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Final report

Estimation of Farmers' Uptake of Improved Postharvest (PH) Management Practices with HVCs, PH Loss Reduction, and Effect on their Income

SUBMITTED

by

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Preface

Hortex Foundation as a key strategic partner of the Department of Agricultural Extension (DAE) component NATP-Phase II has been providing technical assistance on value chain development in 30 pilot Upazilas of 22 districts through improved postharvest management (PHM) practices and stronger market connectivity for vegetables and fruits, with each Upazila concentrating on one high value crop (HVC). The technical services provided by Hortex Foundation include PHM training, creation of Commodity Collection and Marketing Centers (CCMCs) and Collection Points (CPs) in all pilot Upazilas to carry out proper PHM of the HVCs for marketing, facilitation of linkage with traders and other market actors, and assistance of farmers from Common Interest Groups (CIGs) and Producer Organizations (POs) in relevant value chain development activities. The primary objectives of the study are to evaluate how the interventions work to increase farmers' adoption of PHM practices and reduce postharvest losses for HVCs and increase farmers' income.

The study team thankfully acknowledges the cooperation and assistance rendered by the Hortex Foundation and field level personnel of the Department of Agricultural Extension (DAE). The study team also acknowledges the contribution of the members of the Commodity Collection and Marketing Centers (CCMCs), POs, CIGs, participated in the study along with the non-intervention farmers by providing relevant useful information for the assessment. Special thanks also go to market partners like input dealers, local and district market aggregators (*Baparies, Arotiders*, retailers etc.) and transporters. Without their sincere cooperation this study cannot have achieved its goal. The Team leader also likes to acknowledge the contributions of the study team members through their wholehearted cooperation and sincere hard work at all levels of the study.

The Author

Executive Summary

Hortex Foundation is a strategic partner of the NATP-Phase II of the Department of Agricultural Extension (DAE) component for value chain development. It has been offering technical assistance on value chain development through enhanced postharvest management (PHM) practices and greater market linkage in 30 pilot Upazilas encompassing 22 districts, with each Upazila focusing on one specific high value crop (HVC). Hortex Foundation's technical services include PHM training, establishment of Commodity Collection and Marketing Centers (CCMCs) and Collection Points (CPs) in all pilot Upazilas to undertake proper PHM of the HVCs for marketing, facilitation of linkage with traders and other market actors, and support of farmers from Common Interest Groups (CIGs) and Producer Organizations (POs) in related value chain development activities.

The main goal of the study is to depict Hortex Foundation's efforts to improve farmers' knowledge on PHM practices for HVCs, while specific objectives of the assignment are estimation of the extent of uptake by farmers of the improved PHM practices for selected HVCs; estimation of PH loss reduction as a result of the practices followed in the CCMCs; and estimation of the effect on farmers' income due to the value addition/PHM exercises at the CCMCs.

The CCMCs are built to serve smallholder HVC farmers as a community mini-pack house with the goals of improving produce quality, boosting food security, reducing postharvest loss, and improving market linkage for the farmers. The CCMCs are outfitted with sorting mats, grading tables, weighing scales, plastic crates, and other equipment, as well as electric fans and washing facilities, to assist vegetables/fruits farmers in implementing the aforementioned PHM practices, which include harvesting at proper maturity, sorting, grading, washing, surface drying, and appropriate packaging. The CCMC also has one or two rickshaw-vans to deliver farmers' products from their farms to the CCMC in plastic boxes. Out of the 30 CCMCs, 28 are located in rented market structures, the majority of which are too small to perform pack house functions. During the first phase of NATP in 2014, two CCMCs were built in Parbatipur and Kapasia.

Collection Points (CPs) are largely a collection and aggregation center, with only weighing facilitated by the use of a scale and some plastic boxes to aid in the transportation of vegetables and fruits. Small and marginal HVC farmers form Common Interest Groups (CIGs) and activated at the village level. Each CIG has 20-30 members, with at least 30% women. Producer Organizations (POs) are constituted with three representatives from each of the 20 CIGs (the President, Secretary, and Treasurer) to form a 60-member general body. The PO General Body elects a 29-member Executive Committee, which serves as the Market Management Committee (MMC) and is responsible for carrying out the CCMC and CP functions.

The study investigated the producers' demographic status, PHM practices, level of adoption of PH loss technologies, training, estimation of PH loss, and impact on income while taking into account the viewpoints of farmers, DAE officials, Aggregators, and women participation. Ten Upazilas of seven districts were covered based on vegetables and fruit clusters. The study included 600 intervention farmers (83.33%) and 120 control farmers (16.66%). The bulk of responders were in their thirties and forties (45.28%), followed by 51-65 age group (28.33%). The respondents were dominated by male (85.69%) and low participation of the female (14.31%), this was due to the overall participation of female farmers in different levels of farmers' organizations (POs, CIGs etc.) The average family size is 4.94 people, which is higher than the national average household size (4.060). Majority of the respondents have primary (41.94%) and secondary (34.72%) level of education, and about 9.58% is illiterate.

The Hortex Foundation in collaboration with DAE rendered capacity building activities through training on good agricultural and postharvest management practices of selected HVC, and enabling environment such as physical infrastructure for sorting, washing, weighing and packaging facilities, and developing marketing linkages. The overall knowledge indices reveal that the intervention farmers have a moderate awareness of outstanding agricultural approaches for growing vegetables and fruits. The knowledge level of the control farmers was low. Vegetables and fruits output has increased due to the use of good agricultural practices backed by Hortex Foundation, DAE, private sector firms, and NGOs, regardless of intervention and control farmers. In terms of commodity aggregation and marketing through CCMCs, about 81.17% intervention producers accessed the facility against 1.67% of control producers.

The overall adoption indicators reveal that intervention farmers adopted upgraded PHM practices for vegetables and fruits to a medium degree, whereas control farmers adopted them to a low degree. When it comes to sorting and grading vegetables and fruits, intervention farmers outmatch control farmers (72.67% vs. 65.00%). Washing vegetables and fruits has a similar acceptance rate, with 71.83% and 57.50% of intervention and control farmers, respectively. Adopting such practices, the rate of washing practices has found higher in vegetables than in fruits. Plastic crate packing is used by 45.83% of intervention farmers and 38.33% of control farmers for vegetables and fruits, respectively. During the field investigation, it was discovered that packaging materials are not readily available in the local market, and demand for proper packaging is limited only to the posh market, and branding still pays off at a lower level. Formal retail market prices of vegetables and fruits do not cover the cost of packaging that limiting the adoption of packaging at the POs level. The level of adoption of proper transportation of vegetables and fruits at intervention and control farmers' level is found 63.83% and 49.17%, respectively.

Postharvest losses in vegetables and fruits are reduced for both intervention and control farmers' levels. However, intervention farmers suffer more loss, and more loss reduction is registered than control farmers in majority of the selected vegetables and fruits. The majority of intervention farmers (85.33%) and control farmers (70.83%) agreed that improved PHM practices at the CCMCs level are minimizing postharvest losses of vegetables and fruits. Both intervention and control farmers agreed that the adoption of improved PHM practices at the CCMCs level impacted by medium level in reducing postharvest loss of vegetables and fruits.

Since 2018, the average household income in the study areas has increased by approximately 32.82%, and the increase at intervention (CIG and CCMC) and control farmers' levels are 27.87% and 35.12%, respectively. However, the current annual average income of intervention farmers (BDT 349112) is higher than that of control farmers (BDT 306650). Annual household savings have increased regardless of respondent farmers' type, and vegetables and fruits and processing. In contrast, annual household savings have shown a sharp increase in vegetable production, processing and marketing.

Overall, the findings show that improved PHM practices are being implemented at the intervention farmers' level as a result of the Hortex Foundation's collaboration with the DAE in raising awareness and competence. It also implies that establishing and growing organizations such as CCMCs across the country would aid in reducing postharvest losses of vegetables and fruits. It demonstrates that institutional interventions have a significantly better probability of sustaining postharvest loss reduction maintaining quality initiatives in vegetables and fruits, and that these types of clusters should be expanded across the country.

Table of Contents

Contents

Preface	i
Executive Summary	ii
1.0 GENERAL	1
1.1 CONTEXT.....	1
1.2 OBJECTIVE OF THE ASSIGNMENT	2
1.3 GEOGRAPHICAL COVERAGE	3
1.4 ORGANIZATION OF THE IMPACT REPORT	5
2.0 APPROACH AND METHODOLOGY	6
2.1 STAGE I: INITIAL DESK WORK.....	6
2.2 SAMPLING	7
2.2.1 Sampling Technique.....	7
2.2.1.1 Sample Selection Procedure.....	9
2.2.2 Qualitative Method	10
2.3 STUDY METHODS	10
2.3.1 Rapid Reconnaissance Field Survey	10
2.3.2 Household Survey	11
2.4 METHOD OF DATA COLLECTION	11
2.5 PREPARATION OF QUESTIONNAIRE.....	11
2.5.1 Pre-testing of Questionnaire	11
2.6 STAGE II: FIELD WORK (Implementation of Survey)	12
2.7 STAGE III: DATA ANALYSIS AND REPORTING	12
2.8 DATA PROCESSING AND ANALYSIS	12
2.9 REPORT PREPARATION AND SUBMISSION	13
3.0 GENERAL	14
3.1 DEMOGRAPHICAL INFORMATION OF SURVEYED RESPONDENTS	14
3.1.1 Type and Number of Respondents	14
3.2 GENDER STATUS OF THE RESPONDENTS.....	15
3.3 AGE DISTRIBUTION OF RESPONDENTS.....	15

3.4 EDUCATION LEVEL OF PRODUCERS.....	16
3.5 HOUSEHOLD SIZE	16
3.6 LAND HOLDING OF RESPONDENT PRODUCERS	17
3.7 MOVABLE AND FIXED ASSETS OF RESPONDENT PRODUCERS	18
3.8 VEGETABLES AND FRUITS GROWN BY THE RESPONDENTS.....	19
3.9 SERVICES RECEIVED BY RESPONDENTS FROM THEIR CIG/CCMC.....	20
3.10 TRAINING/WORKSHOP RECEIVED BY TYPE, SOURCE, AND QUALITY	21
3.11 FARMERS' KNOWLEDGE ON GOOD AGRICULTURAL PRACTICES OF VEGETABLES AND FRUITS PRODUCTION	23
3.12 ADOPTION OF IMPROVED PHM PRACTICES OF VEGETABLES AND FRUITS BY THE FARMERS.....	25
3.13 LEVEL OF ADOPTION OF IMPROVED PHM PRACTICES OF VEGETABLESAND FRUITS BY THE FARMERS.....	27
3.14 POSTHARVEST LOSSES OF VEGETABLESAND FRUITS AT FARM LEVEL	30
3.15 PERCEPTION OF FARMERS REGARDING FACTORS CONTRIBUTING IN REDUCTION OF POSTHARVEST LOSSES OF VEGETABLES AND FRUITS DUE TO ADOPTION OF IMPROVED PHM PRACTICES AT CCMCS	32
3.16 ANNUAL HOUSEHOLD INCOME.....	34
3.18 ANNUAL HOUSEHOLD SAVINGS.....	35
3.19 CORRELATION BETWEEN DEMOGRAPHIC FEATURES AND ADOPTION OF PHM PRACTICES	36
4.0 HIGHLIGHTS OF FINDINGS	38
4.1 INTRODUCTION.....	38
4.2 METHODOLOGY	38
4.3 FINDINGS OF THE FGDS	39
4.3.1 Postharvest Loss Reduction Practices.....	39
4.3.2 Farmers' Perception on Postharvest Loss	39
4.3.3 Income and Postharvest Management	40
4.3.4 Overall Perception.....	40
5.0 GENERAL	42
5.1 CONCLUSIONS	42
5.1.1 Socio-economic Status of the Respondent HH.....	42
5.1.1.1 Respondent Type and Number	42

5.1.1.2 Respondents' Gender, Age Distribution, and Education Level	42
5.1.1.3 Household Size and Land Holdings and Assets of Respondent Farmers.....	43
5.1.2 Extent of Uptake by Farmers of the Improved PHM Practices.....	43
5.1.2.1 Fruits and Vegetables Grown by the Respondents	43
5.1.2.2 Services Received by Respondents from their CCMCs/CIGs	43
5.1.2.2 Training/Workshop Participated by Type, Source and Quality	43
5.1.2.3 Farmers' Knowledge on Good Agricultural Practices of Vegetables and Fruits Production	44
5.1.2.4 Level of adoption of Improved PHM practices of Fruits and Vegetables by the Farmers	44
5.1.3 Estimation of the PH loss reduction	45
5.1.3.1 Postharvest Losses of Vegetables and Fruits at Farm Level.....	45
5.1.3.2 Perception of Farmers Regarding Factors Contributing in Reduction of Postharvest Losses of Vegetables and Fruits due to Adoption of PHM Practices at CCMCs.....	45
5.1.4. Effects on Farmers' Annual Household Income and Savings.....	45
5.1.5 Relationships between Demographic Features and Adoption of PHM Practices and its Effects.....	46
5.1.6 Overall Conclusion.....	46
5.2 RECOMMENDATIONS.....	47
5.2.1 Adoption of Vegetables and Fruits Production and PHM Practices.....	47
5.2.2 Training and Services Provided by Institutions.....	47
5.2.3 Gender and Youth Engagement.....	48
5.2.4 Organizational Management	48
5.2.5 Cutting-edge Postharvest Loss Reduction Machinery	48
Annex-I	50
Annex -2	55
Annex -3	67
Annex -4	68
Annex -5	69

Acronyms

.....

