WHERE THE RAIN FALLS

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A STUDY OF IMPACTS
FOLLOWING THE PILOT PHASE

FINAL REPORT

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GLOSSARY

°C	Degrees Celsius
Agrahayon	The eighth month of Bengali calendar (time for harvesting Aman) (mid-November to mid-December)
Aman	A monsoon rice variety grown during July/August to December
Asharr	The third month of Bengali calendar (time for harvesting Aus) (mid-June to mid-July)
Ashwin	The sixth month of Bengali calendar (mid-September to mid-October)
Aus	A summer rice variety, mostly rainfed, grown during March till June/July
BDTk	Bangladeshi Taka
Bhadro	The fifth month of Bengali calendar (Mid-August to mid-September)
Bigha	A unit of land (in Kurigram, it equals to 32 decimal, elsewhere in Bangladesh the unit represents one third of an acre)
Bn	Billion
Boishakh	The first month of Bengali calendar (time for harvesting Boro) (mid-April to mid-May)
Boro	A post-winter dry season crop, mostly irrigated, grown during December to late-April/early May (Currently the most important crop towards meeting national food security)
Chala	Generally a roof; also refers to a temporary network of ropes for hanging purposes
Char	Sand bar in the middle of a meandering river bed
Choitra	The twelfth month of Bengali calendar (mid-March to mid-April)
Dhainccha	A nitrogen fixing green manure, may be grown after Boro paddy
Dhan	Paddy, which provides for basic staple for millions of Bangladeshi people
Falgun	The eleventh month of Bengali calendar (Mid-February to mid-March)
Gainja	A traditional Aman variety which can still grow under certain submerged conditions (very low yielding, grown only where potential for HYV Aman does not exist)
Ghar	A house within a large courtyard, a household may have a number of such dwelling units
Hh/HH	Household(s)
Joistha	The second month of Bengali calendar (Mid-May to mid-June)
Kayam	The floodplain adjacent to a river which is not at risk of immediate erosion
Kartik	The seventh month of Bengali calendar (mid-October to mid-November)
Khal	Rivulet or a canal, in order to facilitate drainage and navigation
Magh	The tenth month of Bengali calendar (mid-January to mid-February)
Maund	An equivalent of 40 kilogram, which has been used as a unit of relatively larger amounts of goods
Mohajan	A money lender who operates on trust, however charges hefty interest rates in a non-formal lending arrangement
Monga	Seasonal food insecurity phenomena (observed mostly in northwestern region)
Mung	A popular variety of lentil, grown during the early Rabi season
Mt	Million tons
Parishad	The lowest tier of local government involving an elected body
Poush	The ninth month of Bengali calendar (mid-December to mid-January)
Rabi	A crop season which starts in winter and extends upto summer
Srabon	The fourth month of Bengali calendar (Mid-July to mid-August)
Thana	Erstwhile name of a sub-district, the Bengali word for police station
Union Parishad	The lowest tier of local government institution. Generally a smaller division of a sub-district.
Upazila	A sub-district
US$	United States Dollar (an international currency)

ACRONYMS

BARC	Bangladesh Agriculture Research Council
BINA	Bangladesh Institute for Nuclear Agriculture
BRRI	Bangladesh Rice Research Institute
CARE/CARE Bd	CARE Bangladesh, an international NGO working in Bangladesh
CBA	Community Based Adaptation
CLP	Char Livelihoods Programme
CSO	Civil Society Organization
CVCA	Climate Vulnerability and Capacity Assessment
DAE	Department of Agriculture Extension
ESDO	Environmental and Social development Organization, an NGO
FFS	Farmers' Field School, an organized approach to impart hands on training to farmers
FGD	Focus Group Discussion
GOB	Government of the People's Republic of Bangladesh
HH	Household
HYV	High Yielding Variety
NGO	Non-government Organization
PNGO	Partner NGO
RFP	Request for Proposal
STW	Shallow Tube Well
TOR	Terms of Reference
Union	The lowest administrative boundary involving a few villages
UP	Union Parishad, the lowest tier of local government with specific administrative boundary
UZ	Upazila, a sub-district which is above Union and below district level
VGD	Vulnerable Group Development
VGF	Vulnerable Group Feeding
WtRF	Where the Rain Falls (A project that has been implemented by CARE Bangladesh)

TABLE OF CONTENTS

Annex-II Promotion & capacity building regarding improved & environmentally sound cropping techniques

EXECUTIVE SUMMARY

Kurigram district is known as a food insecurity hot spot for Bangladesh, partly due to general backwardness in adopting advanced technologies and failure to cope with input-based investment intensive agriculture. Climate variability in the recent decades have been affecting crop production, putting additional burden on poor smallholders towards maintaining food security. The poor farmers needed resilient crop varieties which would give them sustained food production, even defying climate variability and change related hazards. Moreover, they needed (financial) means to adopt investment-intensive crop agricultural practices in order to increase overall annual production per unit of land and extra income to support their livelihoods and wellbeing. They also needed measures to sustain their agriculture through environmentally friendly inputs.

CARE Bangladesh has designed a project titled "Where the Rain Falls (WtRF)", based on a research, which has been implemented in two sub-districts of Kurigram district in the northwestern Bangladesh with financial support from Prince Albert II of Monaco Foundation. This study provides an account of effectiveness of a few measures considered under the project, in order to meet the above-mentioned needs of the smallholder farmers of the two target sub-districts.

The farmers of Kurigram have come to know about advanced agronomic systems only recently. Such advanced agricultural practices are fundamentally different than usual rain-fed cropping, relying more on varieties that are high yielding and that require specific inputs – the latter being investment intensive. Despite the fact that information regarding such agronomic practices have been penetrating slowly, mostly due to official extension services and small scale projects undertaken b non-government organizations, due to lack of adequate finance the poor farmers could not take advantage from such advanced agricultural systems.

In such a backdrop, the farmers have been continuing with predominantly rain-fed and low-yielding agriculture and struggling to maintain year-round food security at household level. The analysis reveals that, the majority of the farmers could not ensure food security for more than nine months per year, while the bottom 20% could not even ensure food security for more than seven months a year. The most acute food insecurity used to be felt during mid-September to October, although a second food insecurity period (i.e., mid-March till end-of-April) has also been observed in a significant proportion of the responding households.

As a consequence of food insecurity, the farmers have been used to take stern measures such as consuming low food value containing food, selling labour in advance, borrowing both food and money – all such measures which have gradually deteriorated their economic and social conditions (i.e., health etc.). It has been found as a common practice that the regular borrowing for addressing food insecurity has resulted in erosion of household assets, even productive assets such as land, trees and livestock. Due to diminishing services from such productive assets and increasing poverty, the victims of food insecurity have been facing acute loss of nutrition. It is found that, women have been facing the worst consequences in terms of erosion of nutrition, while the households have been going spirally downward in a state of perpetuation of poverty.

In a bid to reduce economic burden of household food insecurity, males generally migrate out and find temporary employment. To majority of the migrants, it is temporary in nature and follows closely to the periods of food insecurity. As a consequence, it is found that most of the migrating

males leave their household and family for twice a year, only to be reunited later. Permanent migration and migration with spouse are quite uncommon. Harsh social realities in the destination areas generally leave no choice for the male migrants but to leave their spouse as home, which also allow the women to take lead role to ensure family wellbeing in absence of their respective male counterparts. The lead woman in a migrant household also manages productive assets and takes care of standing crops. They even temporarily employ agricultural labour(s), in case the situation demands an immediate involvement of labour(s).

The project organized target farmers, including women farmers, in the form of groups to form Farmers Field Schools (FFS). The project introduced several situation-specific improved crop varieties which enabled the FFS members to select flood-tolerant Aman varieties so that croploss due to floods could be arrested. While that particular intervention already contributed to increase resilience of food production system of the FFS members, the innovative step towards preserving flood-tolerant Aman seeds in locally designed and operated seed bank ensured sustainability of the intervention and contributed to adaptive capacity at local level.

Moreover, a new high yielding mustard variety (i.e., BINA Mustard-4) is introduced to the FFS members. The analysis shows that it fetched an average yield of about 3.84 kilograms per decimal, which has translated into a financial gain of about Bd Tk 30,158 per hectare, which appears to be significantly higher than similar other mustard varieties (resulting in a gain of BD Tk. 10,800 and 10,600 per hectare or so for BARI Mustard-3 and TORI-7 varieties, respectively). With almost three-fold increase in financial gains without having to commit to extra labour or input costs, the farmers have found the short-term rabi crop a significant introduction to their cropping calendar. Since the mustard variety is found to be harvested just days ahead of transplantation of Boro seedlings in the same lands, it does not disturb the economic potential of the land. Furthermore, the extra income from the crop goes straight into purchasing/ensuring irrigation implements (such as rental of equipment, fuel/diesel, labour for transplantation in a short time, etc.), which ensures that the farmers (especially the bottom 20% in terms of economic condition) can actually resort to investment-intensive high yielding Boro production (for example, choosing BRRI Dhan-28), instead of leaving the land as fallow. Therefore, the mustard crop truly appears as a means to realize the dream of harvesting two paddy crops instead of a rain-fed paddy crop. Overall, the major agricultural intervention by the project has increased household food availability by at least two folds, in addition to providing cash for fulfilling household needs or for pleasure.

The project also popularized a few agronomic practices which have long-term environmental co-benefits. For example, the introduction and promotion of parching has been found beneficial as a means of non-chemical pest management, while the promotion of the use of feromone trap also enables the farmers to address pest attack without having to apply harmful agro-chemicals. The production of vermin compost has provided for a business model for a few micro-entrepreneurs, while the use of the product itself has been contributing to add organic substance enriched materials in sandy soils – the latter contributing to long-term environmental benefits to such soils. Similarly, pit compost production and green manure application have been promoted, which in turn would contribute to environmental condition of soils. It is found from questionnaire survey in non-FFS households even in Kurigram district that majority of the farmers outside the project areas have hardly heard of such techniques and virtually no attempt has so far been made to train them on such important and beneficial agronomic issues.

The target FFS members equivocally endorsed the good practices which have been promoted by the project. The respondents admitted that they were subject to frequent food insecurity episodes until 3 years ago. Now most of them (over 98%) can have three meals a day, compared to at the most two meals a day some three years ago. The combination of suitable technologies and advanced know how for improved environmental and agronomic practices enabled them to produce more, which in turn have enhanced food security outcomes in the household. Women are found to be particularly delighted due to the successful outcomes of the project, which not only reduced the burden of frequent food insecurity, but also allowed them to earn cash following the harvesting of an extra cash crop (i.e., the mustard). Such additional petty cash is found to be highly useful to them in order to do a few household things which otherwise would not have been possible under business as usual agricultural production.

Women are found to be confident that the knowledge base and the skills will enable them to contribute more in agriculture, not as a passive supporting hand, but also as an active farmer. Moreover, the improved economic condition helped their respective male counterparts (i.e., husbands) to avoid prolonged migration and plan for shorter and purposeful strategic migration. This has tremendously helped the women to avoid being subject to social hazards in absence of their husbands.

1. INTRODUCTION

1.1 Background of the Study

There have been sporadic early evidences in Bangladesh regarding changing climatic patterns in various agro-ecological regions. While long term trend analyses suggest a general rise in temperature over all seasons since 1950s, extreme event analyses suggest significant changes in rainfall variability across the country, especially an increasing trend of sharp high rainfall episodes. There has been evidence of transformation of micro-scale pattern of available monsoon rainfall in the country, which has been exhibiting two peaks instead of usual single peak distribution (Chowdhury, 2007).

Traditional agricultural practices of subsistent farmers in the country have long been dependent on climatic patterns. With significant changes in micro-structure of pre-monsoon and monsoon rainfall, rainfed agriculture has been deemed as unreliable, resulting in decline in yield in the backdrop of productivity gains due to improvement in both varietal yield and application of inputs. The phenomenon has been placed under examination through a global research, simultaneously undertaken jointly in eight countries including Bangladesh by United Nations University and CARE International. The Bangladesh Case Study probed into relationship between changing climate variability, if not change, with declining livelihoods of rain-fed smallholders and tried to check whether outmigration patterns of smallholders have any linkage with failing farm-based livelihoods.

Following the release of a research titled `Where the Rain Falls' (Ahmed et al., 2012), a model project has been launched by CARE Bangladesh keeping the same title. The two-year (2014-2015) model project aimed at addressing rainfall variability induced complications in food security of marginal poor farming households of Kurigram district so that women's particular vulnerabilities are duly given priority and male-specific in-country displacement could be reduced by creating better income opportunities in areas (localities of Kurigram district) that are adjacent to their ancestral villages. Prince Albert II of Monaco Foundation has provided financial support for the Where the Rain Falls (WtRF) project, which is about to be completed in February 2016. Towards the end of the project, the implementing agency CARE Bangladesh has engaged an Evaluator (Consultant) to analyze various aspects of the project and critically assess relevance, impacts, effectiveness, efficiency and overall sustainability of the project against the objectives of the project. The evaluation also entails a broad-brush assessment of the project's contribution to gender equality, its ability to undertaking analysis and contributing to learning for CARE Bangladesh, efficiency of management & human resource structure deployed and financial efficiency.

1.2 Contextual issues in the study areas

In Kurigram, many NGO-led projects have been implemented in the past, along with regular agricultural development project and various social protection programmes of the government of Bangladesh (GOB). National NGOs such as CARE Bangladesh delivered major projects such as Shouhardo and Char Livelihood Programme (CLP), which were partly implemented in Kurigram Char lands. Most of the NGO-focused projects attempted to address enhancement of livelihoods and income potential through diversification of skills, promotion of technologies and even by means of giving away livelihood assets such as dairy animals. Despite such targeted interventions, external support could not dent the most noticeable and chronic food insecurity issue of Kurigram. Available literature suggest that Kurigram has long been remained the most Monga-affected northern districts in Bangladesh.

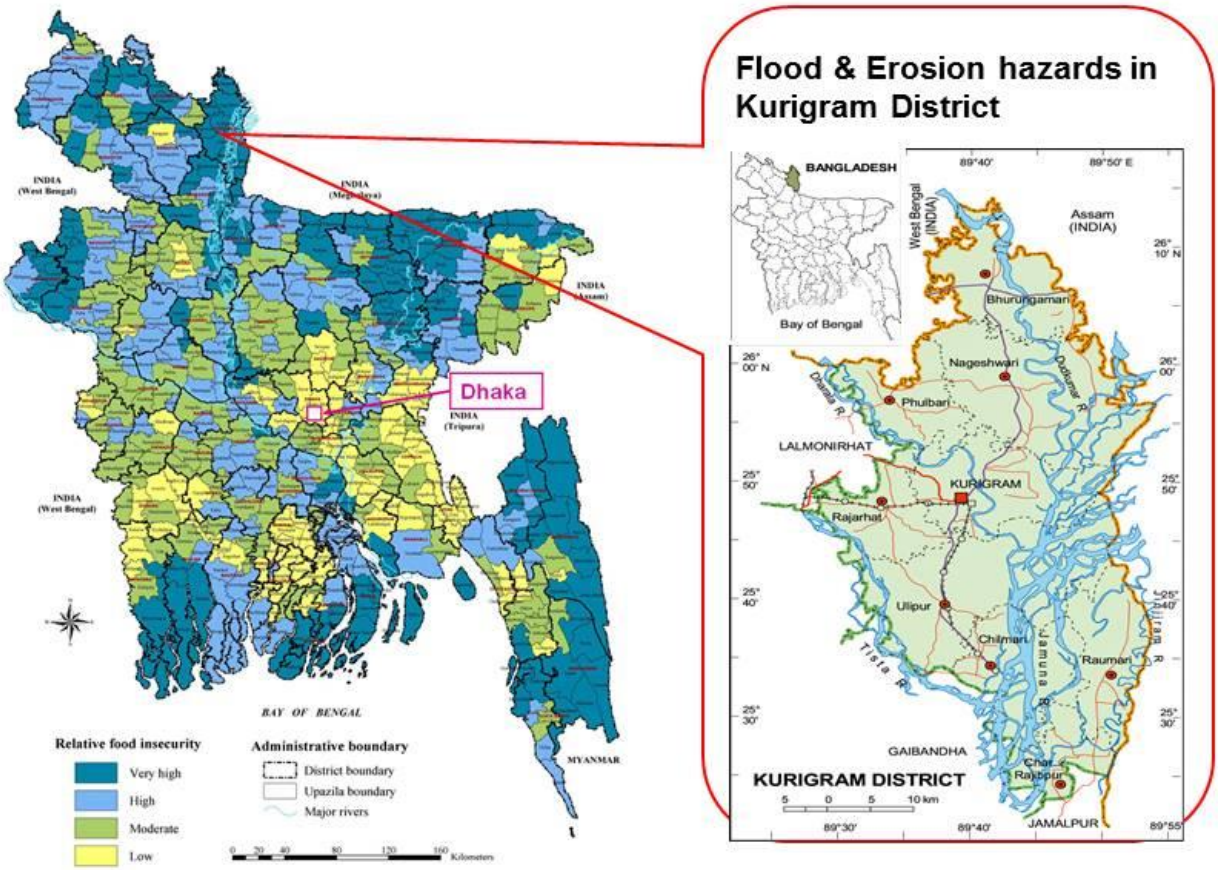

Figure-1: The location of the project where it has been implemented

The abject poverty of poor people of Kurigram had worsened over time, especially with diminishing land holding size with every division of parcels among successive generational hiers and inability of the poor inhabitants to embrace available agricultural technologies due to poverty (lack of investment) and understanding advanced agronomic practices due to poor or inadequate extension at the grassroots levels.

By 2008, the Department of Agricultural Extension (DAE) has started to promote two flooding-tolerant Aman varieties called BRRI-Dhan 51 and 52 in Kurigram district. One local NGO supported such promotional activities. The need for such a variety and its extension was already existing. However, after eight years of extension, not even 5% of the Aman lands[1] have been enjoying coverage of any of the two tested varieties. This anecdotal experience showcases very rudimentary application of extension services in Kurigram district.

Hazard-proneness of majority of the lands in Kurigram, their sandy top soils (48% of all lands having sandy top soils), and inability to hold moisture – all these characteristics have been known as detrimental factors which interplayed and consequently the poor farmers lost belief that their lands

[1] Based on Official statistics in Kurigram Sadar Upazila, kept with the Thana Krishi Officer's Office.

could ever become productive. Because of the lost belief, farmers were reluctant to invest in such lands, thereby they remained in a cycle of low-input low-output agriculture, in spite of the fact that the farmers of rest of the country were highly successful in converting their singly cultivated land into triply cultivated land.

Part of the problem lied with piece-meal support provisioning for Kurigram, especially by the NGOs. Instead of planning for a suitable and viable year-long cropping pattern, NGOs came along with one crop at a time approach, which has shown promises in terms of promoting beneficial crops, but could not enable poor farmers to gain significantly from such efforts. The production of sweet gourd in pits on sandy char lands is an example, which certainly ensured slight increase in household income, however could not ensure year-long food security that could defeat chronic Monga.

Under such experimentations, the GOB institutions have continued to carry out programmes under social protection schemes (previously known as Social Safety Net, SSN), which immensely helped find employment for 40 or 100 days during the time when there was hardly any employment available in predominantly singly cultivated Aman fields. The Vulnerable Group Feeding (VGF) and Vulnerable Group Development (VGD) supports of GOB were also partly responsible to offer food and cash support during hardship periods. However, these social protection schemes were not meant to be offering any agricultural support, therefore the root of the problem (i.e., lowly productive land, yielding even lower) had remained largely untouched.

In this general background, Where the Rain Falls project was conceived, as elaborated earlier. This study entails probing into the impact of the short-lived first phase of the project, undertaken in two Unions of Kurigram sadar Upazila: Panchgacchi and Holokhana Unions.

1.3 Objectives of the Study

Preliminary findings through the (a) project ending documents, (b) the Lessons Learning Effort, and (c) the End-of Project Evaluation effort suggest that the WtRF pilot project (as above) has been contributing to positive economic outcomes at households levels for the beneficiary households, helped improved food security status of participating households and also addressed a few environmental aspects like, using compost fertilizer instead of chemical fertilizer, using insect killing trap instead of applying pesticides. It is also found that all the above outcomes might lead to sustainability of the solutions to a complex, long standing and climate change driven problems that have still been prevailing in the northwestern Monga-affected region of the country.

