (with improved management practice) could be adopted in the research area (haor region).

More details are provided in Annex A.

4.1.2 Pulse crop (Mughbean, Lentil)

Mughbean and Lentil are quite new in the research area. Both the pulses need relatively shorter time, compared to traditional Boro Rice (Table 3). High and low *kanda* fallow lands could be used for the cultivation of these varieties. Extensive motivation among the farmers to adopt these varieties could bring new dimension in the cultivation practices in the haor area.

Usually, recession of water from raised *kanda* lands gets faster and the lands become ready for agricultural activity 30 to 45 days ahead compared to the rice fields (low lying lands). Again, the rice fields get inundated at the beginning of flash floods, while raised *kanda* lands inundated lately. On the other hand *kanda* lands are remaining fallow throughout the year. Therefore these *kanda* lands are quite feasible for agriculture purposes. The only difficulty in cultivation in kanda is lack of irrigation facilities. Thus the *kanda* lands are highly recommended for the crops which need less irrigation.

Duration

Total cultivation time is less than 140 days for both the crops which can be harvested by March. However, cold injury caused 15 to 20 days delay in harvesting compared to a normal year. So it is possible to harvest the crops before flash flood in a normal year.

Table 3: Lifespan of different pulse crop variety

Sl No.	Name of crops	Date of sowing	Date of harvesting	Lifespan (Day)
1	Mungbean	05.12.06	14.04.07	129
2	Lentil	05.12.06	17.03.07	102

Market price

Due to poor germination and disease infestation, yield of the pulses were poor which resulted in net loss for the farmers.

Table 4: Cost-market price comparison of different pulse varieties

Sl. No.	Crops	Yield (Ton/ha)	Cost/ ton (Tk)	Market price (Tk)
1	Mungbean	0.31	124,189	25,000
2	Lentil	0.695	53,700	25,000

Ultimately the trial was found not feasible economically as the cost of production was found higher than the market price. However, the individual performances of the crops were found satisfactory at different stages. To explore the actual potential of the crops (Mung bean and Lentil) similar trial should be continued for at-least three consecutive years.

More details are provided in Annex A.

4.1.3 Oil seed (mustard)

Duration

Life span of mustard is very low compared to other crops in the haor area. It can be harvested within 100 days which has the potential to avoid the threat of early flash flood.

Market price

Mustard was found very profitable crop which had less insect and disease infestation and higher yields.

Table 5: **Lifespan and Cost-market price comparison of oil seed (mustard)**

Crops	Date of sowing	Date of harvesting	Lifespan (Day)	Yield (Ton/ha)	Cost/ Ton (Tk)	Market Price (Tk)
Mustard	13.11.06	18.02.07	97	2.08	13,806	25,000

More details are provided in Annex A.

4.1.4 Vegetables

Cultivation of vegetable is not popular in the haor areas. FGD data revealed that only women members of a few households used to cultivate vegetables in the homesteads and courtyards. But the study team found huge potential of vegetables cultivation in the fallow *kanda* lands. In haor area, severe vegetable shortage arises during winter, which could easily be solved by vegetable cultivation in the fallow *kanda* lands.

Duration

All the demonstrated vegetables are of short duration (Table 6). Crop's life span of some vegetables found so short that they could be cultivated several times in a year. With promotion of such vegetables among the farmers the fallow *kanda*s could be transformed into double or even triple cropped land.

Market price

All of the vegetable crops were found profitable than many other regular crops in the haor region and are possible to harvest before flash flood. The peak poverty period (January to

March) in the haor areas could be overcome with cultivation of the vegetables that can be used as cash crop.

Table 6: Lifespan and Cost-market price comparison of different vegetables

Sl No.	Name of crops	Crop's lifespan (Day)	Cost/ton (Tk)	Market Price (Tk)
1	Radish	65-85	1,863	10,000
2	Spinach	30-50	6,130	10,000
3	France bean	55	9,666	10,000
4	Garden pea	95	3,316	15,000
5	Sweet gourd	65-130	1,248	5,000
6	Red amaranth	30-45	4,066	6,000
7	Stem amaranth	40-65	994	5,000
8	Bitter gourd	80-120	4,142	12,000
9	Potato	72	8,188	15,000
10	Ash gourd	65-85	2,656	5,000

All vegetables except French bean provided a very good result in the research. The study therefore recommends that vegetable cultivation should get high priority while considering adapting new crops.

More details are provided in Annex A.

4.1.5 Spices (Onion, Garlic)

Spices like Onion and Garlic are very much new to haor area. However, spices could be considered as an alternative of rice due to its high yield and profit than rice. Some of the spices are also suitable to grow in rice field.

Duration

Spices usually take more time than vegetables, oil and pulse crops ((Table 7), however, has enough short life span to harvest before the flash flood. So these crop varieties were found very much potential for the haor areas to address flash floods.

Market price

Market demand of spices is very high. Both crops (Onion and Garlic) are very much prospective to change the livelihoods of the farmers of haor region (could be a substitute of rice crops). These crops can generate huge profit margin from a small piece of land which is very encouraging for small and marginal farmers.

Table 7: Lifespan and Cost-market price comparison of different spices

Sl No.	Crops	Lifespan (Day)	Cost/ton (Tk)	Market price /ton (Tk)
1	Onion	120.	5664	20000
2	Garlic	130	12150	50000

Infestation of pest and disease is very low for Onion and Garlic. Combining these facts with the high profitability of these two crop, it is apparent that they have high potentiality in the haor region.

More details are provided in Annex A.

4.2 The input cost and net profit analysis of the research crops.

Table 8: Cost-profit analysis among all successful crops

Crops	Average Production Cost (Taka/hectre)	Profit (Taka/hectre)	Net profit (Taka/hectre)
Garlic	120,536	496,058	375,522
Radish	6,9036	365,436	296,400
Sweet Gourd	85,050	329,929	244,879
Bitter Gourd	117,654	340,960	223,306
Stem Amaranth	46,715	235,818	189,103
Potato	152,755	318,630	165,874
Onion	64,343	204,492	140,149
Pea	33,098	149,682	116,584
Ash gourd	47,548	89,538	41,990
Rice	41,115	63,660	22,545
Spinach	34,086	55,575	21,489
Red Amaranth	36,541	53,378	16,837
Mustard	28,717	41,495	12,778

This cost-profit relation has been described graphically in the following figure.

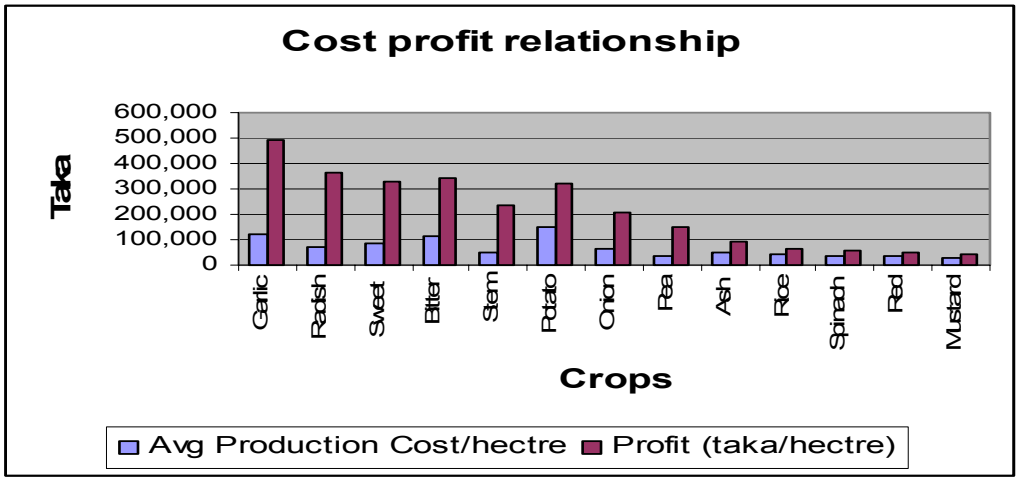


Figure 1: Graphical representation of Cost-Profit analysis of different successful crops

The success of this research activity depends on the following three issues:

a) Whether the crop is free from the flash flood;

b) Whether it is profitable and;

c) Whether it could bring new areas under farming practice.

Considering the three criteria, the research findings suggest that spices and vegetables have a great opportunity for this area.

Table 9: Comparative analysis of research and traditional crops

Name of crop	Flash flood effect			Economic feasibility				Type of land can be used
	Expected days required	Expected harvesting time	To be saved from Flash Floods	Production cost/hectare (Taka)	Production (ton/hectare)	Market price /hectare (taka)	Gross profit Tk/hectare	
BRRI dhan 28	145	Early April	NO	41,310	5.37	64,440	23,130	Winter rice land
BRRI dhan 45	140	End of March	YES	41,310	5.98	74750	33,440	Winter rice land
C H 45	140	End of March	YES	41,310	5.55	66,600	25,290	Winter rice land
Hobiganj boro 6	145	Early April	NO	41,310	4.56	52,440	11,130	Winter rice land
BRRI dhan 29 (new technology)	150	Mid April	NO	40,333	6.18	80,340	40,007	Winter rice land
BRRI dhan 29 (popular practice)	165	End of April	NO	41,356	4.56	52,540	10,107	Winter rice land
French bean	70	Early January	YES	63,726	7.41	74,100	10,374	Kanda land, Adjacent homestead and front yard
Radish	65	Early February	YES	69,024	37.05	370,500	301,476	Adjacent homestead and front yard
Spinach	40	Early January	YES	34,083	5.56	55,600	21,517	Adjacent homestead and front yard
Garden Pea	95	Early March	YES	33,094	9.98	149,700	116,606	Kanda land, Adjacent homestead and front yard
Sweet guard	130	Early February	YES	85,026	68.13	340,650	255,624	Kanda land, Adjacent homestead and front yard
Red Amaranth	45	Early January	YES	36,513	8.98	53,880	17,367	Adjacent homestead and front yard

Steam Amaranth	65	Mid January	YES	46,728	47.01	235,050	188,322	Adjacent homestead and front yard
Bitter gourd	120	End February	YES	117,633	28.4	340,800	223,167	Kanda land, Adjacent homestead and front yard
Potato	75	Mid February	YES	156,063	19.06	285,900	129,837	Winter rice land, Kanda land, Adjacent homestead and front yard
Ash gourd	85	End January	YES	47,542	17.90	89,500	41,958	Adjacent homestead and front yard
Onion	120	End March	YES	64,343	11.36	227,200	162,857	Winter rice land, Kanda land, Adjacent homestead and front yard
Garlic	130	End March	YES	120,528	9.92	496,000	375,472	Winter rice land, Kanda land, Adjacent homestead and front yard

5. Climate

5.1 Temperature

The climatic requirement of rice is wide. It can grow successfully from tropical region to temperate region, where temperature does not fall bellow 25^0 C and long day-length. At the growing season, 25^0 to 35^0 C temperatures are ideal. Favorable temperature for rice seed germination is 30^0C to 35^0C.

At the seedling stage, if temperature falls; the growth is hampered. If temperature falls, the oil contain percentage in mustard reduces. 30^0C to 35^0C is suitable for Murag bean, but it can tolerate up to 40^0C. Suitable temperature for Lentil is 20^0C to 25^0C. (Krisitattic Fosoler Utpadan abong Unnayan, Prof. Dr. Abdul Gaffer, BAU).

From the above information, it is apparent that average temperature of November is 20^0C which is low for rice growing. The temperature of last week of November was very low (bellow 15^0C), which is harmful for rice and other crop's seedling. (Detail in Annex B)

5.2 Rainfall

If 2000 mm rainfall (Equal distribution) occurs in rice cropping season, it is favorable for rice cultivation. Average 750 mm to 900 mm seasonal rain fall is suitable for Mug bean (Krisitattic Fosoler Utpadan abong Unnayan, Gaffer, BAU).

Pea can not tolerate water logging. Data from the above table shows that last five year's annual rainfall is lower than the annual rainfall of 1987 to 1991 in the haor areas. The monthly rainfall of 2006 was not good for the growth of rice, pulses and other crops. The average rainfall in October, November and December, 2006 were72 mm, 12 mm and 3 mm respectively. The annual rainfall of Sunamganj in 2006 was found 3526 mm. But this rainfall was not equally distributed (Detail in Annex B).

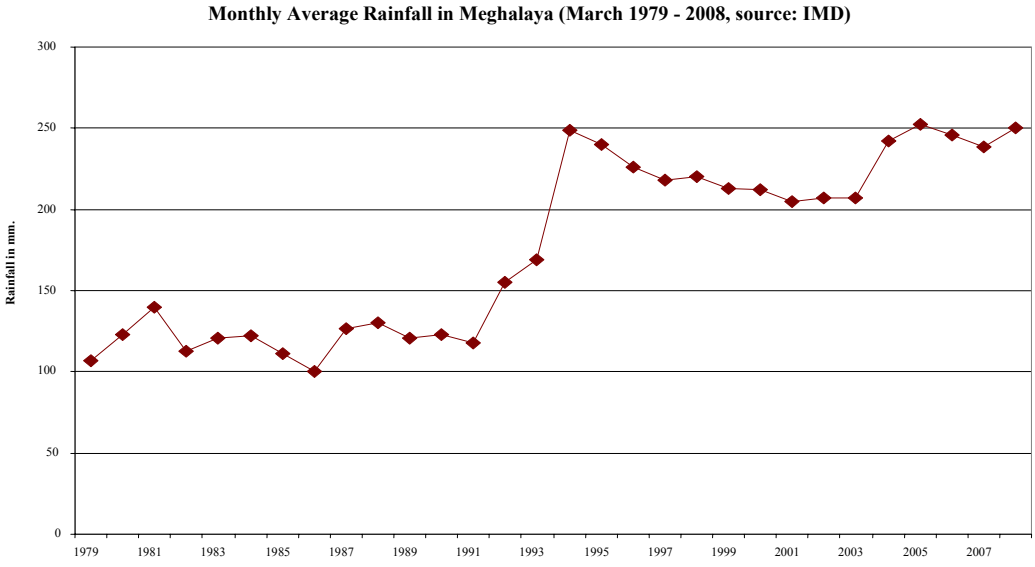


Figure 2: Yearly Rainfall (in March) in Meghalaya.

Figure 2 reveals that rainfall in the month of March at upstream (in Meghalaya) has increased substantially (average rainfall, from 150 mm to 250 mm) intensifying severity of flashfloods.

5.3 Humidity

Pulses (Lentil, Mung, Khasari etc) and Oils (Mustard. Til, Tisi etc) grow well in dry weather. If the humidity rises up, lentil can not grow well (*Krisitattic Fosoler Utpadan abong Unnayan*, Gaffer, BAU).

From the above information, it can be said that the humidity of October, November and December were lower than the other months of the year. From 3 hourly relative humidity data it is found that humidity falls up to 38%, 30% and 16 % in January, February and March 2007 respectively. (Detail in Annex B)

5.4 Water Level

From the water level data, it is seen that the lowest water levels of October, November 2006 and January, February, March, April and May 2007 in the Surma river were 4.26, 3.34, 1.52, 1.48, 1.32, 1.58 and 4.2 meter respectively. On the other hand, the highest water levels of October, November 2006 and January, February, March, April and May 2007 in the Surma River were 6.18, 4.57, 1.98, 1.94, 2.06, 5.78 and 6.85 respectively. The risk level of Surma River is 8.25 meter at Jamalganj. During the cropping season, water level of Surma never touched the risk point (8.25m). Boro crops depend on irrigation. If the water level of Surma River declines, the irrigation facility reduces. On the other hand if the water level exceeds the risk point, flood occurs in this haor region and crop damages. In February and March, insignificant irrigation water crises were found. Because, above 95% lands are irrigated with surface water and this surface water is directly or indirectly related to Surma River system. When the water level of Surma decreases, the water crisis in canal, beel and doba is found (Detail in Annex C).

6. Motivation and Coping Strategies

6.1 Motivation strategy

Alamgir Kabir, a teacher of Fenerbag union is very excited about the vegetable production of another farmer. He is so convinced about the potentiality of vegetable cultivation that he promised to provide loan facility to any of the farmer of his village.

Some crops like boro rice need no motivation activities. It is well practiced by the farmers of this area; if they could get a short duration variety which is free from the devastating fear of flash flood they are very much willing to take the variety. In that case a proper communication system is very much essential.

On the other hand, some crops are very new to the farmers of this area like garlic, onion etc. In order to adapt these types of crops motivation as well as communication is a must. CNRS organized two separate "Field Day", one for message dissemination workshop and the other on cross visit to make people aware about the new crop varieties and technologies. These events played a significant role in case of achieving the objectives of the project.

6.1 Coping Strategies

For rice cultivation, research maintained proper sowing time. It also recommends for using short duration varieties, which are comparatively tall and non-shattering. A new technology, which has already been tested, should be implemented for long duration variety. In case of vegetable and all crops, it is recommended to use pesticide to protect from fungal and bacterial disease during cloudy weather and fogging conditions. Well drainages system should be developed to drain out excessive rainfall water. To protect the crops from different types of pest and insect, it needs to maintain proper crop management practices. To avoid the climatic hazards, crop selection as well as land selection is very important.