PH	-	Postharvest
HVC	-	High Value Crop
NATP	-	National Agricultural Technology Program
DAE	-	Department of Agricultural Extension
PHM	-	Postharvest Management
CCMC	-	Commodity Collection and Marketing Centers
CP	-	Collection Point
CIG	-	Common Interest Group
PO	-	Producer Organization
MMC	-	Market Management Committee
UAO	-	Upazila Agriculture Officer
AAO	-	Assistant Agriculture Officer
AEO	-	Agriculture Extension Officer
ADD	-	Additional Deputy Director
DTO	-	District Training Officer
DD	-	Deputy Director
TOR	-	Terms of Reference
LSS	-	linear Systematic Sampling
FGD	-	Focus Group Discussion
KII	-	Key Informant Interviews

Chapter 1

Introduction

1.0 GENERAL

This report has been prepared for partial fulfillment of the contract for 'Estimation of Farmers' uptake of Improved Postharvest (PH) Management Practices with HVCs, PH Loss Reduction, and Effect on their Income'. The services defined in accordance with the objectives and scope of work broadly set in the TOR (Annex-I), have been implemented during February to June 2022.

1.1 CONTEXT

Strategic Partnership at NATP-II: Hortex Foundation is a strategic partner of the Department of Agricultural Extension (DAE) component of the NATP-Phase II for value chain development. It has been providing technical services on value chain development through improved post-harvest management (PHM) practices and better market linkage in pilot 30 Upazilas covering 22 districts, focusing on one particular high value crop (HVC) per Upazila. Technical services provided by the Hortex Foundation include training on PHM, establishment of Commodity Collection and Marketing Centers (CCMCs) and Collection Points (CPs) in all pilot Upazilas to undertake proper PHM of the HVCs for marketing, facilitated linkage with traders and other market actors, supported farmers from the Common Interest Groups (CIGs) and Producer Organizations (POs), traders, processors, etc. in related value chain development activities.

Commodity Collection and Marketing Centers (CCMCs): A CCMC is serving smallholder HVC farmers as community mini-pack house, was established with the objectives of improving produce quality, enhancing food safety, reducing postharvest loss, and improving market linkage for the farmers. Here the farmers are adopting improved PHM practices for their products to add value and earn a better price. The CCMCs are supplied with sorting mat, grading table, weighing scale, plastic crates, etc. and equipped with electric fans and washing facilities to aid the vegetable/fruit farmers apply the said PHM practices including harvesting at proper maturity, sorting, grading, washing, surface drying and appropriate packaging. One or two rickshaw-vans are also provided at the CCMC to transport farmers' products from their farms using plastic crates to the CCMC. Out of the 30 CCMCs, 28 are established in rented structures of marketplaces most of which are

very small in size and inadequate for functions of a pack house. Two CCMCs were constructed in Parbatipur and Kapasia during the first phase of NATP in 2014.

Collection Points (CPs): A CP is primarily a collection and aggregation center, where only weighing is aided with support of a scale and some plastic crates to help carry produces.

Common Interest Groups (CIGs): CIGs are made up of small and marginal HVC farmers. Each CIG consists of 20-30 members of which 30 percent must be women. CIGs are mobilized at the village level.

Producer Organizations (POs): A Producer Organization (PO) is formed with three representatives (the President, Secretary and Treasurer) from each of the 20 CIGs, to form a 60-member general body. The PO General Body elects a 29-member Executive Committee, which acts as the Market Management Committee (MMC) and is charged with carrying out the functions of the CCMC and CP.

Backstopping Support of Hortex: Hortex Foundation provided the technical assistance such as training to the DAE's Upazila and district officials like UAO, AAO, AEO, ADD, DTO and DD as Master trainers for the required training of farmers and PO-MMCs on value chain activity skills. The DAE officials as Master Trainers carried out all the training events to farmers and the PO-MMCs on the relevant topics. Hortex Foundation consultants also guided a number of training events for CIGs and PO-MMC. Training to the CIG farmers included maturity & harvest index, PHM, food safety, and marketing. PO-MMC were also given training on Production Planning, Marketing, Good Governance, Market Management, Business Management, Financial Management, Contract Farming, PHM& Food Safety, quality assurance, etc. Some local traders, directly involved with CCMCs and CPs, were also trained in proper handling, packaging and transport of fresh fruits and vegetables during marketing.

1.2 OBJECTIVE OF THE ASSIGNMENT

Considering the above delineation, it has been envisaged that the main objective of the study is to portray the endeavors of Hortex Foundation on improving farmers' knowledge on PHM practices for HVCs, while specific objectives of the assignment are:

- estimation of the extent of uptake by farmers of the improved PHM practices for selected HVCs;

- estimation of the PH loss reduction as a result of the practices followed in the CCMCs; and
- estimation of the effect on farmers' income because of the value addition/PHM exercises at the CCMCs.

1.3 GEOGRAPHICAL COVERAGE

The study would be conducted in 10 Upazilas of 7 districts of four divisions of Bangladesh. Upazila list as provided by the Hortex Foundation along with their locations and identified vegetables and fruits clusters are shown in Table 1.1 and Figures 1.1, 1.2 and 1.3.

Table 1.1 Study areas with focused vegetables and fruits clusters

Sl	District	Upazila	Target HVC
1	Jashore	Jhikorgasa	Vegetables
2	Jashore	Sadar	Vegetables
3	Rangpur	Mithapukur	Vegetables
4	Gaibandha	Polashbari	Vegetables
5	Bogra	Shibgonj	Vegetables
6	Narshigdi	Belabo	Vegetables
7	Narshigdi	Shibpur	Vegetables
8	Mymensingh	Muktagacha	Fruits
9	Tangail	Modhupur	Fruits
10	Tangail	Delduar	Fruits

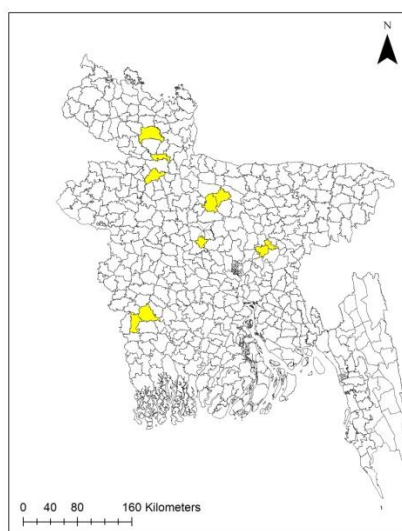


Figure 1.1 Geographical locations of the study areas

Estimation of Farmers' uptake of Improved Postharvest (PH) Management Practices with HVCs, PH Loss Reduction, and Effect on their Income

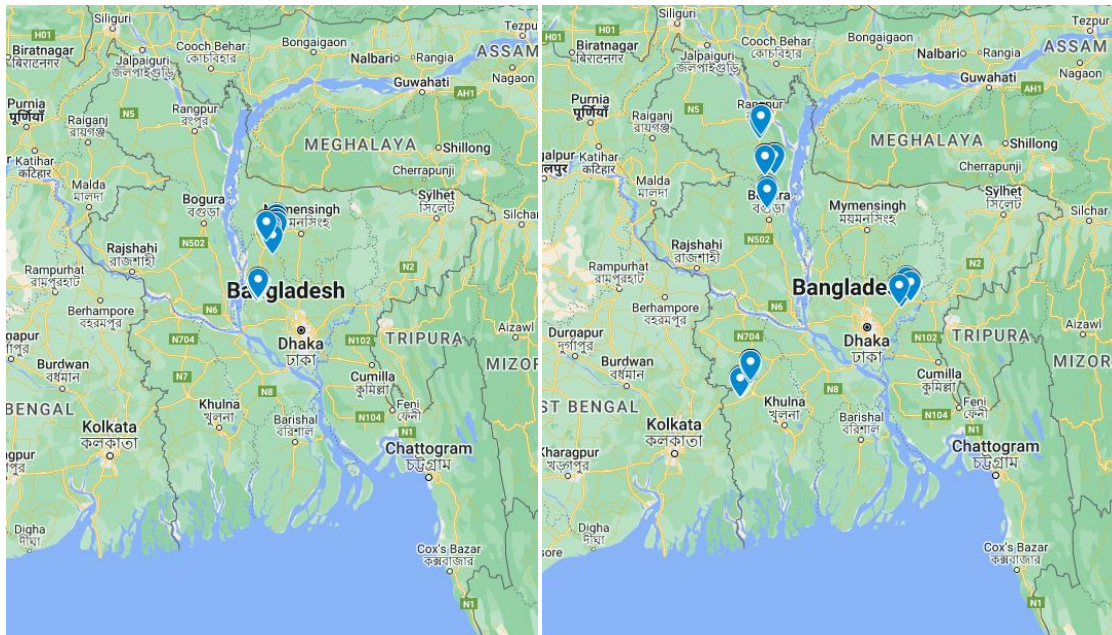


Figure 1.2 Intervention and control farmers' locations (Vegetables)

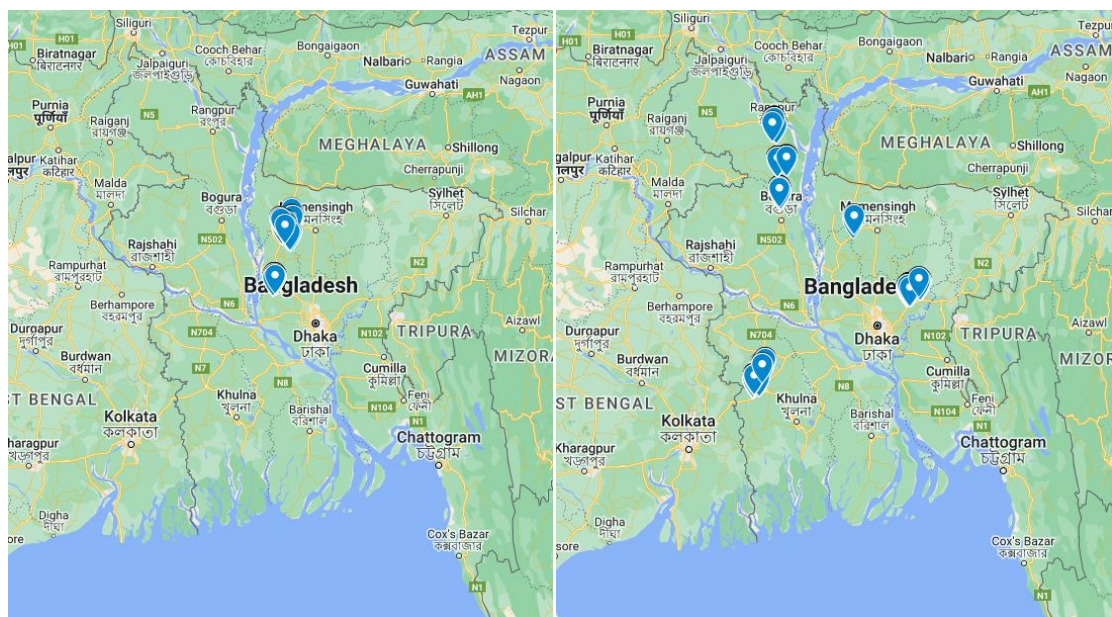


Figure 1.3 Intervention and control farmers' locations (Fruits)

1.4 ORGANIZATION OF THE IMPACT REPORT

Consistent with the ToR of the impact study, this report has been prepared with the contents in the following sequence:

Chapter 1	Introduction - introduces the reference and background of the report preparation.	Introduction ↓
Chapter 2	General Approach and Methodology to the assignment. The section includes general approach considerations, its objectives as well as presents the methodology for carrying out the study.	Approach and Methods ↓
Chapter 3	Findings: The chapter illustrates demography of communities, changes in access to finance, marketing, crop production, assets and livelihood status, PHM practices, PH loss and impact on	Findings (survey) ↓
Chapter 4	FGD Findings: Perception on PH loss and Impact on income and future need of PHM practices.	FGD Findings
Chapter 5	Concluding Remarks: Making conclusions and recommendations based on above findings for the study.	Concluding Remarks

Chapter

Approach and Methodology

2.0 APPROACH AND METHODOLOGY

Based on a series of brain storming sessions by the consultant coupled with exchange of dialogue between the consultant and the officials of the project, the planning of work was designed keeping fully in view the suggested approaches, methods, duties, responsibilities and objectives of the study set forth in the TOR. The study design thus involved three different stages (Fig. 2.1). These are: Stage I: Initial Deskwork (Inception), Stage II: Field Work (Study implementation) and Stage III: Data Analysis and Reporting.