However, the documentation processes were not robust enough (mostly due to lack of time for running the reviews and lack of resources to conduct detailed surveys) to bring out statistical comparison of state of affairs before and after the implementation of the pilot scale project. No effort has been made to quantify the extent of economic, food security and environmental outcomes, especially with respect to the quantitative indicators that had been used in the baseline survey. A similar robust survey based analysis is required in order to ensure that the project indeed has contributed significantly to the above issues, along with understanding project's contribution in social dimensions, particularly gender dimensions in pilot project.

The End-of-project Evaluation clearly indicates that the project's component on introduction of crop (Aman) varieties to suit to local condition has been extremely successful, despite unusual flood conditions. The impact of such extension has been tremendous and highly relevant, given the hydro-

geophysical context of the area. The beneficiary farmers significantly increased their household food availability by just harvesting a crop, which otherwise would have been lost due to very late flooding.

The sustainability potential of such varietal extension is also very high. BINA scientists (research institute) have expressed satisfaction due to fact that it would allow an increased amount of seeds to be made available for subsequent year's extension and the field results have been highly encouraging. The successful experimentation in real life situation, if disseminated properly, might result in increasing Aman production potential significantly. A survey based study of effectiveness of newly introduced variety could present results and outcomes in order for wider communities to learn from the WtRF pilot project. Since the study is considered to be undertaken/completed during the mustard growing season (October-February), the focus of the study will be BINA-4 mustard, compared to traditional mustard varieties.

The overarching research issue as per the Terms of Reference (TOR) is to understand benefits of the new adaptive crops varieties introduced by "Where the Rain Falls Project" in comparison with the conventional variety in climate variability affected Northern district Kurigram, Bangladesh. However, due to short timing for carrying out the research, detailed analysis for a new variety of mustard (i.e., BINA-4 variety) could only be carried out, with perception based responses regarding other major (paddy) crops.

1.4 Limitations of the Study

The study is based on experience of only one full year of extension of a few advanced agricultural technologies, the full appraisal of the effectiveness of the project therefore cannot be understood so quickly. Especially the long-term sustainability issues can never be adequately understood within one year after giving trials of a few technologies.

The timing of the study coincided with mustard cultivation period, therefore effectiveness of a newly introduced mustard variety could have been done adequately. However, the same for newly introduced Aman varieties could not be approached within the given time frame of the study. Moreover, a deeper understanding of the gains from effective application of irrigation in Boro paddy could not be done due to lack of time and resources.

The survey could only use a few indicators, considering a comparison of before and after interventions and taking into consideration of reflections of farmers and their spouses towards responding to set questions. The questionnaire for the survey was limited to as many questions so as to complete the discussion within one hour or so (the draft questionnaire was adequate field tested). The option for a lengthy questionnaire had to be discarded so that the farmers would still remain interested to answering the questions. Therefore, many important indicators could not have been accommodated in the formal questionnaire for conducting the survey and alternately, those have been accommodated in non-questionnaire format such as focus group discussions and key informants' interviews. Due to reliance on people reflections on a few key impact indicators through semi-structured engagements such as FGD and KIIs, numbers could not be generated in all the aspects of the study.

The study had to rely on field based enumerators, who had limited understanding and no experience regarding research. Consequently, there have been difficulties in gathering information, despite giving them adequate exposure (two rounds) to the questions placed in the questionnaire survey.

Had the data been collected by properly trained and more understanding enumerators, the quality of data could have been improved.

The study, by design, is based on perception of primary stakeholders. No attempt is made to understand long-term environmental aspects of cultivation. There was no allocation to scientifically examine top soils before and after the application of composts and vermin compost. The baseline was not available in relation to probing into effect of such compost fertilizers on yield of certain crop varieties. As a result, the environmental co-benefits likely to be accrued from the project could not be examined properly.

1.5 Organization of the Report

This report is a reflection of the field based study. Section 2 highlights brief description of study area and the prevailing contextual account of the area and its population, with particular reference to poor population of the area. Section 3 represents the general approach and Methodology of the Study.

The Findings coming out of this evaluation process are presented in Section 4 to 7. Section 5 presents an analytical account of the project interventions and their effectiveness, as perceived by the primary beneficiaries (i.e., the FFS members). The analysis of efficacy of the introduction of a high-yielding and short-duration BINA-4 is presented in section 6. A brief account of the pro-environmental interventions of the project is placed in section 7. Conclusions of the Evaluation are highlighted in Section 8. The Study Report is furnished with a few references (which have been used) and annexes, which are placed at the end of this Report. The report also presents two annexes, where the details regarding the greater study area and its context as well as the detailed aspects of capacity building of FFS members are presented.

2.0 BRIEF DESCRIPTION OF STUDY AREA AND ITS CURRENT REALITIES

Kurigram is a district in the northwestern region of Bangladesh, belonging to recently constituted Rangpur Division. The district is particularly known to be a regional hub for extreme poverty and food insecurity, which may be largely attributed to low agricultural productivity and intensity, chronically marred by lack of investment in irrigated and input-intensive agriculture. Moreover, high proneness to floods and erosion make the production of rain-fed monsoon crop highly uncertain. This is compounded with lack of employment during two particular seasons, which generally contribute to seasonal food insecurity in the households of non-agricultural labours and smallholder farmers. A more elaborate account of socio-economic realities in Kurigram district is attached in Annex-1.

Kurigram Sadar Upazila has been chosen as the study location. In administrative terms, the upazila has 11 Union Parishads (local government institutions at the lowest tier), one municipality, and 256 villages. The upazila is located next to the Brahmaputra river on its right bank, and diagonally bisected by Dharala river. The map of the Kurigram Sadar Upazila is presented in Figure-1. The total population of the Upazila, according to census in 2011, was about 0,34 million, of which males were 50.81 per cent and females were 49.19 per cent. The population density in 2001 was 935 people per sq.km., currently increasing to about 1053 people per sq.km.. According to official statistics, the current literacy rate is about 63 percent, increased from 40% in 2001. Throughout Kurigram Sadar Upazila, about 57% households have electricity connection, although such households are not being served by reliable electricity.

Table-1 presents the current estimated population and number of households in the two study locations (i.e., Unions): Panchgacchi and Holokhana Unions.

Table-1: The current estimated population in Panchgacchi and Holokhana Unions

Union	Population	Number of households
Panchgacchi	42,512	8,336
Holokhana	40,468	7,935

Data source: Estimates based on Upazila statistics and Bangladesh Population Census, 2011.

Paddy (rice), jute, potatoes and banana are the major crops, while wheat, kaun, corn, vegetables, etc. are cultivated too. The main export products from Kurigram Sadar are jute, paddy, bananas, peanuts, sweet gourd, vegetables (mostly *Potol* and carrot), and potato. Currently, Kurigram Sadar is enjoying good communication networks with the rest of the country, especially after the construction of a bridge over Dharala river in 2010.

While Holokhana is located next to Dharala river, it is subject to severe erosion and annual flooding. Over 60% of the land belongs to sandy char areas, therefore the productivity of such land use to be rather low. In contrast, Panchgacchi is subject to flood, not so much prone to erosion as in the case of Holokhana. Panchgacchi is flooded by the overflowing waters from the Brahmaputra river. The worst flooding occurs when both Brahmaputra and Dharala rivers rise simultaneously, as it happened during 2016 – giving rise to the worst historical flood. Because of proneness to frequent flooding and having low elevation compared to river bed, occasionally low lying lands in both the study areas experience sand casting, the latter severely affecting crop production potential.

3. SCOPE AND METHODOLOGY

3.1 Scope of the Study

The Terms of Reference (TOR[2]) provided by CARE Bangladesh highlights the following research agenda.

- Understand benefits of the new adaptive crops varieties introduced by "Where the Rain Falls Project" in comparison with the conventional variety in climate variability affected Northern district Kurigram, Bangladesh.

The scope of the research, without placing limitation, mainly examines the production gain and adaptability of newly introduced variety of the crops, particularly BINA-4 mustard. The research also seeks to better understand food security status of participating households and also economic outcomes at households' levels for the beneficiary households. The research may extend exploring understanding project's contribution in social dimensions, particularly gender dimensions in pilot project.

Since the study follows the entire growing period of BINA-4 mustard variety, the following tasks are performed.

Collection of primary data by implementing partner's project team with assistance from CARE STAAR[3] team on project activities/practices through KII and FGD with direct and indirect beneficiaries (such as relevant GOB officials/department and service providers, Farmers Field School (FFS) members, community people other than FFS, local govt. representatives.

Collect secondary data through in-depth review of all relevant research & studies including project proposal, baseline report and end evaluation, best practices, CVCA report, gender analysis report and project end report.

3.2 Methodology

As a generic approach, the study considered a questionnaire survey in the two study Unions of Kurigram Sadar. A questionnaire was designed and field tested. In addition to the questionnaire, a separate data collection format was produced regarding the production cycle for BINA-4 mustard, also put it to field test and a training of field enumerators was conducted regarding data input procedure.

A total of 150 questionnaires were filled in, each representing a FFS household. The following distribution was considered for the FFS questionnaire survey: 70 from Panchgacchi and 80 from Holokhana Union. Efforts were made to randomly identify FFS households (out of a pool of over 700), where no two such responding households were within 200 meters of proximity so that unbiased responses are obtained.

[2] Placed in Annex-1.

[3] Due to mismatch in timing of conducting field activities, the support of STARR Team towards conducting participatory socio-economic study could not be ensured.

A similar questionnaire survey involving the same set of questions was conducted involving 150 control households. Since the central discussion in the questionnaire was around mustard cultivation, the control area was chosen purposively in mustard growing areas within Kurigram and outside Kurigram. The mustard growing areas of Greater Kurigram district offered responses from areas which are similar to Study areas, and the same of Gaibandha offered a dissimilar mustard growing area. &5 control questionnaires were filled in Kurigram and 75 other questionnaires were filled in Gaibandha district. The table-2 provides a summary of questionnaires which were filled in various places. In all cases, each questionnaire was filled in by conducting a pre-arranged interview involving one respondent.

Table-2: Number of questionnaires filled in at different places in both study and control areas

	FFS HHs in **Panchgacchi**	FFS HHs in **Holokhana**	**Control** HHs in Gaibandha	**Control** HHs in Kurigram	**Total number**
Number of questionnaires	70	80	75	75	300

The other data input format took care of daily inputs by each participating farmers, in terms of recording daily labour and other inputs, inputs offered by whom and if purchased, with specific purpose and extent of costs, for each of the activities possible throughout the BINA-4 mustard growing season. Daily basis interviews were conducted involving the individual primary producers representing 30 FFS members (15 from Holokhana and 15 from Panchgacchi) and 20 demonstration plot holders (who received substantial support from the project in terms of seeds, inputs, etc.). Since demonstration plots were larger in size compared to that for the small holder FFS members, separate daily surveys were designed for the entire crop growing season (till the harvest and post processing was completed).

The primary data collection efforts were complemented by triangulation method, where focus group discussions (FGD) and key informants' interviews (KII) were applied to understand dynamics of social and economic returns from the above agricultural practices.

Environmental issues, however, were captured based transact walk, field observations and also on FGD and KIIs, since there was no data available on quality of soil and water in the baseline. Anecdotal evidences were gathered from interviews and presented.

Data entry and processing: The field survey data were inserted in a SPSS framework for analysis. The results were compiled and presented, where the comparisons were made with data collected from control groups. Regional differences involving FFS responses were also analyzed. Sensitivity tests were performed regarding output consistency and correlation analyses were done within the SPSS interface. The results are thus interpreted and placed in this report.

4. FINDINGS OF THE STUDY

4.1 The Social and Economic Realities of the Project Beneficiaries

As mentioned before, The study considered a total of 150 members of Farmers' Field School (FFS), who have been actively involved in the various discussions, trainings and exposures to new agricultural technologies. The average number of members in FFS household (HH) appears to be 5.4 (median being 5.0), as against the corresponding average number of 5.0 in control areas. Both the values are consistent with national average HH population size. Table 3 shows the distribution of adults, adolescents and children in HHs of FFS in the study areas.

Table-3: Table showing distribution of adults, adolescents and children in Study HHs

Indicators	All members	Adult members	Adolescent members	Children members
Mean	5.36	3.21	1.58	3.21
Standard deviation	1.87	1.61	1.23	0.84
Sum	794	466	232	99

Source: Questionnaire survey

Among the FFS respondents, 60.7% was female while 38.7% was male. The corresponding figures for female and male among the control respondents were 30.7 and 69.3, respectively. Clearly, in the control areas, women were shy and generally reluctant to speak to outsiders, whereas in the FFS areas, increasing number of respondents were women. The average age of the FFS respondents was almost 40 years, as against 44.3 years for the control respondents.

Only 14% of the FFS respondents was illiterate, as against 11.3% for the control respondents. Figure-2 exhibits the comparison of educational status of the two groups. Clearly, the FFS respondents were lesser educated than the control group, almost 69% was educated below primary level, compared to about 47% among the control group.

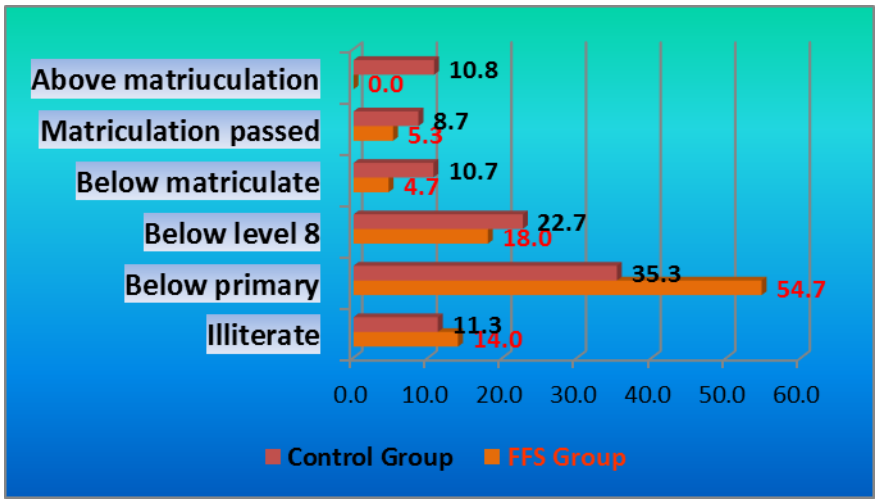

Figure-2: Comparison of education status of respondents involving both FFS and control groups

There is no denying the fact that the WtRF project involved primarily farmers, therefore all the FFS members are some way or the other farmers. However, the respondents themselves have not identified all their HHs to represent farming HHs. The primary occupation of the responding HHs

involving the two groups (i.e., FFS and control groups) has varied significantly. According to the FFS respondents, 72% has identified either farming or farm labour as the main employment of their HHs. While for the control group, those two categories represent only 39.3% of the respondent HHs. It is interesting to note that, even amongst the control group, efforts were made to talk to people with varied primary occupation, however taking keen interests in paddy and mustard cultivation. Figure-3 below exhibits the difference in primary occupation of the two respondent groups.

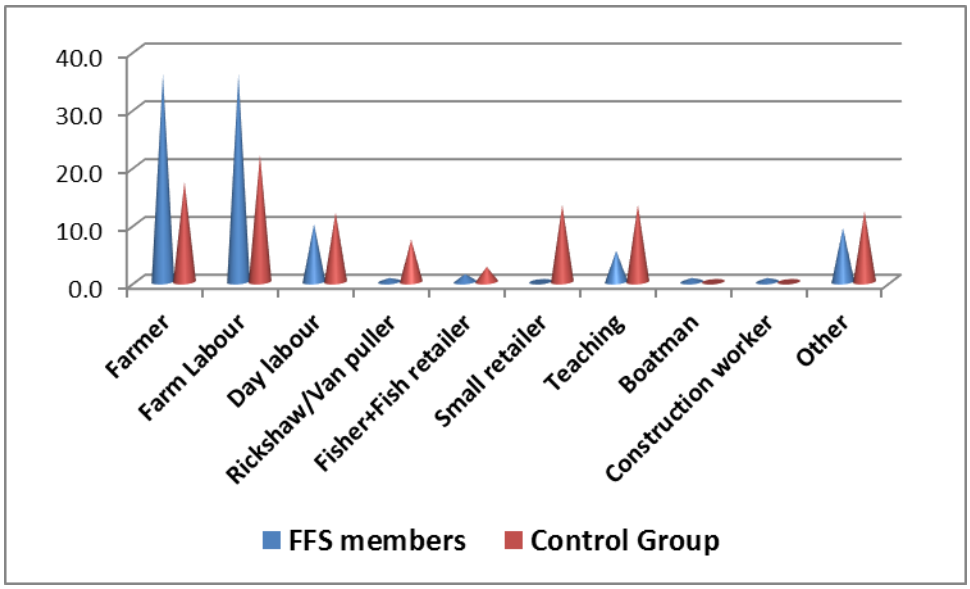

Figure-3: Primary occupation of the respondents representing the FFS and Control Groups

It is found that 59.3% of the FFS HHs has only 1 earning member, while that for the control group appears to involve 69.3% HHs. Almost a quarter of the responding HHs (both FFS and control) has two earning members. About 12% of the FFS HHs has three earning members, which appears to be rare involving the control groups. The income levels of HHs highly correlate with number of earning members in the HH, as has been observed in both the group.

The average land availability among FFS HHs is found to be about 86 decimals, somewhat lower than national average. Average availability of high land (more suitable for Kharif-II cultivation) is only about 21 decimal involving the FFS members. However, in both Holokhana and Panchgacchi Unions, the FFS members are located in charlands which are known to have sandy soils – not so suitable for cultivation of high yielding crop varieties. The relatively higher percentage of high land availability involving FFS HHs does not therefore justify that as farming HHs, these are better off. Moreover, in both the study Unions, most of the lands are prone to annual flooding. Table-4 provides a bird's eye view of the average land holdings of FFS HHs.

Table-4: Average land holdings involving FFS HHs

Indicator	Unit	Total Land	Low land	Medium Land	High Land
Mean availability	Decimal	85.72	26.81	35.23	20.97
Median availability	Decimal	75	20	32	10
Standard deviation	-	54.43	32.23	29.06	29.94
Range availability	Decimal	305	280	160	160

Source: Questionnaire survey

Regional difference in land holding type

An overwhelming majority of the respondents are found to live in their own houses (96.5% for FFS HHs, 87.3% for control HHs). There is no regional difference in ownership of house for the respondents. That signifies typical rural housing ownership. Despite the fact that rental house is quite uncommon in rural Bangladesh, 5.3% of Holokhana (Union #2) is found to live in rental house. Since Holokhana is subject to repeated erosion episodes, a small fraction of the inhabitants do live in either rental houses/lands, or temporarily living in neighbour's land as refugees. Even among the control group, about 6.7% respondents has indicated that they have been temporarily living in neighbours' land – a situation which in common in both Kurigram and Gaibandha districts.

From questionnaire surveys, it becomes extremely difficult to segregate hard core poor HHs from the rest of the respondents. The monetized indicators generally cannot do justice due to the fact that, often the NGO-facilitated HHs tend to hide the 'actual income' or exaggerate 'real expenditure on food'. Therefore, such direct indicators do not generally give an accurate economic reflection regarding the responding HHs.

In order to avoid such apparently misleading data regarding key indicators, alternative indicators such as 'ownership and quality of dwelling units', 'assets belonging to respondent's household', ownership pattern regarding livestock' and 'ownership pattern regarding non-living/transferable assets' ar generally widely used as proxy indicators to supplement income and expenditure related indicators.

While revealing monthly average income level, the FFS HHs have indicated an average of Taka 8,473 (median being Tk 7,250.00) as their monthly income as against Tk 9,543 for the control households (median Tk 8,000). An interesting observation is that, the gap between minimum and maximum (i.e., range) monthly income among FFS HHs is only 17,000 while that for the control HHs is rather high (i.e., some Tk 37,000). It is found that 50% of the FFS HHs has average monthly income Tk 7,000, while that for the control HHs is between Tk 7,000 and 8,000, signifying similarities in the income levels.