7. Recommendations

It is difficult to make any recommendation on any agricultural research based on the findings of one year. Many climatic reasons may impact production of the crops and findings may be misleading. Therefore, study of three consecutive years is required for making any recommendation for agricultural research. However, based on the one year trial and observation, the following recommendations are made.

Onrush water caused by rainfalls in upper catchment in Meghalaya, India during March and April resulted flashfloods in Haor areas. It is evident that rainfalls in Meghalaya in March has increased from average 150 mm to 250 mm. Erratic behavior of rainfalls intensifies the severity of flashfloods in the haor areas. It is experienced that the risk of the hazard to damage winter rice is increasing. Therefore, introduction of alternative cropping practice and short duration rice varieties can be the right solution of the problem as a climate change adaptation measure.

The results so far came out from the research need to be further tested in a wider scale by the respective/ mandated government agencies for mainstreaming the learning. It is noted that haor is a vast area while few plots in one upazila have been covered under this research may not be representative.

Research identified that almost 20% of the land in haor areas are kanda. Kanda lands are a bit raised land. Haor people are dependent on surface water irrigation for winter rice cultivation and kanda lands are found not suitable for rice cultivation. In most of the cases, kanda lands remain fallow. Research results found that kanda lands are suitable for rabi crops viz. pulses, seed oils and vegetables which require very minimum irrigation water. These crops are more profitable than rice. Most of the kanda lands are owned by the government, therefore, these lands can be distributed among the landless households along with technological and input support. But it is also important to keep in mind that there are some other uses of kanda lands viz. grazing land, crop processing, seedbeds, and playground. Historically these lands were characterized by either reed lands or swamp forest. Therefore, ecological phenomenon of the kanda lands should also be taken care of.

Most popular rice variety among the farmers of haor areas is BRRI dhan 29. As per the research findings, it requires a total of 163 days to grow. Production of BRRI dhan 29 is found 6.18 ton/ha in the research plots. On the other hand, research tested a trial variety advanced by BRRI called BRRI dhan 45 in the haor areas. It requires 139 days to grow and production is 5.98 ton/ha. Though the production of BRRI dhan 45 is a bit low than that of BRRI dhan 29 but BRRI dhan 45 can be harvested 24 days ahead and that can reduce risk of damage by flashfloods substantially. Therefore, BRRI dhan 45 can be released for haor areas. DAE can take the role in this regard.

Some crops viz. garlic, onion are found suitable as an alternative of rice to be cultivated in the same land. Profitability of the alternative crops is found much higher than that of winter rice while risk of flashfloods is absent in case of the alternative crops. Moreover, less irrigation water is required for the alternative crops. It may be noted that supply of quality seed is important in this regard.

8. Conclusion

This is an adaptive research on agriculture that looked into the suitability of alternative cropping practices through technological innovation and adoption of piloting of some non popular/ non-practiced rabi crops to address flash floods. Haor is a single cropped area and suitable for winter farming. Duration of the research activity was only one year therefore all the piloting took place during November 2007 to April 2007. This year was found a bit abnormal in the context of some climatic parameters such as temperature and rainfall which impacted test crops with a great extent. Usually, agriculture research needs at least 3 years of time to pilot same thing in 3 consecutive years to have a real picture that can lead to a conclusion of the findings. But in this case, it is difficult to make any clear and concrete decision.

The research identified many crops which were found technically suitable for haor area to address flash floods. But there are many social issues that need to be taken care of under research for wider dissemination of the findings. These issues include technology transfer, market, availability of seeds, protection of crops in the kanda lands from cattle, etc. Kanda lands are found very suitable for many crops. Usually theses lands remain fallow and some parts of the land are used as cattle grazing. Therefore, initiative of few numbers of farmer cannot protect cattles from their farm plots.

In recent times, farmers feel that rice is less profitable and more risky crop. Traditionally, farmers use long duration and local rice variety, which are vulnerable to flashflood and hailstorm. All most every year, haor farmers experience damage of winter rice by flash floods. Though rice production is found less profitable, but the local farmers have been practicing rice cultivation because they are used to this. In recent times, they are trying to come out from this situation. According to farmers, they need short duration and high yielding rice variety and other alternative short duration profitable winter crops. In addition, they need some vegetable crops for fallow land and homestead adjacent area and /or any new technologies which would save their crops and would sustain their farming system. From the research demonstration, maximum involved farmers realized that this type of farming is needed and it was appreciated by all farmers and they accepted the research result with trust. From the next year, they want to cultivate short duration rice variety and adopting new age controlling techniques in case of long duration variety. In addition, other alternative robi crops for comparatively highland and kanda land would be cultivated by the local farmers.

Some crops were also recommended for fallow and homestead adjacent land. Local farmers believe that they can earn more profit with less risk by cultivating these crops. It was suggested that the farmers would take some precautions against the climate condition following the adaptive cultivation methods. As the research was a ‘Need Based Solution’ to the local farmers, the haor region people accepted the result for improving their livelihoods. However, implementation of the recommendations need further study in different ecologically characterized areas of haor, considering socio-cultural practices, developing technological packages and disseminating packages to the farmers, which were beyond the scope of this research.

ANNEX - A: Description of cultivated crops

1.1 Rice

Description of plots

All the rice plots were located at flash flood prone Kandagaon village under Bhimkhali union, part of the Pakhner haor (low land). The area goes under water rapidly during flash flood attack. More than 95% farmers of the area cultivate BR-19, BRRI dhan28, BRRI dhan29 and BRRI dhan45. CH45 (not a variety) and Hobiganj6 is very new for this region. To promote short duration rice, BRRI dhan28, BRRI dhan45, CH45, Hobiganj6 and BRRI dhan29 were cultivated in the experimental plots. Another plot with BRRI dhan29 was cultivated to observe the low aged (20 days) seedling growth, yield and lifespan. Plot size of BRRI dhan28, BRRI dhan45, CH45, Hobiganj6 were 1.06 decimal, while the plot size of BRRI dhan29 were 4.25 decimal. All the farmers of the plots were medium category farmers (section 3.5 of the report).

Input cost

As the cultivated area under the research (following scientific method) was a small area, the production cost was comparatively high. With a larger cultivated area the production cost would be less.

Plot No.	Variety	Seed requirement			Land preparation (Tk/ha)		Fertilizer (Tk/ha)	Weeding (Tk/ha)	Pesticide (Tk/ha)	Irrigation (Tk/ha)	Harvesting and transport cost (Tk/ha)	Lease value of land/season (Tk/ha)
		Unit price (Tk/kg)	Wt. (kg/ ha)	Price (Tk/ ha)	Tillage	Labor						
1	BRRI dhan28	20	11.62	247	3,087.5	3,087.5	9,880	3,087.5	-	6,175	3,087.5	12,658.5
2	BRRI dhan45	20	11.62	247	3,087.5	3,087.5	9,880	3,087.5	-	6,175	3,087.5	12,658.5
3	CH45	20	11.62	247	3,087.5	3,087.5	9,880	3,087.5	-	6,175	3,087.5	12,658.5
4	Hobiganj6	20	11.62	247	3,087.5	3,087.5	9,880	3,087.5	-	6,175	3,087.5	12,658.5
5	BRRI dhan29	20	12	240	2905.8	2905.8	9298.8	2905.88	-	5811.7	4358.82	12,350
6	BRRI dhan29*	20	12.00	240	2905.8	2905.8	9298.8	2905.88	-	5811.7	4358.82	12,350

Transplanted low aged seedling

The farmers did not practice the suggested top dressing method due to their other business or traditional habit. They only top dressed twice while suggested thrice by the research team. On the other hand recommended irrigation method was also ignored by the farmers as the common believe in the region is that if irrigated at the flowering or milking stage, the land would become wet during the harvesting time and that would create obstacle at the harvesting process. Long distance of the source of irrigation water from each plot was another reason. However, the fact is that if in the flowering and milking stage, sufficient water is not available in the rice field yield may decrease to 40% to 50 %.

Crops performance at different stages

Plot No	Germination		Seedling Stage		Vegetative stage		Panicle Initiation Stage		Flowering stage		Milking Stage		Maturity Stage	
	%	Day Req.	Perform.	Day Req.	Perform.	Day Req.	Perform.	Day Req.	Perform.	Day Req.	Perform.	Day Req.	Perform.	Day Req.
1	85	4	Excellent	37	Excellent	40	Excellent	7	Excellent	11	Excellent	16	Moderate	34
2	85	4	Excellent	37	Excellent	38	Excellent	8	Excellent	9	Excellent	14	Moderate	35
3	85	4	Excellent	37	Excellent	39	Excellent	7	Excellent	10	Excellent	16	Moderate	38
4	85	4	Excellent	37	Excellent	41	Excellent	5	Excellent	8	Excellent	13	Moderate	35
5	85	4	Excellent	36	Excellent	83	Excellent	7	Excellent	9	Excellent	15	Excellent	43
6	85	4	Excellent	20	Excellent	83	Excellent	7	Excellent	9	Excellent	15	Excellent	43

All the demonstration plots experienced a hailstorm during the ripening stage (except plot 5 and 6) and maximum grain dropped out from panicle which resulted in a moderate performance in the maturing stage. Duration of all stages in all the plots were standard (as per BRRI) except vegetative stage. The vegetative stage in all the plots took 5-6 days more than the standard duration due to cold injury (cold wave).

Seeds weight and yield

Seed weight (1000 seeds) of experimental plots was also affected by the hailstorm. Weight of the seed (1000 seeds) ranged from 21gm to 29 gm at different experimental plots. On the other hand, yields of experimental plots ranged from 4.56 ton/ha to 6.10 ton/ha, which is higher than the average yield of rice in Bangladesh (3.46 ton/ha; BBS, 2005).

Plot No	Experimental plot (gm)	Expected weight (gm)*	Yield in research plot (ton/ha)	Average Yield (ton/ha)**
1	21	22	5.37	3.46
2	25	27-28	5.98	3.46
3	25	26-28	5.55	3.46
4	29	30-32	4.56	3.46
5	23	23-24	6.10	3.46
6	23	23-24	6.18	3.46

** BRRI Research Report (Varietals Characteristics)*

*** BBS, 2005*

Vegetative growth

Plot No.	Plant height (cm)				Leaves length (cm)			No. of effective tiller/hill		Length of panicle (cm)	No. of filled grain/ panicle
	30 day	60 day	90 day	120 day	30 day	60 day	90 day	30 day	60 day		
1	42	60	75	80	15	20	25	10	21	20	212
2	24	61	75	77	20	14	37	7	25	22	213
3	32	65	68	70	15	16	24	4	24	21	212
4	28	81	90	105	20	32	34	7	28	21	116
5	22	51	79	108	16	32	53	5	31	23.5	245
6	21	51	80	108	16	32	53	5	32	24	244

Pest and disease infestation of rice field

Pest and insects attack the flower of early rice variety at the flowering stage as there is no other crop's in flowering stage in the haor area at that time. Large scale cultivation of early variety would reduce the pest attack. However, all the experimental plots were free from any pest attack except plot 1 and plot 3 which were under rice bug attack during the milking stage at a minimum level. No pesticide was used in any plot.

Most of the experimental plots were infested by disease (except the plot 4 which was free from any disease infestation) as the weather was favorable for disease infestation at vegetative and milking stage. However the yield was not hampered remarkably by disease infestation. No fungicide was used in any plot.

Plot No	Pest infestation			Disease infestation		
	Types of pest	Infestation stage	Infestation rate	Types of disease	Infestation stage	Infestation rate
1	Rice bug	Milking stage	Minimum level	Leaf blight, leaf scroll, BLB	Vegetative stage, Milking stage	Moderate
2	-	-	-	Leaf blight, leaf scroll, BLB	Vegetative stage, Milking stage	Moderate
3	Rice bug	Milking stage	Minimum level	Leaf blight, leaf scroll, BLB	Vegetative stage, Milking stage	Moderate
4	-	-	-	-	-	-
5	-	-	-	Leaf blight, Leaf scroll	Vegetative stage, Milking stage	Minimum level
6	-	-	-	Leaf blight, Leaf scroll	Vegetative stage, Milking stage	Minimum level

Nutrient status in post harvest soil and irrigation facilities

Plot No	Soil test result						Irrigation facilities
	OM (%)	Total N (%)	P (micro gm/gm soil)	K (milli-equivalent/100gm soil)	S (micro gm/gm soil)	P^H	
1	2.24	0.21	7.35	0.15	47.83	5.3	Good
2	2.24	0.21	7.35	0.15	47.83	5.3	Good
3	2.24	0.21	7.35	0.15	47.83	5.3	Good
4	2.24	0.21	7.35	0.15	47.83	5.3	Good
5	2.48	0.23	1.81	0.14	32.75	5.1	Good
6	2.48	0.22	1.75	0.14	34.70	5.1	Good

Crop's lifespan

Plot No.	Date of Sowing	Date of Transplanting	Date of Harvesting	Crop's lifespan
1	18 November 2006	25 December 2006	20 April 2007	152 days
2	18 November 2006	25 December 2006	20 April 2007	152 days
3	18 November 2006	25 December 2006	20 April 2007	152 days
4	18 November 2006	25 December 2006	20 April 2007	152 days
5	18 November 2006	24 December 2006	07 May 2007	171 days
6	04 December 2006	24 December 2006	07 May 2007	155 days

BRRI dhan28, BRRI dhan45, CH45 and Hobiganj6 (Plot 1, 2, 3 and 4 respectively) are short duration rice varieties while BRRI dhan29 (Plot 5 and 6) is comparatively long duration variety. To reduce the life span of BRRI dhan 29, typical management practice (plot 5) was altered in the experimental plot 6. Sowing date for plot 6 was delayed by 16 days (04 December instead of 18 November), however, the seedlings were transplanted in the both plot (5 & 6) on the same day (24 December), and ripening time (date of harvesting) of both the plot were also same (7 May 2007). The lifespan of plot 5 is thus 171 days while is 155 days for plot 6. The yield and other performance of plot 5 and plot 6 are approximately the same. This indicates that if farmers transplant young aged seedlings (of BRRI dhan 29) to the field, it could be harvested comparatively short period of time and flash flood could be avoided.

Cost- Benefit analysis

Crop yield ranged from 4.56 ton/ha to 6.10 ton/ha at different experimental plots. Generally, farmers get 3 ton/ha to 4 ton/ha with traditional cultivation method in this region. Profit from each plot is higher than that of traditionally cultivated rice in the haor area.

Plot No.	Variety	Total cost (Tk/ha)	Total crop production (ton/ha)	Straw value (Tk/ha)	Market price of crops (Tk/kg)	Total income (Tk/ha)	Net profit (tk/ha)	Remarks
1	BRRI dhan28	41,310.5	5.37	3,000	10.50	57161.25	18,100.75	Profitable
2	BRRI dhan45	41,310.5	5.98	3,000	10.50	63642.37	24,581.87	Profitable
3	CH45	41,310.5	5.55	3,000	10.50	59103.75	20,043.25	Profitable
4	Hobiganj6	41,310.5	4.56	3,000	10.50	48729.75	9,669.25	Profitable
5	BRRI dhan29	40,333.65	6.10	2,905	10.50	66,980.59	40,333.65	Profitable
6	BRRI dhan29*	40,333.65	6.10	2,905	10.50	66,980.59	40,333.65	Profitable

1.2 Radish

Description of plots

Research plots were set up at two different unions of the upazila to test the adaptability in different location. In Gongadhorpur village of Fenarbak union, two plots were setup at the front yard of farmers, one with marginal farmers and one with medium farmer. Another plot was setup in Kandagoan village of Bhimkhali union in low *kanda* of a marginal farmer. All the plots are of one decimal size.

Input cost

Plot No.	Variety	Seed requirement			Cost of Land preparation (Tk/ha)		Fertilizer (Tk/ha)	Weeding (Tk/ha)	Irrigation (Tk/ha)	Harvesting and Transportation Cost, (Tk/ha)	Lease value of land/season, (Tk/ha)
		Unit price (Tk/kg)	Wt (kg/ha)	Price (Tk/ha)	Tillage	Labor					
1	Pinke	250	2.47	617.5	3,211	12,350	10,868	6,175	12,350	12,350	12,350
2	Pinke	250	2.47	617.5	3,211	12,350	10,868	7,410	9,880	12,350	12,350
3	Tasakeshan	250	2.47	617.5	3,211	12,350	10,868	6,175	9,880	12,350	12,350

Crop performance at different stages and Vegetative growth

Plot No	Germination		Vegetative stage		Tuber initiation stage		Maturity stage		Plant height (cm)		
	%	Day Req.	Performance	Day Req.	Performance	Day Req.	Performance	Day Req.	20 Days	40 Days	60 Days
1	85	3	Excellent	44	Excellent	5	Excellent	9	10	25	45
2	80	4	Excellent	45	Excellent	6	Excellent	8	12	30	40
3	80	3	Good	40	Good	6	Good	11	15	25	40

Crop's life span, Root length and Yield

The root length of the radish were found less than the standard length (BARI Annual Report 2005-2006). The yield from each plot was also lower than the standard yield (*Krishi Projukti Hath Boi*, BARI). The main reason for that might be lack of cultivation experiences, lack of proper intercultural operation and soil not being pulverized.