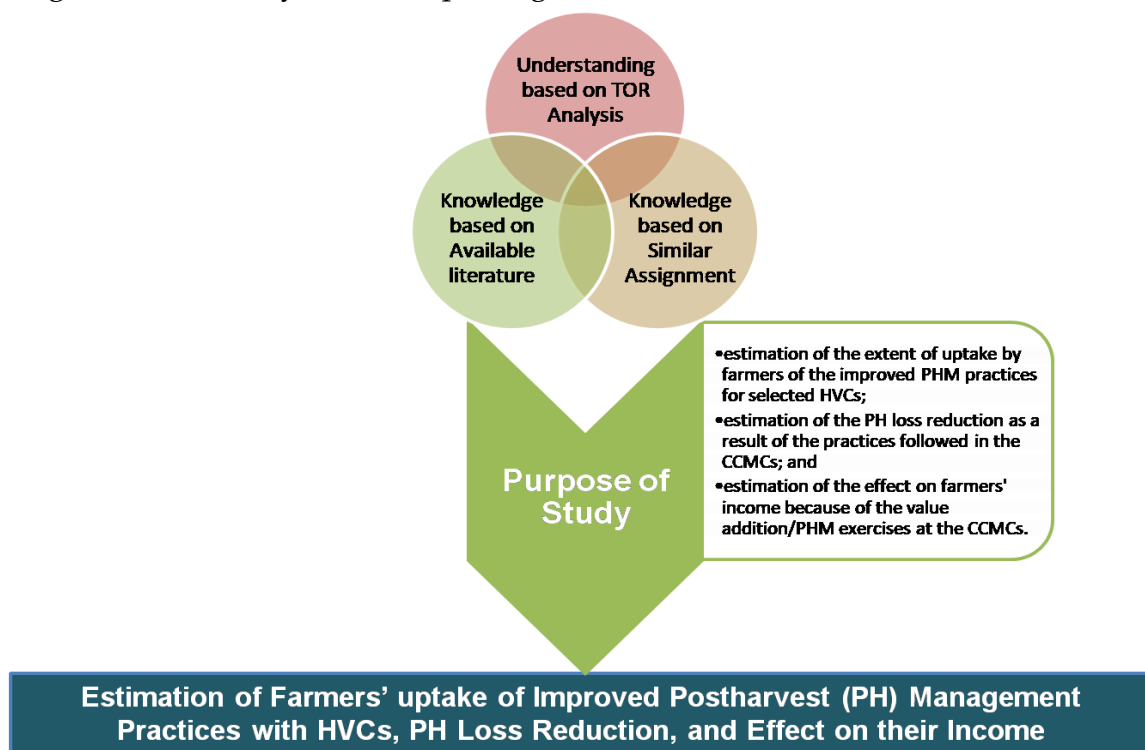


Figure 2.1 Conceptual frameworks for the study

2.1 STAGE I: INITIAL DESK WORK

Initial deskwork (Inception) was limited to conceptualization of the study, development of study methodology for implementation, mobilization of resources

including team personnel, office accommodation, logistics & vehicles, scheduling of field visits and monitoring. The different activities included in this stage were:

- establishing contact with the Hortex Foundation, DAE officials at selected Upazilas, CCMC and PO members;
- review the project baseline and other relevant literatures available at Hortex Foundation;
- ensure that both the quantitative & the qualitative indicators of baseline were taken into consideration;
- action plan for data collection and provide on the spot guidance to the team during field survey;
- designing of appropriate sampling technique and determining the sample size of the survey population;
- designing and drafting of different questionnaires/instruments for collection of information from the field and other secondary sources;
- finalizing the tools after pre-testing at field level;
- development of monitoring and reporting system of the scheduled work;
- developing database in MS-Access (for quantitative part) and code manual;
- designing of the field survey;
- preparation of training guideline for investigators/supervisors;
- designing of an analytical plan;
- designing of dummy tables for output generation;
- preparation of table of content for inception report, draft final report and final report; and
- preparation and submission of study reports.

2.2 SAMPLING

The ToR provided hints on sampling technique of the proposed study. In designing the sampling technique, due considerations were given to the objectives of the study, scope of work, respondents to be covered, categories of target beneficiaries, suggestions, duration of the study etc., mentioned in the ToR, and man-months or budgetary provision for the study.

The sampling plan comprised of following stages:

2.2.1 Sampling Technique

Sample size of the study was drawn during Kick-off stage in consultation with relevant Hortex Foundation team. However, sample size was determined for three

major segments (CCMC, PO and CIGs) with appropriate sampling technique which was explored by using the following formula:

$$SS = \frac{Z^2 \times (p) \times (1 - p)}{C^2}$$

SS = Sample Size

Z = Z-value (e.g., 1.645 for a 90 percent confidence level)

P = Percentage of population picking a choice, expressed as decimal

C = Confidence interval, expressed as decimal (e.g., 0.10 = +/- 10 percentage points)

Calculation:

$$SS = \frac{2.706025 \times 0.5 \times 0.5}{0.01}$$

$$SS = 68$$

Sample Size - Finite Population (where the population is less than 50,000)

$$\text{New SS} = \frac{SS}{\left(1 + \frac{SS - 1}{\text{Pop}}\right)}$$

Pop = Population (e.g., 600 ~ from 20 CIGs in each Upazila)

Calculation:

$$\text{New SS} = \frac{68}{\left(1 + \frac{68 - 1}{600}\right)} \quad \text{New SS} = 61; \text{ rounded to } 60$$

Hence, sample size was 60 producers (households) for each sampled Upazila embracing total sample size of 600. In addition, the study also covered a modest percent (20%) of control respondents those did not receive any support from CCMC/VCD.

2.2.1.1 Sample Selection Procedure

The sample selection procedure ensured maximum geographical spread across the project areas. Table 2.1 shows the sample distribution of the study. The sample members were selected by linear systematic sampling (LSS). The following procedures were followed:

- The foremost job was to list-down all CCMC, PO and CIGs of the selected Upazilas;
- The Production Organization (PO) was the pivotal entity to reach CIGs. Using snowball technique (Snowball sampling or chain-referral sampling is defined as a non-probability sampling technique in which the samples have traits that are rare to find. This is a sampling technique, in which existing subjects provide referrals to recruit samples required for a research study), the POs connected the study team with CIG members who were the sample unit;
- In each Upazila, the study team selected 5-6 CIGs randomly;
- From each CIG, 10-12 respondents were selected for quantitative survey as intervention farmers; and
- In addition, the study team also interviewed a modest number (20 percent) of control farmers - Non CIG, non-intervention farmers from surrounding village/union of each Upazila.

Table 2.1 Sample distribution of the study

Sl.	District	Upazila	Sample		
			Intervention	Control	Total
1	Jashore	Jhikorgasa	60	12	72
2	Jashore	Sadar	60	12	72
3	Rangpur	Mithapukur	60	12	72
4	Gaibandha	Polashbari	60	12	72
5	Bogra	Shibgonj	60	12	72
6	Narshigdi	Belabo	60	12	72
7	Narshigdi	Shibpur	60	12	72
8	Mymensingh	Muktagacha	60	12	72
9	Tangail	Modhupur	60	12	72
10	Tangail	Delduar	60	12	72
			Total		720

2.2.2 Qualitative Method

Qualitative data were collected mainly through Focus Group Discussion (FGD), Key Informant Interviews (KII) and case studies. Some of the qualitative data were collected before the quantitative data collection to understand the situation and to formulate the questionnaire for the household survey. The FGDs and KII conducted by the survey team mentioned in Table 2.2.

Table 2.2 Distribution of FGDs and KII of the study

Particular	Muktagacha Upazilla	Belabo Upazilla
FGD with farmers	02	02
KII with CCMC	02	02
KII with DAE	01	01
KII with Bepari/Faria/Arotdar/ Commission Agent	04	04

2.3 STUDY METHODS

In designing the study techniques/methods, due considerations were given on the objective of the survey, efficiency in collecting the necessary information with the highest degree of preciseness with minimum annoyance to the respondents within the stipulated time consistent with all relevant parameters and suggestions mentioned in the TOR. In this regard, an analysis of the suggested survey methodology as mentioned in the TOR, were considered with necessary modifications for proper adoption to the proposed survey requirements. Accordingly, the *Rapid Reconnaissance Survey* followed by the *Household Survey*, *Qualitative Investigation (FGDs)* and *Key Informant Interview* were considered most appropriate for the proposed study.

2.3.1 Rapid Reconnaissance Field Survey

The Rapid Reconnaissance Field Survey was undertaken by the consultant individually as well as in groups. The process involved, in addition to checking and cross-checking of data collection by the Enumerators, conducting Focus Group Discussion (FGD) to collect some information of special nature that were not covered by the household survey. The FGD allowed the target group members/participants to spontaneously speak of their existing socio-economic conditions in socio-economic conditions, problems, their expectations, involvement and prospects. However, to facilitate the FGD, the Consultant used some pre-designed checklist of queries and questions consistent with the survey objectives.

The information was processed to integrate into the database developed based on field data collection under household survey by the Enumerators.

2.3.2 Household Survey

The household survey, in fact, was the crux of the proposed study, through which the database of the actual picture of the selected sites and the socio-economy of the project area was developed. For making the household survey most efficient in terms of collecting data most accurately with proper motivation of the respondents, the method of data collection and selection of well experienced Enumerators, proper training of the Enumerators and selection of the respondents were considered most important.

2.4 METHOD OF DATA COLLECTION

Data collection involved mostly the *one-to-one interview* by the trained Enumerator under the supervision of Supervisor and checked and crosschecked by the Consultant. The household heads or their representative of the households selected through the procedure as outlined under the detailed sampling design were treated as the respondents for the household survey. The most important and critical item considered in the household survey was the Instrument of collecting the information/data from the respondents. This required a significant effort from the consultant to develop the most meaningful instruments for data collection in the form of structured, semi-structured and open-ended questionnaires.

2.5 PREPARATION OF QUESTIONNAIRE

In designing the questionnaire, two specific goals were considered; First, to obtain information relevant to the purposes of the study and second, to collect that information with maximal reliability and validity.

Data thus required by the TOR was collected through administering a set of questionnaires. To enhance accuracy, the wording and sequence of the questions were designed appropriately to motivate the respondents and to facilitate recall. The instruments thus worked out are shown below:

- a. Instrument - I : Checklist for Key Informant Interview /FGD
- b. Instrument - II : Questionnaire for Producers Level Information

2.5.1 Pre-testing of Questionnaire

Pre-test was carried out to evaluate not only the questionnaire items but also the quality of the interviews, the effectiveness of the field organization, the likelihood

of controversy arising from the survey, the rate of and reasons for refusals, the cost and length of the interview (including call-backs), and the overall appropriateness of the survey method to the problem at hand.

2.6 STAGE II: FIELD WORK (Implementation of Survey)

The survey was implemented in time with the proposed methodology by the Consultant keeping close contact and coordination with the Hortex Foundation management. Once the selection of sites and households was completed, the ultimate producers' survey began. Conforming to the requirement of the scope of work, the field level data collection was carried out for 30 working days following the inception stage.

2.7 STAGE III: DATA ANALYSIS AND REPORTING

The analysis stage included most intensive deskwork involving processing, synthesizing and analysis of data and presentation in appropriate format for incorporating into the report. The data obtained in this study were of both quantitative and qualitative nature, but with the majority of quantitative nature. For the purpose of data entry and ultimate analysis, MS ACCESS, SPSS, MSTAT, wherever applicable were used.

2.8 DATA PROCESSING AND ANALYSIS

Data processing and analysis included code construction, coders' training, coding, data verification and quality control, data punching, data processing and finally the analysis to facilitate the required output generation.

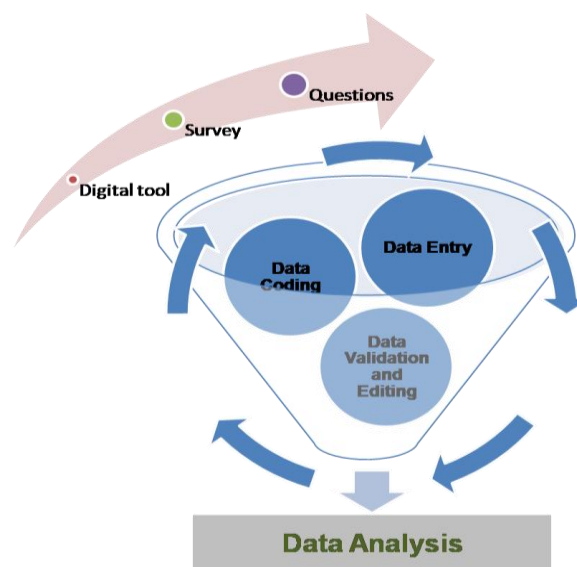


Figure 2.2 Data processing and analysis

2.9 REPORT PREPARATION AND SUBMISSION

Following above, the consultant thus prepared and submitted the following reports adhering to the ToR.

Inception Report: Containing approach, methodology, selection of indicators and data collection tools to the Hortex Foundation after signing contract.

Revised Inception

Report: Incorporating all comments and suggestions in the draft methodology and draft instruments by the Senior Advisors/Component Management.

Draft Final report: The draft final report addressing all the issues under consideration of the study and professional outputs produced were prepared and submitted in hard and soft copy and raw data in Excel format by June 2022.

Final Report: The final report was finalized incorporating the views, ideas, recommendations and comments, received from Senior Advisors/Component Management by August 2022.

Chapter 3

Results

3.0 GENERAL

This chapter is comprised of the principal replies of the sampled producers, which have been evaluated and discussed in relation to a choice of outcome-level indicators. In addition to biographies of the members of the sample HH, subsequent sections describe the HVC production practices, PHL management practices, PH loss, and income of the sample population. The indicators that were not covered through the quantitative survey were covered through spot checking, FGDs, and KIIs, and they were discussed accordingly.

3.1 DEMOGRAPHICAL INFORMATION OF SURVEYED RESPONDENTS

3.1.1 Type and Number of Respondents

During the survey, the project's intervention farmers were completely covered on purpose, whereas the control farmers were chosen using an acceptable sample technique. A total of seven districts with ten Upazilas were covered based on vegetables and fruits clusters. The study included 600 intervention farmers (83.33 %) and 120 control farmers (16.66 %) from a total of 720 respondents (Table 3.1). In other count the total number of vegetables and fruits cluster farmers interviewed were 568 (78.89%) and 152 (21.11%), respectively.