Average monthly expenditure on food for the FFS HHs appears Tk 5,943 (median being Tk 5,000), while that for control HHs is Tk. 4,250 only (median being Tk 3,500). Such deviation in monthly expenditure on food has led to further analysis of the indicator involving the FFS HHs. A percentile distribution of average monthly expenditure on food reveals that the bottom 25% percentile FFS HHs spends Tk 4,000 per month, while the top 5 percentile HHs spends Tk 13,000 or more. Interestingly, the bottom 50 percentile FFS HHs on an average spends Tk 5,000 per month on food, which is similar to that highlighted in recent Household Expenditure Survey Report (BBS, 2016). The regional distribution in average monthly expenditure on food for the two Unions appears similar to that for the region.

It is revealed from the survey that about half of the FFS HHs (i.e., 46.9%) own and use more than three dwellings (i.e., Ghar) for their living. This includes livestock sheds and separate kitchen, which is often detached from the main living dwelling unit. However, only 29.7% of the control HHs own and use more than three dwellings, which indicates that FFS respondents are perhaps economically slightly better off than those in control areas. Table-5 provides a comparative picture of house ownership involving FFS HHs and control HHs. It may be observed that an increasing percentage of HHs in more stable (i.e., not prone to frequent river erosion) Panchgacchi union have more than three houses compared to HHs in less stable Holokhana Union.

Table-5: House ownership patterns in FFS and Control households

Number of house/ghar	Control HHs	FFS HHs	Union=1	Union=2
	%	%	%	%
Just one	4.7	0.0	0.0	0.0
Two houses	26.0	18.4	26.0	10.0
Three houses	40.0	34.7	31.2	38.6
More than 3 houses	29.4	46.9	42.9	51.4

Source: Questionnaire survey

In rural Bangladesh, material with which a house is built could generally exhibit the economic status of the household. However, with increasing purchasing power and declining relative cost for improved building materials such as corrugated tin sheets, it has become almost impossible to indicate the economic status of a household by just observing building material of the dwelling unit. The following table (Table-6) summarizes type of housing units involving both the FFS and control households. Despite the fact that even the poor people prefer corrugated tin roof houses and these materials are now cheaper than any time in the past, FFS HHs in Holokhana Union still have traditional single or double layered tin-roof houses in comparison to that in HHs in Panchgacchi Union. In the latter case, they have more biomass-made houses, which are still being used predominantly as cattle sheds.

Table-6: Types of houses by building materials involving both FFS and control HHs

Type of houses by building material	Control HHs	FFS HHs	Union=1	Union=2
	%	%	%	%
Simple one layered tin roof house	8.0	14.0	26.3	0.0
Double layered tin roof house	16.6	12.0	22.5	0.0
Earthen house	0.0	0.7	0.0	1.4
Biomass-made house	2.0	16.7	12.5	21.4
Biomass wall, tin roof house	44.0	54.0	33.8	77.1
Walls & roof – all made of tin	97.3	91.3	85.0	98.6
Concrete walls, tin roof house	8.7	0.0	0.0	0.0
Other types	0.7	0.7	1.3	0.0

Source: Questionnaire survey

Similar livestock ownership patterns are found among FFS and control HHs. Dairy cows and calfs are commonly owned by almost two-thirds of the households in both the cases. Average cattle population per FFS HHs is found to be 1.79 as against 2.16 for that in the control HHs. Cattle population is found to be highly correlated with average monthly income and the ownership of two or more houses in the household (95% confidence level). Figure-4 represents a histogram of dairy cattle population for the FFS HHs.

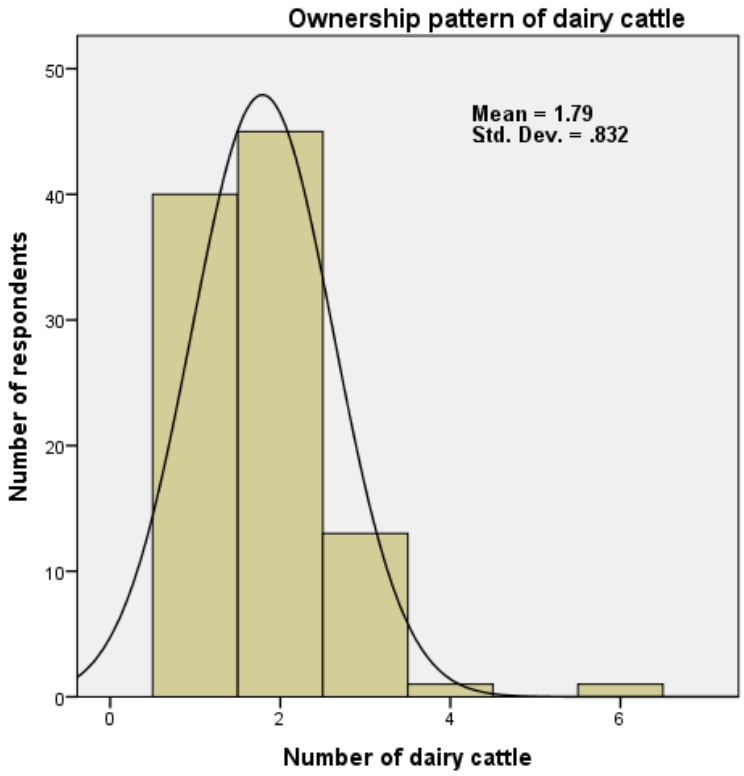

Figure-4: Ownership pattern of dairy cattle in FFS Households

A significant proportion of FFS households (i.e., 68.7%) has chicken compared to that for three-fourth of the control households. While about 47.3% of the latter HH type has duck, it is not as prevalent among the FFS HHs (15.3% FFS HHs). In Gaibandha, duck rearing is a popular livelihood strategy, which is why it is more prevalent among the control households than in the FFS households. Other than cows and calf and chicken, people do have other forms of living assets such as goats (53.3% HHs), sheep (4.7% HHs), Pigeon (8.0% HHs) and buffaloes (2.0% HHs). Such animals are relatively rarely nurtured in Panchgacchi union, where the major focus being on dairy cattle, goat and poultry. Figure-5 presents a distribution of chicken in FFS HHs.

The respondent households involving FFS members also possess a variety of non-living and transferable assets, starting from communication tools (such as cellular telephone sets), entertainment gadgets (radio and television), production/livelihoods gears/equipment (fishing gear, boat, tractor/power tiller, thrasher machine) and physical communication means (bicycles and motorized cycles, rickshaw and vans), etc. Table-7 presents distribution of households possessing such transferable assets for all FFS households, HHs in two Unions and also in control households.

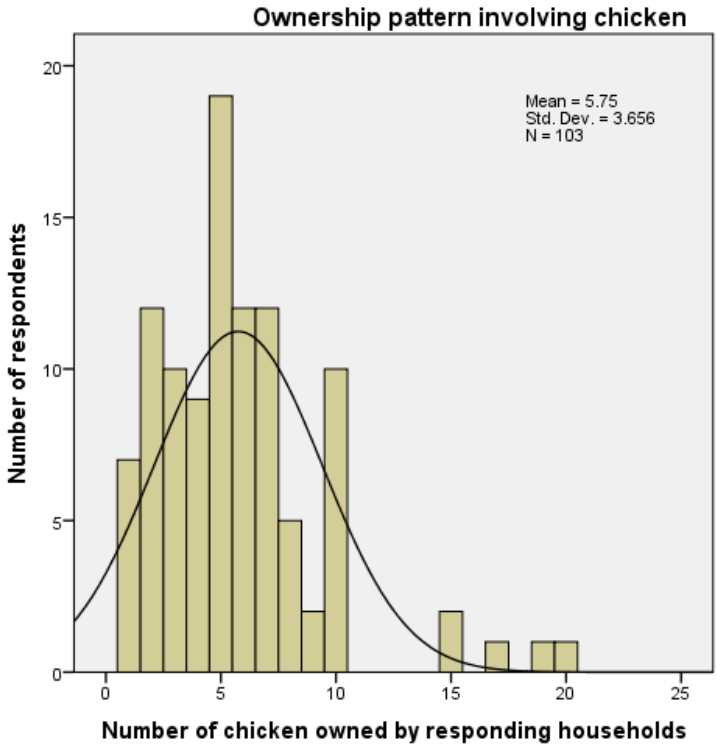

Figure-5: Distribution of chicken population in FFS households

From the table, it appears that the control group owns costlier non-living assets than those in FFS group, with an exception of shallow machine for irrigation. Since Panchgacchi is lesser char and quite stable than Holokhana, an increased proportion of FFS HHs in the former is found to have mechanical irrigators. However, HHs of study area do not tend to spend much on entertainment. Moreover, entertainment in the form of listening to music has been made available by cellular telephones, which not only has replaced radio, also has become a symbol of modern live and living. No wonder, such gadgets have been abundantly found in the study area.

Interestingly, 40% of the FFS HHs do have photovoltaic sets for primarily lighting, as compared to those in control HHs (only 14.7%). Although electrification has reached in remotely placed villages in Kurigram district, as in the case of Gaibandha district and relative penetration is found to 63% for both the districts (Source: Rural electrification Board Offices in Kurigram and Gaibandha), due to frequent deliberate outage of grid electricity and available financial assistance of non-government organizations (NGO) working in the study areas, an increased fraction of FFS households purchased solar home and solar lantern systems to lit their respective houses at night – even if the formal electricity grid fails, their lighting needs are satisfied.

Table-7: Distribution of transferable assets by type in FFS and control households

Type of transferable non-living assets	**Control HHs**	**FFS HHs**	**Union=1**	**Union=2**
	%	%	%	%
Communication tools				
Mobile/cellular telephone sets	98.0	88.7	88.8	88.6
Entertainment gadgets				
Radio	2.0	0.7	0.0	0.0
Television	30.7	5.3	7.5	2.9

Production/livelihood equipment				
Shallow machine for irrigation	15.3	22.0	15.0	30.0
Tractor/power tiller	2.0	2.0	2.5	1.4
Fishing Gear	32.7	13.3	21.3	4.3
Boat	4.0	5.3	5.0	5.7
Paddy Thrasher machine	10.0	8.7	12.5	4.3
Physical communication means				
Rickshaw/van	7.3	0.7	0.0	1.4
Bicycle	64.7	69.3	61.3	78.6
Motor cycle	10.7	3.3	3.8	2.9
Horse carriage	0	0.7	1.3	0.0
Other specific/non-specific categories				
Solar photovoltaic set	14.7	40.0	41.3	31.4
Sewing machine	8.0	2.0	1.3	2.9
Miscellaneous items	0.7	1.3	1.3	1.4

Source: Questionnaire survey

Another interesting feature of ownership of non-living assets (other than house) is that there is hardly any female-friendly or gender-sensitive equipments/gadgets in the FFS HHs. The prevalence of availability of sewing machine is rather low (just 2%), even lower than that in control HHs (8%). Other than gender-neutral cellular telephone sets, women are not really benefitting from such assets. Men use most of such gadgets. A significant proportion of HHs (some 59%) have more than one cellular telephone, the second set being used by the leading female in the household. However, they often do not use the bicycle or motorized cycle for land transportation. However, women have informed that they hire rickshaw van or horse carriage to go to urban centres, especially if such trips are necessary for accessing health care services.

Although paddy thrasher machines are not being owned by most of the FFS HHs, the advent of such technologies has reduced women's workload significantly lower in the study areas. During peak harvesting and post-processing seasons, such equipment are often rented for quick thrashing of paddy pods, thereby significantly reducing women's workload. Although milking cows are available, women in the study areas have not seen or heard that mechanical milking machines are also available in Bangladeshi markets, which might also have significantly reduced their workload in milking their cows.

There is very strong correlation between top percentile income group and HHs with higher value equipment (such as tractors, mechanical irrigation equipment, television, motor cycle, etc.). In a changing economic scenario in rural Bangladesh, the ownership of such equipment can be treated as a better proxy indicator of economic status in addition to average monthly income (which significantly varies by month) or average monthly expenditure on food (again, it reaches at its lowest level in Kurigram during mid-September till mid-October).

4.2 State of Agricultural Activities As Indicated in the Literature

Historically, Kurigram is a district which has long been widely known as part of a region (greater Rangpur region) with extremely poor agricultural mechanization and advancement, distinctly identifiable as rain-fed agricultural zone with minimal investments for inputs (Quddus et al., 2004). The cropping intensity in Kurigram, even after two decades of green revolution in Bangladesh, has remained around 1.0 until 2006-07 (District Agriculture Office, 2017). The geophysical realities have

been primarily responsible for such low input and mechanization levels: about 48% of the land has sandy top soil and over 70% of the available croplands are found to be prone to varied degrees of inundation during the peak monsoon. Moreover, the majority of the landmass belonging to the active Brahmaputra and Teesta floodplains, the lands are subject to occasional riverbank erosion and sand casting – both having direct dampening effects on input-driven agricultural development. This is why, agricultural development has historically been rather poor, especially when one compared Kurigram with other districts.

As a direct result of poor agricultural development, the farmers of Kurigram district (including the members of FFS) have remained significantly poor over the first four decades of independence of Bangladesh. Since they could not afford investment costs for inputs, they had to depend on varieties those have been extremely low-yielding, prone to hazards such as floods (during Kharif-I and Kharif-II season) and droughts (during late rabi season). On top, they repeatedly faced episodes of riverbank erosion and occasional sand casting on top soils. Thereby, these farmers have long been trapped in a low input low output agricultural trap, which had gradually forced them to face acute seasonal food insecurity.

The early impacts of climate variability, if not climate change, have even greater devastating effects on poor farmers of Kurigram (Ahmed et al., 2012). The dwindling nature of rainfall, erratic onset of monsoon, prolonged periods of rainlessness followed by extreme rainfall episodes have made lives of farmers of Kurigram extremely miserable (Ahmed et al., 2012, Etzold et al., 2014). Many farmers had to opt for frequent seasonal out-migration (Siddiqui, 2003; Rashid, 2009), leaving their respective families indebted to local money lenders (i.e., *Mahazans*). Women were particularly vulnerable under extreme poverty situation.

As indicated above, Bangladesh has made tremendous success in quadrupling her foodgrain production in about 40 years since independence in 1971. Many new paddy (producing the staple, rice), wheat, maize, potatoes, spices, oilseeds, fruits and vegetable varieties have been developed in government funded research institutions (such as BRRI, BARI and BINA), tailor made to address prevailing environmental hazards, even location specific hazards. Inundation tolerant paddy varieties have been propagated in the field, while saline tolerant paddy varieties have also been released and promoted in areas where such varieties were found to be appropriate. Although many found the taste of such crops to be inferior to those earlier low-yielding varieties and there have been relentless allegations regarding higher water and input demands of such high yielding varieties, farmers have accepted such varieties with joy. Gradually, the once known subsistence farming in Bangladesh has turned into profit-making farming in most of the districts.

In advent of such varieties, Government's Department of Agriculture Extension (DAE) as well as some NGOs in Kurigram have started promoting a few selected varieties that suited to the environmental and socio-economic contexts of Kurigram. Moreover, microcredit programmes of a few relevant agencies brought access to finance at the footsteps of farmers in Kurigram. A significant fraction of farmers also invested their hard earned remittances from frequent out-migration efforts, which enabled them to try advanced crop varieties along with appropriate packages of inputs – a combination which has turned into instantaneous success. Orchards of bananas came along in sandy soils with high profit potential, lowly productive char-lands were converted gainfully into sweet-gourd gardens and potato fields, irrigation enabled farmers to cultivate irrigated Boro paddy – the latter being known as the single most provider of food security for the millions of farmers across the country.

A small fraction of farmers in Kurigram have also benefitted from such modern farming endeavours. The FGDs and a few KIIs involving farmers reveal that, local varieties of Aman such as *Gainja* used to produce 120 to 160 kg paddy per 32 decimal of land (1 *Bigha*). The alternate HYV Aman variety such as 'BRRI Dhan 33' produces 500 to 640 kg from the same unit of land. However, the geophysical constraints and hazard proneness of farmlands have still posed threats to further advancement in modern agriculture. Kharif-II crop has still remained subject to mercy of God during the peak monsoon, which is why a few extremely low yielding local varieties of Aman paddy have been cultivated by most of the farmers – fully knowing that the overall production would not enable them to ensure household food security. The duration between the harvest of Aman (if not flooded during monsoon by the mercy of God) and transplantation of Boro paddy, there wasn't adequate time to cultivate another crop gainfully. Pulses and oilseeds such as mustard were the automatic choices, however the local varieties or even the early modern varieties could not yield appreciable amount of mustard per unit of land, which might enable farmers to invest purposefully in Boro production. Moreover, the farmers feared that any delay in harvesting of such mustard varieties could eventually interfered with transplantation process of Boro paddy seedlings, which might further reduce their potential food security. As a consequence of all the above, while the rest of the country was gaining from agricultural advancements, the majority of the farmers of Kurigram were still struggling to improve upon the overall cropping intensity in their fields.

The implications of being trapped in low yielding low input agriculture have been significant. Farmers and their family members have been facing moderate to acute seasonal food insecurity. The food insecurity during Kartik (mid-September to mid-October) has been notoriously known as Monga (Zug, 2006; Rahman, 1995), leaving long lasting scars on the memories and well beings of local inhabitants (Ahmed et al., 2012). The GOB had to devise strategic poverty reduction plans, especially mobilization of various social safety net (SSN) programmes for Kurigram and other Monga-affected districts.

4.3 State of Food Security and Insecurity of the Respondents

As has been indicated in earlier sub-section, the target FFS households have been suffering from chronic seasonal food insecurity[4] in the recent past. The fact has been reconfirmed in all the four focus group discussions (FGD) and also through numerous Key Informants' Interviews (KII). From the survey it is revealed that, until 3 to 5 years ago, on an average the FFS HHs have been enjoying food security up to 9 to 10 months. The top 30 percentile FFS HHs used to have 10 months of food security, whereas the bottom 25 percentile FFS HHs used to have only 8 months of food security some 3 to 5 years ago. In contrast, the top 40 percentile control HHs used to enjoy food security for at least 10 months. However, seasonal food insecurity was also prevalent throughout the region, irrespective of locality.

In Panchgacchi Union, no household used to have more than 10 months of food security, while in Holokhana, only about 5% HHs used to have 11 months of food security. In the two Unions, some 41.4 and 23.8% of FFS HHs used to have about 10 months of food security. This suggests that, despite the fact that a few HHs enjoyed 11 months of food security in Holokhana Union, the overall food insecurity there was really high.

[4] In rural Bangladesh, food security is often understood as having adequate cereals for all the members to fill in their stomach – a contextual definition which is far away from the globally established definition of food security (FAO, 1996).

The FFS respondents have been asked to pinpoint why they have believed seasonal food security to set in. An overwhelming majority of the respondents have identified two most important reasons for such acute food insecurity: (a) not having adequate employment opportunities during September-October (74% of HHs as against 66% among control HHs) and (b) low crop yields as against high food requirements of participating households (62.7% FFS HHs as against 27.4% control HHs). A regional comparison of reasons for having such acute food insecurity is presented in Table-8.

As presented in the Table-8, there exists some regional differences in understanding the causes of past food insecurity. While non-availability of gainful employment opportunity in the Monga season has certainly been a major cause, it should not have been the major cause in farming households (as the main survey was conducted in farming HHs). The respondents in Holokhana Union have rightly pointed out that it was the reduction in stored food that used to cause the problem. However, some way or the other, the diminishing food storage has also been a function of low productivity, which has been highlighted by the respondents of Panchgacchi Union.

When enquired about the identification of worst food insecurity periods (i.e., months in the calendar), two time-frame have emerged from responses of FFS members: (a) Ashwin and Kartik (Mid-August till Mid-October) (65.3 and 92.7%, HHs respectively) and (b) Chaitra and Boishakh (Mid-March till Mid-May) (92.0% and 61.3% HHs respectively) as the worst food insecurity period in the study areas. Similar responses have been found in both the Unions and also among control households.