Plot No.	Date of Sowing	Date of Harvesting (Starting Date)	Root Length (cm)	Expected Root Length (cm) *	Yield in research plot (ton/ha)	Average Yield (ton/ha)**
1	29 November 2006	03 February 2007	25	30	39.52	55-60
2	30 November 2006	01 February 2007	22	30	37.05	55-60
3	30 November 2006	28 February 2007	20	40	34.58	70-80

* BARI Annual Report 2005-2006; **Krishi Projukti Hath boi, BARI

Pest and disease infestation

Plot No	Pest infestation			Disease infestation		
	Types of pest	Infestation stage	Infestation rate	Types of disease	Infestation stage	Infestation rate
1	-	-	-	-	-	-
2	-	-	-	Leaf blight	Early stage	Minimum level
3	Epilachna beetle	Early stage	Minimum level	-	-	-

No fungicide was used for disease infestation.

Nutrient status in post harvest soil and Irrigation facilities

Plot No	Soil test result						Irrigation facilities
	OM (%)	Total N (%)	P (micro gm/gm soil)	K (milli-equivalent/100gm soil)	S (microgm/gm soil)	P^H	
1	0.26	0.01	1.99	0.05	1.43	7.0	Medium
2	1.72	0.04	2.78	0.09	9.07	5.8	Medium
3	0.62	0.07	1.68	0.17	22.65	5.2	No

Cost- Benefit Analysis

Analysis of data revealed that yield and other performance of radish in front yard is better than low *kanda*. One of the reasons might be that farmers can closely monitor crop at the front yard rather than in the low *kanda* which is far away from the homestead. Farmers sold their products in the local market at a low price (TK 8.00/kg); with better marketing facilities profit might be increased.

Plot No	Total cost (Tk/ha)	Total crop production (ton/ha)	Market price of crops (Tk/kg)	Total income (Tk/ha)	Net profit (Tk/ha)	Remarks
1	70,271.50	39.52	8	316,160	246,135.5	Profitable
2	69,036.50	37.05	8	296,400	227,363.5	Profitable
3	67,801.50	34.58	8	276,640	208,838.5	Profitable

1.3 Spinach

Description of plots

Two different plots at homestead adjacent low *kandas* in the Kandergaon village of Bhimkhali union were selected for Spinach (Variety - Evan). As Spinach is a short duration crop, farmers would able to use the land as threshing ground after harvesting the crop. Two types of farmers were selected: one marginal (plot size 0.75 decimal) and medium farmer (plot size 1 decimal) with the objective to compare the cultivation technique and knowledge of these two types of farmers.

Input cost

Plot No	Plot Size (Decimal)	Seed requirement			Cost of Land preparation		Fertilizer (Tk/ha)	Weeding (Tk/ha)	Pesticide (Tk/ha)	Irrigation (Tk/ha)	Harvesting and Transportation cost (Tk/ha)	Lease value of land/season (Tk/ha)
		Unit price (Tk/kg)	Wt. (kg/ha)	Price (Tk/ha)	Tillage (Tk/ha)	Labor (Tk/ha)						
1	1.00	80	12.35	988	2,470	7,410	4,940.0	3,705	0	2,470.0	2,470.0	11,115.0
2	0.75	80	9.26	741	1,852	3,705	2,778.7	0	0	1,852.5	1,852.5	5,557.5

Crop performance at different stages, Vegetative growth and Crop's life span

Plot No	Germination		Vegetative stage		Plant height (cm)			Date of Sowing	Date of Harvesting
	%	Day Req.	Performance	Day Req.	20 Days	40 Days	60 Days		
1	70	6	Good	40	10	15	22	10.12.06	Harvest started from early January
2	75	6	Good	40	11	17	24	10.12.06	Harvest started from early January

Pest and disease infestation

No pest and disease attack at any stage of crop's life cycle.

Nutrient status in post harvest soil and Irrigation facilities

Plot No	Soil test result						Irrigation facilities
	OM (%)	Total N (%)	P (micro gm/gm soil)	K (milli-equivalent/100gm soil)	S (microgm/gm soil)	P^H	
1	0.50	0.05	2.98	0.22	20.65	5.2	Medium
2	0.43	0.06	2.74	0.22	21.30	5.3	Medium

Cost -Benefit Analysis

Net profit from plot 1 (medium farmer) is comparatively higher than plot 2 (marginal farmer). As the marginal farmer possesses less land and is not capable to invest as much as the medium farmer, he obtains less production and thus less profit. However, net profit from plot 1 and 2 is more than rice production in the same area.

Plot No	Total cost (Tk/ha)	Total crop production (ton/ha)	Market price of crops (Tk/kg)	Total income (Tk/ha)	Net profit (Tk/ha)	Remarks
1	35,568	6.18	10	61,750	26,182	Profitable
2	32,604	4.94	10	49,400	16,796	Profitable

1.4 Onion

Description of plots

Fallow land (low *kanda*) at the frontal yards of two farmers (one rich farmer with plot size 1.5 decimal and one medium farmer with plot size 1.2) in Soyhara village of Fenarbak union was selected for Onion (BARI 1) cultivation. Rich and medium farmers were selected as onion cultivation is more expensive than any other crops in the area.

Input cost

Plot No	Plot Size (Decimal)	Seed requirement			Cost of Land preparation		Fertilizer (Tk/ha)	Weeding (Tk/ha)	Pesticide (Tk/ha)	Irrigation (Tk/ha)	Harvesting and Transportation Cost (Tk/ha)	Lease value of land/season (Tk/ha)
		Unit price (Tk/kg)	Wt. (kg/ha)	Price (Tk/ha)	Tillage (Tk/ha)	Labor (Tk/ha)						
1	1.5	1,000	8.2	8,233	3,211	8,233	4,940.0	8,233.3	0	3,293.3	13,173.3	12,350
2	1.2	1,000	8.2	8,233	3,211	10,291	5,145.8	8,233.3	0	4,116.6	15,437.5	12,350

Crop performance at different stages and Vegetative growth

As none of the farmers had any earlier experience on onion cultivation, they were advised for intensive tillage by the research team. But they did not follow it perfectly; the soil was also not pulverized, as a result the tuber did not grow well.

Plot No	Germination		Seedling stage		Vegetative stage		Bulb initiation stage		Maturity stage		No of leaf/plant			Plant height (cm)			
	%	Day Req.	Performance	Day Req.	Performance	Day Req.	Performance	Days Req.	Performance	Day Req.	Days			Days			
											20	30	40	20	30	40	60
1	75	5	Excellent	50	Excellent	40	Excellent	12	Good	15	3	5	8	10	18	28	47
2	70	5	Good	52	Good	42	Good	11	Moderate	15	6	7	9	12	21	32	45

Crop's life span, Individual bulb weight and Yield

As farmers did not follow the recommended practices by the research team (soil pulverization, tillage), the tubers could not develop well. Single tuber weight was less than expected (BARI standard) in both the plots. However, yield in both the plots were higher than average yield.

Plot No.	Date of Sowing	Date of Transplanting	Date of Harvesting	Crop Duration	Unit bulb weight (gm)	Expected Unit bulb Weight (gm)*	Yield in research plot (ton/ha)	Average Yield (ton/ha)**
1	28.11.06	25.12.07	25.03.07	117	30.5	35	11.42	6.83
2	02.12.06	30.12.07	27.03.07	115	28.6	35	11.30	6.83

**BARI Annual Report 2006-2007; **BBS, 2005*

Nutrient status in post harvest soil and Irrigation facilities

Plot No	Soil test result						Irrigation facilities
	OM (%)	Total N (%)	P (micro gm/gm soil)	K (milli-equivalent/100gm soil)	S (microgm/gm soil)	P^H	
1	2.79	0.17	47.88	1.40	175.63	5.8	Medium
2	1.41	0.09	13.10	0.73	224.50	5.8	Medium

Pest and disease infestation

Due to proper care (weeding, irrigation, drainage etc.), there was no pest infestation at any stage of the crop's life cycle. However, plot 1 and 2 were infested with Leaf blight and Purple blotch disease respectively during vegetative stage. As the infestation was of minimum level, no fungicide was used.

Cost- Benefit Analysis

The research revealed that Onion would be a profitable crop in this area. The experimental cultivation was conducted in small scale. Large scale cultivation would reduce the production cost, increasing the net profit.

Plot No	Total cost (Tk/ha)	Total crop production (ton/ha)	Market price of crops (Tk/kg)	Total income (Tk/ha)	Net profit (Tk/ha)	Remarks
1	61,667.67	11.42	18	205,627.5	143,959.8	Profitable
2	67,019.33	11.30	18	203,359.2	136,339.9	Profitable

1.5 Garlic

Description of plots

Three research plots in Fenarbak and Gongadhorpur village of Fernabak union, located in the middle of the haor area were selected for Garlic cultivation.

Plot No.	Variety	Plot size (Decimal)	Location		Types of land	Type of farmers
			Village	Union		
1	BARI 1	2	Fenarbak	Fenarbak	Front Yard	Rich
2	BARI 1	2	Fenarbak	Fenarbak	Front Yard	Marginal
3	BARI 1	2	Gongadhorpur	Fenarbak	Front Yard	Medium

Input cost

Plot No	Seed requirement			Cost of Land preparation		Fertilizer (Tk/ha)	Weeding (Tk/ha)	Pesticide (Tk/ha)	Irrigation (Tk/ha)	Harvesting and Transportation Cost (Tk/ha)	Lease value of land/season (Tk/ha)
	Unit price (Tk/kg)	Wt. (kg/ha)	Price (Tk/ha)	Tillage (Tk/ha)	Labor (Tk/ha)						
1	120	494	59,280	3,211	7,410	4,940	12,350	0	3,705	18,525	12,350
2	120	494	59,280	3,211	7,410	4,940	12,350	0	0	18,525	12,350
3	120	494	59,280	3,211	7,410	4,940	12,350	0	3,705	18,525	12,350

Marginal farmer (Plot 2) did not irrigate due to lack of financial solvency.

Crop performance at different stages and Vegetative growth

Plot No	Germination		Vegetative stage		Bulb initiation stage		Maturity stage		No of leaf/plant			Plant height (cm)		
	%	Day Req.	Performance	Day Req.	Performance	Days Req.	Performance	Day Req.	Days			Days		
									30	60	90	30	60	90
1	80	5	Excellent	82	Excellent	19	Excellent	20	4	5	8	25	45	52
2	75	4	Excellent	76	Excellent	20	Excellent	24	3	5	7	20	42	50
3	80	5	Excellent	81	Excellent	20	Excellent	18	4	6	8	15	32	45

Crop's life span, Individual bulb weight and Yield

Standard unit bulb weight and yields from experimental plots were better than national average.

Plot No.	Date of Sowing	Date of Transplanting	Date of Harvesting	Crop Duration	Unit bulb weight (gm)	Expected Unit bulb Weight (gm)*	Yield in research plot (ton/ha)	Average Yield (ton/ha)**
1	28.11.06	05.04.07	128	28.11.06	36.20	30-35	10.12	3.53
2	30.11.06	05.04.07	126	30.11.06	36.00	30-35	9.63	3.53
3	30.11.06	05.04.07	126	30.11.06	35.50	30-35	10.00	3.53

**BARI Annual Report 2006-2007; **BBS, 2005*

Pest and disease infestation

Due to proper care (weeding, irrigation, drainage etc.), there was no pest infestation. However, each of the plots was infested with Leaf blight disease during vegetative stage. As the infestation was of minimum level, crop production was not much affected.

Nutrient status in post harvest soil and Irrigation facilities

Plot No	Soil test result						Irrigation facilities
	OM (%)	Total N (%)	P (micro gm/gm soil)	K (milli-equivalent/100gm soil)	S (microgm/gm soil)	P^H	
1	1.85	0.09	13.96	0.28	100.20	5.0	Medium
2	1.50	0.10	14.70	0.29	99.55	5.1	Medium
3	1.53	0.11	17.04	0.27	98.77	5.0	Medium

Cost- Benefit analysis

The research revealed that Onion would be a profitable crop in this area. The experimental cultivation was conducted in small scale. Large scale cultivation would reduce the production cost, increasing the net profit.

Plot No	Total cost (Tk/ha)	Total production (ton/ha)	Market price of crops (Tk/kg)	Total income (Tk/ha)	Net profit (Tk/ha)
1	121,771	10.12	50.00	506,350	384,579
2	118,066	9.63	50.00	481,650	363,584
3	121,771	10.00	50.00	500,175	378,404

1.6 Mustard

Description of plot

Low *kanda*s of Sunapur village under Jamalganj union are usually kept fallow. The village is located near the river Surma. Deposition of silt from the river each year makes the land fertile. These kinds of lands are suitable for mustard cultivation. Three plots (each of 5 decimals) were cultivated with the BARI 11 variety of Mustard: one medium farmer (Plot 1) and two marginal farmers (Plot 2 and 3).

Input cost

Due to financial insolvency marginal farmer of plot 2 did not use fertilizer as recommended (i.e. for top dressing, applied 2 kg of urea instead of 2.5 kg, recommended by the research team). The weeding was also not up to the mark at plot 2 and 3 as the marginal farmers did not give emphasis on weeding.

Plot No	Seed requirement			Cost of Land preparation			Fertilizer (Tk/ha)	Weeding (Tk/ha)	Pesticide (Tk/ha)	Irrigation (Tk/ha)	Harvesting and Transportation Cost (Tk/ha)	Lease value of land/season (Tk/ha)
	Unit price (Tk/kg)	Wt. (kg/ha)	Price (Tk/ha)	Tillage (Tk/ha)	Labor (Tk/ha)	Total						
1	40	9.88	395.2	3,211	2,470	568	2,717	4,446	1,482	9,88	3,705	9,880
2	40	9.88	395.2	3,211	2,470	568	2,470	3,952	1,482	9,88	2,470	9,880
3	40	9.88	395.2	3,211	2,470	565	2,717	3,952	1,482	9,88	3,705	9,880

Crop performance at different stages and Vegetative growth

Plot No	Germination		Vegetative stage		Flowering stage		Fruiting stage		Maturity stage		Plant height (cm)				No. of fruit/ plant
	%	Day Req.	Performance	Day Req.	Performance	Days Req.	Performance	Day Req.	Performance	Day Req.	Days				
											20	30	40	50	
1	85	5	Excellent	55	Excellent	8	Excellent	17	Excellent	10	20	60	110	150	125
2	85	4	Excellent	53	Excellent	10	Excellent	15	Excellent	11	22	50	100	135	124
3	80	4	Excellent	52	Excellent	8	Excellent	16	Excellent	10	25	65	119	140	113

Crop's life span, Seed weight and Yield

Weight of seeds (1000 seeds) at research plots was slightly less than the standard weight (BARI standard). Proper care of the crops by the famers, according to the research team's advice, weight of seeds might be higher. On the other hand, yield from experimental plots was higher than average yield (BBS 2005).

Plot No.	Date of Sowing	Date of Harvesting	Crop lifespan	Seed weight (1000 seeds) (gm)	Expected weight (gm) *	Yield in research plot, (ton/ha)	Average Yield (ton/ha)**
1	12.11.06	15.02.07	95	2.45	2.6	2.32	0.79
2	13.11.06	15.02.07	94	2.50	2.6	2.03	0.79
3	13.11.06	18.02.07	97	2.50	2.6	1.88	0.79

* **BARI Annual Report 2006-2007; **BBS, 2005*

Pest and disease infestation

Aphid attacked mustard crops at flowering and fruiting stage at a minimum level in all the three plots and insecticides were used to control the attack. However, yield of crops was not hampered at all.

Plot 1 and 2 were infested with Cercospora leaf spot during vegetative stage at a minimum level. On the other hand, plot 3 was infested with Leaf and fruit spot during fruiting stage at a moderate level which hampered the yield slightly. Fungicides were used in all the three plots.

Nutrient status in post harvest soil and Irrigation facilities

Plot No	Soil test result						Irrigation facilities
	OM (%)	Total N (%)	P (micro gm/gm soil)	K (milli-equivalent/100gm soil)	S (microgm/gm soil)	P^H	
1	0.95	0.06	2.70	0.46	24.70	5.6	Good
2	0.90	0.06	6.75	0.10	84.80	4.6	Good
3	0.90	0.05	6.39	0.11	83.86	4.6	Good

Cost- Benefit analysis

Plot No	Total cost (Tk/ha)	Total crop production (ton/ha)	Market price of crops (Tk/kg)	Total income (Tk/ha)	Net profit (Tk/ha)	Remarks
1	29,294.20	2.32	20	46,436.00	17,141.80	Profitable
2	28,059.20	2.03	20	40,508.00	12,448.80	Profitable
3	28,800.20	1.88	20	37,544.00	8,743.80	Profitable

1.7 French bean

Description of plot

As French bean is a new crop for this region, rich and medium farmer with two small plots (0.5 decimal) in high kanda in Kandagaon village of Bimkhali union were selected for the research. These high *kanda* lands were never used as cropland. The BARI 1 variety of the French bean was selected experiment.