Table 3.1 Type and number of respondents

District	Upazila	Number of respondents						
		Intervention		Control		Total		
		Fruits	Vegetables	Fruits	Vegetables	Fruits	Vegetables	Total
Bogra	Shibganj	0	60	0	12	0	72	72
Gaibandha	Palashbari	0	60	0	12	0	72	72
Jessore	JessoreSadar	0	60	0	12	0	72	72
	Jhikargachha	0	60	0	12	0	72	72
Mymensingh	Muktagacha	56	4	12	0	68	4	72
Narsingdi	Belabo	0	60	0	12	0	72	72
	Shibpur	0	60	0	12	0	72	72
Rangpur	Mithapukur	0	60	0	12	0	72	72
Tangail	Delduar	60	0	12	0	72	0	72
	Madhupur	0	60	12	0	12	60	72
Total: 07	10	116	484	36	84	152	568	720
	%	16.11%	67.22%	5.00%	11.67%	21.11%	78.89%	100.00%

3.2 GENDER STATUS OF THE RESPONDENTS

The field survey included 720 respondents from various Upazilas across seven districts. Regardless of study site or respondent category, it was identified that 617 (85.69%) were male farmers and 103 (14.31%) were female farmers (Table 3.2). Because these respondents were chosen based on the geographic distribution of the project area, CCMC, CIG, and HVC production, gender balance representation was not crucial.

Table 3.2 Number of respondents by sex

District	Upazila	Number of respondent				
		Male		Female		Total
Bogra	Shibganj	55	(76.39)	17	(23.61)	72
Gaibandha	Palashbari	72	(100.00)	0	0.00	72
Jessore	JessoreSadar	63	(87.50)	9	(12.50)	72
	Jhikargachha	72	(100.00)	0	0.00	72
Mymensingh	Muktagacha	54	(75.00)	18	(25.00)	72
Narsingdi	Belabo	61	(84.72)	11	(15.28)	72
	Shibpur	52	(72.22)	20	(27.78)	72
Rangpur	Mithapukur	54	(75.00)	18	(25.00)	72
Tangail	Delduar	62	(86.11)	10	(13.89)	72
	Madhupur	72	(100.00)	0	0.00	72
Total: 07 districts	10	617	(85.69)	103	(14.31)	720

Note: Numbers in parentheses are in percentages.

3.3 AGE DISTRIBUTION OF RESPONDENTS

Regardless of project site or respondent category, household members between the ages of 36 and 50 were the most common (45.28 %), followed by 51-65 years (28.33 %), 18-35 years (20.56 %), and 65+ years (5.83 %)(Table 3.3). Thus, most responders were experienced middle-aged, followed by the 51-65 age group. It is also evident that the young (18-35) age group is emerging quite a significant way in PHL reduction activities and farmer organizations such as CCMC and CIG.

Table 3.3 Age distribution of respondents

Age distribution	Intervention		Control		Total	
18-35 years	118	(19.67)	30	(25.00)	148	(20.56)
36-50 years	267	(44.50)	59	(49.17)	326	(45.28)
51-65 years	178	(29.67)	26	(21.67)	204	(28.33)
65+ years	37	(6.17)	5	(4.17)	42	(5.83)
Total	600	(100)	120	(100)	720	(100)

Note: Numbers in parentheses are in percentages.

3.4 EDUCATION LEVEL OF PRODUCERS

As the sample was drawn from CCMC and CIG, all the respondents were found to be literate and to have attended any level of schooling or to know how to read and write. This greater literacy rate may lead to the adoption of PHL management strategies in the study areas.

It is evident that most of the producers' populations have primary (41.94%) and secondary (34.72%) level of education, and only about 4.03% have graduate level of education (Table 3.4). The level of formal education among the respondent indicates that the majority of them have the ability to grab simple smart production and postharvest management practices of fruits and vegetables. However, a higher and complex level of production and postharvest management practices are usually beyond their understanding and need long-term intensive training and mentoring sessions to enhance their capacity to be a good producer and organizer.

Table 3.4 Education level of respondents

Education level	Intervention		Control		Total	
Illiterate	53	(8.83)	16	(13.33)	69	(9.58)
Primary education	252	(42.00)	50	(41.67)	302	(41.94)
Secondary education	205	(34.17)	45	(37.50)	250	(34.72)
Higher Secondary	60	(10.00)	7	(5.83)	67	(9.31)
Diploma/Technical education	2	(0.33)	1	(0.83)	3	(0.42)
BA/graduate	28	(4.67)	1	(0.83)	29	(4.03)
Total	600	(100)	120	(100)	720	(100)

Note: Numbers in parentheses are in percentages.

3.5 HOUSEHOLD SIZE

Regardless of study site or respondent group, the average family size was discovered to be 4.94, which is greater than the national household size (4.06). The average household size of intervention producers was larger than that of control producers (Table 3.5).

Table 3.5 Household size

Category	Intervention (n=600)		Control (n=120)		Total (n=720)	
	Average	Standard Deviation	Average	Standard Deviation	Average	Standard Deviation
Household size	5.01	1.93	4.56	1.62	4.94	1.89
Average Male adult (18+ years)	1.89	1.05	1.72	1.13	1.86	1.06
Average female adult (18+ years)	1.79	0.97	1.55	0.74	1.75	0.94

3.6 LAND HOLDING OF RESPONDENT PRODUCERS

The average land holding of the respondents by category is tabulated in the following Table 3.6. The study shows that the mean homestead area of the surveyed fruit and vegetable producers remains unchanged for both control and intervention producers. For water bodies, there is an unchanged number except for an increasing number of vegetable intervention producers. The net cultivated area also increased, except for the fruit intervention producers.

Table 3.6 Land holding of respondent HHs by category

Land type	Intervention				Control			
	Fruits		Vegetable		Fruits		Vegetable	
	Mean, decimal	Standard Deviation	Mean, decimal	Standard Deviation	Mean, decimal	Standard Deviation	Mean, decimal	Standard Deviation
Homestead land (Before)	13.28	10.26	25.41	31.13	13.16	11.30	23.91	20.81
Homestead land (Now)	13.32	10.26	25.93	31.08	13.28	11.35	24.47	21.59
Water bodies (Before)	16.23	66.79	2.76	16.12	2.50	15.00	1.19	4.39
Water bodies (Now)	14.69	63.16	3.35	20.12	2.50	15.00	1.29	4.45
Net cultivated area (Before)	197.48	213.22	112.58	133.47	184.06	216.01	83.43	54.16
Net cultivated area (Now)	193.11	196.82	118.44	132.54	185.17	216.00	87.73	51.58

3.7 MOVABLE AND FIXED ASSETS OF RESPONDENT PRODUCERS

Movable and fixed assets of respondent producers by category are tabulated in Tables 3.7 and 3.8. The study shows that the increase in number of movable assets like mobile phone sets, televisions, water pumps, and diesel engines are quite higher compared with other assets. The increase in number of motorcycles is higher than power tillers, and power tiller service is taken from local service providers. Regarding fixed assets, the number of *pucca* houses, tin sheds, cattle and poultry sheds indicates that control farmers' financial capability is higher than the intervention producers. Field observation established that the control farmers have good contact with input and output market players such as local seed, fertilizer and insecticide dealers; relations with local *baparies* of fruits and vegetables that provide them an edge for having preference in business dealings.

Table 3.7 Total movable assets

Asset type	Intervention				Control			
	Fruits		Vegetables		Fruits		Vegetables	
	Before	Now	Before	Now	Before	Now	Before	Now
Diesel engines	22	24	5	5	29	49	8	9
Engine boat	1	1					1	1
IPS	1	1			3	5		
Maize Sheller	1	1			6	6		
Mobile phone	250	388	35	49	570	904	106	168
Motorcycle	42	48	6	7	51	69	8	8
Power Tiller	9	13	3	3	24	25	2	3
Television	91	107	11	12	245	284	44	51
Thresher	19	23	2	2	37	40	6	6
Water Pump	94	97	15	15	171	185	26	31

Table 3.8 Total fixed assets

Asset type	Intervention (n=600)				Control (n=120)			
	Fruits		Vegetables		Fruits		Vegetable	
	Before	Now	Before	Now	Before	Now	Before	Now
Cattle shed	107	116	15	16	207	238	34	38
Poultry shed	22	23	2	2	98	109	16	17
Pucca house	85	152	3	6	243	318	26	30
Sanitary toilet	119	134	21	24	392	484	71	91
Solar panel	8	8			9	32	0	3
Tin shed house	343	396	58	65	499	571	98	107

3.8 VEGETABLES AND FRUITS GROWN BY THE RESPONDENTS

From the following Table 3.9, it is seen that for aromatic rice, production is increased regardless of land size, as for the control producers, the land utilization is less compared with previous land use. This is due to improved rice cultivation technique and the HYV introduction. banana, tomato, pointed gourd, sweet gourd, and bitter gourd cultivation has increased, as has production. For the control producers, the production of Brinjal goes down but the land use is higher than before. Lemon production is up from before, but for the intervention producers, land utilization is found to be less than before. The summer tomato is not found among intervention producers, but the control producers have this commodity production, which production increases with time. Irrespective of intervention and control farmers the production of fruits and vegetables has increased because of adoption of good agricultural practices promoted by Hortex Foundation along with DEA, and private sector companies and NGOs.

Table 3.9 Vegetables and fruits grown by the respondents

Commodity type	Unit of production	HVC producers							
		Intervention				Control			
		Area decimal (Before)	Area decimal (Now)	Production (Before)	Production (Now)	Area decimal (Before)	Area decimal (Now)	Production (Before)	Production (Now)
		Mean	Mean	Mean	Mean	Mean	Mean	Mean	Mean
Aromatic rice	kg	57	62	259	411	119	102	176	277
Banana (cluster of plantains)	Bunch	168	172	1590	1649	120	134	1083	1092

Commodity type	Unit of production	HVC producers							
		Intervention				Control			
		Area decimal (Before)	Area decimal (Now)	Production (Before)	Production (Now)	Area decimal (Before)	Area decimal (Now)	Production (Before)	Production (Now)
		Mean	Mean	Mean	Mean	Mean	Mean	Mean	Mean
Bitter gourd	kg	22	24	1080	1499	40	44	1286	1967
Brinjal	kg	26	30	1729	2196	30	33	3536	3263
Lemon	Piece	57	44	4538	6695	69	65	15816	20948
Pointed Gourd	kg	24	24	2174	2739	26	28	2267	3326
Summer Tomato	kg					30	30	3900	4050
Sweet Gourd	kg	31	40	4391	5446	22	26	2510	3187
Tomato	kg	15	23	1933	3015	19	24	2035	2898
Others	kg	35	34	1291	2922	55	59	9052	12509

3.9 SERVICES RECEIVED BY RESPONDENTS FROM THEIR CIG/CCMC

Intervention producers are associated with CCMC and POs, therefore, having the opportunity of being enrolled in those institutions, avail the capacity building programs on good agricultural production and postharvest management of vegetables and fruits, and forward and backward market linkages through the project. Therefore, they have shown distinct resilience in having such interventions. Intervention producers have the criteria of aggregation at commodity collection and marketing, which is 81.17% over 1.67% of control producers (Table 3.10). Except loan criteria, intervention producers lead over control producers. Both control and intervention producers show less interest in loans. Savings are found at only 10.33% for intervention producers, where there is no savings for control producers through organizations.

Table 3.10 Services received by respondent from their CIG/CCMC

Type of services	Intervention		Control		Total	
Aggregation at CCMC	487	(81.17)	2	(1.67)	489	(67.92)
Better Market linkage	217	(36.17)	0	0.00	217	(30.14)
Business Plan Preparation	181	(30.17)	1	(0.83)	182	(25.28)
Cleaning and washing	358	(59.67)	1	(0.83)	359	(49.86)
Collective marketing of produces	111	(18.50)	0	0.00	111	(15.42)
Collective procurement of inputs	95	(15.83)	0	0.00	95	(13.19)
Cooling	40	(6.67)	1	(0.83)	41	(5.69)
Farm advisory services	49	(8.17)	0	0.00	49	(6.81)
Loan	4	(0.67)	0	0.00	4	(0.56)

Type of services	Intervention		Control		Total	
Proper packing	57	(9.50)	1	(0.83)	58	(8.06)
Savings	62	(10.33)	0	0.00	62	(8.61)
Sorting and Grading	419	(69.83)	2	(1.67)	421	(58.47)
Transportation of produces	142	(23.67)	0	0.00	142	(19.72)
Treatment	172	(28.67)	2	(1.67)	174	(24.17)
Other (Specify)	1	(0.17)	0	0.00	1	(0.14)
Total respondents	600		120		720	

Note: Numbers in parentheses are in percentages.

3.10 TRAINING/WORKSHOP RECEIVED BY TYPE, SOURCE, AND QUALITY

Training on business planning, fruits production, PH management, value chain development, and vegetables cultivation were evaluated for the intervention producers in terms of field level follow ups, field days, training, workshops, and group discussion as presented in the Tables 3.11 and 3.12. The impact is greater when programs are organized by DAE with support from Hortex Foundation, followed by CCMC-with support from Hortex Foundation, and CCMC-with support from DAE. For the control producers, the amount of intervention was less and a few of them participated in some field days and training.