Table-8: Reasons for experiencing acute food insecurity in the past

Reasons cited	Percentage of households responding in			
	Control HHs	**All FFS HHs**	**Panchgacchi**	**Holokhana**
During the season, no work available	66.0	74.0	82.9	66.3
Stored food diminished before Monga	63.2	30.7	2.9	55.0
Low production, cannot sustain	47.2	36.7	34.3	38.8
Low yield, HH needs are high	27.4	62.7	87.1	41.3
No significant savings to buy food	5.7	17.3	1.4	31.3
Other reasons	2.8	0.7	0.0	1.3

Source: Questionnaire survey

The FFS HHs have also been asked to portray current sense of food insecurity. It is revealed that 16.0% and 43.3% FFS HHs has round the year and 11 months food security, respectively. Among the control HHs, proportion of HHs having round the year food security has now increased to 72.0%, which is found to be quite commendable. Even the fewer HHs having 12 months of food security in the study areas can be seen as a great leap in achieving food security compared to past food insecurity.

Generally women suffer the most in any phase of food insecurity (Ahmed et al., 2012). It appears that the situation is gradually changing in Kurigram district. Three to five years ago, all members in the household used to suffer through food insecurity in 58.6% of FFS HHs (Table-9). However, women were still the primary sufferer in Panchgacchi Union. Although women were generally affected by food insecurity, they used to try their level best to offer food to the children first. That is why, an insignificant proportion of HHs have indicated that only the children used to suffer through food insecurity some 3 to 5 years ago. Figure-6 presents the comparison involving different groups on indentifying who used to suffer through seasonal food insecurity.

Table-9: Household members who generally suffer through seasonal food insecurity

Household members in responding HHs	Percentage of households responding in			
	Control HHs	All FFS HHs	Panchgacchi	Holokhana
Only children/young members of HH	0.0	1.4	0.0	2.5
Only elder/adult members	2.8	23.4	44.3	3.8
Only female members	3.8	30.3	58.6	3.8
All members simultaneously	66.0	58.6	35.7	78.8

Source: Questionnaire survey. Multiple answers were allowed.

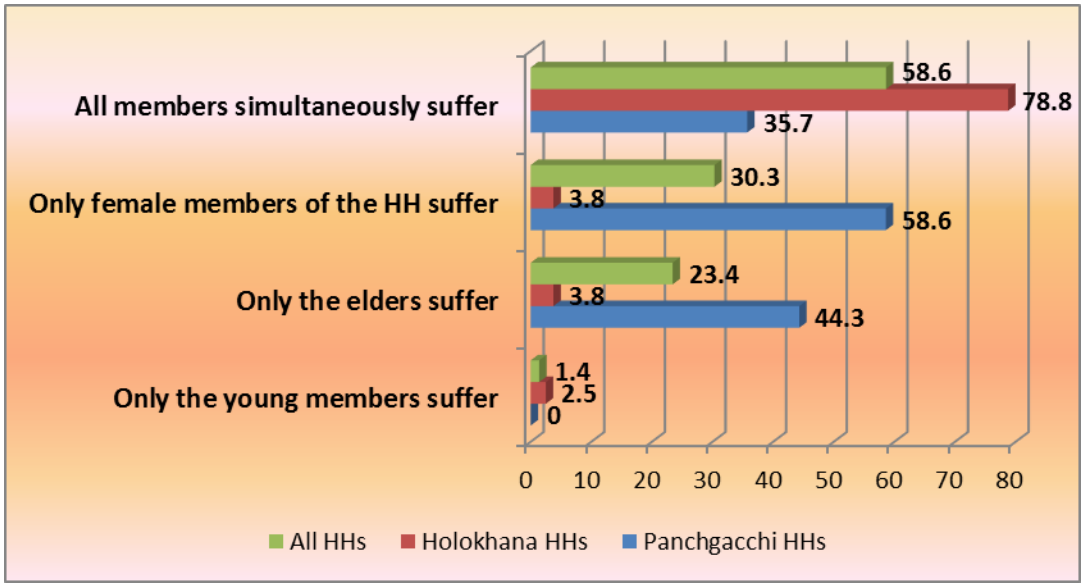

Figure-6: Household members who used to suffer through periods of food insecurity

Responding households used to take a host of measures to ameliorate food insecurity. Figure-7 gives a summary account of various modalities applied by different HH groups to reduce extent of food insecurity involving FFS HHs. Clearly, opting for lowly priced non-protein based food and skipping a meal per day had been the most preferred measures that the HHs used to consider in a bid to reduce the burden of food insecurity. Although borrowing food has been another measure in the control areas, such a measure is found to be more prevalent only in Holokhana Union. There are households who used to take just one meal a day. A further analysis clearly establishes a very high correlation with the state of poverty. The lesser the income/expenditure levels, the more the tendency to reduce food consumption among responding households.

Scavenging locally available material with whatever food value used to be the most commonly used modality to address food insecurity (Ahmed et al, 2012). Two of the other most common modalities to 'manage' and/or address food insecurity are to (a) reduction of expenditure so that more cash may be made available for purchasing food and (b) made extra cash available by selling off household assets. Both such measures are generally extreme measures, which have significant adverse social, economic and psychological implications among the household members (Ahmed et al., 2012).

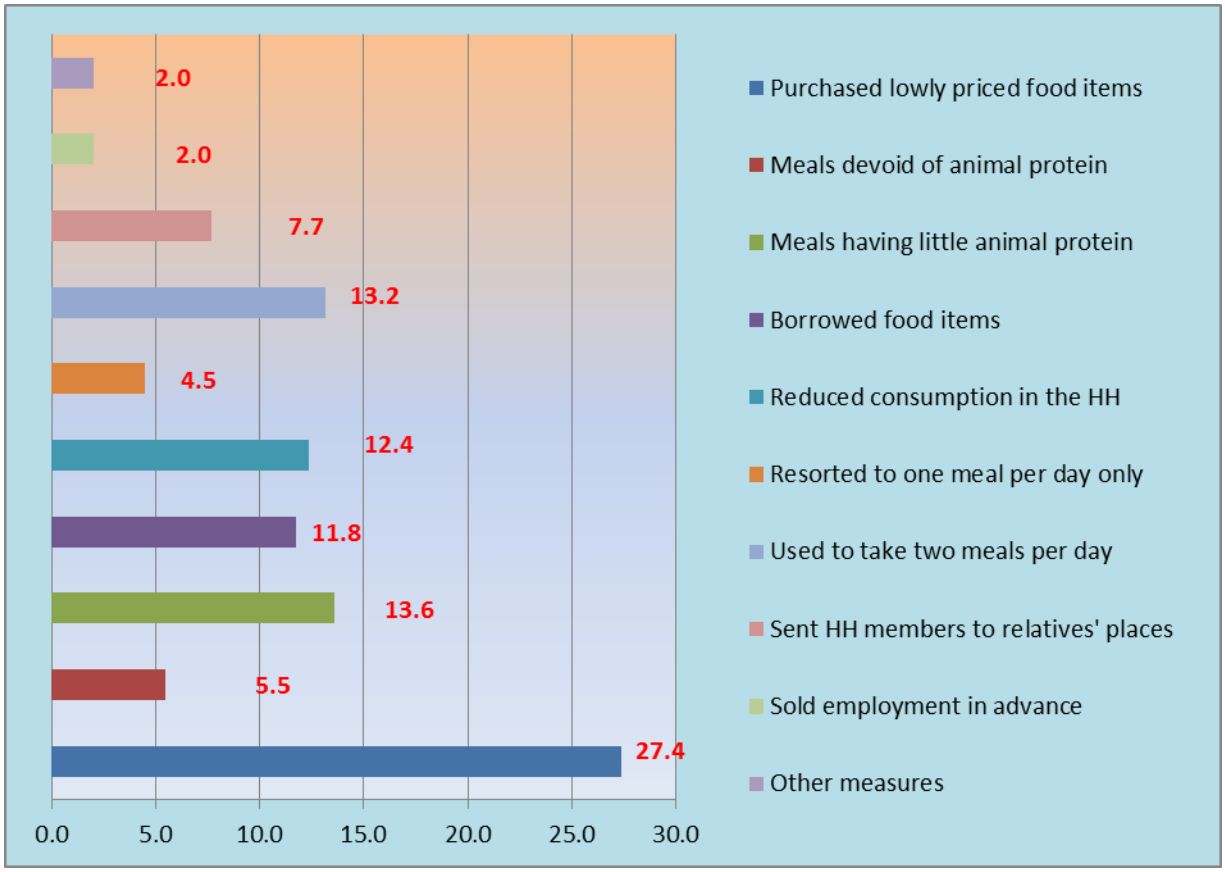

Figure-7: Summary of various measures considered by FFS HHs during food insecurity periods

Similar measures have been reported to be considered by the neighbours of target FFS HHs. It appears obvious that most of the measures to address seasonal food insecurity are such extreme ones which either heavily erode nutrition and/or productive assets, both having severe social and economic consequences. Since cash borrowing is also highly prevalent, repayment of cash becomes an annual headache for the poor people, which eventually becomes an impediment to invest in agriculture in the subsequent season. This in turn triggers a perpetuation of poverty involving the poor smallholder households.

An overwhelming majority of the FFS HHs (99.3%) admitted that they used to reduce expenditure of the household, as against only 69.8% control households. In the FGD, females have informed regrettably that, they had to suppress their desire to purchase virtually anything other than food items for a long time (even over 20 years at a stretch!) due to chronic food insecurity in study areas. Both the FFS and the control group have recognized that their neighbours' also had to reduce household expenditure in order to address food insecurity. The corresponding figures are 95.9% and 100%, respectively for FFS and control households.

A further probe into the issues has revealed that, the most common ways of reducing household expenditure (other than opting for food items with low calorific value) were: (a) reduction of purchase of non-food household items (such as clothing, utensils, etc.), (b) avoidance to commit to health care costs, (c) (drastic) reduction in consumption of high value proteins such as fish or meat, and (d) sacrificing children's educational costs (books, fees, tiffin, school dress, etc.). Figure-8 summarizes the intensity of various responses by the different household groups both in control and study areas. There have been some regional differences in responses, as evident from the comparison between respondents of Panchgacchi and Holokhana Unions.

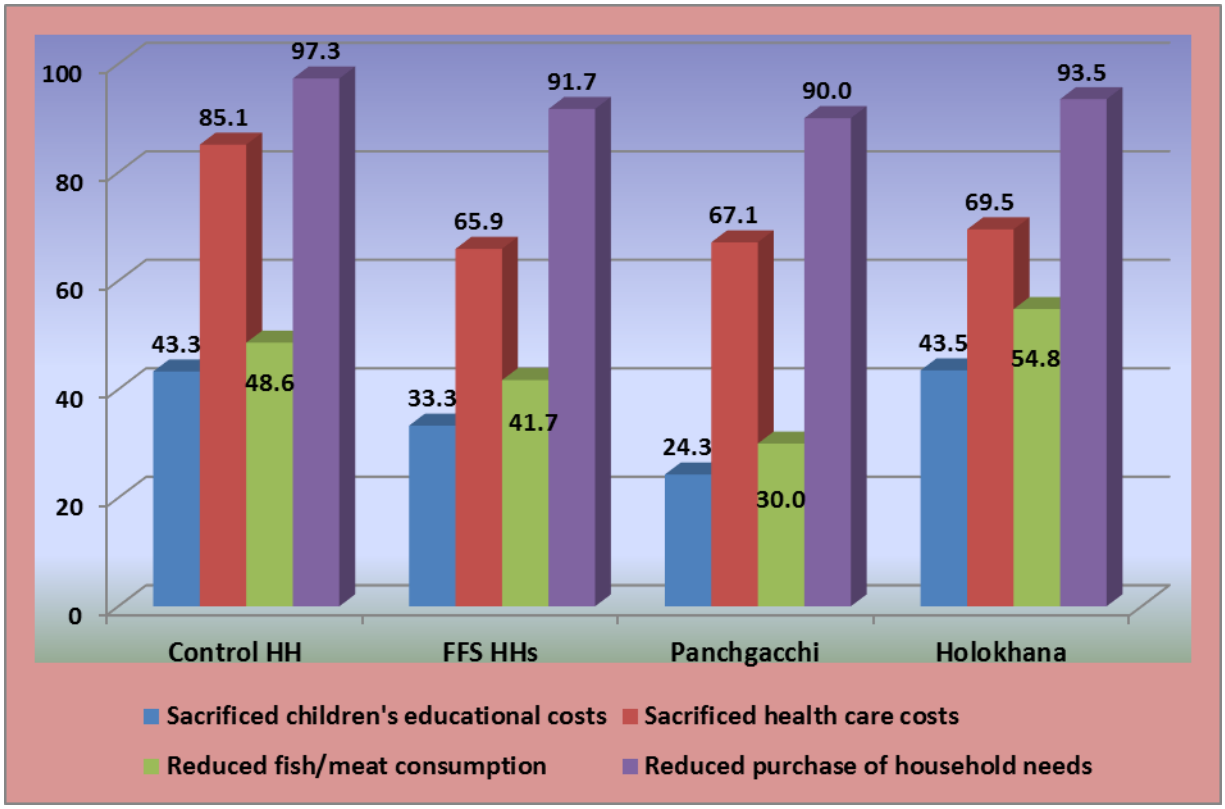

Figure-8: Extent of measures considered by various HH groups towards reducing HH expenditure

The various respondent groups not only admitted to consider such extremely harsh measures, they also have indicated that their respective neighbours had to do the same, perhaps at different extents. Table-10 summarizes the responses for the neighbours of the various respondent groups.

Table-10: Differences in response of measures considered for reduction of household expenditure by respondents' neighbours

Measures considered to reduce HH expenditure	Percentage of respondents informing			
	Control HHs	Neighbours of Control HHs	FFS households	Neighbours of FFS HHs
Sacrificed children's educational costs	43.3	62.9	33.3	48.1
Sacrificed health care costs	85.1	94.4	65.9	50.4
Reduced purchase of household needs	97.3	67.1	91.7	100.0
Reduced fish/meat consumption	48.6	93.7	41.7	77.5

Source: Questionnaire survey. Multiple answers were allowed.

Since selling off household assets was identified as another common modality to address food insecurity, the issue was probed in further details. Among all households involving FFS members, 88.5% used to sell off household assets (98.6% for Panchgacchi and 93.1% for Holokhana Union). Such measure was equally prevalent among control households (98.1% HHs).

Most of the HHs used to sell their assets twice a year, both in target and control households, as evident from Figure-9. The data finds a very strong correlation between frequency of facing sesonal food insecurity and frequency of selling off household assets, irrespective of regional locations of the respondent households.

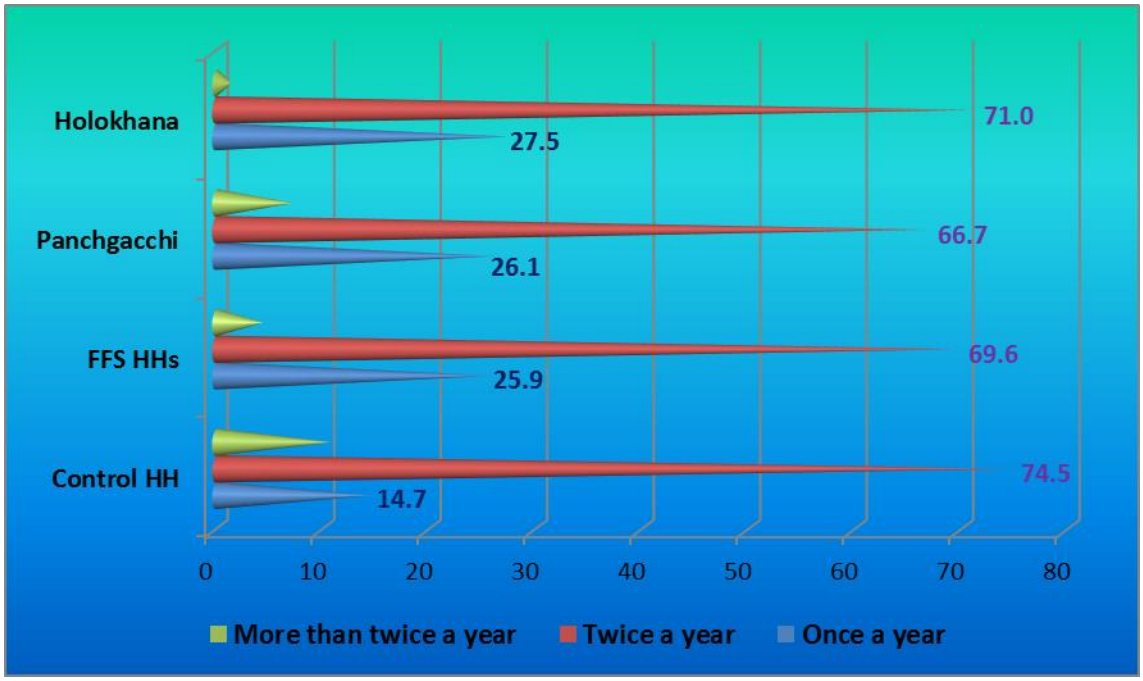

Figure-9: Frequency at which households used to sell off household assets among various groups

As in the case of measures such as reduction in household expenditure, the respondents also have opined that their respective neighbours (HHs in the community where they live in) also used to sell off their assets whenever they needed extra cash to reduce the burden of food insecurity. Interestingly, the same statement was also found to be true for the control households.

In the FGDs, the participants were unanimous regarding the fact that, it was the very process which began pauperization process in the area. Most of the poor households used to have large tracts of land and other assets. However, with every generation, such land assets were divided among hiers. On top, they started facing acute seasonal food insecurity. Then they started to sell off most of their valuable belongings, especially land. People indicated that, over the past decade, their land holdings had come down to a bare minimum – almost no land to be sold. If they had to sell off the last parcel of land, they would have become beggars.

Figure-10 presents the types of various household assets being sold by the respondents as a response to food insecurity. The corresponding figures for the FFS HHs and the control HHs are more or less similar. There is no appreciable regional difference between the HHs in two study unions. People have also indicated that their respective neighbours have done more or less the same, if such situation had arised in the past.

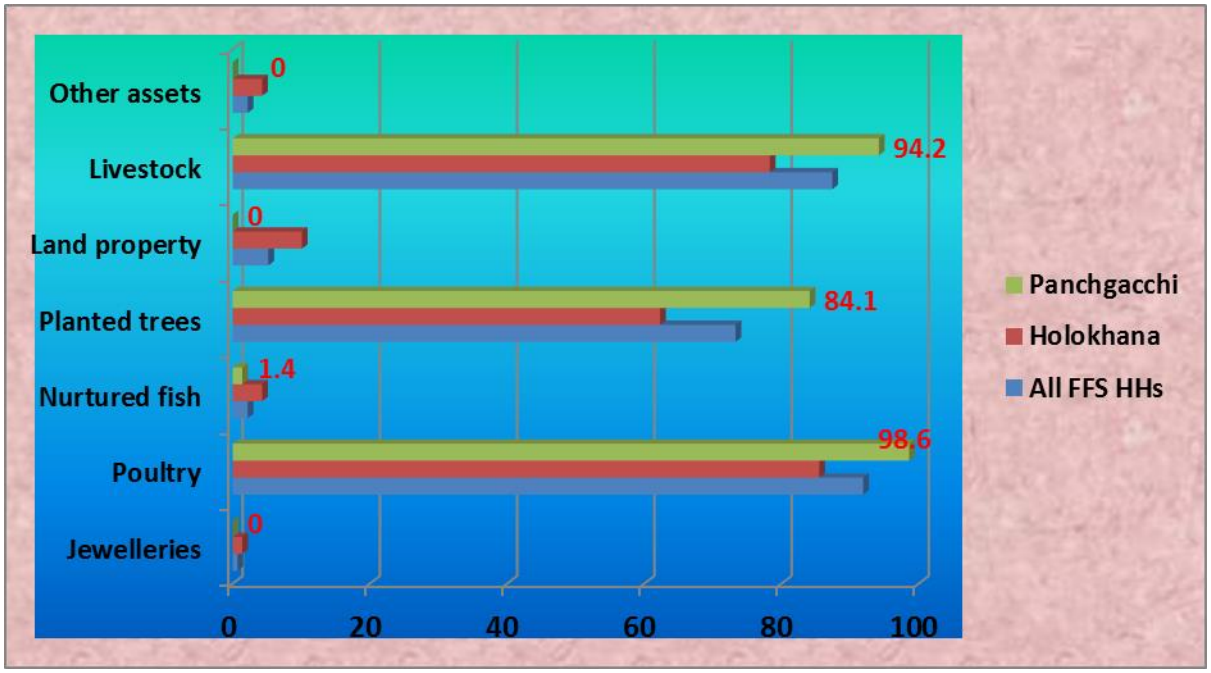

Figure-10: Types of assets being sold by the respondents as a response to food insecurity

By analyzing the types of assets being sold, one may infer that as long as the affected people had livestock (dairy animals, sheep, goats, etc.), poultry (chicken, duck, pigeons, etc.) and standing trees in their respective courtyards, they did not have to sell off their lands. However, possession over such useful living assets also required land around their courtyards. Because of frequent experience of food insecurity in the study regions, people had to repeatedly sell off valuable assets. Now they are left with bare minimum assets, not at all adequate enough to withstand and cope with subsequent food insecurity episodes.