Input cost

Plot No	Type of farmers	Seed requirement			Cost of Land preparation		Fertilizer (Tk/ha)	Weeding (Tk/ha)	Pesticide (Tk/ha)	Irrigation (Tk/ha)	Harvesting and Transportation cost (Tk/ha)	Lease value of land/season (Tk/ha)
		Unit price (Tk/kg)	Wt. (kg/ha)	Price (Tk/ha)	Tillage (Tk/ha)	Labor (Tk/ha)						
1	Medium	120	123.5	9,880	3,211	12,350	12,350	4,940	-	4,940	9,880	12,350
2	Rich	120	123.5	9,880	3,211	12,350	12,350	4,940	-	4,940	7,410	12,350

Crop performance at different stages and Crop's life span

Plot No	Germination		Vegetative stage		Flowering stage		Fruiting stage		Maturity stage		Date of Sowing	Date of Harvesting	Crop life span
	%	Day Req.	Performance	Day Req.	Performance	Days Req.	Performance	Day Req.	Performance	Day Req.			
1	80	5	Excellent	45	Good	5	Moderate	4	Moderate	4	06.12.06	30.01.07	55
2	75	6	Excellent	47	Moderate	6	Moderate	5	Moderate	5	06.12.06	28.01.07	53

Pest and disease infestation

Due to proper care (weeding, irrigation, drainage etc.), there was no pest infestation. However, plot 1 was infested with Leaf spot disease during vegetative stage at a minor level. On the other hand, plot 2 was infested with Leaf and fruit spot at vegetative and fruiting stage at a moderate level.

Vegetative growth, Seed weight and Yield

Plot No.	Plant height (cm)				Pod size (cm)		No. of pod / plant	No. of branch/ plant	Seed weight (1000 seeds) (gm)	Expected weight (gm) *	Yield in research plot (ton/ha)	Average Yield (ton/ha)**
	20 days	30 days	40 days	50 days	Length	breadth						
1	5	14	17	29	14	1.50	17	5	310	320	7.41	13-14
2	4.5	15	18	27	15	1.75	18	5	300	320	5.92	13-14

**Unnoto Sabje Utpadon Kalakousal, BARI; ** Krishi Projukti Hat Boi, BARI*

Lack of experience of the farmers of French bean cultivation might be a reason of under weight and less yield.

Nutrient status in post harvest soil and Irrigation facilities

Plot No	Soil test result						Irrigation facilities
	OM (%)	Total N (%)	P (micro gm/gm soil)	K (milli-equivalent/100gm soil)	S (microgm/gm soil)	P^H	
1	0.19	0.01	2.51	0.04	1.13	7.2	Medium
2	0.90	0.11	2.46	0.20	17.76	5.1	Medium

Cost- Benefit analysis

As the French bean is quite new for the farmer, they could not follow the cultivation method as per recommendation of the research team. On the other hand, the research plots were very small which resulted in higher production cost.

Plot No	Total cost (Tk/ha)	Total crop production (ton/ha)	Market price of crops (Tk/kg)	Total income (Tk/ha)	Net profit (Tk/ha)	Remarks
1	63,726	7.41	10.00	74,100	10,374	Less profit due to crop damage
2	61,256	5.92	10.00	59,280	1,976	Less profit due to crop damage

1.8 Garden Pea

Description of plot

Two research plots (one decimal each) in high *kanda* of Kandagaon village under Bimkhali union were selected for Garden pea (BARI 2) cultivation. The owners of the plots were medium category farmers. Garden pea is quite new crop for this area.

Input cost

Plot No	Seed requirement			Cost of Land preparation		Fertilizer (Tk/ha)	Weeding (Tk/ha)	Pesticide (Tk/ha)	Irrigation (Tk/ha)	Harvesting and Transportation Cost (Tk/ha)	Lease value of land/season (Tk/ha)
	Unit price (Tk/kg)	Wt. (kg/ha)	Price (Tk/ha)	Tillage (Tk/ha)	Labor (Tk/ha)						
1	60	24.70	1,482	3,211	4,940	3,705	2,470	2,470	2,470	3,705	9,880
2	60	24.70	1,482	3,211	4,940	3,705	2,470	2,470	-	3,705	9,880

Crop performance at different stages and Crop's life span

Plot No	Germination		Vegetative stage		Flowering stage		Fruiting stage		Maturity stage		Date of Sowing	Date of Harvesting	Crop life span
	%	Day Req.	Performance	Day Req.	Performance	Days Req.	Performance	Day Req.	Performance	Day Req.			
1	85	4	Excellent	45	Excellent	9	Good	7	Good	10	06.12.06	11.03.07	95
2	85	4	Excellent	47	Good	12	Good	7	Good	7	06.12.06	08.03.07	92

The total life span of the crops was extended due to heavy cold (the cold wave of 2007) during vegetative stage.

Vegetative growth and Yield

Plot No.	Plant height (cm)				Leaves size (cm)		No. of branch/ plant	No. of pod/ plant	Yield in research plot (ton/ha)	Average Yield (ton/ha)**
	20 days	30 days	40 days	50 days	Length	breadth				
1	12	16	20	25	5	3	5	25	10.43	10-12
2	12	15	20	25	5	3	5	30	9.52	10-12

** *Krishi Projukti Hat Boi, BARI*

Pest and disease infestation

Minimum level pest attack occurred in plot 1 at vegetative stage by Mite and at fruiting stage in plot 2 by Aphid. On the other hand plot 2 was infested with Leaf and fruit spot diseases during fruiting stage at minimum level. Yield was slightly reduced by these pest and disease attack.

Nutrient status in post harvest soil and Irrigation Facilities

Plot No	Soil test result						Irrigation facilities
	OM (%)	Total N (%)	P (micro gm/gm soil)	K (milli-equivalent/100gm soil)	S (microgm/gm soil)	P^H	
1	0.26	0.02	2.29	0.04	1.72	7.0	Medium
2	0.36	0.07	1.44	0.20	29.01	5.3	Medium

Cost- Benefit Analysis

Plot No	Total cost (Tk/ha)	Total crop production (ton/ha)	Market price of crops (Tk/kg)	Total income (Tk/ha)	Net profit (Tk/ha)	Remarks
1	34,333	10.43	15	156,536.3	122,203.3	Profitable than rice cultivation
2	31,863	9.52	15	142,827.8	110,964.8	Profitable than rice cultivation

1.9 Sweet gourd

Description of plot

During dry season, there are not enough vegetable available in the haor area. Cultivation of sweet gourd could play an important role in mitigating the vegetable crisis in the rainy season. Farmer can cultivate sweet gourd in the winter season and stored them for rainy season.

Plot No.	Variety	Plot size (Decimal)	Location (Village, Union)	Types of land	Type of farmers
1	Sweety (hybrid)	5	Rajapur, Fenarbak	Road side	Land less
2	Sweety (hybrid)	3	Mahmudpur, Bhimkhali	High *kanda*	Medium
3	Baromasi (local)	2	Gonghadhorpur, Fenarbak	Low *kanda*	Marginal

Input cost table

Plot No	Seed requirement			Cost of Land preparation		Fertilizer (Tk/ha)	Weeding (Tk/ha)	Pesticide (Tk/ha)	Irrigation (Tk/ha)	Harvesting and Transportation Cost (Tk/ha)	Lease value of land/season (Tk/ha)
	Unit price (Tk/kg)	Wt. (kg/ha)	Price (Tk/ha)	Tillage (Tk/ha)	Labor (Tk/ha)						
1	6,500	4.94	32,110	3,211	9,880	10,868	4,940	17,290	4,940	7,410	1,350
2	6,500	4.94	32,110	3,211	8,233.3	8,645	6,175	18,936	4,116	8,233.3	12,350
3	800	4.94	4,322	3,211	1,2350	8,645	6,175	19,760	6,175	9,262.5	12,350

Crop performance at different stages and Crop's life span

Plot No	Germination		Vegetative stage		Flowering stage performance	Fruiting stage performance	Maturity stage performance	Date of Sowing	Date of Harvesting
	%	Day Req.	Performance	Day Req.					
1	85	5	Excellent	120	Excellent	Good	Good	25.11.06	Start from end week of January
2	80	6	Excellent	124	Excellent	Good	Good	10.12.06	Start from end week of January
3	75	5	Good	115	Excellent	Good	Moderate	01.12.06	Start from end week of January

The vegetative growth was stunted and the vegetative stage was prolonged due to heavy cold (the cold wave of 2007).

Vegetative growth, Unit fruit weight and Yield

Plot No.	Leaves length (cm)		Leaves breadth (cm)		Unit Fruit weight (kg)	Yield in research plot (ton/ha)	Average Yield (ton/ha)**
	30 days	50 days	30 days	50 days			
1	15	25	13	21	4.75	75.82	30-35
2	15	24	12	20	4.55	64.46	30-35
3	17	28	15	18	4.75	64.10	30-35

***Sabji Utpadan Adunik Kolakousal, BARI*

Pest and disease infestation

All the plots were infested with pest and diseases but no significant damage to crops.

Plot No.	Pest infestation			Disease infestation		
	Types of pest	Infestation stage	Infestation rate	Types of disease	Infestation stage	Infestation rate
1	Red pumpkin beetle, Epilacchna beetle and Cucurbit fruit fly	Vegetative stage Fruiting stage	Minimum level	Leaf blight and fruit rot	Vegetative stage Fruiting stage	Minimum level
2	Red pumpkin beetle, Epilacchna beetle and Cucurbit fruit fly	Vegetative stage Fruiting stage	Minimum level	Leaf blight and fruit rot	Vegetative stage Fruiting stage	Moderate
3	Red pumpkin beetle, Epilacchna beetle and Cucurbit fruit fly	Vegetative stage Fruiting stage	Minimum level	Leaf blight and fruit rot	Vegetative stage Fruiting stage	Minimum level

Nutrient status in post harvest soil and Irrigation Facilities

Plot No	Soil test result						Irrigation facilities
	OM (%)	Total N (%)	P (micro gm/gm soil)	K (milli-equivalent/100gm soil)	S (microgm/gm soil)	P^H	
1	0.45	0.04	1.66	0.07	37.43	5.8	Medium
2	0.45	0.06	1.93	0.14	18.50	5.0	Medium
3	0.43	0.05	1.70	0.14	20.23	5.0	No

Plot 1 was irrigated several times because the source of irrigation was near the plot but plot 2 and plot 3 were not irrigated as per recommendation.

Cost- Benefit analysis

Plot No	Total cost (Tk/ha)	Total crop production (ton/ha)	Market price of crops (Tk/kg)	Total income (Tk/ha)	Net profit (Tk/ha)	Remarks
1	70,889	75.82	5.0	379,083	276,084	Profitable
2	102,011	64.46	5.0	322,335	220,324	Profitable
3	82,251	64.10	5.0	320,482	238,231	Profitable

1.10 Red amaranth

Description of plots

In the haor area, each and every house has some cultivable fallow land at the frontal yard. These lands are highly fertile and productive. If farmers cultivate some short duration crop at these lands, they can use the land as threshing ground after harvesting. To utilize these fallow lands, Red amaranth, a short duration crop was demonstrated in three different plots in Fenarbak, Mahmudpur and Gnghadhorpur village.

Plot No.	Variety	Plot size (Decimal)	Location (Village, Union)	Types of land	Type of farmers
1	BARI 1	1	Fenarbak, Fenarbak	Front Yard	Medium
2	BARI 1	1	Mahmudpur, Bhimkhali	Front Yard	Marginal
3	BARI 1	1	Gonghadhorpur, Fenarbak	Front Yard	Medium

Input cost

Plot No	Seed requirement			Cost of Land preparation		Fertilizer (Tk/ha)	Weeding (Tk/ha)	Pesticide (Tk/ha)	Irrigation (Tk/ha)	Harvesting and Transportation Cost (Tk/ha)	Lease value of land/season (Tk/ha)
	Unit price (Tk/kg)	Wt. (kg/ha)	Price (Tk/ha)	Tillage (Tk/ha)	Labor (Tk/ha)						
1	150	2.47	370.5	3,211	4,940	4,940	6,175	0	2470	3,705	9,880
2	150	2.47	370.5	3,211	4,940	4,940	6,175	0	3,705	3,705	9,880
3	150	2.47	370.5	3,211	6,175	4,940	4,940	0	2,470	4,940	9,880

The farmers were not followed the recommended management practices regarding weeding and irrigation (less effort than recommended).

Crop performance at different stages and Crop's life span

Plot No	Germination		Vegetative stage		Date of Sowing	Date of Harvesting
	%	Day Req.	Performance	Day Req.		
1	80	5	Excellent	33	29.11.06	Harvesting started from 03.01.07
2	80	4	Excellent	35	30.11.06	Harvesting started from 01.01.07
3	80	4	Excellent	35	30.11.06	Harvesting started from 02.01.07

The vegetative period were found satisfactory in comparison to an earlier research by CNRS in that area.

Vegetative growth, Individual plant weight and Yield

Plot No.	Plant height (cm)				Individual plant weight (gm)	Yield in research plot (ton/ha)	Average Yield (ton/ha)**
	10 days	20 days	30 days	40 days			
1	10	19	27	30	9	9.39	12-14
2	10	18	25	28	8	8.89	12-14
3	09	18	26	29	7.5	8.65	12-14

** *Krishi Projukti Hat Boi, BARI*

One of the reasons for lower yield than average might the lack of proper irrigation and weeding.

Pest and disease infestation

There were no pest infestation in plot1, however plot 2 and 3 were infested by Epilachna beetle and Leaf hopper respectively during vegetative stage at a minimum level. These attacks damaged the crop slightly as the farmer did not take any control measure (use of chemical).

On the other hand all the three plots were infested with Leaf spot diseases during vegetative stage at a minimum level. It however, did not damage the crop significantly. No controlling measure was taken.

Nutrient status in post harvest soil and Irrigation Facilities

Plot No	Soil test result						Irrigation facilities
	OM (%)	Total N (%)	P (micro gm/gm soil)	K (milli-equivalent/100gm soil)	S (microgm/gm soil)	P^H	
1	1.62	0.09	17.51	0.73	204.82	6.3	Medium
2	0.19	0.05	2.20	0.08	7.32	5.90	Medium
3	0.29	0.04	2.15	0.09	9.13	5.80	Medium

Cost- Benefit Analysis

Input cost was comparatively high as farmers have not enough experience on Red amaranth cultivation. On the other hand the yield was also reduced due to pest and disease attack. As a result, net profit was not very high. However, is better than keeping the land fallow.

Plot No	Total cost (Tk/ha)	Total crop production (ton/ha)	Market price of crops (Tk/kg)	Total income (Tk/ha)	Net profit (Tk/ha)
1	35,691.5	9.39	6.0	56,316	20,624.5
2	36,926.5	8.89	6.0	53,352	16,425.5
3	36,926.5	8.65	6.0	50,388	13,461.5

1.11 Stem amaranth

Description of plot

Three front yards plots in the Fenarbak union were selected for Stem amaranth as the front yards are not used as cropping land even the lands are very fertile and productive.

Plot No.	Variety	Plot size (Decimal)	Location (Village, Union)	Types of land	Type of farmers
1	Bhutan	1.5	Fenarbak, Fenarbak	Front Yard	Medium
2	Bhutan	1.5	Fenarbak, Fenarbak	Front Yard	Rich
3	BARI 1	1.0	Soyhara, Fenarbak	Front Yard	Marginal

Input cost

Plot No	Seed requirement			Cost of Land preparation		Fertilizer (Tk/ha)	Weeding (Tk/ha)	Pesticide (Tk/ha)	Irrigation (Tk/ha)	Harvesting and Transportation Cost (Tk/ha)	Lease value of land/season (Tk/ha)
	Unit price (Tk/kg)	Wt. (kg/ha)	Price (Tk/ha)	Tillage (Tk/ha)	Labor (Tk/ha)						
1	100	1.98	197.6	3,293	4,940	4,116.66	2,470	0	3,293	3,293.33	12,350
2	100	1.98	197.6	3,293	4,116	4, 116.66	2,470	0	3,293	3,293.33	12,350
3	100	2.47	247	3,458	6,175	4,940.00	3,705	0	4,940	3,705.00	12,350

Crop performance at different stages and Crop's life span

Plot No	Germination		Vegetative stage		Date of Sowing	Date of Harvesting
	%	Day Req.	Performance	Day Req.		
1	75	5	Excellent	55	29.11.06	Harvest started from mid January
2	75	6	Excellent	62	30.11.06	Harvest started from mid January
3	70	5	Excellent	58	05.12.06	Harvest started from mid January

Vegetative growth, Individual plant weight and Yield

Plot No.	Plant height (cm)				Individual plant weight (gm)	Expected plant weight (gm)*	Yield in research plot (ton/ha)	Average Yield (ton/ha)
	10 days	20 days	30 days	40 days				
1	15	25	60	70	447	350 - 400	50.64	45 –52**
2	10	20	35	50	396	350 - 400	47.42	45 –52**
3	10	15	30	45	375	350 - 400	42.98	44-49***

Kreshi Projukti Hat boi, BARI; ** Seed store; * Krishi Projukti Hat Boi,BARI*

Pest and disease infestation

There were no pest infestation in plot1, however plot 2 and 3 were infested by Cut worm during vegetative stage. No control measure (chemical insecticide) was taken as the attack was at a minimum level. These attacks, however damaged the crop slightly.