Table 3.11 Training/workshop received by type, source, and quality (intervention farmers)

Issue of training/workshop	Type of event	Intervention (n=600)					
		CCMC-with support from DAE		CCMC-with support from Hortex Foundation		DAE with support from Hortex Foundation	
		Average	Satisfactory	Average	Satisfactory	Average	Satisfactory
Business Planning	Field level follow ups (counseling)	0	0	1	1	1	0
	Field-day	0	0	0	0	3	3
	Training	2	10	12	90	13	111
	Workshops/Group discussions	0	0	1	5	6	4
Fruits Production	Field level follow ups (counseling)	0	0	0	1	0	0
	Field-day	5	0	0	1	1	1
	Training	1	13	6	37	47	123
	Workshops/Group discussions	1	0	0	1	0	0
Post-Harvest Management	Field level follow ups (counseling)	1	0	1	1	0	1
	Field-day	3	2	0	2	3	2

Issue of training/ workshop	Type of event	Intervention (n=600)					
		CCMC-with support from DAE		CCMC-with support from Hortex Foundation		DAE with support from Hortex Foundation	
		Average	Satisfactory	Average	Satisfactory	Average	Satisfactory
	Training	7	34	11	107	45	149
	Workshops/Group discussions	0	2	1	1	7	5
Value Chain Development	Field level follow ups (counseling)	0	0	2	0	0	0
	Field-day	1	3	0	2	2	1
	Training	2	5	5	24	14	83
	Workshops/Group discussions	0	2	0	2	4	2
Vegetable Production	Field level follow ups (counseling)	0	0	1	1	0	0
	Field-day	0	12	1	0	5	2
	Training	0	14	17	117	27	212
	Workshops/Group discussions	1	2	0	10	4	0
All	Field level follow ups (counseling)	1	0	5	4	1	1
	Field-day	9	17	1	5	14	9
	Training	12	76	51	375	146	678
	Workshops/Group discussions	2	6	2	19	21	11

Table 3.12 Training/workshop received by type, source, and quality (Control farmers)

Issue of training/ workshop	Type of event	Control (n=120)				
		CCMC-with support from DAE	DAE with support from Hortex Foundation		Others	
		Satisfactory	Average	Satisfactory	Average	Satisfactory
Business Planning	Field level follow ups (counseling)	0	0	0	0	1
	Field-day	0	0	1	0	1
	Training	1	1	3	0	3
	Workshops/Group discussions	0	0	0	0	0
Fruits Production	Field level follow ups (counseling)	0	0	0	0	1
	Field-day	0	0	0	0	1

Issue of training/ workshop	Type of event	Control (n=120)				
		CCMC- with support from DAE	DAE with support from Hortex Foundation		Others	
		Satisfactory	Average	Satisfactory	Average	Satisfactory
	Training	0	2	1	0	3
	Workshops/Group discussions	0	0	0	0	0
Post-Harvest Management	Field level follow ups (counseling)	0	0	0	0	1
	Field-day	0	1	1	1	1
	Training	0	5	3	0	3
	Workshops/Group discussions	0	0	0	0	0
Value Chain Development	Field level follow ups (counseling)	0	0	0	0	1
	Field-day	0	0	0	0	1
	Training	0	1	2	0	3
	Workshops/Group discussions	0	0	0	0	0
Vegetable Production	Field level follow ups (counseling)	0	0	0	0	2
	Field-day	0	0	0	8	1
	Training	0	3	4	7	6
	Workshops/Group discussions	0	0	0	0	0
All	Field level follow ups (counseling)	0	0	0	0	6
	Field-day	0	1	2	9	5
	Training	1	12	13	7	18
	Workshops/Group discussions	0	0	0	0	0

3.11 FARMERS' KNOWLEDGE ON GOOD AGRICULTURAL PRACTICES OF VEGETABLES AND FRUITS PRODUCTION

Farmers' knowledge on good agricultural practices of vegetables and fruits production was assessed with eight important indicators on a scoring scale of 0-5 and compared among intervention and control farmers, and the knowledge level is categorized as low (up to 1.66), medium (1.67 to 3.32) and high (3.33 to 5.0). The overall knowledge indices indicate that intervention farmers have medium level of knowledge on good agricultural practices of vegetables and fruits production, and the knowledge level of control farmers is low (Table 3.13). The variation among the weighted average of the intervention farmers' knowledge on vegetables and fruits

production is better than control farmers. The intervention farmers received capacity building hands-on training on good agricultural practices on vegetables and fruits production by the Hortex Foundation in collaboration with the Department of Agricultural Extension (DAE) personnel. On the contrary, the control farmers have received limited training on good agricultural practices of vegetables and fruits production (Section 3.10). However, it is observed that the vegetables and fruits marketing is dominated by local *Baparies* and export company representatives and they set few common standards of vegetables and fruits quality and handling of the produce, therefore, farmers, either received interventions or not having some shorts of common knowledge on good agricultural practices of vegetables and fruits production.

Table 3.13 Overall farmers' knowledge on good agricultural practices of vegetables and fruits Production

Dependent Variable	Scoring method	Possible score	Categories	Intervention				Control			
				weighted average (N-600)				weighted average (N-120)			
				Vegetables		Fruits		Vegetables		Fruits	
				Mean	SD	Mean	SD	Mean	SD	Mean	SD
Knowledge on Vegetables and Fruits Production	8 item, 0-5 scale	0-5	Low (up to 1.66)					1.61		0.32	
			Medium (1.67-3.32)	2.84	1.13	2.79	1.02		1.61		0.96
			High (3.33-5)								

The assessment included eight important criteria of good agricultural practices of vegetables and fruits production such as identification of high-value crops, preparation of soil, composition of compost, characteristics of quality seed, size of seedbed, IPM, irrigation scheduling and special management practices (Table 3.14). In most of the indicators of good agricultural practices of vegetables and fruits production the intervention farmers have scored higher compared to control farmers. On the contrary, in a few specific practices such as identifying quality seed, specific size of vegetable seedbed and IPM control farmers have scored slightly higher than intervention farmers. In all cases, the Standard Deviations were found in the narrow range that indicates good agreement among the views of the farmers. The similarity in the mean scores among the intervention and control

farmers might have due to the common criteria set by the local *Baparies* and Export Company representatives at the assembly market level and few common good agricultural practices are long been promoted by the DAE.

Table 3.14 Farmers' knowledge on good agricultural practices of vegetables and fruits production

Attribute	Intervention (n=600)				Control (n=120)			
	Vegetables		Fruits		Vegetables		Fruits	
	Mean	Standard Deviation	Mean	Standard Deviation	Mean	Standard Deviation	Mean	Standard Deviation
High value crops	3.88	0.77	3.67	0.91	3.57	0.94	3.00	0.00
Preparation of soil suitable	3.36	0.87	3.02	0.99	3.19	0.87	3.00	0.00
Compositions compost	3.28	0.98	3.48	0.85	3.17	1.02	3.00	0.00
Characteristics of good quality seed	3.59	0.91	3.04	0.98	3.58	0.87	3.33	1.15
size of vegetable seedbed	3.01	0.88	2.13	0.95	2.81	1.04	3.33	0.58
Define IPM	2.23	1.07	2.93	0.90	2.38	1.08	3.67	0.58
Irrigation scheduling maintained	3.04	0.81	2.92	0.82	2.85	0.80	2.67	0.58
Special management practices	3.02	0.86	3.20	0.86	2.79	0.92	2.67	0.58

3.12 ADOPTION OF IMPROVED PHM PRACTICES OF VEGETABLES AND FRUITS BY THE FARMERS

The adoption of improved PHM practices of vegetables and fruits by the farmers were evaluated with four criteria such as practice of sorting/grading, washing, packaging and good transportation.

In the case of sorting and grading of vegetables and fruits, the rate of adoption is found higher in intervention farmers (72.67%) compared to control farmers (65.00%) (Table 3.15). However, adoption rate is also found higher in vegetables sorting and grading compared to fruits.

Similar adoption rate is found in washing of vegetables and fruits, where the adoption rate of practice such activities for intervention and control farmers are

71.83% and 57.50%, respectively, and rate of adoption of washing practice is found higher in vegetables compared to fruits (Table 3.16). Generally, farmers do not wash vegetables/fruits before marketing with few exceptions like radish, carrot etc.

The rate of adoption of packaging of vegetables and fruits is found quite less by both intervention and control farmers 45.83% and 38.33%, respectively (Table 3.17). During field investigation it is identified that appropriate packaging container especially plastic crates are not easily available in the local market, demand of proper packaging is limited only in the posh market, market retail price does not cover the cost of packaging and branding still pays back at a lower level that limiting the adoption rate of packaging at the producers' organization level.

The adoption rates of using proper transportation of vegetables and fruits by the intervention and control farmers are found 63.83% and 49.17%, respectively (Table 3.18). The adoption rate of proper transportation of vegetables is found to be higher compared to fruits like other postharvest processing practices.

Table 3.15 Adoption of sorting/grading practices for vegetables and fruits

Respondent type	Intervention (n=600)		Control (n=120)	
	Yes	No	Yes	No
Vegetable	358	126	57	27
	(73.97)	(26.03)	(67.86)	(32.14)
Fruits	78	38	21	15
	(67.24)	(32.76)	(58.33)	(41.67)
Total	436	164	78	42
	(72.67)	(27.33)	(65.00)	(35.00)

Table 3.16 Adoption of washing practices for vegetables and fruits

Respondent type	Intervention (n=600)		Control (n=120)	
	Yes	No	Yes	No
Vegetable	357	127	56	28
	(73.76)	(26.24)	(66.67)	(33.33)
Fruits	74	42	13	23
	(63.79)	(36.21)	(36.11)	(63.89)
Total	431	169	69	51
	(71.83)	(28.17)	(57.50)	(42.50)

Table 3.17 Adoption of packaging practices for vegetables and fruits

Respondent type	Intervention (n=600)		Control (n=120)	
	Yes	No	Yes	No
Vegetable	240	244	34	50
	(49.59)	(50.41)	(40.48)	(59.52)
Fruits	35	81	12	24
	(30.17)	(69.83)	(33.33)	(66.67)
Total	275	325	46	74
	(45.83)	(54.17)	(38.33)	(61.67)

Table 3.18 Adoption of good transportation practices for vegetables and fruits

Respondent type	Intervention (n=600)		Control (n=120)	
	Yes	No	Yes	No
Vegetable	318	166	46	38
	(65.70)	(34.30)	(54.76)	(45.24)
Fruits	65	51	13	23
	(56.03)	(43.97)	(36.11)	(63.89)
Total	383	217	59	61
	(63.83)	(36.17)	(49.17)	(50.83)

3.13 LEVEL OF ADOPTION OF IMPROVED PHM PRACTICES OF VEGETABLES AND FRUITS BY THE FARMERS

Level of adoption of improved PHM practices of vegetables and fruits by the farmers was assessed with twelve important indicators on a scoring scale of 0-5 and compared among intervention and control farmers and the adoption level is categorized as low (score: up to 1.66), medium (score: 1.67 to 3.32) and high (score: 3.33 to 5.0). The overall level of adoption indices indicate that intervention farmers have medium level of adoption of improved PHM practices of vegetables and fruits, and control farmers have low level of adoption (Table 3.19). However, the mean scores show that the level of adoption at intervention farmers is higher than the control farmers in all indicators. Both the intervention and control farmers are selling their produces in the same market and under the same set of criteria imposed by the market players, therefore, either having proper training or not they used to comply same set of quality (washing, sorting, grading, packaging etc.), safety and transportation (use of plastic crates, rickshaw van) criteria.

Table 3.19 Level of adoption of improved PHM practices of vegetables and fruits by the farmers

Dependent Variable	Scoring method	Possible score	Categories	Intervention				Control			
				weighted average (N-600)				weighted average (N-120)			
				Vegetables		Fruits		Vegetables		Fruits	
				Mean	SD	Mean	SD	Mean	SD	Mean	SD
Perception on PHM Practices of Vegetables and Fruits Production	12 item, 0-5 scale	0-5	Low (up to 1.66)					1.57	1.54	0.29	0.88
			Medium (1.67-3.32)	2.73	1.20	2.76	1.15				
			High (3.33-5)								

The level of adoption of improved PHM practices of vegetables and fruits by the farmers was assessed with twelve important indicators such as parameters of quality and safety, good agricultural practices, crop maturity, harvesting maturity of Tomato, Brinjal, Bitter Gourd, Banana, harvesting method of vegetables & fruits, handling of harvested vegetables & fruits, and aggregation place of vegetables and fruits (Table 3.20). The Standard Deviations are found in the narrow range that indicates good agreement among the views of the farmers. The mean adoption values of all the indicators are found higher in intervention farmers' level as they have received training on improved PHM practices of vegetables and fruits, and logistics provided by the Hortex Foundation in collaboration with the DAE (NATP-2 project). However, the adoption level of improved PHM practices even at intervention farmers' level is in medium category and there is still scope for improvement of the adoption level. During qualitative investigation at the field level, the study identified that the infrastructural facilities such as modern sorting/grading, washing and packaging machines are still lacking in the CCMCs.