4.4 State of Out-Migration of the Respondents

Kurigram has been known to generate large outflux of seasonal migrant workers (Ahmed et al., 2012). In search of employment elsewhere, a large number of people were found to ride on top of buses leaving Kurigram – especially during late August, every year. Survey reveals that migration was a popular response to increasing food insecurity during Monga period, involving 93.4% FFS HHs compared to 75.5% among control HHs. Again, there exists a very high correlation between those HHs who have been forced to skip a meal or two and those reporting out-migration of family member(s) (above 95% confidence level). Moreover, another very high correlation is found between households facing food insecurity in Kartik (Mid-September to Mid-October) and those reporting out-migration of HH member(s).

It is already known that migration for remittance has been committed and done by males in the households (Ahmed et al., 2012) in the study areas. When respondents were asked to reflect on who among the household members used to migrate out to bring home remittance, 64.5% respondent specifically identified that it used to be the male head of the household, followed by 34.7% identifying other male(s) in the household as the primary migrant member(s). The corresponding figures for the control households are 63.7% and 28.7%, respectively. This leads to the inference that, it is the leading male (generally, the household head) of the household who migrate out in a bid to earn and send remittance.

In contrast to male only out-migration, women's migration in FFS and control HHs are reported to be in 0.8 and 1.3% respondents, respectively. In the latter cases where women migration has actually taken place, the women were accompanied by their respective male counterparts, suggesting a rare joint out-migration. However, the KII involving male migrants suggest that, "… no male can be that lucky to be able to take along his wife while making money away from home". Male migrants do not tend to inspire their spouses to accompany them because of many factors. Over 90% of the male migrants perceive that the social conditions in destination areas are not 'suitable' for their 'respective partners'. Moreover, women's presence at the households are also deemed to be absolutely necessary in the absence of males, where women take control over assets and welfare of family members – the latter function often has no alternative.

Along with welfare of family members, male migrants also value the economic value of the presence of females while they out-migrate. The women generally take care of all productive assets, including the welfare of live animals belonging to the migrants' households. According to 67% of the male respondents, women must also take care of living animals including bovines while the males themselves do migrate out. They do perceive that, if females also migrate out, the welfare of the household including family members and productive assets will be in jeopardy.

People also have suggested that life after seasonal migration can be quite harsh and unfriendly. According to over 90% of the male migrants, the social conditions in the destination areas are completely uncertain and unfriendly. People perceive that migration can even lead to being in completely awkward situations, where "… nobody would dare to subject his dearest ones in such harsh and unfriendly conditions". When a migrant Mr. Abdul Alim (39) was interviewed, he commented *".. ami ki kaam-i kormu, naki bouer bhalo mondo dekhte thakmu? Din gele taha (i.e. Taka) lagey, kaam na korle taha keu dibo na. Takar leiga-i-to jaon …"* (Should I spend time to look after my wife, or should I be working to make money? Every single day costs money, if I cannot make money how can I sustain? Nobody would give me money. It is for money we do migrate out).

Reflecting on neighbours' migration patterns, the respondents indicated similar migration patterns involving the main migrant. There is hardly any regional difference in such migration patterns involving neighbour's households.

As migration has been a response to seasonal food insecurity and there used to be two such episodes per year, most of the respondents (79.4%) mentioned that the frequency of migration was twice per annum. The percentage of HHs experiencing two migrations per annum among FFS HHs is somewhat similar to that for the non-FFS control HHs (involving 80% control HHs). Only 11.5% of FFS HHs used to experience single migration in the past, compared to 5% control HHs experiencing the same.

Extreme poor FFS HHs are found to migrate thrice a year, the latter corresponds to about 8.4% of all FFS HHs. However, about 12.9% of HHS from Panchgacchi indicate that the HHs used to observe three migrations per annum, perhaps indicating much higher levels of vulnerability of the area compared to Holokhana area. A further examination into the matter reveals that the bottom-most poor households (about 8.4% of all FFS) have no choice but to migrate thrice in a year. Similar proportion of control HHs are found to migrate more than two times a year.

There exists a significant regional difference in frequency of migration between the two study Unions, as presented in Table-11. The correlation between HHs migrating just one time a year and higher monthly income is significantly high. This leads to the inference that, before the project

intervention, relatively well-to-do FFS households used to experience just one migration per annum – only to earn and support household expenditure during the major food insecurity period. However, the majority of the FFS households used to migrate as many times a year – as they used to face food insecurity.

Table-11: Differences in response of frequency of migration as a response to seasonal food insecurity

Frequency of out-migration	Percentage of respondents informing			
	Control HHs	FFS HHs	FFS of Panchgacchi	FFS of Holokhana
Once a year	5.0	11.5	11.4	11.5
Twice a year	80.0	79.4	74.3	85.2
More than twice a year	12.5	8.4	12.9	3.3
Other frequency	2.5	0.8	1.4	0.0

Source: Questionnaire survey. Multiple answers were allowed.

It is known from literature that most of the migration during seasonal food insecurity is domestic in nature and also a significant proportion of such migration has historically been (a) as agricultural labour and (b) as day labour or rickshaw pulling in urban centres (Ahmed, et al., 2012, Etzold et al., 2014). In the study area, the majority of the respondents have identified agricultural labour being the most common type of employment after migration, as highlighted in the Figure-11.

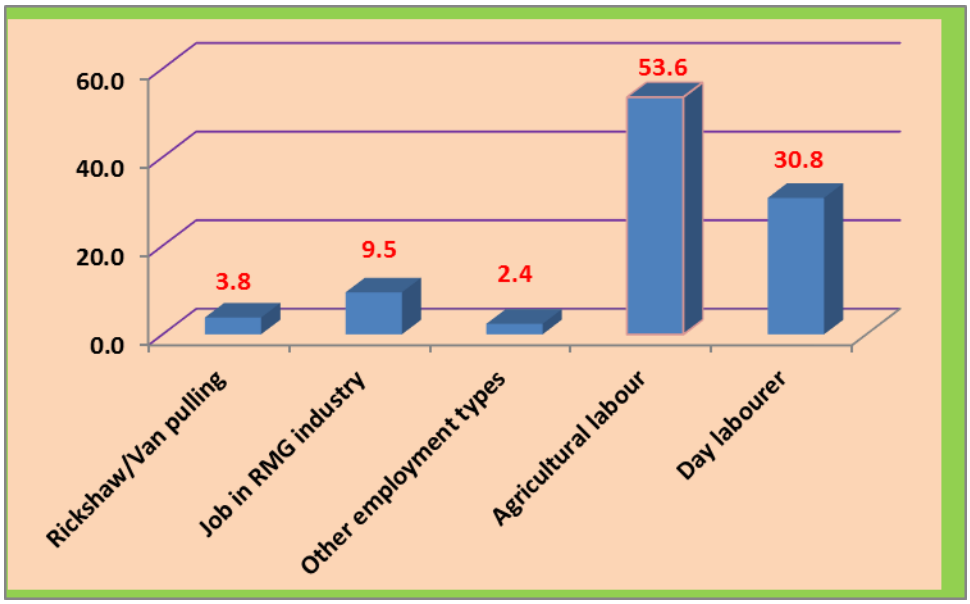

Figure-11: Post-migration employment type which are experienced by FFS households

Interestingly, the respondents of Holokhana Union generally find employment predominantly as agricultural labour (95.1%) and as daily labour (73.8%), while only 28.6% of the respondents of Panchgacchi union find employment as day labours. In comparison, 72.5 and 22.5% of the respondents from the control areas find employment as agricultural and daily labours, respectively, after migration.

Such a finding suggests that (as summarized in Figure-11), the migrants (among FFS members) used to find employment in sectors where they had some skills. Unlike conventional wisdom, despite the booming industrial and economic activities in urban centres, only a small fraction of migrants used to find employment in RMG industries and/or as rickshaw/van puller. This indirectly indicates that,

out-migration as a response to food insecurity has been predominantly 'rural to rural' in nature. Rural to urban migration is found to be of lesser importance to the migrants.

The above also indicates that, since the employment pattern is labour intensive, despite facing acute poverty and food insecurity, female migration did not often take place. This was further compounded by the fact that, Kurigram has largely remained 'far away' from Dhaka[5] and thereby, women of Kurigram used to be outside the economic access to opportunities for women.

Since women were not use to migrate out, it does not necessarily mean that they did not have any responsibility when their male counterparts were away from home. Rather there has been a significant gender-based social and economic cost women had to put on when their respective main male counterparts were away from home (Ahmed et al., 2012).

The survey re-established the fact that main woman in the migrant's household used to take care of the household affairs in absence of her male partner. 90.6% of the FFS respondents have opined so. This is found to be true in all geographic region involving migrants' households.

According to the key informants, the extent of migration from Kurigram has significantly changed, with decreasing extent of seasonal food insecurity.

[5] According to Poverty Map, Bangladesh (GOB & WFP, 2010), Kurigram falls within the same category of areas having the furthest economic access to Dhaka, the capital of the country and the major economic hub.

5 PROJECT INTERVENTIONS AND THEIR ASSESSMENT

The Where the Rain Falls (WtRF) Project intended to deliver a variety of livelihoods related aspects, especially those for enhancing adaptive capacity of target farmers groups so that they can fight with climate change driven hazards and ensure food security. Most of such adaptive capacities are related to agricultural activities so that either production can be enhanced and/or production cost can be minimized and income optimized from crop agriculture.

A close examination of all the activities considered under the project yields the following few targeted interventions:

- Assessment of local level vulnerabilities (keeping climate change and food security at the center stage), by applying participatory vulnerability and adaptive capacity assessments & sharing of such assessments extensively;
- Introduction of crop varieties that suits to the prevailing climate conditions;
- Introduction of new cropping patterns to increase overall cropping intensity for enhancing food security;
- Promotion of cropping techniques to further strengthen adaptive capacity;
- Building a community seed bank.

These are complemented with the following interventions:

- Building capacity of farmers;
- Helping women towards economic upliftment and subsequent empowerment;
- Reducing rate of outmigration so that social cohesion is maintained; and
- Building linkages with government agencies for accessing livelihood related services.

5.1 Assessment of local level vulnerabilities

An assessment of local level vulnerability to climate change was conducted in each of the two Unions. Each of the Union based vulnerability assessments was done in two levels: (a) at community level with an approximate area of about 1km^2, and (b) at a higher level within the geographical jurisdiction of the lowest tier of local governance system called Union Parishad (UP). While the former has provided an account of causes of climate variability (and change) induced vulnerability and resulting effects at a microcosm, the latter probed the same involving a larger area, where institution led adaptive measures could be considered in a bid to reduce overall vulnerability of the area.

Since standard participatory vulnerability and capacity analysis (CVCA) tools have been applied in such vulnerability assessments and communities were fully involved in the process, such processes not only had produced an account of local level vulnerability, but also raised awareness among participants. The process at the higher tier involved local officials (such as Sub-Assistant Agriculture Officers) and elected leaders, which enabled the poor food insecure and climate vulnerable population to seek solutions from both political and institutional service providers. In the FGDs and key interviews with elected members, the participants from both ends expressed satisfaction regarding such a process and its outcomes.

5.2 Introduction of crop varieties that suits to the prevailing climate conditions

The project focused on enhancing crop systems in the wake of greater climate variability (if not climate change per se). The foremost important activity under this category was to introduce crop varieties that suited to the prevailing climate condition (addressing variability). Both the study Unions (i.e., Holokhana and Panchgacchi Unions) are extremely flood vulnerable (Ahmed et al., 2012). Both the Unions are also highly erosion prone and have undergone severe forms of erosion in recent years. Due to low elevation of lands and flood proneness, people hardly can get good yield from known monsoon rice (i.e., Aman) varieties (such as BRRI Dhan 9, BRRI Dhan 13) – which is why they remain largely food impoverished. The project looked for advanced varieties of Aman paddy from research institutions, which are lesser known to the local farmers due to inadequate extension service and lack of dissemination of information. Such hazard-resistant varieties were known to sustain inundation for a considerable period of time during peak flooding.

The project collaborated with institutions such as Bangladesh Rice Research Institute (BRRI) and Bangladesh Institute for Nuclear Agriculture (BINA), and facilitated extension of flood tolerant varieties (such as BINA-Dhan-11, BRRI-Dhan-52, etc. Both the varieties are high yielding Kharif-II suitable Aman varieties, however, not hybrid varieties.) with high yield potential. The project proponents organized a total of eleven 'Farmers' Field School' (FFS) Groups, arranged regular information sharing meetings (generally twice a month) involving the members of FFS and discussed about the importance of choosing Aman varieties such as BRRI-Dhan 51 and BRRI-Dhan 52 (both developed by BRRI) and BINA-Dhan-11 and BINA-Dhan-12 (both being developed by BINA). The FFS members have been convinced that such newly developed varieties might go in submergence condition in case of a late flood in late August or early September, however would be able to sustain through a threshold period of 15 to 20 days of submergence and still yielding relatively higher than other High Yielding Varieties (HYV) of Aman.

The varieties with following characteristics have also been promoted:

- **BRRI-Dhan 51**: Can tolerate a threshold of about 15~16 days of submergence soon after transplantation, average field condition yield is about 5.5 to 6.0 tons per hectare
- **BRRI-Dhan 52**: Can tolerate a threshold of about 15~16 days of submergence soon after transplantation, average field condition yield is about 5.5 to 6.0 tons per hectare
- **BINA-Dhan-11**: Can tolerate a threshold of about 15 to 20 days[6] of submergence soon after transplantation, average field condition yield is about 4.0 to 4.5 tons per hectare under submergence condition and 5.0 to 5.5 tons per hectare under non-flooded condition
- **BINA-Dhan-12**: Can tolerate a threshold of about 25 days of submergence soon after transplantation, average field condition yield is about 3.5 to 4.0 tons per hectare under submergence condition and 4.5 tons per hectare under non-flooded condition

Such extension could be taken to the field during the Kharif-II season (i.e., monsoon season when Aman paddy is grown) of 2015 and to a lesser extent, during the unprecedented flood of 2016[7]. Unfortunately, The late flood[8] in Panchgacchi Union exceeded the design threshold for all the

[6] Design tolerance threshold is claimed to be up to 25 days, as indicated by BINA.

[7] The worst flood in recorded history for Teesta Floodplain.

[8] Flood water continued to inundate majority of the crop lands until September 22, A phenomenon which has not been observed more than once during the last quarter century. As a result of unusually late flood, majority of the crops have been severely affected. However, in the Dharala floodplain in Holokhana Union, the late flood has been receded by 11th of September. This has caused destruction of BRRI-Dhan 51 and 52 varieties by exceeding design threshold, however allowing BINA-Dhan-11 varieties to avoid complete destruction. The latter demonstrated that the 'new' variety will be just adequate to avoid crop loss during average late floods.

varieties in most of the lands and the anticipated yield could not be obtained by the flood affected farmers. However, where the land elevation allowed early drainage of flood water, both the BRRI-Dhan-52 and BINA-Dhan-11 demonstrated excellent results! In MoulaviPara village of Panchgacchi Union, awestruck people used to stop by the excellent paddy field of Mr. Abdus Salam, only to appreciate the thriving BRRI-Dhan-52, which defied continuous inundation of 18 days in 2016 and the variety eventually produced almost 7.1 tons paddy per hectare. While all the affected farmers lost almost all their HYV Aman crops due to high floods, the new varieties proved that it would still be possible to sustain through the prolonged submergence and still yield much more than the known 'HYV varieties'!

Since the farmers are now aware of sustenance of yield even under severe flood conditions, 100% respondents opined that they would no longer rely on extremely low yielding Aman varieties such as Gainja and Malshira. People are now ready to embrace flood-tolerant varieties. However, over 90% of the respondents have indicated that there is a dearth of seed of desired varieties in the areas. The Upazila Agricultural Officer and his junior officials also admitted that adequate quantity of seeds of flood-tolerant varieties cannot be found in local level, which can be a potential obstacle to further extension of such beneficial varieties.

Figure-12: BINA-Dhan-11 (on the left side) has been found to be still standing after 16 consecutive days of submergence, while the other Aman varieties in the next plot had all perished

The first phase of the CBA project was designed for 2 years[9] and could test such extension in only one full cropping season. The test results are based on very limited field experimentation. It may be expected that the newly introduced HYV Aman varieties will greatly contribute to both household level food security of poor and marginalized farmers and also the national food security by increasing production of paddy during monsoon period.

The above analyses clearly suggest that:

[9] But new phases of the project are secured until end of 2018

The component on introduction of crop (Aman) varieties to suit to local condition has been extremely successful, despite unusual flood conditions.

The extension has been highly relevant, given the hydro-geophysical context of the area.

The FFS and subsequent demonstrations through demonstration plots have been highly effective, that allowed testing the varieties in real life worst flood conditions. The modality of engagement of farmers has also been highly effective (vouched by FFS members, both male and female).

The impact of such extension (although no iteration effect could be observed) has been tremendous. The FFS members could significantly increase their household food availability by just harvesting a crop, which otherwise would have been lost due to very late flooding. Those who had cultivated BRRI-Dhan-52, for instance, could harvest in the order of 18 to 24 maunds per Bigha, while usual high yielding Aman varieties could not yield any grain! Those who could transplant local variety such as Gainja, the yield appeared 3 to 5 maunds per Bigha.

The sustainability potential of such varietal extension is also very high. BINA scientists have expressed satisfaction due to fact that it would allow an increased amount of seeds to be made available for subsequent year's extension and the field results have been highly encouraging.

Boro production also faces difficulties due to sharp but short-lived (5 to 6 consecutive days) cold spells, particularly in late December up to late January. The dense foggy layer that hangs around as drapes over the Boro seedbeds or freshly transplanted Boro seedlings cause significant cold injury to the crop, which eventually results in reduced productivity. Farmers tend to believe that in recent years the number of cold foggy days has increased in the Kurigram region (Ahmed et al., 2012).

As a solution to fog induced cold injury to seedlings, the project offered training to farmers towards using a transparent polythene sheet over a low-cost bamboo structure (total cost is less than Bd Taka 100 per seedbed) – mimicking a shed that captures fog and protects the seedlings from cold bites. Every morning the condensation of fog takes place over the polythene shed and the farmers can remove the cold water from the top so that no cold injury takes place. The FFS members were informed regarding the simple technique and the farmers had successfully employed the technique to safe guard their Boro crop during 2014-15 and 2015-16 winter seasons. The beauty of this simple but useful technique is its simplicity and low cost, which makes it an obvious method towards reducing climate related vulnerability to cropping. Each bed, having the dimension of 3 feet by 8 to 10 feet, needed a polythene sheet worth 100 to 120 Taka, four pieces of sticks and an initial labour input of about 30 to 45 minutes to set up the "dry bed". In each foggy day, manual labour of about 15 minutes was required to remove the fog collected over the polythene envelop.

5.3 Introduction of new cropping patterns

As a part of the strengthening of crop system in Kurigram, the project intended to introduce new cropping patterns to adjust better with prevailing climate conditions and to optimize farm based income. Historically, Kurigram area has been stuck with Aman-Boro-Fallow cropping pattern. However, because of high susceptibility to regular flood, Aman has been found to be tentative – often resulting in damage of HYV Aman. Even in cases of partial recovery by cultivating local varieties

(such as *Gainja*[10] variety), the output yield has been so low that household food security could have never achieved with such cultivation practices.