On the other hand all the three plots were infested with Leaf spot diseases during vegetative stage at a minimum level. It however, did not damage the crop significantly. No controlling measure was taken.

Nutrient status in post harvest soil and Irrigation Facilities

Plot No	Soil test result						Irrigation facilities
	OM (%)	Total N (%)	P (micro gm/gm soil)	K (milli-equivalent/100gm soil)	S (microgm/gm soil)	P^H	
1	1.41	0.08	14.40	0.79	218.45	6.50	good
2	0.47	0.05	1.65	0.16	21.72	5.40	good
3	0.29	0.04	2.05	0.13	16.20	5.30	good

Cost- Benefit Analysis

Input cost was comparatively high as farmers have not enough experience on Red amaranth cultivation. On the other hand the yield was also reduced due to pest and disease attack. As a result, net profit was not very high. However, is better than keeping the land fallow.

Plot No	Total cost (Tk/ha)	Total crop production (ton/ha)	Market price of crops (Tk/kg)	Total income (Tk/ha)	Net profit (Tk/ha)
1	50,931.4	50.64	5	253175	202,243.6
2	49,696.4	47.42	5	237120	189,695.6
3	39,520.0	42.98	5	214890	175,370.0

1.12 Mung bean

Description of plot

Mung bean is a quite new crop in the study area. Three plots in the low *kanda* of Fenarbak village in Fenarbak union were selected for Mung bean (BARI 4) cultivation. All the plots are of 1 (one) decimal size.

Input cost

Plot No	Type of farmers	Seed requirement			Cost of Land preparation		Fertilizer (Tk/ha)	Weeding (Tk/ha)	Pesticide (Tk/ha)	Irrigation (Tk/ha)	Harvesting and Transportation cost (Tk/ha)	Lease value of land/season (Tk/ha)
		Unit price (Tk/kg)	Wt. (kg/ha)	Price (Tk/ha)	Tillage (Tk/ha)	Labor (Tk/ha)						
1	Medium	40	39.52	1,580.8	4,940	4,940	5,137.6	4,940		5,928	1,976	9,880
2	Rich	40	39.52	1,580.8	4,940	4,940	5,137.6	3,952		5,928	1,976	9,880
3	Medium	40	39.20	1,580.8	4,940	4,940	5,137.6	3,952		4,940	2,470	9,880

Crop performance at different stages and Crop's life span

Plot No	Germination		Vegetative stage		Flowering stage		Fruiting stage		Maturity stage		Date of Sowing	Date of Harvesting	Crop life span
	%	Day Req.	Performance	Day Req.	Performance	Days Req.	Performance	Day Req.	Performance	Day Req.			
1	30	7	Good	40	Good	5	Moderate	7	Moderate	6	05.12.06	14.04.07	128
2	35	8	Good	42	Good	6	Moderate	7	Moderate	8	05.12.06	14.04.07	128
3	35	7	Good	38	Good	5	Moderate	6	Moderate	7	05.12.06	14.04.07	128

During the seed sowing period, the moisture content of the plots were low. Though the farmers were advised to irrigate the land at tilling period, the farmers did not follow the advice. This resulted in low germination percentage. On the other hand, heavy cold stunted the vegetative growth for 7 to10 days; as a result the total life span was prolonged.

Vegetative growth, Grains weight and Yield

Plot No.	Plant height (cm)				Grains weight (1000 grains) (gm)	Expected weight (gm)*	Yield in research plot (ton/ha)	Average Yield (ton/ha)**
	30 days	40 days	50 days	60 days				
1	7	9	12	18	32.50	31.9	0.33	0.74
2	6.5	9	11	24	31.0	31.9	0.30	0.74
3	7	9.5	14	26	31.5	31.9	0.30	0.74

**Mungbean in Bangladesh; **BBS, 2005*

Heavy rainfall and cold injury might be the reasons for under weight and low yield of the Mung bean in the research plots.

Pest and disease infestation

There was no pest infestation in any of the plots. However, Plot 2 and 3 were infested with Cercospora leaf spot and Yellow mosaic respectively at a minimum level during vegetative stage, while plot 1 was free from any disease infestation. No fungicide was used in any plot.

Nutrient status in post harvest soil and Irrigation Facilities

Plot No	Soil test result						Irrigation facilities
	OM (%)	Total N (%)	P (micro gm/gm soil)	K (milli-equivalent/100gm soil)	S (microgm/gm soil)	P^H	
1	0.84	0.07	1.08	0.48	21.23	5.70	Good
2	0.88	0.05	3.13	0.41	18.86	5.7	Good
3	0.88	0.06	3.24	0.45	21.85	5.8	Good

Cost- Benefit Analysis

Plot No	Total cost (Tk/ha)	Total crop production (ton/ha)	Market price of crops (Tk/kg)	Total income (Tk/ha)	Net profit (Tk/ha)	Remarks
1	39322.4	0.33	25.0	8151.0	- 31171.4	Low yields in the research plots resulted in losses.
2	38334.4	0.30	25.0	7719.2	- 30614.2	
3	37840.4	0.30	25.0	7533.5	- 30306.9	

1.13 Lentil

Description of plot

Four low *kanda* plots (2.5 decimal each) in Fenarbak village of Fenarbak union were selected for Lentil (BARI 2) cultivation. Low *kanda* lands are very fertile and productive. The selected plots belong to three types of farmer, rich, medium and marginal.

Input cost

Plot No	Type of farmers	Seed requirement			Cost of Land preparation		Fertilizer (Tk/ha)	Weeding (Tk/ha)	Pesticide (Tk/ha)	Irrigation (Tk/ha)	Harvesting and Transportation cost (Tk/ha)	Lease value of land/season (Tk/ha)
		Unit price (Tk/kg)	Wt. (kg/ha)	Price (Tk/ha)	Tillage (Tk/ha)	Labor (Tk/ha)						
1	Medium	40	59.28	2371.2	3952	4940	4446	4940	0	4940	1976	9880
2	Rich	40	59.28	2371.2	3952	4940	4446	5928	0	2964	2470	9880
3	Medium	40	59.28	2371.2	3952	4940	4446	4940	0	3952	2470	9880
4	Marginal	40	59.28	2371.2	3952	4940	4446	4940	0	4940	2470	9880

None of the farmers followed the recommendations of research team regarding weeding and irrigation except the rich farmer. However, the rich farmer weeded his field accordingly but did not irrigate as recommended.

Crop performance at different stages and Crop's life span

Plot No	Germination		Vegetative stage		Flowering stage		Fruiting stage		Maturity stage		Date of Sowing	Date of Harvesting	Crop life span
	%	Day Req.	Performance	Day Req.	Performance	Days Req.	Performance	Day Req.	Performance	Day Req.			
1	75	5	Excellent	65	Excellent	6	Poor	12	Poor	6	05.12.06	17.03.07	101
2	80	6	Excellent	68	Excellent	7	Poor	10	Poor	7	05.12.06	14.03.07	98
3	75	6	Excellent	63	Excellent	6	Poor	11	Poor	6	05.12.06	14.03.07	98
4	75	5	Excellent	60	Excellent	7	Poor	12	Poor	6	05.12.06	15.03.07	99

Water-logging at the end period of fruiting stage due to heavy rainfall and lack of proper drainage facility affected the performance of the crops at fruiting and maturing stage.

Vegetative growth, Seeds weight and Yield

Plot No.	Plant height (cm)				Seeds weight (1000 seeds) (gm)	Expected weight (gm)*	Yield in research plot (ton/ha)	Average Yield (ton/ha)**
	30 days	40 days	50 days	60 days				
1	5	7	15	25	8.0	12.5	0.60	0.79
2	4.5	7.5	18	22	9.0	12.5	0.58	0.79
3	5	7	20	28	8.25	12.5	0.55	0.79
4	4.5	7	18	24	8.5	12.5	0.49	0.79

**Lentil in Bangladesh, BARI; **BBS, 2005*

Heavy rainfall and cold injury might be the reasons for under weight and low yield of the Lentil in the research plots.

Pest and disease infestation

There was no pest infestation in any of the plots.

As a result of water-logging at the end period of fruiting stage, due to heavy rainfall and lack of proper drainage facility, all the crop plots were infested with Root rot diseases during fruiting and maturing stage severely. However, no fungicide was used in any plot.

Nutrient status in post harvest soil and Irrigation Facilities

Plot No	Soil test result						Irrigation facilities
	OM (%)	Total N (%)	P (micro gm/gm soil)	K (milli-equivalent/100gm soil)	S (microgm/gm soil)	P^H	
1	1.24	0.10	2.37	0.23	23.98	5.5	Good
2	1.24	0.11	2.78	0.24	20.34	5.4	Good
3	1.41	0.11	2.41	0.24	26.53	5.3	Good
4	1.31	0.11	2.93	0.25	25.98	6.0	Good

Cost- Benefit Analysis

Plot No	Total cost (Tk/ha)	Total crop production (ton/ha)	Market price of crops (Tk/kg)	Total income (Tk/ha)	Net profit (Tk/ha)	Remarks
1	37,445.2	0.60	25.0	15,131.22	- 22,315.96	Low yields in the research plots resulted in losses
2	36,951.2	0.58	25.0	14,387.26	- 22,562.96	
3	36,951.2	0.55	25.0	13,585.00	- 23,366.20	
4	37,939.2	0.49	25.0	12,,350.00	- 25,589.20	

1.14 Bitter gourd

Description of plot

In the haor area, the front yard of houses are never used for cultivation, rather they use it as threshing ground after harvesting the crops, even though these lands are fertile and productive. As Bitter gourd is a profitable crop and could be harvested by early March, farmers can earn some extra money from its cultivation.

Plot No.	Variety	Plot size (Decimal)	Location (Village, Union)	Types of land	Type of farmers
1	Tia	2.0	Fenarbak, Fenarbak	Front Yard	Medium
2	Tia	1.5	Fenarbak, Fenarbak	Front Yard	Marginal
3	Tia	1.0	Gonghadhorpur, Fenarbak	Front Yard	Medium

Input cost

Plot No	Seed requirement			Cost of Land preparation		Fertilizer (Tk/ha)	Weeding (Tk/ha)	Pesticide (Tk/ha)	Irrigation (Tk/ha)	Harvesting and Transportation Cost (Tk/ha)	Lease value of land/season (Tk/ha)
	Unit price (Tk/kg)	Wt. (kg/ha)	Price (Tk/ha)	Tillage (Tk/ha)	Labor (Tk/ha)						
1	12000	7.41	88,920	3,087	6,175	5,557	2,470	0	3,087.5	9,262.5	12,350
2	12000	7.41	88,920	3,293	8,233	5,763	4,116	0	3,293.3	8,233.3	12,350
3	12000	7.41	8,8920	3,211	12,350	4,940	3,705	0	3,705.0	12,350.0	12,350

Crop performance at different stages

Plot	Germination		Vegetative stage		Flowering stage		Fruiting stage		Maturity stage	
No	%	Day Req.	Performance	Day Req.	Performance	Days Req.	Performance	Day Req.	Performance	Day Req.
1	90	6	Excellent	60	Excellent	Continuous	Excellent	Continuous	Excellent	Continuous
2	85	6	Excellent	67	Excellent	Do	Excellent	Do	Excellent	Do
3	90	7	Excellent	62	Excellent	Do	Excellent	Do	Excellent	Do

Due to heavy cold, growth of bitter gourd slightly stunted and vegetative period slightly expanded.

Crop's life span, Vegetative growth, Individual fruit weight and Yield

Plot No.	Date of Sowing	Date of Harvesting	Plant height (cm)			Individual fruit weight (gm)	Expected weight (gm)*	Yield in research plot (ton/ha)	Average Yield (ton/ha)**
			30 days	45 days	60 days				
1	04.12.06	Harvest start from end February	60	100	150	198	150 - 200	33.34	25-30
2	06.12.06	Harvest start from early March	15	50	120	130	150 - 200	19.26	25-30
3	02.12.06	Harvest start from early March	40	90	140	133	150 - 200	32.60	25-30

**Annual Research Report on Vegetable Crops, HRC, BARI; **Sabji Utpadan Adunik Kolakousal, BARI*

Pest and disease infestation

There was no pest infestation or disease infestation in any of the plots.

Nutrient status in post harvest soil and Irrigation Facilities

Plot No	Soil test result						Irrigation facilities
	OM (%)	Total N (%)	P (micro gm/gm soil)	K (milli-equivalent/100gm soil)	S (microgm/gm soil)	P^H	
1	0.88	0.06	6.10	0.12	90.21	5.1	Medium
2	1.62	0.12	16.02	0.83	232.50	6.4	Medium
3	0.22	0.03	3.66	0.10	14.33	5.6	Medium

Cost- Benefit Analysis

Plot No	Total cost (Tk/ha)	Total crop production (ton/ha)	Market price of crops (Tk/kg)	Total income (Tk/ha)	Net profit (Tk/ha)	Remarks
1	130,910	33.34	12.0	400,140	269,230	Profitable than rice cultivation.
2	80,522	19.26	12.0	231,192	150,670	
3	141,531	32.60	12.0	391,248	249,717	
4	130,910	33.34	12.0	400,140	269,230	

1.15 Ash gourd

Description of plots

Two front yard plots (1 decimal each) in Gongadhorpur village of Fenarbak union were selected for Ash gourd (Martina variety) cultivation. As Ash gourd is a low labor-intensive crop, women farmers were selected for the research: one marginal farmer and one medium farmer.

Input cost

Plot No	Type of farmers	Seed requirement			Cost of Land preparation		Fertilizer (Tk/ha)	Weeding (Tk/ha)	Pesticide (Tk/ha)	Irrigation (Tk/ha)	Harvesting and Transportation cost (Tk/ha)	Lease value of land/season (Tk/ha)
		Unit price (Tk/kg)	Wt. (kg/ha)	Price (Tk/ha)	Tillage (Tk/ha)	Labor (Tk/ha)						
1	Marginal	600	6.17	3705	3705	7410	7410	4940	-	-	7410	12350
2	Medium	600	6.17	3705	3705	6175	8645	3705	-	-	9880	12350

Crop performance at different stages

Plot	Germination		Vegetative stage		Flowering stage		Fruiting stage		Maturity stage	
No	%	Day Req.	Performance	Day Req.	Performance	Days Req.	Performance	Day Req.	Performance	Day Req.
1	70	4	Excellent	38	Good	12	Good	Continuous	Moderate	Continuous
2	70	4	Good	43	Good	13	Moderate	Do	Moderate	Do

Vegetative growth

At 20 days, Plant height (12 cm) of plot 1was higher than the plant height (10 cm) of plot 2.But at the age of 40 days and 60 days, plant height was 20 cm and 31 cm respectively, which were higher than that of plot 2

Crop's life span, Unit fruit weight and Yield

Plot No.	Date of sowing	Date of harvesting	Unit fruit weight (kg)	Expected weight (kg)*	Yield in research plot (ton/ha)	Average Yield (ton/ha)*
1	25.11.06	Harvest start from end January	2.5	1.5 -1.7	19.14	42-45
2	10.12.06	Harvest start from end January	2.2	1.5 -1.7	16.67	42-45

** Krishi Projukti Hat Boi, BARI, 2003*

Due to lack of pollination at research plots, yield was lower than the average yield.

Pest and disease infestation

As pest attack at plot 1 was of minimum level, no pesticide was used. However, farmer of plot 2 was advised to use mechanical and chemical control as the plot was infested at moderate level, but the farmer only used mechanical control. That resulted in crop damage and reduced production. On the other hand, as disease infestation in both the plots at minimum level, no fungicide was used and there were no crop damage.