Table 3.20 Level of adoption of improved PHM practices of vegetables and fruits by the farmers

Attribute	Intervention (n=600)				Control (n=120)			
	Vegetables		Fruits		Vegetables		Fruits	
	Mean	Standard Deviation	Mean	Standard Deviation	Mean	Standard Deviation	Mean	Standard Deviation
Parameters of quality and safety of fruits	3.16	0.81	3.32	0.95	2.94	0.83	3.00	0.00

Attribute	Intervention (n=600)				Control (n=120)			
	Vegetables		Fruits		Vegetables		Fruits	
	Mean	Standard Deviation	Mean	Standard Deviation	Mean	Standard Deviation	Mean	Standard Deviation
and vegetables								
Good Agricultural Practices (GAP) learnt from training	2.81	0.96	2.58	1.00	2.47	1.04	2.33	0.58
Perception on crop maturity	3.31	0.93	3.10	0.88	3.08	0.86	2.33	0.58
Appropriate harvesting maturity of Tomato	3.16	1.03	3.20	0.84	2.86	1.04	3.00	0.00
Appropriate harvesting maturity of Brinjal	3.33	0.91	3.10	0.86	3.08	0.79	2.33	0.58
Appropriate harvesting maturity of Bitter Gourd	3.26	1.02	2.89	0.87	3.04	1.02	2.33	0.58
Appropriate harvesting maturity of Banana	3.08	1.07	3.30	0.80	3.00	1.04	3.00	0.00
Appropriate harvesting time of fruits and vegetables	3.21	0.84	3.23	0.84	2.94	0.85	2.67	0.58
Harvesting methods of vegetables	3.18	0.82	3.10	0.94	3.00	0.89	3.67	0.58
Harvesting methods of fruits	3.12	0.85	3.28	0.89	2.92	0.95	3.67	0.58
Field handling of harvested vegetables and fruits	3.03	0.81	3.06	0.91	2.84	0.69	3.00	1.00

Attribute	Intervention (n=600)				Control (n=120)			
	Vegetables		Fruits		Vegetables		Fruits	
	Mean	Standard Deviation	Mean	Standard Deviation	Mean	Standard Deviation	Mean	Standard Deviation
Appropriate aggregation place of harvested fruits and vegetables	2.93	0.77	3.06	0.88	2.78	0.85	3.00	0.00

3.14 POSTHARVEST LOSSES OF VEGETABLES AND FRUITS AT FARM LEVEL

The postharvest losses of vegetables and fruits at farm level as perceived by the respondent farmers are shown in Table 3.21 and Table 3.22. For both intervention and control farmers, the postharvest losses of vegetables and fruits are less than before. However, in most of the selected vegetables and fruits levels, the loss and loss reduction are improved in intervention farmers compared to control farmers. Moreover, the higher losses of fruits are evident, and the reduction of losses is still low. On the contrary, there is significant reduction of loss in aromatic rice (2.5%) and lemon (3.5%) at intervention farmers' level compared to control farmers. On the contrary, the highest levels of losses were found in vegetables like brinjal (17.1%), bitter gourd (14.4%), and pointed gourd (11.4%) even at intervention farmers' level. There is mentionable reduction of postharvest losses in these vegetables in both intervention and control farmers' level; however, there are scopes for further reduction of postharvest losses by adopting the improved PHM practices (Table 3.22). The overall findings indicate that the improved PHM practices are being adopted in intervention farmers' level as their awareness and capacity have been developed by the Hortex Foundation in collaboration with the DAE.

Table 3.21 Postharvest losses of fruits and vegetables at farm levels as perceived by the farmers

Crop type	Postharvest loss (%) by crop type															
	Intervention (n=600)								Control (n=120)							
	Vegetables cluster				Fruits cluster				Vegetables cluster				Fruits cluster			
	Loss (before)		Loss (after)		Loss (before)		Loss (after)		Loss (before)		Loss (after)		Loss (before)		Loss (after)	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD

Aromatic rice	2.5	0.7	2.5	0.7						7.7	5.9	5.2	3.9				
Banana (cluster of plantains)	4.2	1.3	3.3	1.2	17.4	4.6	6.1	2.9	6.3	6.6	4.5	5.0	15.9	6.4	7.2	6.7	
Bitter gourd	14.4	9.3	9.2	6.9					14.8	9.7	9.9	7.4					
Sweet Gourd	9.8	3.9	6.7	3.6					9.9	5.1	5.1	2.6					
Pointed Gourd	11.4	11.3	7.8	8.5					11.9	11	7.8	7.8					
Brinjal	17.1	11.4	12.2	9.3					13.7	9.9	9.0	7.7					
Lemon	4.0	2.8	3.5	2.1	21.0	10.2	17.1	5.0	10.8	9.6	9.9	8.5	18.5	10.6	13.3	6.0	
Summer Tomato	10.0	0	8.0	0					10	0	7.9	0.4					
Tomato	10.0	1.7	8.2	2.4					9.8	3.3	6.6	3.0					
Others	10.9	1.9	6.9	3.1					11.3	4.7	6.1	4.1	14.0	8.3	9.4	6.3	

Table 3.22 Postharvest losses perceived by the farmers

Crop	Intervention				Control			
	Loss (%)							
	Vegetables cluster		Fruits cluster		Vegetables cluster		Fruits cluster	
	Now	Loss saved	Now	Loss saved	Now	Loss saved	Now	Loss saved
Aromatic rice	2.5	0.00			5.2	32.47		
Banana (cluster of plantains)	3.3	21.43	6.1	64.94	4.5	28.57	7.2	54.72
Bitter gourd	9.2	36.11			9.9	33.11		
Sweet Gourd	6.7	31.63			5.1	48.48		
Pointed Gourd	7.8	31.58			7.8	34.45		
Brinjal	12.2	28.65			9	34.31		
Lemon	3.5	12.50	17.1	18.57	9.9	8.33	13.3	28.11
Summer Tomato	8	20.00			7.9	21.00		
Tomato	8.2	18.00			6.6	32.65		
Others	6.9	36.70			6.1	46.02	9.4	32.86

3.15 PERCEPTION OF FARMERS REGARDING FACTORS CONTRIBUTING IN REDUCTION OF POSTHARVEST LOSSES OF VEGETABLES AND FRUITS DUE TO ADOPTION OF IMPROVED PHM PRACTICES AT CCMCS

The reduction of postharvest losses in vegetables and fruits due to adoption of improved PHM practices at the CCMCs level as perceived by the respondent farmers are shown in Table 3.23. The overwhelming majority of the farmers (85.33%) opined that postharvest losses of vegetables and fruits are being reduced due to adoption of improved PHM practices at the CCMCs level. About 70.83% of control farmers also echoed the same view. It confirms the fact that the impact of institutional interventions has far more likelihood of sustaining the postharvest loss reduction efforts in fruits and vegetables and need to scale in such clusters all over the country.

Table 3.23 Adopted of improved PHM practices at the CCMCs to reduce postharvest loss of vegetables and fruits as perceived by the farmers

Respondent type	Intervention (n=600)		Control (n=120)	
	Yes	No	Yes	No
Vegetable	406	78	59	25
	(83.88)	(16.12)	(70.24)	(29.76)
Fruits	106	10	26	10
	(91.38)	(8.62)	(72.22)	(27.78)
Total	512	88	85	35
	(85.33)	(14.67)	(70.83)	(29.17)

The opinion of the farmers on overall level of adoption of improved PHM practices at the CCMCs to reduce postharvest loss of vegetables and fruits has been assessed and shown in Table 3.24. A 7- item contributing factors on a scale of 0-5 have been used for the aforesaid purpose. The respondent intervention farmers opined that the adoption of improved PHM practices at the CCMCs level could impact medium levels in reducing the postharvest loss of vegetables and fruits. Similar trend is also observed in the case of control farmers' level. It further indicates that establishing and scaling of institutions like CCMCs all over the country may sustain the reduction of postharvest losses of vegetables and fruits.

Table 3.24 Overall level of adopted of improved PHM practices at the CCMCs to reduce postharvest loss of vegetables and fruits

Dependent Variable	Scoring method	Possible score	Categories	Intervention				Control			
				Weighted average (N-600)				Weighted average (N-120)			
				Vegetables		Fruits		Vegetables		Fruits	
				Mean	SD	Mean	SD	Mean	SD	Mean	SD
Perception on reduce postharvest loss	7 item, 0-5 scale	0-5	Low (up to 1.66)							1.23	
			Medium (1.67-3.32)	2.23	1.23	2.95	0.94	1.67	1.36		1.72
			High (3.33-5)								

The seven point contributing factors for reduction of postharvest losses of vegetables and fruits due to use of PHM practices at CCMCs as perceived by the respondent farmers are factors of losses, ways of reduction of losses, treatment to control microbial contamination, knowledge on Chitosan, increase shelf life of Banana & Tomato, and best practices of packing vegetables and fruits (Table 3.25). Most of the seven contributing factors of postharvest loss reduction of vegetables have shown higher scores for intervention farmers followed by control farmers. However, the scores related to fruits show similar trends. It is evident that institutional interventions such as CCMCs and POs have made sustained impact on the reduction of postharvest losses of vegetables and fruits.

Table 3.25 Factors contributing to reduction of postharvest losses of fruits and vegetables due to use of PHM practices at CCMCs as perceived by the farmers

Attribute	Intervention (n=600)				Control (n=120)			
	Vegetables		Fruits		Vegetables		Fruits	
	Mean	Standard Deviation	Mean	Standard Deviation	Mean	Standard Deviation	Mean	Standard Deviation
Factors those contributing to the postharvest losses of fruits and vegetables at farm level	3.12	0.75	3.68	0.97	2.81	0.74	4.09	1.04
Ways of reduction of postharvest losses of fruits	3.01	0.83	3.26	0.90	2.88	0.88	3.90	0.57

and vegetables								
Methods of treatment to control microbial contamination and rotting	2.88	0.88	3.32	0.96	2.55	0.92	3.80	0.42
Chitosan	1.74	0.86	2.15	0.63	1.86	0.94	2.10	0.57
Increase shelf life of Banana	2.78	0.86	3.26	0.84	2.67	0.96	3.50	0.71
Increase shelf life of tomato	2.91	0.85	3.07	0.89	2.64	0.89	3.60	0.52
Best practices of packing vegetables and fruits	3.11	0.73	3.20	0.87	2.98	0.69	3.70	0.67

3.16 ANNUAL HOUSEHOLD INCOME

The average household income in the study areas revealed that the overall income increases of the household increased by about 32.82% (Table 3.26) and that increase for intervention and control farmers are 27.87% and 35.12%, respectively since 2018. However, the present annual average income of the intervention farmers (BDT 349112) is comparatively higher than the control farmers (BDT 306650) and the baseline income in 2018 of the intervention farmers was also higher. It indicates that both the intervention and control farmers have sustained increase in household income because of the intervention provided by the Hortex Foundation in the area of PHM of vegetables and fruits, and it would be good to scale the experience to other farmers of different clusters of vegetables and fruits production in the country.

Table 3.26 Average Household annual income by category

Respondent type	Total average income in BDT					
	Intervention		Control		Overall	
	Before	Now	Before	Now	Before	Now
Vegetable	226281	342877	206607	309202	223028	337309
Fruits	353636	364131	274444	300694	340189	353358
Total	263638	349112	226958	306650	257525	342035
Percent increase		27.87		35.12		32.82

Table 3.27 shows the sources of annual primary income from different on and off farm activities of the respondent farmers. The table indicates that the major sources of primary income of the respondent farmers (intervention and control) are dominated by the incomes from fruits, vegetables and paddy cultivation. The contribution of non-farm businesses in household income is also increasingly prominent among the farmers irrespective of intervention and control farmers.

Table 3.27 Sources of annual primary income by category

Source of Primary income	Intervention (n=600)				Control (n=120)				Overall (n=720)	
	Fruits		Vegetable		Fruits		Vegetable		Before	Now
	Before	Now	Before	Now	Before	Now	Before	Now		
Agri-Processing	0	0	620	1653	0	0	5952	5952	1643	1901
Agricultural labor	3448	3448	2231	2066	0	0	2143	0	1956	1379
Cattle fattening	6034	6034	0	145	0	0	0	0	1509	1545
Dairy	0	0	847	1302	0	0	0	714	212	504
Fruits	188060	201767	2655	2345	163750	174861	0	0	88616	94743
Nonfarm business	22845	28017	4607	6550	0	0	10119	10119	9393	11171
Non-farm labor	0	0	310	269	0	0	595	595	226	216
Paddy	3017	20690	5764	7045	0	8889	3393	4226	3044	10213
Pond fish culture	0	0	723	723	0	0	0	0	181	181
Poultry (broiler)	0	0	0	558	0	0	3214	3214	804	943
Remittance	3448	3448	6715	8884	0	0	2738	3095	3225	3857
Service (job with Govt or NGO)	6897	10345	6601	8399	0	0	4167	4167	4416	5728
Vegetables	0	0	97224	111311	0	0	101345	101583	49642	53223
Medicinal Plants	0	0	0	103	0	0	0	0	0	26
Other	0	0	1095	1240	0	0	0	0	274	310
Total	233750	273750	129393	152592	163750	183750	133667	133667	165140	185940

3.18 ANNUAL HOUSEHOLD SAVINGS

The annual household savings has been increased irrespective of respondent farmers' type and vegetables and fruits production and processing (Table 3.28). However, annual household savings have shown a sharp increase in vegetables

production, processing and marketing. The high values of Standard Deviations also indicate that the annual household savings are widely dispersed as variation in production volumes depending on the farm holdings dedicated to vegetables and fruits.