The opportunity of Boro came along just about three decades ago in Kurigram area, with the introduction of irrigation. Application of irrigation has increased production and farm income significantly, however such technologies has largely remained un-accessible to the poor and marginalized farmers. Therefore, the benefits from such cropping patterns could not be fully realized by the small and marginalized farmers. This has been one of the primary reasons for so talked about out-migration of male labours from Kurigram area (Ahmed et al., 2012).

The project thus attempted to introduce new cropping patterns with the advent of new varieties (i.e., technologies), which can provide for an opportunity to adopt either 'Aman-Rabi cash crop-Boro' for low lying land and 'Aman-Rabi cash crop-Boro-nitrogen fixing or short vegetative growth' cropping patterns for high land instead of traditional Aus/Jute-Aman-Fallow and/or more recent Aman-Boro-Fallow patterns. In doing so, the project proponents have built collaboration with Research Institutions such as BRRI and BINA and evaluated 'research-level' trials of practicing new cropping patterns. Such patterns are introduced to participating farmers (FFI groups including females) and demonstration plots are identified in a consultative process.

In an attempt to accommodate a rabi (cash) crop (say, oilseed mustard) in between Aman and Boro paddy (both providing for household staple), the variety must be a short-maturing one. This has long been a major limitation towards increasing cropping intensity in the northwestern region, since rabi cash crop varieties generally needed longer than available maturation period, which the farmers could not avail. In anticipation of a risk to staple producing Boro paddy, the smallholder farmers generally tend to forfeit any possibility of rabi cash crop.

As an alternative, the Aman paddy variety should ideally be an early maturing one so that intended shift can create adequate timeline for the subsequent rabi (cash) crop to be harvested. The project, in consultation with research institutions such as BINA and BRRI has fulfilled both the conditions and has provided with crop varieties that would ensure an early Aman paddy, followed by a short-maturing rabi cash crop (mustard) followed by high yielding Boro paddy cultivation.

The cropping pattern-1 (for high lands), following the project intervention, appears as: **BINA-Dhan 7/BRRI Dhan-33 + BINA-4 Mustard + BRRI-Dhan 28 + Green manure/vegetable, a pattern consisting of 4 crops per year**

Similarly, the cropping pattern-2 (for low-lying lands) appears as: **BRRI-Dhan-52 + BINA-4 Mustard + BRRI-Dhan 28, a pattern consisting of three crops per year**

The above transformation enabled farmers to not only avoid damage to prolonged submergence, also to squeeze in BINA-4 mustard variety before clearing the land for Boro transplantation. An overwhelming majority of the FFS members, some 97.3% of FFS households, opined that the introduction of BINA-4 mustard has not affected the timing of cultivation of Boro paddy – the latter having significant importance in defining household food security (subject to availability of irrigation). The project just delivered that to the FFS members. No wonder, about 98.3% of the FFS members reported that they would continue to cultivate the new improved BINA-4 mustard in future.

[10] The yield is around 0.7 mt/ha, which does not ensure food security of poor and marginal farmers. However, such local variety grows with rising water levels and suitable for very low lying crop lands.

The field trials have been hugely successful in Kurigram (i.e., pilot areas). Section- 6 provides evidences of such successful trials for BINA-4 mustard variety. The insertion of a cash crop and its field performance as against traditional mustard varieties has been proven to be a 'dream come true' for the poor farmers. The poor farmers can now harvest a viable third crop (mustard to fetch cash), still retaining potential to produce adequate rice for maintaining household food security.

The opportunity to overcome a long lasting 'limitation' to traditional cropping by the introduction of a short-maturing mustard has indeed opened up excellent resilience potential. The most important one has immediately been realized by the smallholders: they could afford to pay for the cost of irrigation with that extra income, an input which eventually enabled them to overcome dry season irrigation demand and ensure another harvest of staple. All on a sudden, the smallholders accustomed to rain-fed agriculture has transformed themselves into farmers who can even increase farm productivity and simultaneously handle increasing climate variability!

The financial effectiveness of the cultivation of BINA-4 mustard is placed in sub-section 4.6 below. The market response of the mustard has been excellent (Tk. 1,250 to 1,400/40 kg) which brought immediate financial satisfaction for the producers. Farmers could even kept a few kilograms of seeds for the coming season, without being forced to sell off all the mustard to maximize cash flow. The women are found to be excited by just the sight of somewhat bigger grain size of the newly introduced high yielding mustard. The 'extra' cash has also been useful to fulfill intra-household unmet/unattended as well as little suppressed demands.

The promotion of the pattern involving 'BINA-Dhan 11 – BINA-4 Mustard – BRRI-Dhan 28 – nitrogen fixing species' has just started, although not to the extent of the 3-crops based pattern. As a nitrogen fixing species, Dhaincha is promoted to be mulched while still green – just to supplement nitrogenous elements into the top soil. The idea has been to reduce potential mining of nutrients such as nitrogen due to increasing cropping intensity of the soil and bringing back the inherent strength of the top soil profile. The farmers are increasingly participating in such promotional patters and they understand that reduction in the use of fertilizer (i.e., nitrogen based urea) could also reduce their expenditure on it, thereby reducing cost of production.

5.4 Promotion of cropping techniques to further strengthen adaptive capacity

Recognizing the low level of understanding of farmers in the study areas regarding sustainable but high yielding agro-ecological practices, the project has designed a few targeted trainings and organized demonstrations so that farmers get acquainted with advanced beneficial techniques. A host of issues have been covered in such capacity building programmes with a view to either enhance general agronomic practices, to promote environmentally sustainable practices for both healthy living and achieving good market price, and recoup with dietary losses that might have resulted from frequent past food insecurity episodes. The issues covered under the capacity building programme are the following (a more detailed account is placed in Annex-II).

- Homestead vegetable gardening
- Covered seed beds
- Seed preservation
- Pit composting
- Green manure production
- Vermin compost
- Feromone trap

- Line sowing
- Parching

Unlike other NGO-driven projects, WtRF did not start with giving away agricultural inputs. Rather it attempted to generate knowledge, based on practical hand on practices, so that a lasting impression is created among the poorly informed farmers and they continue to thrive by helping each other within the same community, thereby a solid foundation towards defiance of climate variability and change induced hazards and disasters are addressed with 'transformed local knowledge'. Of course, such advancement, if at all occurred in the field, cannot be documented through any methodology, if applied within months of delivery of project components. No number, therefor, was created to capture the advancements. However, reflections of service receivers, GOB facilitators and also monitoring tools combined have provided insights into such capacity building outcomes.

The environmental benefits of such capacity building efforts cannot be perhaps observed in one or two years of extension. However, the farmers are overwhelmed by the simplicity of the techniques introduced and the immediate results of application of such techniques. Mrs Mollika Khatun (32) of Moulavipara village of Holokhana Union said "… I did not offer chemically treated vegetables to my children. Now that pests are managed without chemicals, I give them vegetables from my own garden – fully knowing that these are safe. I hope my children will be healthier …".

5.5 Building a community seed bank

Although the newly introduced varieties (such as early maturing and/or flood tolerant Aman pady, short maturing mustard, etc.) are the products of national research systems (such as BINA, BRRI and BARI), there is significant shortages of preferred varieties of seeds in respective research institutes. In reality, seeds are generally distributed to farmers through two channels:

- The public channel involves the distributing agency: the Bangladesh Agriculture Development Council (BADC), and
- The private channel, which operates as per regulatory guidance provided by the Government.

BADC employs a large number of 'contact farmers' to grow quality seeds. Generally BADC channel is a reactive one, which responds to demands for seeds as exhibited by majority farmers in a given locality. However, BADC also has a tiny proactive modality to popularize particular varieties. In the latter cases, BADC provides for sample seeds of newly available varieties primarily to the DAE, which eventually gives away through a small number of farmers to establish a 'demonstration' effect. This proactive model of extension is generally slow and moreover, real smallholders cannot get the benefit of early trials of newly introduced seeds due to the fact that the minimum requirement for having a demonstration plot is to have at least 1 acre of land, which many smallholders do not have.

The newly introduced varieties are not common to most of the farmers in the target areas. For example, flood tolerant BINA-Dhan-7 came into existence in 2007 while BINA-Dhan-11 has just been released in 2013. The year 2015-16 has been the first year of its extension and the DAE Officials have not yet been introduced to such varieties before being introduced by the project initiatives. It was therefore well understood that, given the efficacy of the flood tolerant variety exhibited during flood 2015, the variety would become quite a demanding variety following its early trial.

Similarly, the tremendous potential for BINA-mustard-4 was quickly realized by the farmers in the target areas. It was also soon realized that the apparently most appropriate variety was neither available through the public seed distribution channel not through the private channels.

The project analyzed the shortcoming of an imperfect extension and discussed the issue with FFS members. Since all the activities have been carried out in two pilot Unions (Holokhana and Panchgacchi), both being part of the Kurigram Sadar Upazila, the farmers decided to save as much of their harvest as seeds based on their demand for seed for the next year! However, the participating farmers did not have in-house capacities to procure and restore seeds for the next season.

As a result of their eager approach and the potential benefit of maintaining the seeds for the next season, the leadership of Holokhana Union Parishad came forward with the idea of establishing a 'seed bank'. The project proponents have offered the basic cost of the infrastructure (approximately a 7 X 8 square feet concrete building) and the Union Parishad donated the land within its Office premises.

Each farmer contributed a portion of her/his harvest, which is being procured as seeds under the leadership of the Chairman of the Union Parishad, with a promise to the distributed to contributing farmers and others in the neighbourhood at a price that would be affordable (usually less than market price in the following season) to even a smallholder farmers. The UP has been maintaining list of farmers who have contributed to a truly community-based seed bank, just to make sure that the resilient crop variety will continue to be cultivated even if the public system somehow fails to reproduce and supply.

The early success involving flood tolerant Aman seeds inspired the UP Chairman of Panchgacchi Union to build another seed bank in their Union Parishad complex, with assistance from World Bank. If the second seed bank comes along, it would be possible to store over a 1,000Kg BINA-mustard-4 seeds in 2017, to be distributed to non-FFS members. The non-FFS members are looking forward to receive improved and resilient seeds from such initiatives so that they can also enhance their farm productivity by changing their cropping pattern. The seed bank is most likely to continue to provide the vital input towards sustainability, since it is being formed and maintained by the local people under the local leadership, without the direct control by the proponents over it.

5.6 Cross-cutting interventions

5.6.1 Building capacity of farmers

It is indicated earlier that FFS members have been provided with training on variety of issues and techniques towards enhancing their capacity. Even females of households involving FFS members have been brought under training. In addition to utilize such trainings towards enhancing productivity and farm income, the farmers understood the value of exchanging views and experiences with government service providers, especially those relating to crop agriculture. The project brought the Sub-Assistant Agriculture Officers (SAAO) closer to the smallholders. Most of the target FFS members did not have the minimum of 1 acre of land, so they have long been deprived of any government support with respect to extension. This project has abolished such criteria and gave smallholders a chance to talk to SSAOs on a regular basis and learn hands on from them regarding new resilient varieties, better agronomic practices including water saving techniques, IPM and composting. They had received invaluable suggestions and comments on a regular basis from the SAAOs.

While talking to SAAOs, many came to know what additional extension and other services the government of Bangladesh has been offering to them. Such exchange of information has been an eye opener to many smallholders, who had the perception that support services had been meant for only the rich or elite farmers. This has tremendously contributed to local capacity building.

Such capacity building has been particularly useful for the women farmers. The poor women are no longer afraid of receiving support services from the Union Parishad and even beyond UP. They informed that their mobility within the locality has been on the rise in search of government's support services – be it for registering the birth of a newborn, or gathering social safety net support from the UP. Moreover, they are now confident of gathering crop agriculture related information from the SAAOs working in their vicinity. The respective SSAO is now within the reach of a cell call to all of them!

5.6.2 Contributing to household food security

By promoting flood tolerant variety in a most flood susceptible area such as Kurigram, the project presented the smallholder farmers new ray of hope! Those of whom had chosen BINA-Dhan-11 and/or BRRI Dhan-52, their neighbours identified them 'lucky', since the latter ones could ensure food security despite the late flood.

However, those of whom had avoided flooding due to their higher elevation lands, their choice of early maturing Aman variety (i.e., BINA-Dhan-7) allowed them to go for early rabi cash crop such as BINA-mustard-4, which not only gave valuable cash, but also allowed them to cultivate Boro paddy (mostly BRRI-Dhan-28). To 97.6% of FFS HHs, the cultivation of BINA-4 was profitable. About 97.5% FFS households who have been introduced to BINA-4 mustard, have opined that the cultivation of the new mustard variety helped them addressing food insecurity. Figure-13 presents how the extent with which the household income of participating FFS households have changed due to the cultivation of BINA-4 mustard.

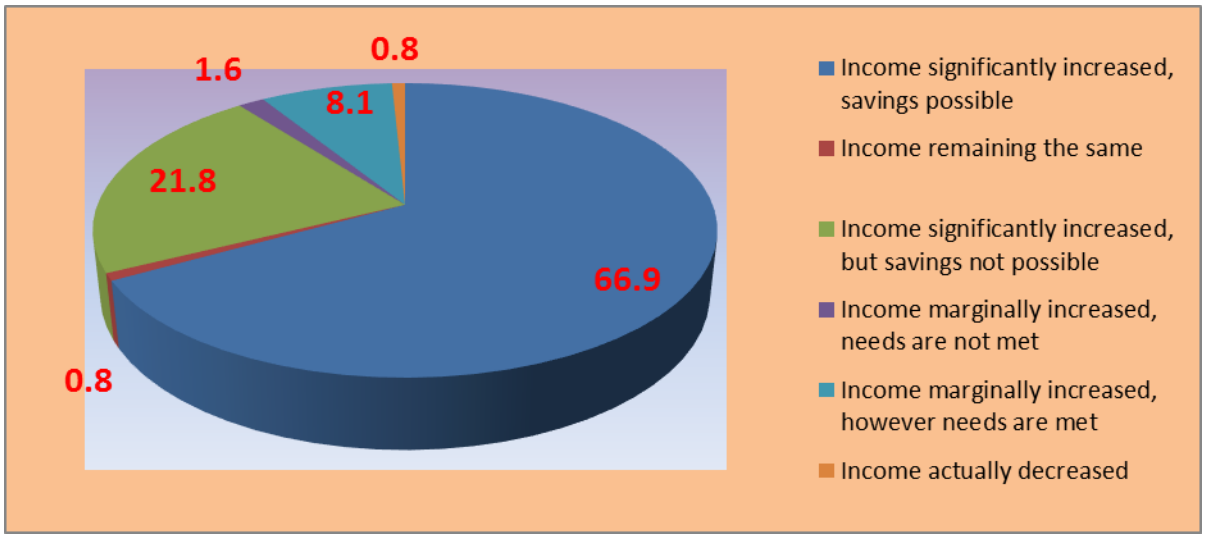

Figure-13: The extent of income being changed due to the cultivation of BINA-4 mustard

As explained above, the ability to invest in irrigation enabled the FFS to cultivate advanced Boro varieties. Such a crop rotation yielded plenty of paddy (almost 6 tonnes per hectare), adequate for the smallholders to ensure three meals a day, even without having to migrate out for long period

and selling labours. For those households, the code for demystifying food insecurity had been deciphered successfully, perhaps for the rest of their lives.

5.6.3 Helping women towards economic upliftment and subsequent empowerment

The project provided with suitable but advanced technological choices, training and knowledge support for the participating women – inputs which have been designed to help smallholder women to make the best available low cost options which had the inherent strengths to defy odds – both climatic and non-climatic odds. The explanations in numerous meetings under the FFSs, the close and informative interactions with BINA Scientific Officers and the locally deployed SSAOs, trainings and techniques have greatly helped women farmers to gain from crop agriculture, rather than leaving farming consequences to God almighty and accept losses.

As influenced by the project, the target women farmers have become wise farming entrepreneurs, who not only can earn from their respective smallholdings, also are eager to take lease from others and make it a profit making farming venture! They are no longer afraid of natural calamities. They have started to believe in knowledge and technologies which can help them defy natural calamities, even allow them to overcome all odds!

The extra cash from additional crops gave the right impetus to become food secure and self-sufficient in staple – a status which had been aspired by the local poor women for so long. Participating women have just taken the first step to become empowered, by means of their own choices and hard works. The women representing FFS HHs successfully cultivated BINA-4 mustard. The additional income from such cultivation enabled them to do a few things, as summarized in Figure-14 below, which they could not have afforded to do in the recent past.

Mrs Halima, A women FFS Group member in Mondalpara village, Holokhana union, informs gleefully, “now I get an extra sari and the kids get many things that we could not have afforded earlier. We also have more food available for our consumption and having three servings a day is no longer a problem”. The women decisively said, the extra money allowed the respective migrating males to stay back or to cut short the duration of (temporary) migration, which has greatly contributed to social harmony and increased respective women’s safety and security from various forms of harassments.

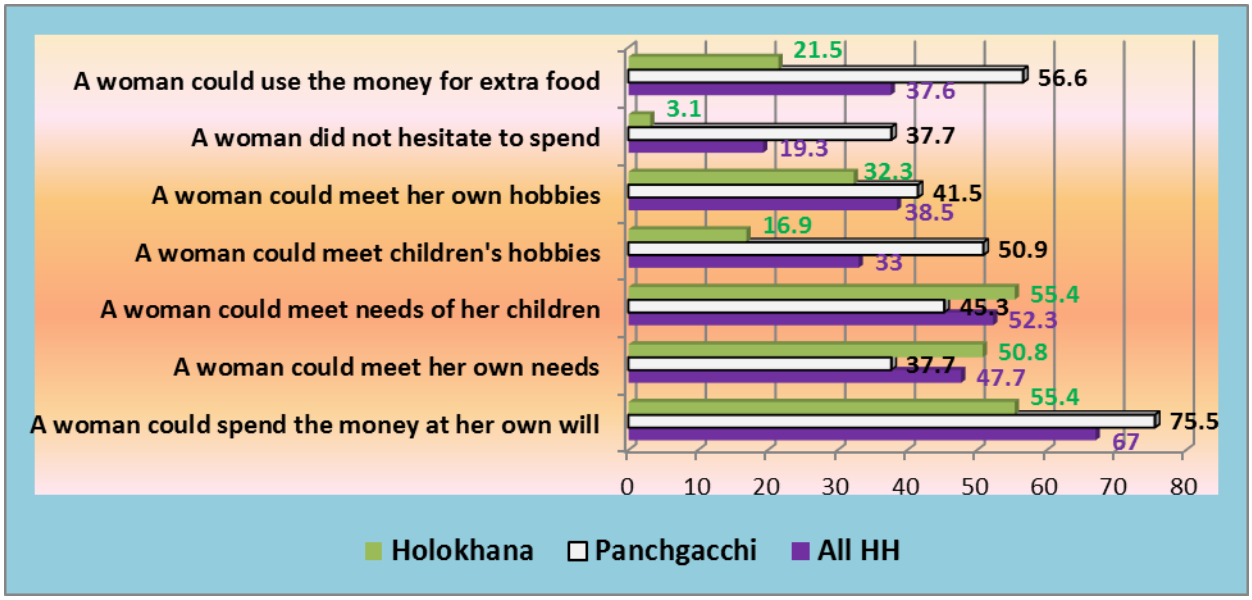

Figure-14: Modalities with which the 'extra income' enabled women to do certain things

The same 'extra income' from mustard was also useful for the children of the FFS HHs. Figure-15 presents the modalities with which the extra income from mustard was useful for the children of the respondent households.