Plot No.	Pest infestation			Disease infestation		
	Types of pest	Infestation stage	Infestation rate	Types of disease	Infestation stage	Infestation rate
1	Cucurbit fruit fly, Red pumpkin beetle, Epilachna beetle	Vegetative & Fruiting	Minimum Level	Leaf blight	Vegetative	Minimum Level
2	Cucurbit fruit fly, Red pumpkin beetle, Epilachna beetle	Vegetative & Fruiting	Moderate Level	Leaf spot, Leaf blight & Fruit rot	Vegetative & Fruiting	Minimum Level

Nutrient status in post harvest soil and Irrigation Facilities

Plot No	Soil test result						Irrigation facilities
	OM (%)	Total N (%)	P (micro gm/gm soil)	K (milli-equivalent/100gm soil)	S (microgm/gm soil)	P^H	
1	0.17	0.04	1.70	0.08	37.76	5.4	Good
2	0.22	0.03	2.08	0.07	35.99	5.5	Good

Cost- Benefit Analysis

Plot No	Total cost (Tk/ha)	Total crop production (ton/ha)	Market price of crops (Tk/kg)	Total income (Tk/ha)	Net profit (Tk/ha)	Remarks
1	46,930	19.14	5	95712.5	48,782.5	The farmer of plot 1 worked according to the researcher team's advice and got higher profit.
2	48,165	16.67	5	83362.5	35,197.5	

1.16 Aroid

Description of plots

A large area in the haor region remains fallow due to water-logging. To utilize these waterlogged areas, hydroponics was introduced in the research area to familiarize the farmers with the technology. Once hydroponics is prepared, it could be used for crop cultivation round the year and when the hydroponics is no longer suitable for cultivation, could be used in cropland as organic matter. Two plots (located near roadside) in Mahmudpur village of Bhimkhali union were developed, one of 36.78 m^2 and other one was 33.44 m^2 in size. Two marginal farmers were selected to cultivate Aroid (Latiraj variety) in the hydroponics.

Input cost

Plot No	Plot size (m^2)	Seed requirement			Hydroponics Making cost (Tk)	Weeding (Tk)	Irrigation (Tk)	Harvesting and Transportation cost (Tk)	Lease value of land/season (Tk)
		Unit price (Tk/100 seedlings)	No of. Seedlings	Price (Tk)					
1	36.78	25	150	37	800	-	-	20	20
2	33.44	25	150	37	700	-	-	20	20

Crop performance at different stages and Crop's life span

Plot No	Vegetative stage		Stolen initiation Stage		Maturity stage	
	Performance	Day Req.	Performance	Day Req.	Performance	Day Req.
1	Good	75	Good	40	Good	45
2	Good	70	Good	42	Good	45

Due to heavy cold, growth of Aroid was stunted.

Vegetative growth, Weight of stolen and Yield

Plot No.	Plant height (cm)			Wt. of stolen/ plant (gm)	Expected weight (gm)*	Stolen Yield (ton/ha)**		Rhizome yield (ton/ha)**	
	20 days	40 days	60 days			Research plot	Standard	Research plot	Standard
1	10	20	31	716	748.33	27.18	25-30	17.67	18-22
2	12	19	27	720	748.33	27.51	25-30	18.24	18-22

** Annual Report 2005-2006, P-35, TCRC, BARI; ** Krishi Projukti Hat Boi, BAR*

Due to better management, the yield of plot 2 was higher than plot 1.

Crop's life span

Plot No	Date of plantation	Date of harvesting (stolen)	Date of rhizome harvesting	Crop duration
1	22.12.06	From early April	25.05.07	5 months
2	23.12.06	From early April	25.05.07	5 months

When the stolen initiation reduced, the rhizomes were harvested.

Pest and disease infestation

Both the plots (Plot 1 and 2) were infested by Mite during vegetative stage at a minimum level. None of the farmers use any chemical insecticide. However, they did take some mechanical control measure. On the other hand no disease infestation in plot 1, while plot 2 was infested with Leaf spot during vegetative stage. As the infestation was at a minimum level, no fungicide was used. The disease did not hamper the growth and yield of Aroid.

Cost- Benefit Analysis

Plot No	Total cost (Tk)	Total stolen production (kg)	Total rhizome production (kg)	Market price of stolen/rhizome (Tk/kg)	Total income (Tk)	Net profit (Tk)
1	877	100	65	12	1980	1003
2	777	92	61	12	1836	1059

1.17 Potato

Description of plots

Plot No.	Variety	Plot size (Decimal)	Location		Types of land	Type of farmers
			Village	Union		
1	Diamond	2.35	Soyhara	Fenarbak	Low kanda	Marginal
2	Diamond	2.34	Soyhara	Fenarbak	Low kanda	Marginal
3	Diamond	1.22	Soyhara	Fenarbak	Low kanda	Medium
4	Diamond	2.56	Soyhara	Fenarbak	Low kanda	Medium
5	Cardinal	1.94	Soyhara	Fenarbak	Low kanda	Rich
6	Cardinal	3.03	Soyhara	Fenarbak	Low kanda	Marginal
7	Cardinal	1.67	Kandagoan	Bhimkhali	High kanda	Rich

Input cost

Plot No	Seed requirement			Cost of Land preparation		Fertilizer (Tk/ha)	Weeding (Tk/ha)	Pesticide (Tk/ha)	Irrigation (Tk/ha)	Harvesting and Transportation Cost (Tk/ha)	Lease value of land/season (Tk/ha)
	Unit price (Tk/kg)	Wt. (kg/ha)	Price (Tk/ha)	Tillage (Tk/ha)	Labor (Tk/ha)						
1	25	1576	39414	4204	10510	8408	7882	36787	5255	7882	13138
2	25	1583	39583	4222	10555	8444	7916	31666	5277	10555	13194
3	25	2024	50614	7086	15184	12147	10122	50614	-	10122	20245
4	25	1929	48242	5789	14472	9648	9648	38593	3859	9648	14472
5	25	1909	47744	5092	12731	10185	12731	44561	3819	10185	15914
6	25	2037	59100	5706	12227	9782	10189	32607	4075	12227	12227
7	25	2218	55464	3697	7395	7395	3697	36976	-	7395	11832

As the individual plot area under the research was small, the production cost was comparatively high. With a larger cultivated area the production cost would be less.

Crop performance at different stages and Crop's life span

Plot No	Germination		Vegetative stage		Tuber initiation stage		Maturity stage		Date of plantation	Date of Harvesting	Crop life span
	%	Day Req.	Performance	Day Req.	Performance	Days Req.	Performance	Day Req.			
1	80	6	Excellent	40	Excellent	14	Good	7	01.12.06	11.02.07	72
2	82	5	Good	38	Good	10	Moderate	6	02.12.06	12.02.07	72
3	80	4	Good	43	Good	15	Moderate	7	01.12.06	14.02.07	75
4	85	5	Excellent	42	Excellent	16	Good	8	03.12.06	14.02.07	73
5	83	4	Excellent	45	Excellent	15	Good	6	04.12.06	12.02.07	70
6	80	6	Excellent	44	Excellent	15	Good	6	01.12.06	14.02.07	75
7	70	5	Moderate	45	Poor	16	Poor	7	06.12.06	15.02.07	71

Due to disease (Late blight) infestation all the plots were harvested before the maturity stage which resulted in reduced crop life span.

Vegetative growth, Seeds weight and Yield

Plot No.	Plant height (cm)				Yield per plant (kg)	Expected Yield/ plant (kg)*	Yield in research plot (ton/ha)	Average Yield (ton/ha)**
	20 days	30 days	40 days	50 days				
1	12	22	50	60	1.50	1.00 – 1.50	20.00	14.88
2	20	30	45	60	1.00	1.00 – 1.50	18.03	14.88
3	10	25	50	58	0.75	1.00 – 1.50	19.26	14.88
4	15	25	45	55	1.20	1.00 – 1.50	23.22	14.88
5	16	22	39	60	0.75	1.00 – 1.50	26.67	14.88
6	15	25	45	55	0.75	1.00 – 1.50	20.25	14.88
7	10	15	25	32	0.50	1.00 – 1.50	6.03	14.88

**Sabji Utpadonar Adunik Kolakousol, BARI, 200; **BBS, 2005*

Heavy fogging and rainfall caused Late blight disease in plot 7 at severe scale. The infestation hampered the tuber initiation and the tubers did not mature up to the mark which resulted in fewer yields per plant than the standard yield in that plot.

Pest and disease infestation

The Rats and Cutworms cut the stem of the potato plants. In an attempt to control the Rats farmers used poisons but it was very difficult to control. On the other hand, farmers used flood irrigation to control Cutworm rather than using any chemical insecticide.

Due to heavy fogging and rainfall, Late blight infested plot 2, 3 and 4 (moderately to severely). Fungicides were applied on those plots several times but rainfall washed out the fungicides.

Plot No.	Pest infestation			Disease infestation		
	Types of pest	Infestation stage	Infestation rate	Types of disease	Infestation stage	Infestation rate
1	Cut worm	Seedling & vegetative	Minimum level	Early Blight	Vegetative	Minimum level
2	Cutworm and Rat	Seedling, vegetative& Tuber initiation	Moderate	Early Blight	Vegetative	Moderate
3	Cutworm	Seedling, vegetative& Tuber initiation	Minimum level	Late Blight	Maturity	Moderate
4	Cutworm and Rat	Seedling, vegetative& Tuber initiation	Moderate	Early Blight	Vegetative	Minimum level
5	Rat	Tuber initiation	Moderate	Early Blight	Vegetative	Minimum level
6	Cutworm	Seedling, vegetative	Minimum level	Early Blight	Vegetative	Minimum level
7	Cutworm	Seedling	Moderate	Late Blight	Tuber initiation	Severe

Nutrient status in post harvest soil and Irrigation Facilities

Plot No	Soil test result						Irrigation facilities
	OM (%)	Total N (%)	P (micro gm/gm soil)	K (milli-equivalent/100gm soil)	S (microgm/gm soil)	P^H	
1	2.6	0.14	15.67	0.47	124.73	5.1	Medium
2	3.0	0.17	23.88	0.71	297.52	4.7	Medium
3	2.17	0.14	13.67	0.50	139.26	5.0	Medium
4	2.90	0.16	14.48	0.49	112.19	4.7	Medium
5	0.22	0.01	2.67	0.05	3.34	7.0	Medium
6	0.45	0.05	1.66	0.10	25.31	5.4	Medium
7	0.29	0.03	3.82	0.09	17.86	5.4	Medium

Cost- Benefit Analysis

Severe infestation by Early blight in plot 7 caused poor yield (6.03 ton/ha only), which resulted in loss for the farmer.

Plot No	Total cost (Tk/ha)	Total crop production (ton/ha)	Market price of crop (Tk/kg)	Total Income (Tk/ha)	Net profit (Tk/ha)	Remarks
1	133,485.1	20.00	15	300,105	166619.9	Profitable
2	131,416.7	18.03	15	270,465	139048.3	Profitable
3	176,139.3	19.26	15	288,990	112850.7	Profitable
4	154,375.0	23.22	15	348,270	193895.0	Profitable
5	162,969.1	26.67	15	400,140	237170.9	Profitable
6	158,145.2	20.25	15	303,810	145664.8	Profitable
7	176,006.0	6.03	15	88,920	-87085.0	Loss

ANNEX - B: Climatic data of the research area

B1: Three hourly rainfall data, Station: Sylhet (Data Source: BDM)

Year	Month	Hour	Day of the month																													
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
2006	11	0	0	0	0	0	0	0	0	0	0	0	0.8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
2006	11	3	0	0	0	0	0	0	0	0	0	0	0.3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
2006	11	6	0	0	0	0	0	0	0	0	0	0	0.4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
2006	11	9	0	0	0	0	0	0	0	0	0	0	0.2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
2006	11	12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
2006	11	15	0	0	0	0	0	0	0	1	0	0	0.2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
2006	11	18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
2006	11	21	0	0	0	0	0	0	0	0	0	0.6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
2006	12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2006	12	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2006	12	6	0	0	0	0	0	0	0	0	0	0	0	2.8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2006	12	9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2006	12	12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2006	12	15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2006	12	18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2006	12	21	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2007	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2007	1	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2007	1	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2007	1	9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2007	1	12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2007	1	15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.6
2007	1	18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2007	1	21	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2007	2	0	0	0	0	0	3	0	0	17	0	0	0	0	0	6.4	0	0	0	0	0	0	0	0	0	0	0	0	0	0			
2007	2	3	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0			
2007	2	6	0	0	0	0	0	0	0	0	0	0	0	0.2	0	0.8	0	0	0	0	0	0	0	0	0	0	0	0	0	0			
2007	2	9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0			
2007	2	12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0			
2007	2	15	0	0	0	0	0	0	0	0	0	0	0	0	0.2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0			

2007	2	18	0	0	0	0	1	0	0	0	0	0	0	0	0.8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0			
2007	2	21	0	0	0	0	0	0	0	0	0	0	0	0	1.4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0			
2007	3	0	0	0.9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	2	3.8	0	0	0	0	0	0
2007	3	3	2.2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	11	0	0	0	0	0	0	0	0
2007	3	6	3.6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2007	3	9	0.2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
2007	3	12	0	0	0	0	0	0	0	0	0	0	0	0	0	0.8	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
2007	3	15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2007	3	18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	3.8	0	0	0	0	0	0	0	0
2007	3	21	0.1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	6	0	0	0	0	0	0	0
2007	4	0	0	0	0	2	0	31	1	4	0	8.2	5	0	0	0	0	0	7	0	0	1	7.2	5	3.8	0	0.4	0.8	0	0	0	0	
2007	4	3	0	0	0	0	0	8	0	0	0	0.2	0.9	0.4	0	0	0	0	1.6	0	0	0	5.6	18	31	31	0	0.6	5	0	0	0	
2007	4	6	0	0	0	0	0	0	0	0	0	0	0.4	1.6	0	0	0	0	0	0	0	0	5	1.2	0	8	10	0.4	0	0	0	0	
2007	4	9	0	0	0	0	0	0	0	0	0	0	0	0.4	0	0	0	0	0	0	0	0	0	0.4	0	0	0	4.8	0	0	0	0	
2007	4	12	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2.4	0	0	0	0	0	0	0	0	0	
2007	4	15	0	0	0	9	0	0	0	0	0	16	0	0	0	0	0	0	0	0	0	0	0	0.4	0	0	0	0	0.4	0	0	0	0	
2007	4	18	0	13	13	23	0	9	0	18	35	0.4	0	0	0	0	0	0	0	0	0	0	0	0	0	1.4	15	0	0	0	0	0	0	
2007	4	21	0	9.4	34	8	0	0	25	0	0	0.4	0	0	0	0	0	0	0	0	0	8	3	8.4	0	0.4	2	11	0	0	0	0	0	
2007	5	0	0	0	0	0	0	0	5	4	0	0	0.8	0	0	0	9	3.2	0	0	0	7	0.2	0	0	0	0	0.4	0	0.8	2.2	0	0.2
2007	5	3	0	0	0	0	0	0	3	3	0	0	63	0	0	0.2	4	0.4	0	0	1	3	94	0	70	4	0	0	27	0.4	45	1.2	0.6
2007	5	6	0	0	0	0	0	0	0	0	0	0	5.4	0	0	0.8	1	0	0	0	0	0	65	0	0	8	0	0	0	0	0	0	0
2007	5	9	0	0	0	0	0	0	0	0	0	0	0	0	0	0.1	0	0	0	0	0	0	17	0	0	0	16	0	0	0	0	0	0
2007	5	12	0	0	0	0	0	0	0	0	0	0	0	0	0	0.5	0	0	0	0	0	0	0.2	0	0	0	1	0	0.2	0	0	0	0
2007	5	15	0	0	0	0	0	0	0	0	8	0	0	0	0	1.4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
2007	5	18	0	0	0	0	0	0	0	0	0	0	0	0	0	0.4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	10	4.2
2007	5	21	0	0	0	0	0	26	9	0	0	5	0	0	0	3.8	0	0	0	0	29	0	0	0	7	0	0	1.6	0	11	5.4	15	23

Legend

00 Rainfall during these period damaged the potato crops

00 Rainfall during these period damaged the lentil crops

B2: Three hourly relative humidity (%), Station: Sylhet (Data Source: BDM)