Table 3.28 Average annual savings of respondent farmers by category

Attribute	Intervention				Control				Overall			
	Vegetable		Fruits		Vegetable		Fruits		Vegetable		Fruits	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Annual savings in thousand BDT (before)	42.9	53.4	63.8	74.4	37.9	38.9	44.7	55.9	42.1	51.3	60.5	71.9
Annual savings in thousand BDT (Now)	78.2	94.6	73.2	71.6	105.6	432.8	55.7	55.5	82.7	195.5	70.2	69.4
Percent increase	82.28		14.74		178.63		24.60		96.44		16.03	

3.19 CORRELATION BETWEEN DEMOGRAPHIC FEATURES AND ADOPTION OF PHM PRACTICES

The farmers' knowledge on good agricultural practices of vegetables and fruits production has a significantly positive correlation with level of adoption of PHM practices and postharvest loss reduction of vegetables and fruits due to adoption of PHM practices (Table 3.29). However, no significant relationship is found with the annual household income, as the premium for PHM practices is not visible in the vegetables and fruits market due to inadequate awareness among the market actors and consumers. Therefore, awareness building activities need to be promoted among the stakeholders about safe and nutritious vegetables and fruits consumption for maintaining health. On the other hand, significant positive relationships have been observed among age, education and present cultivated land holding with annual household income due to adoption of PHM practices. It indicates that higher education along with experience with age and higher land holding usually lead to a higher annual income of the households due to adoption of PHM practices.

Table 3.29 Correlation matrix between demographic features and adoption of PHM practices

Pearson Correlations (N=720)			
Demographic features	Level of adoption of PHM practices of vegetables and fruits	Postharvest loss reduction due to adoption of PHM practices	Annual HH income (Now) due to adoption of PHM practices
Age (years)	.023	.003	.185**
Education (years)	.044	.034	.119**
Net cultivated land holding (Now)	.001	-.032	.305**
Farmers knowledge on GAP of vegetables and fruits	.753**	.516**	.001
**. Correlation is significant at the 0.01 level			
*. Correlation is significant at the 0.05 level			

Chapter

FGD

4.0 HIGHLIGHTS OF FINDINGS

The following findings are from a series of two (2) focus groups discussion conducted with CCMC and CIG producers in Muktagacha, Mymensingh and Belabo, Narshingdi district. The focus group discussion incorporated the current practices to reduce postharvest loss, perception on postharvest loss and impact of postharvest loss reduction practices on income of the farmers.

4.1 INTRODUCTION

The focus group discussions were carried out in Muktagacha, Mymensingh and Belabo, Narshingdi districts to identify the current practices of postharvest loss reduction for the farmers concerned. Farmers' opinion on postharvest loss, postharvest loss reduction, and impact on income due to postharvest loss reduction practices were investigated in the FGDs. Besides that, opinions of Upazila Agriculture officer (UAO), Agriculture Extension Officer, Sub Assistant Agriculture Officers and Aggregators were also collected to understand the status of postharvest losses related to fruits and vegetables, practices and other associated relevant with the study.

4.2 METHODOLOGY

The following section outlines the methodology followed in focus group discussion (FGD). The FGDs involved CIG/CCMC/UAO/AEO/Aggregators in Muktagacha, Mymensingh and Belabo, Narshingdi district as per requirement of the study. The following Table 4.1 outlines the locations of the FGDs conducted.

Table 4.1 Location and dates of the FGDs

Location	Date
UAO office - Muktagacha, Mymensingh	2/6/2022
Collection center, Muktagacha, Mymensingh	
UAO office - Belabo, Narshingdi	7/6/2022
Collection center, Belabo, Narshingdi	

The local business facilitators of the Hortex Foundation associated with CCMCs in consultation with the consultant organized the FGDs. The participants of the FGDs comprised of CIG members associated with the CCMC and collection point (CP) and designated CCMC executives. In Muktagacha, Mymensingh a total of 21 farmers participated in the FGD of which 14 male and 7 female and in Belabo, Narshingdi a total of 23 male farmers participated in the FGD. UAO of the related places taken care of the overall arrangements and assisted the study team. At the beginning of the FGDs, the issues, outputs, norms and timeframe of the session were discussed and clarified. The findings from these FGDs are highlighted in this section based on participants' truthful comments by consensus.

4.3 FINDINGS OF THE FGDS

4.3.1 Postharvest Loss Reduction Practices

Participant farmers explained the currently used PHM practices such as sorting, washing and packaging and reiterated that the practices reduced loss significantly and made their produce attractive to the market (Fig. 4.1 and 4.2). The major outcomes of the FGDs are as follows:

- Shorting based on color, size, variety and maturity;
- Shorting was done in two stages, at first during harvesting and then in the collection point;
- There is no shorting machine in the collection point and farmers have no idea about modern shorting machines;
- Color, size and maturity are the most important characters for getting good price of the produce;
- Washing is mainly done in the collection point and there is a washing basin in collection point provided by the Hortex Foundation;
- There is no modern washing machine (based on crop) in the collection point and producers have no idea about modern washing machines;
- Awareness of washing and its effect on marketable produce was built through training by Hortex Foundation;
- Hardboard packaging and plastic crates for carrying are used which are readily available in the local market;
- Jute bags are still used for packaging mainly for local market; and
- For export, hard paper board boxes are used for packaging after shorting.

4.3.2 Farmers' Perception on Postharvest Loss

Regarding postharvest loss estimation, participants in the FGD expressed that they ever haven't measured/estimated the postharvest loss, however, they can perceive the postharvest losses at different stages of postharvest processing of fruits and

vegetables. However, their attention is more on marketing and production of fruits and vegetables rather than on reduction of postharvest loss. The perception of the participant farmers on postharvest losses of fruits and vegetables are as follows:

- From field to *Foria* (local buyers) or aggregators (*Bepari*) the amount of postharvest loss varies in the range of 5% to 15% depending on season, crop, variety, weather, transport facility and availability of labor; and
- As perceived by the farmers, the postharvest processing loss is about 5-10% and additional 5% loss is incurred during transportation of the produce due to poor handling and use of traditional bamboo-weaved baskets and gunny bags.

The respondent farmers also opined that the capacity building trainings offered by the Hortex Foundation and the Department of Agricultural Extension on postharvest loss reduction of fruits and vegetables are quite effective; however, the training should focus on modern processing machineries along its operation, maintenance and safety.

4.3.3 Income and Postharvest Management

Postharvest management has a direct impact on marketing of the crops, and it is also depending on market situation which is totally under control of *Foria* and local aggregators. The price of the crops is determined by the *Foria* and local aggregators and farmers cannot escape the process. Farmers do not keep the record of production cost formally and thus, it is difficult to estimate the exact amount they produce, postharvest loss and the profit margins. They can earn an extra amount by adopting the modern PHM practices and reducing postharvest losses. In response to a question of present possible postharvest loss of fruits and vegetables at farmers' level the farmers and UAO perceived that the amount is not higher than 5% compared to the past due to use of modern PHM practices.

4.3.4 Overall Perception

Participants in all groups have shown their keen interest in modern postharvest technologies and disappointment on market price currently they are getting from local buyers. They share that...

- They are concerned about the government schemes and informed that till date they haven't received any direct subsidy regarding postharvest loss reduction machines and facilities;
- Farmers demand food processing schemes with modern machinery for producing local pickle, Jam, chips etc. and for long term processing and storage they need dryer and community based cold storage.

- Access to finance, information and sourcing of modern machinery are very limited.



Figure 4.1 FGD at Muktagacha, Mymensingh



Figure 4.2 FGD at Belabo, Narsingdi

Chapter

Conclusion and Recommendation

5.0 GENERAL

This chapter delineates the conclusions and recommendations based on the field study findings and interpretations.

5.1 CONCLUSIONS

Based on the quantitative and qualitative field surveys, data analyses, and interpretation of the findings, the following conclusions are reached to assess the estimation of the extent of uptake by farmers of the improved PHM practices for selected HVCs, estimation of the PH loss reduction as a result of the practices followed in the CCMCs, and estimation of the effect on farmers' income as a result of the value addition/PHM exercises at the CCMCs, and other related aspects. The selected HVCs included in the study were Aromatic rice, Banana, Sweet gourd, Bitter gourd, Pointed gourd, Brinjal, Tomato, summer Tomato and Lemon.

5.1.1 Socio-economic Status of the Respondent HH

5.1.1.1 Respondent Type and Number

Based on vegetables and fruits clusters, seven districts and ten Upazilas were covered. From a total of 720 respondents, 600 intervention farmers (83.33%) and 120 control farmers (16.66%) participated in the study.

5.1.1.2 Respondents' Gender, Age Distribution, and Education Level

It was discovered that among the respondents 617 (85.69%) were male farmers, while 103 (14.31%) were female farmers. The most prevalent age group was middle-aged 36 and 50 years (45.28%), followed by 51-65 years (28.33%), 18-35 years (20.56%), and 65+ years (5.83%). The land ownership depends on the heredity law in the country and only the aged people own that right when the household head (father/mother) handed over the ownership to their offspring. Most of the producers have a primary (41.94%) and secondary (34.72%) level of education, with only around 4.03% having a graduate level of education. Further non-formal education like the trainings on improved PHM practices rendered by the Hortex Foundation in partnership with the DAE need to be continued to enhance the

quality of adoption of the skills towards strengthening the safe food and nutrition security of the nation.

5.1.1.3 Household Size and Land Holdings and Assets of Respondent Farmers

The average family size has been determined to be 4.94, which is larger than the national household size (4.060). The average homestead area of the vegetables and fruits producers examined remains unchanged for both intervention and control producers except there are an increase in cultivation area of vegetable intervention producers. When compared to other assets, the quantity of transportable assets such as mobile phone sets, televisions, water pumps, and diesel engines has increased significantly. The number of motorcycles is increasing faster than the number of power tillers, and power tiller service is being provided by local service providers. In terms of fixed assets, the presence of *pucca* houses, tin sheds, cattle and poultry barns imply that control farmers have greater financial capabilities than intervention producers.

5.1.2 Extent of Uptake by Farmers of the Improved PHM Practices

5.1.2.1 Fruits and Vegetables Grown by the Respondents

Regardless of intervention and control farmers, vegetables and fruits outputs have been increased mainly due to the adoption of good agricultural production and postharvest management practices supported by Hortex Foundation and DEA, and few interventions from private sector enterprises and NGOs.

5.1.2.2 Services Received by Respondents from their CCMCs/CIGs

Intervention producers outperformed control producers in all aspects of PHM practices, aggregation, market linkage, collective input procurement, collective product selling, aggregation at CCMCs and business planning. However, both intervention and control producers are seriously lagging in savings and having access to credit for production and postharvest practices of vegetables and fruits. The PO and CIG members related to CCMCs need to be encouraged to actively participate in savings and provide credits to its members in high value crop production like vegetables and fruits. There are agricultural credit policies to provide credit to producers, however, steps to be taken to develop bankable project proposals for their members.

5.1.2.2 Training/Workshop Participated by Type, Source and Quality

The PO and CIG members (intervention farmers) received quite a lot of trainings on business planning, vegetables and fruits production and postharvest management practices and value chain development from Hortex Foundation and

DAE in collaboration with CCMCs. On the contrary, only a few numbers of such trainings were received by the control farmers. These training courses have direct relationships with the knowledge gained on good agricultural production and postharvest management practices of vegetables and fruits, and positive reflections are quite visible.

5.1.2.3 Farmers' Knowledge on Good Agricultural Practices of Vegetables and Fruits Production

The overall knowledge indices show that intervention farmers have a medium degree of understanding about good agricultural practices for production of vegetables and fruits. The variation in the weighted average of intervention farmers' knowledge on vegetables and fruits production is greater than that of control farmers. However, it has been observed that local *Baparies* and export company representatives dominate the vegetables and fruits market, and they set few common standards of vegetables and fruits quality and handling of the produce. As a result, farmers either received interventions or did not have some common knowledge on good agricultural practices of fruit and vegetable production.

5.1.2.4 Level of adoption of Improved PHM practices of Vegetables and Fruits by the Farmers

The adoption of improved PHM practices of vegetables and fruits by the farmers were evaluated with four criteria such as practice of sorting/grading, washing, packaging and good transportation. From the assessment it is evident that PHM practices like sorting/grading, washing and transportation are adopted quite well by both intervention and control farmers by number. However, quite a low number of both intervention and control farmers were adopted packaging (Plastic crates and paper cartons) of vegetables and fruits.

During the field investigation, it was identified that packaging materials (improved packaging materials like plastic crates, paper cartons etc.) are not easily available in the local market, while demand for proper packaging is limited only to the posh market, and market retail prices do not cover the cost of packaging, however, branding still pays off at a lower level, these factors limiting the adoption rate of packaging at the producer's organization level. According to the overall adoption indices, intervention farmers have a medium level of adoption of improved PHM methods for fruits and vegetables, whereas control farmers have a low level of adoption. This is because, the intervention farmers have better access to capacity building trainings and infrastructural facilities provided by the Hortex Foundation in partnership with DAE, on the contrary, the control farmers have little access to

those interventions. However, as both intervention and control farmers sell their products in the same market and under the same set of criteria imposed by market players thus, whether they have proper training or not, they must comply with the same set of quality (washing, sorting, grading, packaging, etc.), safety, and transportation (use of plastic crates, rickshaw van) criteria.

5.1.3 Estimation of the PH loss reduction

5.1.3.1 Postharvest Losses of Vegetables and Fruits at Farm Level

Vegetables and fruits postharvest losses are lower than before interventions for both intervention and control farmers. However, in most of the selected fruit and vegetables levels, intervention farmers experience higher loss and loss reduction than control farmers. Furthermore, larger fruit losses are visible, and loss reduction is still minimal, even at the intervention farmer level, the highest levels of losses persist in vegetables such as Brinjal (17.1%), Bitter Gourd (14.4%), and Pointed Gourd (11.4%). There are mentionable reduction of postharvest losses of vegetables and fruits in both intervention and control farmers' level; however, there are scopes for further reduction of postharvest losses by adopting the improved PHM practices.