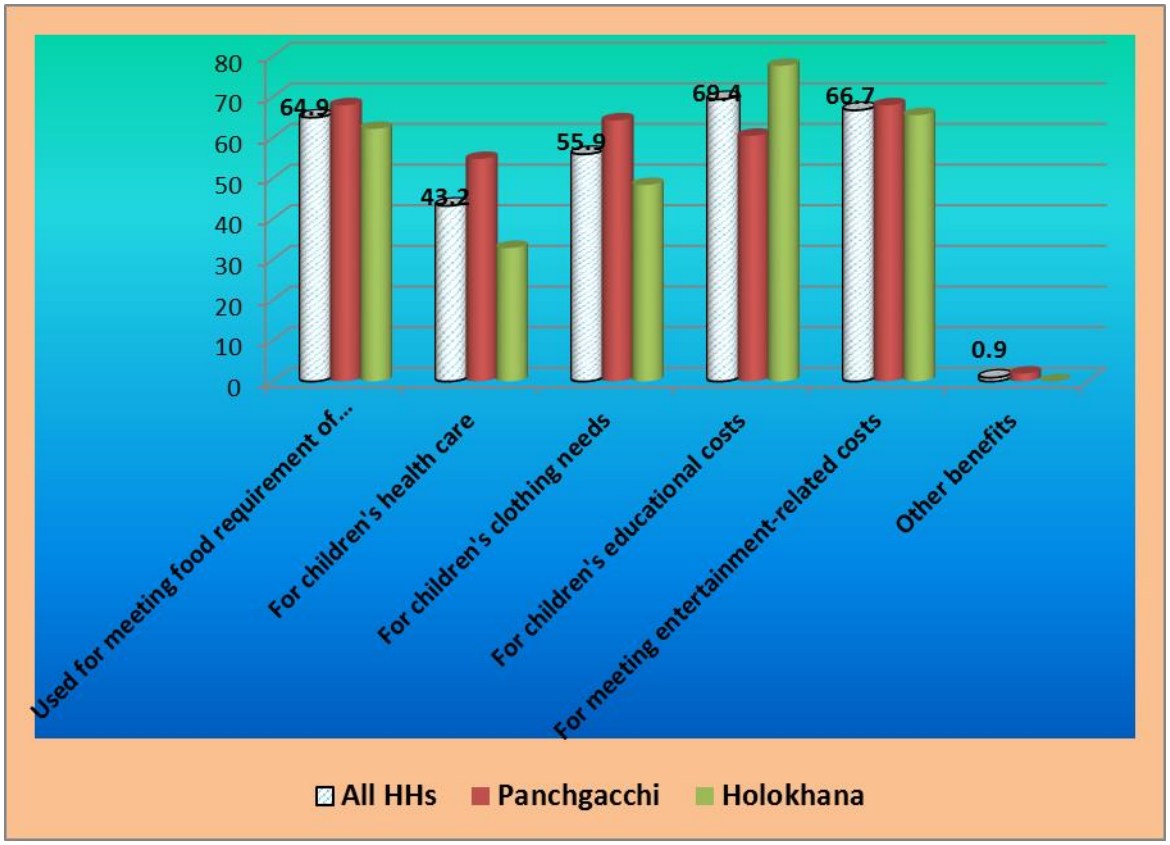

Figure-15: Modalities with which the extra income appear useful for the children of the HHs

5.6.4 Reducing the rate of out-migration

Extent of migration from FFS households decreased as a consequence of project interventions. Migrating males found adequate economic activities while still living with the family. Kurigram Sadar

have already posted a cropping intensity of 257[11], which is above average than the entire country. This signifies that the availability of employment in the locality has suddenly increased due to increase in cropping intensity. Moreover, the increase in overall yield from the same smallholding has made the male farmers increasingly self-reliant, which is manifested by reduction of migration in about 39% FFS HHs. Figure-16 exhibits the evidence of the reduction of rate of out-migration involving the FFS HHs. The potential migrants now weigh the adverse social implications of out-migration as against income potential in the locality[12], which had resulted into much reduced outmigration from the locality.

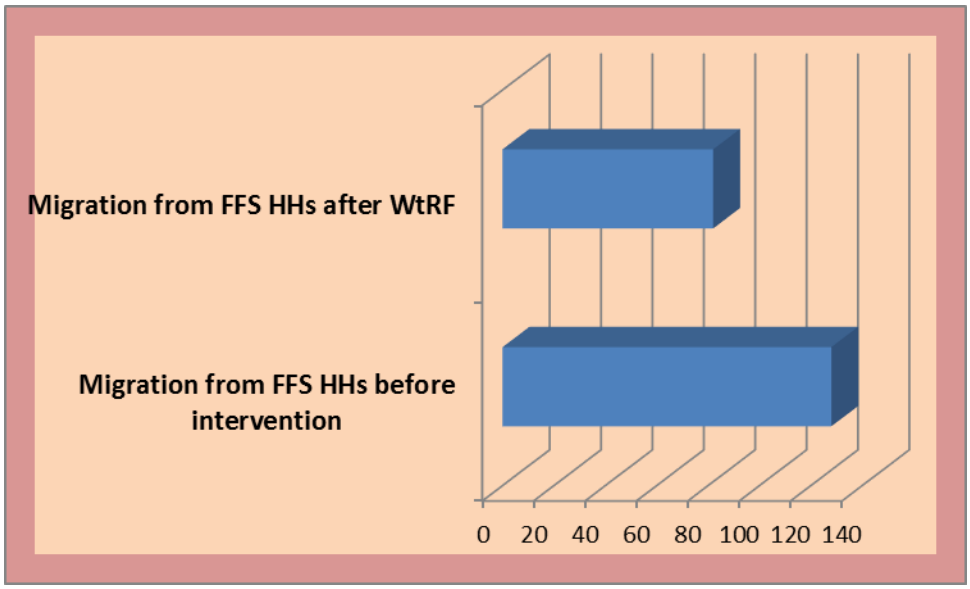

Figure-16: Number of migrating households (FFS) before and after the project interventions

In earlier days, out-migration had been 'forced', obvious and prolonged. A significant proportion of target smallholders are still found to migrate (some 64% compared to pre-project intervention), however such migrations are no longer forced migration. Rather, they migrate for a shorter period only to catch the peak cropping season, thereby they optimize income from such migration. The migrants now weigh the daily wage differential that exists between Kurigram and the destination[13], before committing to such migration. The financial proceeds from such migration are found to be employed within a strategic decision framework in migrants' households, mostly to pay off for better agricultural investments. Figure-17 provides for the major purposes for which the FFS members still out-migrate. The usual forced outmigration has now been turned into strategic outmigration for the participating smallholders.

When FFS respondents were asked whether the introduction of BINA_4 mustard would change their migration patterns, about 59.1% of the respondents opined that they would no longer require to migrate for long duration, while 33.9% of the respondents thought the frequency of migration would be reduced. Only 1.7% of the respondents still anticipated a frequent migration, despite the cultivation of BINA-4 mustard followed by a Boro paddy crop. This summarizes the confidence which has been instilled by the introduction of BINA-4 in the project areas.

[11] The data has been proudly provided by the Upazila Agriculture Office, Kurigram Sadar Upazila.

[12] Validated through the FGD and KIIs.

[13] During the study period (October 2016 – February 2017), the average wages of agricultural labour in Kurigram and Munshiganj (the primary destination of migrants from study areas) are found to be BDTk 300 and 600~700, respectively.

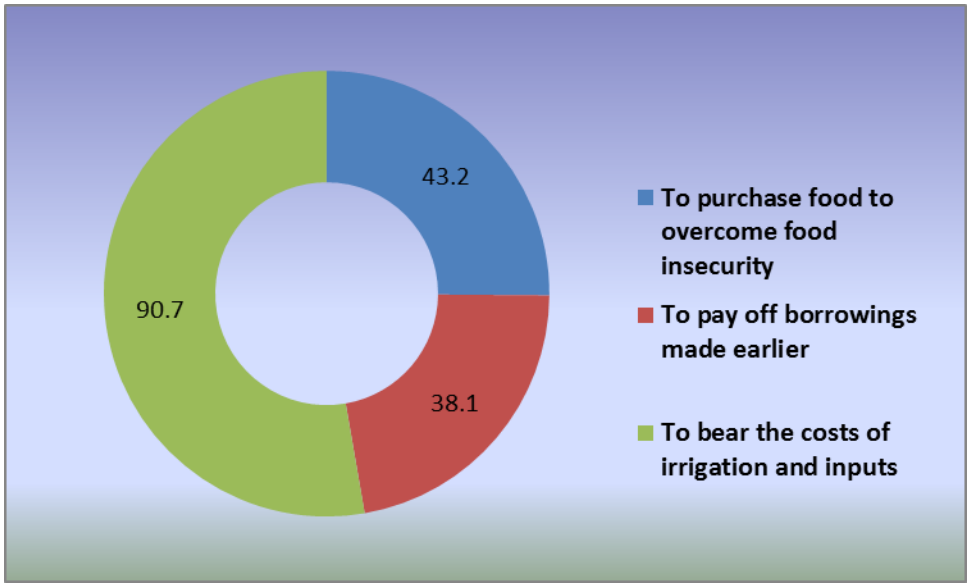

Figure-17: The purpose of out-migration following the implementation of the WtRF Project

There exists a significant geographic difference in perceiving future migration patterns involving the FFS members. Figure-18 presents the geographic distribution of perceptions regarding future migration patterns following the cultivation of BINA-4 mustard.

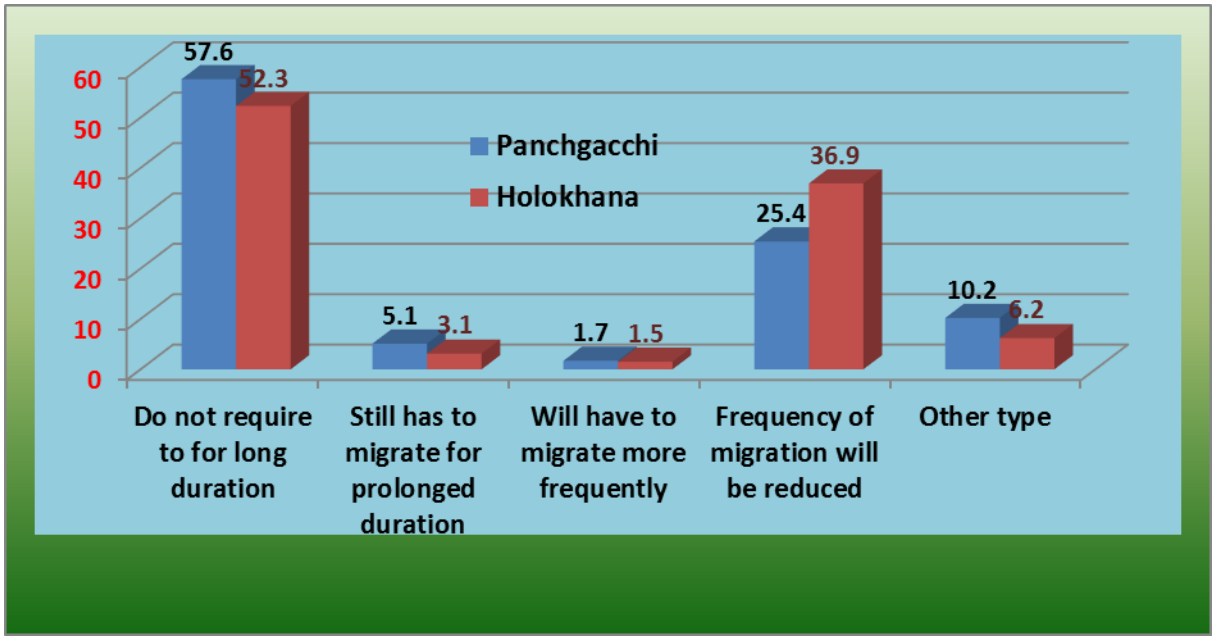

Figure-18: Reflection of perceptions of respondents on future migration patterns in two study Unions

5.6.5 Linking with government institutions

There is no denying the fact that GOB extension service is rather elite centric, especially given the context of farming in recent times. The DAE organized 'demonstration plots' are generally set up in large farmers' parcels, while the smallholders almost never get a first hand dissemination of advanced agronomic techniques. Due to entrapment in a low input low output agricultural system, smallholders often cannot afford to pay frequent visits to Upazila centres (sub-district growth centres) where most of the government officers are available to provide whatever support services.

As a result of all these, smallholders are generally far away from technologies, knowledge and improved inputs (Ahmed et al., 2012).

The project proponents acknowledged the prevailing realities around the smallholders in the target areas. They took advantage of biweekly meetings organized in each FFS and started to discuss available services. As it has already been discussed, they have arranged frequent visits of Scientists (none of the participants had ever seen a real scientist in their lives prior to this project!) in the target area, who not only discussed pros and cons regarding the newly introduced varieties, they also had provided with hands on training to the farmers. To the benefit of females in the area, a female scientist from BINA was also persuaded to make trips to the area. Moreover, there had been frequent discussions involving SSAOs. The Deputy Director of DAE, who has an office in Upazila headquarters, was persuaded to make field visits to inspire both the SSAOs and the poor farmers. All such efforts brought the farmers closer to the agriculture related officials of GOB and helped dissemination of appropriate technologies.

The efforts taken to organize events at National Disaster Reduction Day or International Women's Day allowed local people, especially women to learn more about available services at sub-district and district levels. The occasional presence of the District Commissioner, the head of administration at the district level, in a few occasions gave people confidence that, even if they try something absolutely new, their risks would perhaps be shouldered by the district administration. That sense of security was absolutely needed to build confidence among disaster-affected poor farming communities in the target areas.

6. THE BENEFITS OF THE INTRODUCTION OF A HIGH-YIELDING AND SHORT-DURATION MUSTARD VARIETY

Over 98% of the respondents who have cultivated BINA-4 Mustard said that the income was extremely useful for the overall benefit of the household. In monetary terms, A return of Bd Tk 210±10 per decimal of land, with a profit of about BdTk 154±6 (excluding human labour applied and its opportunity cost) is no way considered to be satisfying. Yet, the respondents are all (i.e., 100%) satisfied because of the introduction of such a variety in between the two paddy crops (i.e, Aman in Kharif-II and Boro in the dry Rabi season). One may easily pose a question, why is it so?

In reality, the amount received (after keeping a few kilograms for household consumption and as seed) following harvesting goes right into investing into irrigated Boro cultivation. All the male respondents have indicated that they preferably invested the proceeds from sales of harvested mustard for bringing irrigator on a rental basis and purchase of diesel to run such irrigator machines. Instead of borrowing money at high interest rates in a bid to irrigate Boro paddy, the 'extra income' enabled the farmers to plan for investing into irrigated agriculture (because Boro production ensures year-long food security!). The apparently little 'extra' income comes in the right moment when the hands would have been empty, had the crop was not cultivated. This is why the mustard plays a significant role towards crop intensification and also for enhancing intra-household food security. No wonder, every experienced FFS is now interested to continue to cultivate BINA-4 Mustard. It is found that after the second harvest, 31% additional households kept their seeds from own harvest, perhaps as a guarantee for availing the next early Rabi season.

The survey results have also been quite interesting. Of course, many advancement have been occurring simultaneously and it is next to impossible to pinpoint what actually helped achieve resilience to such a chronic food insecurity in Kurigram. However, a large majority of the FFS respondents compared their current state of food insecurity with that of some three to five years (i.e., before the intervention of the project). The results are convincing.

It is heartening to find that the responding households have achieved tremendous success in food security in recent years compared to 3 to 5 years ago. Even the control households have achieved greater food security within the past 3 to 5 years, where 98.0% of control households now enjoy three meals a day compared to some 94.3% of HHs who used to have two meals a day. However, the project target groups (the FFS households) have done better than the control group. About 97.2% of FFS HHs has claimed now to have three meals a day, up from only 78.6% having only two meals a day some 3 to 5 years ago. Table-12 presents a comparative picture regarding achievement of food security involving FFS and control households. Since the FFS HHs achieved high level of food security from a lower baseline compared to those of control HHs, the success may largely be attributed to increase in production through greater resilience and the harvesting of three crops in a year.

Table-12: Comparison of achievement of food security in FFS and control households

Extent of food consumption	Percentage of households indicating food security			
	FFS HHs		Control HHs	
	Before WtRF	After WtRF	3 to 5 yrs ago	Currently
Having only 1 meal a day	**20.7**	2.1	0.9	1.0
Having two meals a day	78.6	2.8	94.3	1.0
Having three meals a day	0.7	97.2	4.7	98.0

Source: Questionnaire survey. There have been a few missing answers.

Similar trends have emerged across regions. While only 4.7% control HHs used to have three meals a day, currently about 98.1% of the control household has three meals a day. However, people still cannot have their most preferred diet. That remains to be achieved in near future. Table-13 presents a summary of changing food security status in terms of meals consumed per day.

Table-13: Changing food security scenario between now and the recent past

Extent of food consumption	Percentage of households indicating food security			
	Panchgacchi		Holokhana	
	3 to 5 yrs ago	Currently	3 to 5 yrs ago	Currently
Having only 1 meal a day	0.0	0.0	37.5	3.8
Having two meals a day	98.6	0.0	60.0	1.3
Having three meals a day	0.0	98.6	1.3	92.5
Did not answer	1.4	1.4	1.4	2.5

Source: Questionnaire survey. There have been a few missing answers.

The FFS members of both the Unions could successfully enhance their household food security. Since almost all of them cultivated and benefited from BINA-4 Mustard, efforts have been made to check sensitivity of such mustard cultivation with subsequent Boro cultivation. A very strong correlation is found between the two, which somewhat verifies that the two together paved the way to intensification of the production system and appeared immensely beneficial for much enhanced food security.

The hypothesis was further tested by investigating cash borrowing behavior of respondent households. Before the interventions of WtRF (some 3 to 5 years ago), 100 and 97.3% of the FFS HHs in Panchgacchi and Holokhana Unions, respectively used to borrow money to address food insecurity, let alone investing on irrigated Boro cultivation. The frequency of borrowing from lenders was highly correlated with episodes of food security. Table-14 presents a summary of regional differences in borrowing behavior of respondents. Following the project interventions, majority of the FFS members in both the unions do not require to borrow cash – which may also be attributed to higher production from land resources, however with distinctively higher cropping intensity.

Table-14: Regional differences in cash borrowing behavior of respondents

Frequency of borrowing cash	Percentage of households indicating food security			
	FFS HHs in Panchgacchi		FFS HHs in Holokhana	
	3 to 5 yrs ago	Currently	3 to 5 yrs ago	Currently
Once a year	41.4	11.0	28.8	9.8
Twice a year	57.1	0.0	63.0	1.4
More than twice a year	1.4	0.0	5.5	0.0
Did/Do not borrow cash	0.0	89.0	2.7	88.8

Source: Questionnaire survey. There have been a few missing answers.

Based on daily basis survey of efforts, labour and inputs for traditional and advanced varieties of mustard involving control and FFS Fields, respectively, have given rise interesting comparison of apparent and real gains per unit of land. Table-15 presents far-related information for each dominant varieties being cultivated during October 2016 and February 2017.

Table-15: Farming related information for different mustard varieties

Mustard variety	Number of farmers monitored	Total area cultivated	Average plot size	Total Production
	#	decimals	decimals	Kg
BARI-3	9	364	40.4	699
TORI-7	11	384	34.9	731
BINA-4 with FFS members	20	518	25.9	1989
BINA-4 with Demonstration farmers	10	231	23.1	837

Source: Questionnaire survey. There have been a few missing answers.

Clearly, traditional (control) mustard farmers were using larger plots than those by FFS members. However, the production per unit of land appears far better, almost twice as much for BINA-4 compared to two other varieties. Table-16 presents cost of production by type of input for each of the examined variety.

Table-16: Cost of production of mustard varieties

Mustard variety	Family giving time inputs, voluntarily (mostly provided by family members, women)	Producer's inputs, could have been replaced by actual labour cost	Actual cash spending, to purchase inputs (seed, irrigation, fertilizers, etc.)	Total Production costs
	Taka			
BARI-3	8,475	12,410	9,284	30,169
TORI-7	9,573	12,380	9,965	31,918
BINA-4 with FFS members	20,433	17,252	20,457	58,142
BINA-4 with Demonstration farmers	10,226	6,435	11,597	28,258

Source: Questionnaire survey. There have been a few missing answers.

Each farmer had to pay cash for seed, fertilizer, pesticide, and rental cost for pesticide and irrigation equipment throughout the course of the production cycle. Such costs cannot be compensated otherwise. So this must be the real cost paid by the farmers for different varieties. It is to be mentioned here that, if the main male farmer replaces the major labour cost, for which hiring a labour becomes optional, the actual cost of production can be significantly minimized.