Year	Month	Hour	Day of the month																													
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
2006	11	0	93	91	99	95	94	93	91	81	94	97	97	94	95	100	90	92	90	89	95	97	97	91	100	92	92	98	89	89	92	89	
2006	11	3	78	78	73	75	91	70	82	74	84	89	79	62	66	80	82	58	65	67	75	92	80	86	92	80	86	90	85	69	74	72	
2006	11	6	57	62	56	57	79	55	62	60	64	75	81	54	54	61	55	47	54	46	55	63	66	74	58	57	64	60	54	47	52	47	
2006	11	9	57	51	52	55	74	54	64	53	67	80	79	51	49	51	39	43	48	39	48	56	51	55	44	52	60	42	41	35	37	44	
2006	11	12	75	75	61	65	87	70	67	71	78	79	78	75	70	70	70	62	69	60	72	77	77	77	64	76	72	61	62	59	59	72	
2006	11	15	88	82	84	82	93	84	90	97	89	90	91	81	82	84	75	77	73	77	80	87	86	85	74	80	89	83	74	86	78	85	
2006	11	18	91	91	84	93	92	87	91	93	93	95	86	86	91	87	84	83	88	89	93	87	87	91	82	90	93	86	71	92	89	90	
2006	11	21	91	91	91	92	92	88	91	94	95	97	87	86	91	80	87	85	90	92	93	92	88	94	83	93	94	87	72	92	83	92	
2006	12	0	95	94	96	95	89	81	87	78	92	97	91	90	98	97	97	93	80	77	89	86	83	83	77	94	100	100	97	97	90	96	100
2006	12	3	82	84	82	79	73	70	73	70	74	88	88	84	87	82	84	69	57	69	74	71	61	56	69	79	100	89	100	83	78	87	100
2006	12	6	55	57	57	47	47	48	51	46	61	67	62	82	68	56	57	37	43	51	49	37	41	41	46	53	55	60	61	73	54	63	67
2006	12	9	47	47	36	35	38	40	45	43	48	56	46	67	33	46	40	42	38	45	38	31	33	32	38	46	43	43	49	59	44	31	54
2006	12	12	75	75	71	62	71	59	69	67	68	63	75	80	76	76	75	55	53	60	66	62	59	55	58	63	58	75	73	79	70	67	65
2006	12	15	86	90	88	83	74	82	79	81	84	82	89	87	77	86	85	51	69	79	61	65	60	71	81	78	72	82	88	91	84	85	87
2006	12	18	88	93	93	84	80	90	89	92	87	89	91	95	90	89	73	59	57	70	74	75	68	82	88	90	85	88	92	96	81	89	94
2006	12	21	91	94	94	87	81	91	93	91	89	90	92	94	91	89	78	69	58	69	82	79	73	84	91	89	88	90	97	95	93	91	94
2007	1	0	100	97	100	100	100	100	100	94	91	100	93	93	93	96	89	72	70	81	88	83	81	91	90	79	79	78	85	87	90	84	92
2007	1	3	100	94	100	97	100	99	100	91	82	93	83	78	79	92	70	59	59	63	66	81	74	76	69	60	59	57	64	69	69	67	85
2007	1	6	77	75	85	61	79	62	79	79	58	59	54	51	54	53	37	37	31	37	51	54	52	45	40	34	42	38	40	43	50	54	63
2007	1	9	63	52	54	47	55	48	59	68	49	50	44	37	41	32	24	32	24	29	22	46	49	31	40	30	29	32	27	35	35	43	56
2007	1	12	85	60	73	89	82	87	88	89	70	69	67	60	64	52	38	53	42	42	62	64	69	59	38	49	47	44	52	55	62	65	76
2007	1	15	96	81	85	91	95	96	100	97	92	87	90	77	87	69	64	69	56	77	81	69	83	67	69	71	68	66	76	83	79	80	91
2007	1	18	95	94	94	93	95	100	100	96 1	0	91	91	90	91	78	67	74	77	88	88	75	89	84	76	76	79	83	86	87	88	87	95
2007	1	21	95	94	95	94	100	100	100	98 1	0	92	92	91	93	81	73	77	79	89	90	76	91	85	79	83	81	83	87	87	91	89	92
2007	2	0	93	85	100	84	97	97	94	92	96	86	73	73	92	97	93	97	85	94	74	94	89	81	74	76	91	91	94	78			
2007	2	3	84	76	90	85	88	85	81	79	68	64	57	82	76	97	83	75	60	64	58	69	59	58	52	57	67	87	71	58			
2007	2	6	61	59	58	72	64	61	60	65	46	44	46	78	51	90	76	44	44	40	40	40	37	35	37	40	49	40	43	40			
2007	2	9	60	54	43	66	68	58	51	49	41	29	29	67	53	76	55	31	43	34	43	30	38	39	27	29	45	35	38	28			
2007	2	12	71	77	67	73	79	76	69	59	58	46	52	78	62	85	60	47	46	46	46	47	43	60	47	57	45	54	46	37			
2007	2	15	74	95	74	84	84	79	77	89	74	69	75	92	74	92	82	78	78	87	64	70	64	68	70	67	76	70	74	62			

2007	2	18	86	98	81	89	94	90	81	94	86	67	79	91	85	92	89	81	85	86	83	85	66	78	82	79	90	79	84	79			
2007	2	21	85	100	82	89	95	91	83	94	84	67	82	91	87	93	92	82	87	87	85	87	71	81	82	84	91	84	84	81			
2007	3	0	83	97	95	98	97	95	89	73	73	79	67	70	86	90	95	85	67	76	82	68	73	90	90	95	96	82	73	69	73	60	62
2007	3	3	89	95	74	61	71	67	59	49	49	54	49	50	55	56	98	59	41	41	47	41	55	87	94	93	89	56	43	44	44	38	52
2007	3	6	92	75	50	41	45	37	23	22	31	35	40	38	38	49	53	44	18	25	30	26	34	64	77	67	48	43	33	25	32	19	35
2007	3	9	66	67	42	35	33	27	22	16	21	21	36	22	22	50	39	27	16	17	29	21	29	70	65	39	28	17	14	20	15	22	34
2007	3	12	83	75	46	46	43	43	29	26	36	29	45	49	45	67	54	40	31	32	37	29	46	84	74	60	35	26	24	36	31	32	44
2007	3	15	90	90	70	71	70	64	59	64	56	52	69	68	64	76	75	50	57	55	62	58	67	92	85	73	64	55	52	54	51	64	75
2007	3	18	90	94	90	86	82	83	71	72	74	69	78	58	77	90	70	67	65	74	80	71	70	91	95	89	74	65	55	67	67	59	82
2007	3	21	92	93	92	88	85	83	77	72	75	71	75	58	77	92	84	69	69	76	77	77	73	93	95	86	79	67	58	67	72	62	81
2007	4	0	91	86	91	99	93	95	95	95	97	95	98	84	95	76	84	91	91	87	93	95	94	96	95	77	94	92	85	80	85	89	
2007	4	3	62	80	76	79	79	95	73	79	88	83	86	88	70	51	58	61	91	66	78	86	98	97	98	97	69	86	91	62	64	62	
2007	4	6	50	64	65	66	63	65	66	62	68	76	69	95	50	48	48	56	72	56	65	91	87	81	95	98	58	63	64	54	58	49	
2007	4	9	42	50	60	53	48	59	55	57	64	66	59	86	42	42	44	50	71	51	55	59	84	74	88	67	71	61	63	55	49	39	
2007	4	12	43	61	80	66	67	66	65	67	72	75	66	84	48	46	51	57	61	58	61	66	96	82	77	72	76	73	67	61	53	42	
2007	4	15	57	68	87	98	83	79	79	80	78	98	80	90	69	74	81	74	81	77	70	86	94	88	81	77	77	87	80	78	79	66	
2007	4	18	61	88	88	91	83	93	83	96 1	0	94	78	94	81	87	87	84	89	87	78	81	96	88	83	93	79	89	93	89	87	79	
2007	4	21	61	92	97	90	91	91	98	94 1	0	92	78	94	84	85	89	88	90	89	99	87	97	89	80	85	97	79	94	87	90	82	
2007	5	0	84	81	85	87	87	93	93	97	89	91	95	91	95	82	98	98	93	93	95	98	91	96	88	95	91	94	95	91	95	96	93
2007	5	3	56	52	64	61	69	74	95	94	69	68	98	61	73	86	81	83	81	85	81	96	99	92	98	96	74	78	99	91	97	88	87
2007	5	6	48	44	52	51	53	56	79	67	61	60	89	59	60	82	91	73	67	71	72	74	98	85	89	85	67	67	85	68	76	81	73
2007	5	9	32	42	48	45	50	54	63	53	55	58	76	65	52	79	93	63	63	63	63	67	96	85	82	72	96	61	88	68	69	73	67
2007	5	12	45	52	52	50	56	66	64	58	64	49	77	74	58	87	95	66	66	65	69	72	96	87	77	78	95	69	94	74	73	77	69
2007	5	15	73	62	59	76	72	76	83	79	95	69	89	83	71	76	98	83	82	80	83	81	97	92	82	82	91	81	87	86	86	85	86
2007	5	18	75	70	64	83	87	86	89	81	93	81	89	88	75	67	97	91	90	83	100	87	97	87	94	91	91	93	91	90	94	97	94
2007	5	21	75	74	70	85	92	100	91	83	97	96	91	90	76	81	97	91	91	87	98	87	98	87	99	93	92	95	91	88	97	90	100

Legend

High Humidity damaged Potato & Sweet Gourd

B3: Three Hourly Dry Bulb Temperature in Degree Celsius, Station: Sylhet (Data Source: BDM)

			Day of the month																													
Year	**Month**	**Hour**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**	**25**	**26**	**27**	28	29	30	31
2006	11	0	22.8	22	21.6	22	23.1	21.5	22.8	22.5	21.6	22.5	22.8	21	21.2	21.3	20.5	20.5	19.2	18.9	19	18.7	19	18.9	17.5	18.2	19	18.2	16.3	15.8	13.8	14.5	
2006	11	3	24.6	25	26.3	27	25	25.6	24.5	25.3	23.4	24.5	23.2	26	26.5	24.9	24.5	25.4	25	24.2	23.3	20.8	21.8	21	20.6	22	21	20.8	19	18.5	18.7	17.8	
2006	11	6	28	29.5	30.5	30	27	30	26.8	29	26.8	26.5	23	29.7	30.2	30.5	29.7	30	28.5	28	28.3	25.3	25.5	25	25	26.2	25	26	24.5	23.6	23.4	24.4	
2006	11	9	29	31.5	32.5	31	28.4	31	27.1	29.8	27	26.8	25	31.3	31.5	30.5	32	30.8	30.5	30	29	27.6	27.8	27.8	27.2	27.6	27.4	27	26.6	27	25.5	25.6	
2006	11	12	25.6	27.2	28.5	28	25.1	27.2	26.5	27	25.5	25.4	24	27	27.2	27.2	26	27.2	25	25.8	24	23.4	23	23.7	23.5	23	23	22	21.5	22	19.3	20.3	
2006	11	15	22.8	25	25	26	22.8	25	23.6	22.8	23.8	24	22.4	24.2	25	24.8	24.5	24	23.5	22.4	22	22	20.2	22	20.7	21.5	20.5	18	18.4	17.3	17	17.1	
2006	11	18	22.2	23.1	23.5	24	22.3	23.6	23	22.2	23.5	23.5	22	23	23.3	23.5	22.2	22	20.7	20.5	20	20.6	20	20.4	20	20	19.2	17.3	17.8	15.2	15	16	
2006	11	21	22	22	22.1	23	21.8	22.8	23	21.8	23	22.8	21.8	22.5	23	21.5	21.2	21.3	20.4	19.5	19.4	19.8	19.8	19.8	19.5	19.2	18.5	17	17.5	14.5	15.5	15	
2006	12	0	14.7	15	15.8	15	15	15.3	15.6	16.5	15.5	15.8	16	16.5	14.7	12.7	14.5	15.4	15.8	18.7	18	17	17.2	16.9	16.4	16	16	14.1	14.5	14.2	14.5	12.8	12.4
2006	12	3	17.2	18	18.5	19	19	19.8	19.5	20	19	19	18.6	18	18.9	17.7	17.5	19.7	21.5	22	21.7	20.5	22	21.5	19.9	19.5	16.6	17.2	15.2	16.6	17	16.7	14.5
2006	12	6	23.5	24	24	24	25	25.3	26	25.9	25	24.2	23.8	19.6	23.8	23.1	23.3	26.4	25.2	26.7	26.6	27.5	26.8	25.5	26.5	25.2	25	23.5	22.2	20.8	22.7	21.4	21.5
2006	12	9	25.4	26	26.2	27	27	27.5	27.7	27.3	27.8	26.4	27.2	22.3	25.5	25	26.4	28	29	27	28.2	28.4	28.4	29	28	27.6	27.5	26.4	24	23	26.4	25.5	25
2006	12	12	20.5	20.8	21.5	22	21	23	22.3	22.8	22	22.5	21	20.5	20.2	20	20.6	22.7	24	23.5	23.3	23.6	23	22.7	23.3	23.5	22.5	20.5	20.2	19.5	21	20.5	21.2
2006	12	15	17.8	18.4	18.7	18	18.5	19.3	19.5	20	19.2	18.8	18.5	18.8	17.2	17.3	17.8	21.3	20.2	20.6	21	21.6	21	19.3	19.4	20.2	19.5	18	16.1	16.8	18	16.7	17.2
2006	12	18	16.4	17	17	17	16.2	17.2	17.5	17.8	17.2	17.4	17.5	16.7	15.5	15.7	17.7	19.5	20.4	20	19	20	19.2	17.2	17.6	18.5	17	16.4	15.3	15.8	15.5	15.2	15
2006	12	21	15.8	16.2	16.3	16	15.5	16.3	16.8	17.1	16	16.9	16.9	16	15.3	15	17.1	18	19.6	19.6	17.7	19.2	18	16.5	16.5	17.5	16.4	15.2	14.5	15	13	13.5	13.5
2007	1	0	12.5	12.5	11.7	11	12	14.5	14.5	15.5	15.3	13	13.1	13.4	12.6	11.8	8.8	10	10.8	10.4	10.4	12.4	13.6	12.7	12	13	12.8	13.9	13.8	15.2	15.2	16.7	17.5
2007	1	3	14.5	14	12.5	13	12.5	15	15	16	16.7	15	16	16.5	15.4	14	14	13.7	15.8	15	14.4	14	15.2	15.3	15.8	16.8	17.4	17.7	18	18.5	19	20	19.8
2007	1	6	20	19.5	17.5	21	18.5	21.7	18.8	18.6	22	23	22	23.5	22	21.2	21.7	20	22.2	22.5	20.5	19.8	20.4	22.5	22.2	24.8	24	24.4	25	25.6	25	25	24.2
2007	1	9	22.5	22.8	21.8	23	23	25.2	23	20.7	24.4	25	24.5	26	23.6	23	23.2	22.5	26	25	23.7	23.5	22.8	25	22.2	27	27.5	27.5	28.7	29.1	27	27.4	26
2007	1	12	19.5	20	17.5	17	19.2	19.3	17.5	16.8	20	20.3	21	20.7	19.3	17.7	17.7	18.5	20.5	19	18.8	19.3	18.5	20	19.8	21.7	22.5	24.2	24	23.7	23	24.5	23.1
2007	1	15	17	16.2	14.8	16	17	16.7	15.5	14.8	16	17	18	16.7	15.7	14	13	14.5	15.5	15.5	15.3	17	15.4	16.8	17.3	17.5	18.7	19.5	19.3	19.5	19.5	20.5	20.9
2007	1	18	15.4	14	13	15	15	15.3	15.5	15.6	14	16	16	14.5	14	11.5	12	11.8	12.3	13.3	13.4	15.4	13.7	13.8	14.2	14	15.8	15.5	16.8	17	17.4	18.2	19.9
2007	1	21	14.8	13	12.5	14	14.5	14.7	15.5	15	14	15	15.2	13.5	13.2	11	11.2	11	11.6	12.1	12.8	14	13	13.2	13.8	13.1	15	14.5	16	15.5	16.6	17.8	19
2007	2	0	16.8	17.4	18	18	16.7	16.8	17.5	16	16	16.8	17.3	17.5	15	17.1	16.5	13.5	14	14	14.4	13	15	15.7	16.3	16.1	16.8	18.4	16	17			
2007	2	3	18	20	19.5	19	17.8	19	19.5	19	20	20.8	21	18.6	18.5	17.3	18	17.3	18	18.7	18.6	18	19	19.8	20.9	21	20.5	20.6	21.5	21			
2007	2	6	23	24.8	24.5	22	21.4	22.8	23.6	22	25.2	26	25	18.7	24	19	19.6	22.3	24.2	24.6	25	24.5	25.5	27	27.5	27.3	27	27.2	26.8	27.1			
2007	2	9	25.2	26.8	28	23	21.2	23.6	26.8	24.3	28.5	29	29	21.5	24.7	20.2	22.6	24	25.4	25.8	26.2	27.5	28	29.5	30.2	29.8	30.8	28.3	28.5	29			
2007	2	12	23.2	23.5	23.8	21	19.5	21.5	19.4	22.7	25	25	25	20.2	22	19	20	21	22.5	22	22	23.4	24.3	25.2	25.4	26.8	26.5	24.5	25	25.7			
2007	2	15	21.7	20.5	21	19	18.8	19.7	17.5	19	21	21.2	21	17.8	19	18.4	17.2	17.3	18	16.5	19	19.9	21	21.3	22	22.8	22	22	20.7	22			

2007	2	18	18.8	19.2	19.2	18	17.6	18.5	17.5	17.8	18.7	19	18.5	17	18.5	17.6	16	15.4	16.3	15.5	16	17.4	19	18.5	19.5	20	19.5	20	18	19			
2007	2	21	17.6	17.8	18.5	17	17.5	18	17	17	18	18.3	17.5	16.4	18	17	15.5	14.9	15.5	15	14.5	16.9	17.5	17.6	18.7	19	18.4	18.8	17.5	18.3			
2007	3	0	16.6	17.8	15.4	15	16.1	15.4	15	15.3	15	16.1	18.4	20	19.7	20.2	19.3	18.4	15.3	15.4	17	19.2	20	20.8	19	22	23.2	19	19.5	19.7	20.1	21.4	21.6
2007	3	3	17	19	20.6	21	21.2	20.5	20.8	20	20.5	22	22.2	24.7	25.5	25.5	19.2	21.3	21	22.5	23	25.5	24.2	20.8	20.4	24.3	25.3	24.7	25	26	26	26.5	26.5
2007	3	6	18	21	25.6	28	27	26.8	26	26	27.2	29.2	27.5	31.3	31.7	29.4	27.8	25	27	29.5	30	31.3	31.2	25	23.4	29	30.5	30.7	30.5	32.2	32.8	33.7	33.5
2007	3	9	21.4	22	27	29	29.4	28.8	27.4	27.7	30.6	31.2	31.6	33.3	33.6	28	29.5	28.2	29.2	32	32.4	34.2	32.3	24.5	26.4	32.4	32	33	33.3	35.2	35.8	35	35
2007	3	12	20.2	20.5	24.7	25	25	25	24	25	26.2	28	29	29.4	28.2	23	26.2	24	25.5	27	28	29.3	29.5	23	25.4	28.2	28.3	29.5	30	30.2	32.4	32.5	32
2007	3	15	19	19	21.2	22	21.7	20.8	18.5	19.8	22.2	23.4	23.6	27.2	25.7	22	23	20	21	22.8	23.8	24.8	26.3	21.3	23.7	26.6	24	24.5	24.5	26.4	26	26.1	27.2
2007	3	18	19	18	19	19	19.5	18.7	16.5	17.1	19	20.7	21.5	24.5	23.5	19.5	23	18	19.2	19.3	20.5	22.5	25	20.4	22.5	24.2	21	21.5	23	22.7	22.8	22.7	25
2007	3	21	18.8	17.4	17.7	19	18.5	17.8	15.5	16.3	18.4	19.4	20.5	23.6	22.6	18.4	20	17.4	18.2	18	19.2	21	24.1	19	22	23	20.1	20.5	22	22	22	21.6	24
2007	4	0	22.6	24.7	21.6	21	20.5	21	22.1	19.5	20.3	20	20.2	20.8	18	21.5	22.8	23.3	25.4	23.2	24.8	23.2	21.5	22.4	22.2	22.5	20	20.4	22.7	22.4	23.5	24	
2007	4	3	27.5	26.3	26.3	25	24.3	21.5	27.4	22.2	21.5	21.8	21	21	23.7	27.8	28.4	29	22.7	29	28.7	25.8	22.5	21	21.2	18.8	24	22	20.3	26	28.3	29.5	
2007	4	6	31	29	30	30	28.2	26.5	30	26	25.5	23.8	23.5	20	27	30.8	31.8	31	28	31.8	31.4	26	24.8	23.6	22	20	25.5	26	26.5	29.4	31.4	33	
2007	4	9	33.8	32.7	31.5	31	32	30	31.8	28.2	28	25.5	24.8	20.5	30	32	33.9	33	29.8	33.5	33.5	30.4	25.4	25.4	22.8	24.5	25	28.2	26.5	30.6	33	34.6	
2007	4	12	31	29.7	25.5	30	29.5	28.3	29.7	27.5	27	24.5	23.4	20.4	27.8	30.4	31	31.7	29.6	31	31.5	29.3	24.5	24.8	23.5	24.2	24.9	27	26.5	29.8	31.8	33.2	
2007	4	15	28	28.6	25	25	27	26.9	27.5	24.3	25.2	22	22	20	25	26.4	27	29.2	26.1	28.5	27.1	27.1	23.7	24.3	23	23.5	23.4	24.4	23.7	26	28	29	
2007	4	18	26.8	21.4	23.3	22	26.8	23.3	27	20.2	19	21.1	21.7	19	23	24	25.4	27.4	24.8	26.5	25.5	25.6	23.4	23	22.8	19.7	22.6	23.8	22.7	24.8	25.8	27	
2007	4	21	26.2	20.8	22.3	21	22	22	19.2	20	19	20.8	21.5	18.8	22.5	22.7	24	26.4	24.2	25.5	23	24.5	22	22.6	22.6	20	19.8	23	22.2	23.5	24.5	26.2	
2007	5	0	24.8	25.5	25	26	27	27.3	22.5	24	26.3	24.8	24	26	26	26.3	21.2	23.2	25.8	25.3	26	24.5	25.3	25.5	23.8	23.7	24.5	22.6	24.8	24.2	24.6	25	24.8
2007	5	3	30.5	30	30.2	30	31.3	29.8	23.8	24	30.5	29.4	24	31.8	29.5	25.8	23.8	26.5	27.5	27.4	27.8	25.5	24.5	26.3	22.2	23.6	28	25.3	25.1	25.8	23.8	27.7	27.6
2007	5	6	33.7	34.4	34	34	35	31.4	28	29.4	32	32.7	26	32	32	26	23.3	29	31	30.8	30	29.5	24	28.3	24.2	26.3	30.1	29.6	28.9	29.3	28.5	29.8	30.3
2007	5	9	36.2	35.7	36	34	35	33.5	31	32.1	33.5	33.6	29	31.6	34	25.6	23.8	30.4	31.8	32.3	32	31.3	25	28.3	25.5	28	21.7	31.3	25	31.7	31.3	32.2	32.5
2007	5	12	33.8	34	32.2	33	33.2	32.3	30.8	31.5	29	32.6	28.8	30.4	33.2	24	23	30.7	31.5	31.3	31	30.7	25.7	28	26.3	27.8	22.5	29.5	25.4	30.3	30.8	31.5	31.5
2007	5	15	29.5	29.1	29.5	30	29.6	29.8	27.5	28	24.5	28.4	26.8	28	29.3	23.5	23.1	28	28.5	29	29.1	28	25.3	26.5	25.8	26.5	23	28	24.4	28.5	29.1	29.5	28.2
2007	5	18	27.3	27	27.3	29	27.8	28.2	26.8	27.4	25.3	28	26.5	27.2	27.3	24.5	23.3	26.4	26.2	27.2	24.7	27	25.6	26	25.7	25.5	23	26.8	24	28.6	27	27	26.5
2007	5	21	26.7	26	25.6	28	27.2	22	25.5	26.9	25	25.5	26	26.9	26.5	23	23.5	26	25.5	26.5	24.5	26.9	25.2	25.5	22.7	24.5	22.9	25.1	24	27	26	25.5	23.5

Legend

Low temperature caused rice sterility

B4: Monthly & Yearly Average Dry Bulb Temperature (^{O}C), Station: Sylhet

Year	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Annual
1987	19.2	21.5	23.4	25.3	27.2	26.7	27.1	27.2	27.2	26.2	23.7	20.1	24.6
1988	19.2	21.2	23.6	26.7	25.5	28	27.6	27.1	27.6	26.3	23.6	20.5	24.8
1989	16.8	20	24.1	26.2	28	27.4	27.4	28.3	27.1	26.2	22.2	18.4	24.4
1990	19.2	20.6	22.1	23.7	27.3	27.6	27.6	28.2	26.9	25.8	24.2	19.8	24.5
1991	17.6	20.9	24.8	25.5	24.2	26.8	28.3	28.2	26.7	26.1	21.9	18.3	24.2
1992	18	18.3	24.6	26.8	26.1	27.9	27.2	28.3	27.4	26.1	22.9	18.5	24.4
1993	17.1	20.6	22.7	25.2	25.5	26.7	27.5	27.7	27.5	26.3	23.3	20.3	24.2
1994	19	19.3	23.3	25.7	27.3	27.4	28.6	28.6	28.5	25.8	23	19.3	24.7
1995	17.7	19.8	24	26.9	28.3	27.5	27.5	27.8	27.8	27.1	23.8	19.5	24.8
1996	18.1	21	24.7	26.7	26.8	27.4	27.4	27.5	28.5	26.2	23.4	20.2	24.9
1997	26.2	19.1	24.5	24.5	27	26.9	27.9	28.5	26.5	26	23.5	19.2	25
1998	17.4	20.9	22.6	25.8	27.7	27.7	26.9	27.4	28.5	27.8	24.9	21	24.9
1999	19.4	23.2	25.5	28.1	26.8	27.9	27.8	27.9	27.8	26.9	23.9	20.5	25.5
2000	18.1	19.3	23.1	25.6	26.5	27.5	28.3	27.6	27.1	26.7	23.2	19.8	24.5
2001	17.6	20.6	24.3	26.6	27	27.6	28.3	28.9	28	26.6	23.4	19.4	24.9
2002	18.8	21.5	24.3	24.9	26	27.1	27.4	28.1	28.2	26.4	23.6	19.9	24.7
2003	17.4	21.1	22.9	26.5	27.2	26.8	28.4	28.8	28	26.8	22.7	20.1	24.8
2004	18.5	21.1	25.8	24.5	27.9	27.9	27.3	28.9	27.1	25.9	23	20.3	24.9
2005	18.1	21.7	24	26.5	25.3	28.3	28	28.1	28.8	26.9	23.3	21	25.1
2006	18.8	23.3	25.9	26.2	27.4	27.3	28.9	29.1	28.1	27.4	23.5	20	25.5

Source: Bangladesh Meteorological Department

B5: Monthly and yearly average Rainfall (mm), Station: Sylhet

Year	Jan.	Feb.	Mar.	Apr.	May.	Jun.	Jul.	Aug.	Sept.	Oct.	Nov.	Dec.	Annual
1987	2	29	184	402	222	****	1038	860	922	157	41	14	****
1988	0	29	133	332	1129	959	738	1157	772	169	122	80	5620
1989	6	33	11	312	543	870	1342	665	1081	524	34	1	5422
1990	2	45	176	574	546	551	596	582	1023	216	40	3	4354
1991	10	55	60	405	1063	1203	351	437	781	173	3	79	4620
1992	0	55	172	129	544	666	901	374	459	203	3	0	3506
1993	35	149	96	261	587	1099	1174	471	702	153	2	0	4729
1994	23	43	514	326	342	584	757	573	227	145	4	0	3538
1995	10	29	****	176	327	941	874	832	423	79	102	0	****
1996	2	76	257	252	759	518	745	745	379	281	0	0	4014
1997	1	27	111	170	347	796	681	486	946	31	23	18	3637
1998	7	15	239	548	366	858	1245	665	313	90	42	0	4388
1999	0	0	49	207	731	472	775	503	253	344	0	0	3334
2000	48	3	119	500	670	1120	330	981	733	188	0	0	4692
2001	0	143	42	177	481	729	612	609	347	281	55	0	3476
2002	2	2	78	441	548	701	841	469	396	108	132	14	3732
2003	0	0	170	311	359	1038	497	438	499	237	0	7	3556
2004	1	8	40	622	371	553	1394	545	478	235	5	12	4264
2005	0	48	388	296	895	354	978	626	319	259	0	0	4163
2006	0	62	16	353	572	1288	436	424	288	72	12	3	3526

**** Data not available

Source: Bangladesh Meteorological Department, Dhaka

B6: Monthly & Yearly Average Relative Humidity (%), Station: Sylhet

Year	Jan	Feb	Mar	Apr.	May	Jun.	Jul.	Aug	Sep	Oct.	Nov.	Dec.	Annual
1987	71	65	71	77	77	90	90	89	89	82	77	73	79
1988	70	71	70	75	87	84	88	91	86	82	76	79	79
1989	75	66	62	72	79	86	88	85	88	85	79	76	78
1990	82	72	71	80	79	87	87	85	89	83	77	74	80
1991	73	73	68	76	88	89	85	85	90	84	77	77	80
1992	79	74	73	75	81	84	87	84	86	82	75	74	79
1993	77	75	70	75	83	87	87	87	85	85	77	71	79
1994	76	71	74	75	80	87	83	84	82	83	78	72	78
1995	73	71	64	71	79	88	87	87	86	81	81	80	79
1996	77	68	76	76	83	85	90	88	83	82	77	74	79
1997	88	72	69	73	79	87	88	84	89	79	78	81	80
1998	78	71	70	78	80	88	92	90	85	83	76	73	80
1999	71	65	64	75	83	85	87	86	86	85	77	72	78
2000	76	70	74	80	84	88	83	88	87	82	77	70	79
2001	71	69	62	71	82	88	87	86	87	87	83	77	79
2002	77	70	64	79	82	91	92	88	83	83	80	81	80
2003	76	67	68	74	78	87	84	83	86	85	76	73	78
2004	75	62	65	80	77	83	87	82	87	82	73	70	76
2005	74	70	75	72	81	83	85	87	81	82	75	69	77
2006	73	70	60	73	77	86	82	80	83	78	76	72	75

Source: Bangladesh Meteorological Department, Dhaka

ANNEX - C: Water level data of the research area

C1: Water Level at Shologhor point, Sunamganj (Data Source: BWDB, Sunamganj)

Date	Water level	Date	Water level	Date	Water level	Date	Water level	Date	Water level	Date	Water level	Date	Water level
Nov'06	(Meter)	Dec'06	(Meter)	Jan'07	(Meter)	Feb'07	(Meter)	Mar'07	(Meter)	April'07	(Meter)	May'07	(Meter)
1	4.57	1	****	1	1.98	1	1.58	1	1.46	1	1.58	1	5.35
2	4.50	2	****	2	1.94	2	1.64	2	1.48	2	1.64	2	5.18
3	4.47	3	****	3	1.95	3	1.72	3	1.54	3	1.80	3	5.02
4	4.47	4	****	4	1.96	4	1.80	4	1.57	4	2.02	4	4.86
5	4.36	5	****	5	1.91	5	1.92	5	1.58	5	2.13	5	4.76
6	4.28	6	****	6	1.90	6	1.94	6	1.66	6	2.16	6	4.66
7	4.23	7	****	7	1.88	7	1.97	7	1.68	7	2.38	7	4.9
8	4.18	8	****	8	1.85	8	1.91	8	1.68	8	2.55	8	4.45
9	4.13	9	****	9	1.83	9	1.85	9	1.70	9	2.85	9	4.36
10	4.08	10	****	10	1.81	10	1.79	10	1.68	10	3.78	10	4.28
11	4.05	11	****	11	1.78	11	1.74	11	1.62	11	4.03	11	4.32
12	3.98	12	****	12	1.93	12	1.66	12	4.53	12	4.22	12	4.38
13	3.93	13	****	13	1.70	13	1.58	13	1.46	13	4.23	13	4.5
14	3.88	14	****	14	1.66	14	1.62	14	1.34	14	4.16	14	4.45
15	3.80	15	****	15	1.62	15	1.59	15	1.32	15	4.06	15	4.4
16	3.74	16	****	16	1.62	16	1.74	16	1.35	16	3.93	16	4.5
17	3.70	17	****	17	1.65	17	1.84	17	1.40	17	3.78	17	4.7
18	3.64	18	****	18	1.70	18	1.88	18	1.48	18	3.36	18	4.82
19	3.60	19	****	19	1.78	19	1.92	19	1.62	19	3.48	19	4.95
20	3.55	20	****	20	1.82	20	1.93	20	1.74	20	3.41	20	5.1
21	3.50	21	****	21	1.80	21	1.86	21	1.86	21	3.66	21	5.6
22	3.46	22	****	22	1.75	22	1.82	22	2.00	22	3.76	22	5.9
23	3.42	23	****	23	1.70	23	1.75	23	2.05	23	4.15	23	6.08
24	3.38	24	****	24	1.60	24	1.66	24	2.06	24	4.70	24	6.8
25	3.34	25	****	25	1.60	25	1.56	25	2.03	25	4.26	25	6.72
26	0	26	****	26	1.55	26	1.48	26	1.91	26	5.18	26	6.73

27	0	27	****	27	1.52	27	1.56	27	1.80	27	4.75	27	6.85
28	0	28	****	28	1.52	28	1.48	28	1.64	28	5.78	28	6.82
29	0	29	****	29	****	29	****	29	1.54	29	5.66	29	6.78
30	0	30	****	30	****	30	****	30	1.47	30	5.50	30	6.78
31	0	31	****	31	****	31	****	31	1.53	31	****	31	6.7

**** Data not available

C2: Monthly Average Water Level at Sologhor Point, Sunamgonj

Year	Month	Average Water Level (m)	Year	Month	Average Water Level (m)
2006	July	7.7	2007	January	1.76
2006	August	6.7	2007	February	1.74
2006	September	6.69	2007	March	1.73
2006	October	5.17	2007	April	3.63
2006	November	3.93	2007	May	5.34
2006	December	***	2007	June	7.89
			2007	July	7.94

*** Means data missing

Source: Bangladesh Water Development Board, Sunamgonj