Table-17 presents effectiveness of production of mustard by variety. Clearly, BINA-4 mustard had performed far better than the other varieties, irrespective of the fact that labour optimization gains could have been achieved in larger plot sizes involving the other popular varieties (i.e., control).

Table-17: Estimation of economic gains for BINA-4 variety compared to other popular varieties

Mustard variety	Productivity	Cost paid by cash	Apparent monetary gain	Real gain	Real relative gain
	Kg/decimal	Taka/kg	Taka	Taka	Taka/Ha
BARI-3	1.92	13.3	57.6	44.3	10,772
TORI-7	1.90	13.6	57.1	43.5	10,565
BINA-4 with FFS members	3.84	10.3	134.4	124.1	30,158
BINA-4 with Demonstration farmers	3.62	13.9	126.8	113.0	27,450

Source: Questionnaire survey. There have been a few missing answers.

In this calculation, the market price for BARI-3 and Tori-7 mustard varieties are considered as BdTaka 1,200 per maund (as verified in Jatrapur bazar, Kurigram on 6th February, 2017). The corresponding price for BINA-4 mustard was Bd Taka 1,400 to 1,450 per *maund* (i.e., 40 kg), which has been plugged into the estimation of economic efficiency of various mustard varieties. From the close monitoring of all daily inputs and labour, voluntary and/or through hired labour, the final cost-benefit analysis for BINA-4 mustard variety clearly demonstrates that the FFS members were hugely benefitted, if the cost of voluntary family labour is not costed in the economic return. In general, the family voluntary input (non-monetized) is about 30 to 35% of all cost. Even taking that into consideration, BINA-4 fares far better than other popular mustard varieties.

In real terms, the FFS members had gained in cash from the high yielding new mustard variety. The money was immediately utilized for investing into irrigation for the subsequent Boro crop. Such a combination enabled the farmers to ensure a much better economic return at the end of the cropping calendar.

The Upazila level agriculture officer was contacted to reflect on such changes. He commented extremely positively that such new varieties have been very useful in quickly changing the food insecurity scene and making Kurigram a region thriving with advanced agriculture. He shared a hard fact, which is perhaps a testimony to the changing face of agriculture in Kurigram. At the beginning of the Millennium, the cropping intensity was hovering around 1.0, which has now reached to 2.57! Kurigram is no longer a land of famine. It has now turned into a food exporting region, defying all past backwardness and climatic obstacles.

Figure-19: Accommodating an extra cash crop (i.e., BINA-mustard-4) within a cropping pattern has been the highlight of the project

7. THE IMPLICATIONS OF THE PRO-ENVIRONMENTAL INTERVENTIONS

While over 65% of the respondents in control HHs have never heard of vermin compost, 100% of FFS respondents surveyed have expressed their acquaintance on vermin compost. About 98.6% of the FFS HHs admitted that compost fertilizers including vermin compost was useful for their agriculture. When further probed into the issue, the overwhelming majority of the farmers opined (100%) that such organic laden fertilizers would enhance soil fertility, in addition to requiring lesser amounts of chemical fertilizers and increasing top soil water retention capacity. Figure-20 summarizes the results of the survey.

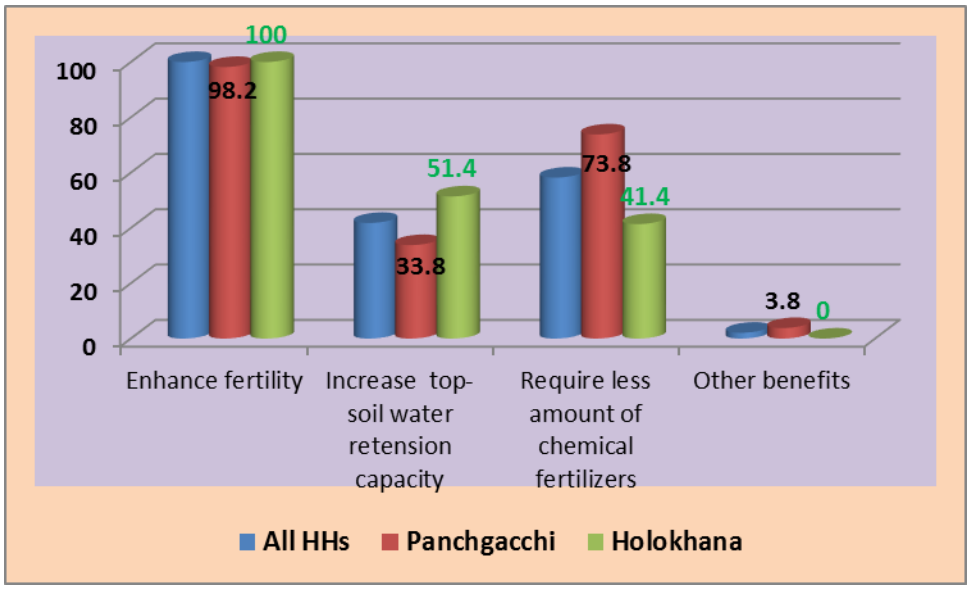

Figure-20: Differences in ways various environmental services will be attained by using composts

In the FGDs and KIIs, the users of pheromone trap and bio-fertilizers have expressed deep satisfaction for helping them understand the organic processes of farming. The majority of the respondents do believe that their environmentally friendly produces (i.e., vegetables) are both eye appealing and safe. It is found that over 60% of the male farmers and 85% of female farmers are willing to spend time in order to practice such environmentally friendly agronomic techniques in future years.

Mrs Lovely Begum of Moulavipara village of Holokhana commented "If I may offer safe food round the year to my children and family members, I think all my aspirations will be fulfilled". In a nut shell, she not only expressed her aspiration as a farming specialist, she also gave the definition of food security.

8. CONCLUSIONS

CARE Bangladesh implemented a short-duration pilot project, which has been emerged from a study conducted in 2012. The pilot project has been designed to address rain-fed poor farmers' particular vulnerability to climate variability and change induced difficulties towards maintaining food insecurity in the Northwestern region of Bangladesh.

Instead of focusing on giving away livelihoods inputs, the project focused on building resilience by promoting hazard-tolerant improved crop varieties and building both confidence and capacities by means of training, persuasion/discussion and demonstration. The project contacted the national research institutions in search of advanced technologies which might be useful in the context of Kurigram – both in terms of prevailing environmental realities and also in terms soil and other agronomic characteristics. A few new varieties of crops, having specific hazard tolerance and high yield potential, have been found out. The project initiated Farmers' Field Schools and persuaded farmers to try out those advanced seed technologies with appropriate packages of agronomic practices.

The project also promoted better and proven agronomic practices and techniques with an aim to long term sustainability of cropping system, however ensuring immediate financial and social gains. Women were given due priorities in extension of new and appropriate (location and context-specific) technologies including varieties and cropping patterns so that it could contribute to their social and economic empowerment. Moreover, the project successfully brought extension and research services to the doorsteps of the smallholders, who have been deprived of such extension and training services due to design exclusion.

Despite the fact that the project had identified hydro-geophysical vulnerabilities and risks of disasters due to weather extremes and did not consider remedial measures, the project had involved the local leadership, although limited to just two pilot localities (i.e., Unions), to document the local needs of disaster risk reduction. Moreover, with the help of the locally elected leaders and local government institutions, the project had facilitated the building of a seed bank for restoration of newly introduced varieties, a few of such varieties were awaiting to be uptaken by the formal extension service and to be put into extension. Thus the potential for auto-replication of the early success of the project had been retained in the locality.

From the household surveys it was revealed that the major floods of both 2015 and 2016 were extremely detrimental to the extension and popularization of flood tolerant varieties such as BRRI-Dhan-52 and BINA-Dhan-11. However, both survived through prolonged flooding and provided yields in the range of 7 tons per hectare, which appeared to be surreal to the farmers – especially when most of other popular HYV Aman varieties (such as BRRI-Dhan-33) had perished partially in 2015 and completely in 2016. The harvest was voluntarily collected as seeds for future application by neighbours of successful farmers, even without any support from the project.

The mustard cultivation was also hugely successful in both the pilot study sites. BINA-4 mustard has already made its name as a viable crop in between two paddies (Aman and Boro). The yield appears very high compared to local varieties, as much as twice compared to local varieties and 40 to 50% higher compared to popular HYV such as Torri-7. It is found that, the more the timely application of two irrigations, one application of pesticide and one application of fertilizer mix (including Boron-

based fertilizer), the BINA-4 mustard performs beautifully and yields the most. Because of larger pods, BINA-4 was received well in the market and was sold at Taka 1,200 to 1,400 per 40 kg (i.e., 1 *maund*).

Although the per decimal profit for BINA-4 was perhaps nominal (only 3% of monthly expenditure on food, based on an average household), it however hugely contributed to household food security. The cash came along at a time, which matched well with financial requirement for hiring irrigating equipment and purchasing diesel to run the machines. Since the farmers did not have to borrow money, they did not hesitate to invest the additional income from proceeds of BINA-4 mustard and could afford the cost of irrigation for Boro. As a consequence, even the farming households at the bottom-most economic tiers (bottom 20 percentile) transformed its rainfed Boro cultivation to irrigated Boro cultivation, which eventually gave them first bumper production in 2016. Following the harvest of BINA-4 mustard, the farmers did the same in 2017 (at least at the point of transplantation, which took place in the second week of February).

The respondents admitted that they were subject to frequent food insecurity episodes until 3 years ago. Now most of them (over 98%) can have three meals a day, compared to at the most two meals a day some three years ago. The combination of suitable technologies and advanced know how for improved environmental and agronomic practices enabled them to produce more, which in turn have enhanced food security outcomes in the household.

Since the FFS members involved women, women are greatly benefitted from the project. Not only they could contribute to their household food security, they are now handling a little cash – the first time ever in their lives in rural Kurigram, in a bid to meeting a few coveted needs for the members of their respective households. Women are confident that the knowledge base and the skills will enable them to contribute more in agriculture, not as a passive supporting hand, but also as an active farmer. Moreover, the improved economic condition helped their respective male counterparts (i.e., husbands) to avoid prolonged migration and plan for shorter and purposeful strategic migration. This has tremendously helped the women to avoid being subject to social hazards[14] in absence of their husbands.

[14] Young females are often subject to social harassment, socially derogatory words/teasing and even sexual harassment, especially when their male counterparts are no longer in the household. Women who are left alone in the household (i.e., in absence f their respective husbands) often face such social hazards.

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Annex-1

A BRIEF ACCOUNT OF KURIGRAM DISTRICT

Kurigram is a district in the northwestern region of Bangladesh, belonging to recently constituted Rangpur Division. Kurigram exhibits a flat topography with little gradient from north to south, as in most of the areas in Bangladesh. The land belongs to the Teesta Meandering floodplain and is crisscrossed by a number of major rivers of Bangladesh, namely the mighty Brahmaputra, Teesta, Dharala, Dudhkumar, etc. The large river Brahmaputra bisected the district, where the two banks are separated by about 8 to 12 kilometers of water ways, depending on the time of the year. It is therefore quite difficult to reach the administrative centre of Kurigram district from the very eastern parts.

The climate of the district is moderate, with maximum temperature at 32.3°C and the minimum temperature at 11.2°C. The area is endowed with appreciable rainfall, in the order of 2931 mm per annum, which is amongst the highest in the western parts of the country. The typical wet season (monsoon) is between June and September, as elsewhere in the country. However, rainfall inside Kurigram does not determine the volume of runoff through the regional rivers – rather the rainfall in Indian upstream areas often determines whether Kurigram will be flooded or not.

The main **occupations** in Kurigram district are agriculture (45.91 per cent of the total population), agricultural labourer (29.57 per cent), wage labourer (2.83 per cent), commerce (7.12 per cent), service (3.78 per cent) and others (10.79 per cent) (TAS, 2006). Total cultivable land is about 0.16 million hectares. About 48% land in Kurigram district, some 77,000 hectares, belong to sandy char lands. And yet, fallow land is very little, hovering around 19,312 hectares. Due to the proximity of major rivers and prolonged rainfall season, about 21 per cent of the agricultural lands are singly cropped, while doubly cropped and triply cropped lands are also found (53 and 26 per cent, respectively). Farming households dominate the landscape, 46 per cent of the population is landless, 30 per cent is small holders, 17 per cent having intermediate land holding, and 7 per cent having large land holdings (1 hectare or more). Cultivable land per head was 0.10 hectare around 2005 (TAS, 2006), which has been declining with increasing population.

Kurigram is known as a land of agriculture. Major produces include rice, potatoes, bananas, jute, wheat, and tobacco. Agriculture is the major driving power of this district's economy. Livestock management has also been a significant economic activity. Although input-intensive agriculture has began in Bangladesh in the 1980s, due to poor affordability of inhabitants, real mechanization and input-intensive agriculture have been adopted only recently. Kurigram used to be a hub for rain-fed agriculture and could not grow dry season paddy (i.e., Boro paddy) due to reluctance of using irrigation. Currently, people use irrigation systems during the dry season to cultivate high-yielding varies of rice. Several cold storages exist, which preserve agricultural products, in particular potatoes.

Kurigram is not particularly known to have a strong industrial base**,** therefore cannot offer large scale non-agricultural employment. Part of the problem lies with limited or no access to natural gas.

Due to poor energy infrastructure and industrialization, the economy of the district has remained dependent on agriculture.

Road communication is the most common and major transport system of this district. Kurigram is well connected with rest of the country through inter-district and inter-subdistrict buses. Trains conveniently connect Kurigram with the nearest districts, e.g. Lalmonirhat, Rangpur, but the frequency is quite lower than buses. In addition to these, the people of a few sub-districts usually use boats and ferries to come into the main land of the district by crossing their nearest rivers. Mechanized rickshaws are the most convenient and cheap, but relatively slower, transport system and are used all over the district. However, rural people also use van carts (manually driven tri-cycles) and horse carriages for transportation of both passengers and goods.

The people in Kurigram district are facing poverty and food insecurity, even when the district is not being struck by a hazard or a disaster. People often are forced to deal with the vagaries of nature. Riverbank erosion is a common problem in meandering fluvial systems. The district hosts as many as 16 rivers and the poor are living particularly close to rivers. Therefore, the poor are particularly hit hard by erosion. Many char dwellers have experienced many instances of riverbank erosion, which further aggravates their acute poverty.

In addition to chars, the mainland Kurigram is also vulnerable to natural hazards such as occasional floods. The occurrence of a `late flood´ (in late-August) can have devastating effects on the production of Aman-rice. Although high yielding variety (HYV) of Aman has been promoted in the Kurigram district, as elsewhere in the floodplains, such varieties do not perform well in low-lying lands. The newly accreted chars are not suitable for paddy cultivation, which also affects overall food production potential of the region. Despite all such drawbacks, according to national statistics, Kurigram is a food surplus district (Kabir, 2005; GoB&WFP, 2004).). It is only the access to food which inflicts occasional food insecurity – the issue being highlighted ever year during the *monga* months.

For the ultra-poor of Kurigram district, erratic rainfall patterns have added a different dimension of vulnerability. High rainfall variability, with a potential bimodal shift towards the beginning and end of monsoon season, complicates and exacerbates the existing livelihood problems of the poor. It appears that the gains achieved in the fight against seasonal food insecurity are gradually being eroded due to the added complexity and insecurity associated with climate variability and change (Ahmed et al., 2012).

Annex-II

PROMOTION & CAPACITY BUILDING REGARDING IMPROVED & ENVIRONMENTALLY SOUND CROPPING TECHNIQUES

Aspects covered	Trainings provided on	Key achievements
1. Homestead vegetable gardening		
	• Seed sowing method • Broadcasting pattern • Fertilizer dosage • Compost dosage • Bed size • Spacing (bed to bed and boarder to bed) • Selection of species	• In an average each demo farmer cultivated on 9.27 decimal lands • In an average each demo farmer produced 280.73 kg vegetables of which 145.27 kg were consumed • In an average each demo farmer 1649.45 taka were generated as extra income • Major spices cultivated were red amaranth, radish, data *shak*, palong *shak*, carrot, brinjal, bottle gourd, bean, tomato etc. Many other minor crops were also produced such as kalmi spinach, Indian spinach, bitter gourd, snake gourd, ridge gourd, okra and cowpeas.
2. Covered Seed Bed ("Dry seed bed")		
	• Spacing • Seed rate • Seed treatment • Transparent Polythene shit • Compost dosage • Bed size • Seedling age	• Maximum yield were obtained as 6.28, 7.33 & 7.85 MT/ha for the varieties BINA dhan 14, BRRI dhan 28 & BRRI dhan 58 respectively • Bed was covered by polythene sheet therefore no injury were happened due to long cold spell, 2 times hailstorm • Farmers of the community had successfully avoided cold injury by covering the seedlings
3. Seed preservation		
	• Process • Biological control • Preservation materials • Moisture content & risks • Filling materials • Covering materials	• At household levels, seeds of the following varieties have been preserved under improved and scientific preservation techniques: BINA Mung -8, BINA mustard-4 Mustard, BINA-Dhan-14, BINA-Dhan-5, BRRI-Dhan-28, BRRI-Dhan-58, BINA-Dhan-7, and BRRI-Dhan-33.
4. Pit Compost (for Sustainable Water Management)		
	• Size • Structure • Materials needed • Layer preparation • Fertilizer • Time requirement	• A total of 6965 kg compost was lifted up from 11 compost demos. • A total of 4670 kg compost was used on 361 decimal lands during Boro rice cultivation. • A total of 2295 kg compost was used on 255 decimal lands for vegetable cultivation.
5. Green Manure Production		
	• Seed rate • Seed sowing method • Incorporation period	• On an average, 2.27 repetition of application of irrigation could be saved in lands treated by green manures. Water retention capacity of the lands was increased, with a corresponding water savings of almost 25% with respect to conventional irrigation system. The rough water saving potential is 4 million liters per hectare. • Vegetative growth was faster due to influence of biologically fixed nitrogen & added organic matter into the soil.

6. Vermin Compost		
	• Method • Ring diameter & height • Ring density (number per unit area) • Bottom coverage • Structure • Raw materials • Species of worm • Pre-digestion period • Total requirement of time	• The compost they got was prepared by recycling of agro-waste on their homestead with no extra cost. • On an average, 80 kg vermin compost was collected from per demo. • FFS farmers applied 5-8 kg vermin compost per decimal area. • The crops looked fresh and grew well after each application of organic manure/compost.
7. Pheromone Trap		
	• Trap making • Use of pheromone • Trap spacing/density • Trap maintenance	• Farmers in about 40% of the FFS households (out of over 700 FFS households) successfully used pheromone traps in their vegetable gardens. On an average, 2.5 to 3.0 decimals of vegetable garden could be served with single pheromone trap, thereby saving the utilization of chemical pesticides, generally sprayed until about a week before the harvest. • The household members consumed fresh looking and hazard-free (i.e., chemical free) vegetables. • Farmers could market fresh looking and bore-hole free vegetables, which attracted buyers and received relatively slightly higher market price (compared to chemical treated vegetables).
8. Line Sowing		
	• Sowing technique (intervals, row distance, borders) • Transplantation method	• Enabled farmers to apply weeding, pest control, roughing, broadcasting (i.e., application) of fertilizers and harvesting with ease, compared to usual methods of sowing. • Significant labour savings was possible: a farmer was able to perform weeding in his own plot (15 decimal) with a single rice weeder whereas 4 labors would have been required to perform the same activity in each weeding in the same plot with zigzag transplant. • Over 80% FFS members and almost 50% of their respective neighbours have now been adopted the beneficial sowing method. • Farmers have started to do the same in case of transplanted Aman.
9. Parching		
	• Stick selection • Techniques for establishment (intervals)	• According to farmers, insect infestation has noticeably reduced, especially for rice stem borer and rice bugs. As a result, yield of Boro has been boosted. In case of BRRI-Dhan 52, despite the worst flood in the region, an unprecedented yield of 24 maunds (i.e., 960 kg) of paddy was obtained per bigha. • Now almost 90% rice plots of the communities are equipped parching.

Source: Field observations, discussions with field facilitators and supervisors, various organizational records (2015-16).