5.1.3.2 Perception of Farmers Regarding Factors Contributing in Reduction of Postharvest Losses of Vegetables and Fruits due to Adoption of PHM Practices at CCMCs

A seven point contributing factors for reduction of postharvest losses of fruits and vegetables due to use of PHM practices at CCMCs as perceived by the respondent farmers are factors of losses, ways of reduction of losses, treatment to control microbial contamination, knowledge on Chitosan, increase shelf life of Banana & Tomato, and best practices of packing fruits and vegetables. Most of the respondent intervention farmers opined that the adoption of improved PHM practices at the CCMCs level could impact medium level in reducing the postharvest loss of vegetables and fruits. Similar trend is also observed in the case of control farmers' level. It further indicates that establishing and scaling of institutions like CCMCs all over the country may sustain the reduction of postharvest losses of vegetables and fruits.

5.1.4. Effects on Farmers' Annual Household Income and Savings

The average household income in the study areas revealed that the overall income of the household increased by approximately 32.82%, with increases of 27.87% and 35.12% for intervention and control farmers, respectively, since 2018. However, the present annual average income of the intervention farmers (BDT 349112) is

comparatively higher than the control farmers (BDT 306650) and their baseline income in 2018 of the intervention farmers was also higher. The major sources of primary income of the respondent farmers (intervention and control) are dominated by the incomes from fruits, vegetables and paddy cultivation. Regardless of intervention and control of farmers, the contribution of non-farm businesses to household income is also becoming more prominent among farmers. It indicates that both the intervention and control farmers have sustained increase in household income because of the intervention provided by the Hortex Foundation in the area of PHM of vegetables and fruits, and it would be good to scale the experience to other farmers of different clusters of vegetables and fruits production in the country.

The annual household savings has been increased irrespective of respondent farmers' type and vegetables and fruits production and processing. However, annual household savings have shown a sharp increase in vegetables production, processing and marketing. Annual household savings vary substantially due to variations in farm holdings dedicated to fruits and vegetables and their quality.

5.1.5 Relationships between Demographic Features and Adoption of PHM Practices and its Effects

The farmers' knowledge on good agricultural practices of vegetables and fruits production has a significantly positive correlation with level of adoption of PHM practices and postharvest loss reduction of vegetables and fruits due to adoption of PHM practices. However, no significant relationship is found with the annual household income, as the premium for PHM practices is not visible in the vegetables and fruits market due to inadequate awareness among the market actors and consumers. Therefore, awareness building activities need to be promoted among the stakeholders about safe and nutritious vegetables and fruits consumption for maintaining health. On the other hand, significant positive relationships have been observed among age, education and present cultivated land holding with annual household income due to adoption of PHM practices. It indicates that higher education along with experience with age and higher land holding usually lead to a higher annual income of the households due to adoption of PHM practices.

5.1.6 Overall Conclusion

The overall findings indicate that improved PHM practices are being adopted at the intervention farmer level as a result of the Hortex Foundation's partnership with the DAE in developing their awareness and competence. The study suggests

that building and expanding organizations like CCMCs across the country may help to reduce postharvest losses and maintain quality of vegetables and fruits. The study also reveals that institutional interventions have a much better chance for improving the safe and nutritious vegetables and fruits production and postharvest loss reduction in the country. Scaling such experiences to other clusters would enhance safe food and nutrition security in the country.

5.2 RECOMMENDATIONS

Based on the study findings and conclusions, the following recommendations are made:

5.2.1 Adoption of Vegetables and Fruits Production and PHM Practices

- Adoptions of good agricultural practices are quite familiar among farmers as such extension activities have been in place by the Department of Agricultural Extension (DAE) for quite a long time. However, improved postharvest management (PHM) practices that are being promoted by Hortex Foundation in collaboration with DAE are quite recent and access to these technologies are still limited to the intervention farmers of the project. Both intervention and control farmers have shown keen interest to have access to this production and PHM practices knowledge and skill for adoption and enhance their production and economic return. Establishing and scaling of institutions like CCMC in vegetables and fruits clusters all over the country as rendered by Hortex Foundation and her partner DAE would sustain the safe production and reduction of postharvest losses of vegetables and fruits. Such a program may include private sector companies and non-governmental organizations (NGOs).

5.2.2 Training and Services Provided by Institutions

- The program established that properly designed capacity building activities may result in better adoption of knowledge and skill related to production and postharvest loss reduction of vegetables and fruits. The participant farmers of the study expressed their desire to have long term hands-on training and exposure visits to increase their knowledge and skill level. Digital media like short films and mobile apps about good production and PHM practices of different vegetables and fruits would be good ways to learn and adopt.
- Alongside farmers, input dealers and local market aggregators need to be included in the program and trained in order to use sophisticated PHM practices to reduce postharvest losses of vegetables and fruits. Only

intervention farmers are currently receiving training, and their numbers are still small in comparison to overall producers. Apart from that, private sector participation is critical, including NGOs and commercial companies/corporations.

5.2.3 Gender and Youth Engagement

- Women constitute half of the farming population in the country and usually engaged in homestead activities including vegetables and fruits cultivation. However, female farmers' involvement in the POs and CIGs are limited and more limited participations are identified in the CCMCs which impedes adoption of PHM practices. Therefore, in future scaling of PHM practices and reduction of postharvest losses of vegetables and fruits a significant number of women farmers need to be included in the program, especially in the POs.

5.2.4 Organizational Management

- Farmers' group savings are seriously lagging and have access to credit for production and postharvest practices of vegetables and fruits. The PO and CIG members related to CCMCs need to be encouraged to actively participate in savings and provide credits to its members in high value crop production like vegetables and fruits. There are agricultural credit policies to provide credit to producers, however, steps to be taken to develop bankable project proposals for their members.
- Literacy in digital financial management will be a wonderful answer for providing transparency in monetary management, especially the savings and credit management.
- For developing value chain and establishing high value-added production business modern digital business assessment tool like FAO develop 'Rural Invest' tool may be a good choice for this purpose.

5.2.5 Cutting-edge Postharvest Loss Reduction Machinery

- Modern PH loss reduction technologies/machines including mechanical harvesters, color graders, grading and shorting machines, washing machines, packaging machines, transporters, polisher machines, dryers, cold chambers etc. to be introduced in phases to CCMCs and POs to maintain quality and shelf life of the fresh vegetables and fruits produce.
- Farmers, aggregators, businesses, marketing and processing entrepreneurs and institutions such as DAE, NGOs, and Hortex Foundation need to use

PH loss reduction equipment to improve PH loss reduction and enhance shelf life and quality of vegetables and fruits.

Annex-I

Terms of Reference (ToR)

for

Estimation of farmers' uptake of Improved Postharvest (PH) Management Practices with HVCs, PH Loss Reduction, and effect on their incomeNational Agricultural Technology Program – Phase II Project (NATP-2) (1st Revised)

Hortex Foundation, Dhaka

Introduction

The Government of Bangladesh (GoB) initiated the National Agricultural Technology Program- Phase II Project (NATP-2) with support from the World Bank, IFAD (International Fund for Agricultural Development) and the USAID (United States Agency for International Development) with the objective of increasing agricultural productivity of smallholder farms and improving smallholder farmers' access to markets in selected districts. In order to fulfil the second objective of improving smallholder farmers' access to markets, Hortex Foundation is providing technical services on value chain development (VCD) as a Strategic Partner to the Department of Agricultural Extension (DAE) under a Strategic Partnership Agreement.

Hortex Foundation is providing its services in value chain development through improved post harvest management (PHM) practices and better market linkage in 30 upazilas covering 22 districts, focussing on ONE particular HVC (high value crop) in EACH upazila for vertical production. A total of six HVCs, namely, Brinjal, Bitter gourd, Sweet gourd, Tomato (summer & winter), Banana, and Aromatic rice were selected for vertical production as shown in Table 1.

Table 1: Selected HVCs for vertical expansion shown against Value Chain Cluster upazilas in NATP-2

Brinjal-6 clusters	Bitter Gourd - 5 clusters	Tomato-6 clusters		Sweet Gourd-5 clusters	Banana - 5 clusters	Aromatic Rice-3 clusters
		Winter	Summer			
1. Raipura, Narshingdi	1. Kaliganj, Jhenaidah	1. Chandina, Cumilla	5. Bagherpara, Jessore	1. Sadar, Bogra	1. Shibganj, Bogra	1. Birganj, Dinajpur
2. Shibpur, Narshingdi	2. Madhupur, Tangail	2. Dakkhin, Surma, Sylhet	6. Jhikorgacha, Jessore	2. Baraigram, Natore	2. Polashbari, Gaibandha	2. Chiribandar, Dinajpur
3. Sadar, Jessore	3. Belabo, Narshingdi	3. Mirsarai, Chittagong		3. Delduar, Tangail	3. Kapasia, Gazipur	3. Nakla, Sherpur
4. Islampur, Jamalpur	4. Sadar, Naogaon	4. Godagari, Rajshahi		4. Sadar, Kishoreganj	4. Sadar, Khagrachhari	
5. Sreemangal, Moulvibazar	5. Mithapukur, Rangpur			5. Savar, Dhaka	5. Muktagachha, Mymensingh	
6. Parbatipur, Dinajpur						

It is important to note here that the selected HVCs for the following upazilas were changed due to prevalence of other HVC instead of the selected ones mentioned in the DPP. Those crops were popular earlier but were found to be dwindling having very low acreage. Instead the changed new HVCs are very popular and have very high acreage.

These are mentioned in the Addendum to Table 1 below:

Addendum to Table 1: Changes in selected HVCs

Sl. No.	Name of Upazila, district	Selected HVC as per DPP	Changed HVC adjusted due to higher coverage
1.	Jhikorgachha, Jashore	Summer tomato	Pointed gourd
2.	Delduar, Tangail	Sweet gourd	Lemon
3.	Kishoreganj sadar	Sweet gourd	Tomato
4.	Sreemangal, Moulvibazaar	Brinjal	Lemon

Background

In carrying out the VCD activities, Hortex Foundation has provided a range of training courses, established Commodity Collection and Marketing Centres (CCMCs) and Collection Points (CPs) in all the 30 pilot upazilas to undertake proper PHM of the HVCs for marketing, facilitated linkage with traders and other market actors, supported farmers from the Common Interest Groups (CIGs) and Producer Organizations (POs), traders, processors, etc. in related VCD activities.

Organization of the CCMCs and CPs

A CCMC, in other words a mini-packhouse, was established with the objectives of improving produce quality, enhancing food safety, reducing postharvest loss, and improving market linkage for the farmers. Here the farmers are adopting improved PHM practices for their products to add value and earn a better price. The CCMCs are supplied with sorting mat, grading table, weighing scale, plastic crates, etc. and equipped with electric fans and washing facilities to aid the vegetable/fruit farmers apply the said PHM practices including harvesting at proper maturity, sorting, grading, washing, surface drying and appropriate packaging. One or two rickshaw-vans are also provided at the CCMC/CP to transport farmers' products from their farms using plastic crates to the CCMC/CP. These facilities are available to non-CIG farmers also who grow and bring vegetables/fruits to the CCMC. A CP however, is primarily a collection and aggregation centre, where only weighing is aided with support of a scale and some plastic crates to help carry produces. Out of the 30 CCMCs, 28 are established in rented structures of a market, most of which are very small in size, which is inadequate for functions of a packhouse. Two CCMCs were constructed in Parbatipur and Kapasia during the first phase of NATP in 2014.

The farmers from the production clusters coming to a CCMC are originally organized by the SAAOs from the DAE in 20 Common Interest Groups (CIG), each comprising either 20 or 30 farmers. A Producer Organization (PO) is then formed with three representatives (the President, Secretary and Treasurer) from each of the 20 CIGs, to form a 60-member general body. The PO General Body elects a 29-member Executive Committee, which acts as the Market Management Committee (MMC) and is charged with carrying out the functions of the CCMC and CP.

All the farmers regularly receive production technology training from DAE with orientation on clean cultivation and related extension support. For the required training of farmers and PO-MMCs on value chain activity skills, Hortex provided the technical assistance in training DAE's upazila and district officials like UAO, AAO, AEO, ADD, DTO and DD as Master trainers. These DAE officials as Master Trainers carried out all the training events to farmers and the PO-MMCs on the relevant topics. Hortex consultants also guided a number of training events for CIGs and PO-MMCs. Training to the CIG farmers included maturity & harvest index, PHM, food safety, and marketing. PO-MMCs were given training on Production Planning, Marketing, Good Governance, Market Management, Business Management, Financial Management, Contract Farming, PHM & Food Safety, Quality

Assurance, etc. Some local traders, directly involved with CCMCs and CPs, were also trained on proper handling, packaging and transport of fresh fruits and vegetables during marketing.

As already mentioned above, Hortex provided the CIG farmers training on PHM and relevant maturity & harvest index. Through a series of meetings and with the help of the training courses the operations in the CCMCs were initiated.

The CCMC exists at the heart of the market linkage approach, around which 20 CIGs comprising HVC farmers are organized in clusters in an upazila. The responsibility for managing the affairs of the CCMC lies with the Market Management Committee (MMC). The MMC has to organize and oversee the overall marketing of the agri-commodities brought by their fellow CIG farmers. As a start, the LBF (from Hortex, appointed by the Project) assists the MMC/PO to manage operations of the CCMC, while they gradually take up the CCMC functions. Local traders are engaged and are procuring from the assembled commodities in the CCMCs. Neighbouring non-CIG farmers also have access, which has a positive impact in society, reflecting the way CCMCs are viewed.

The MMC meets regularly each month to discuss, plan and review the CCMC functions and related affairs. These meetings are also participated by local traders, who are buying from the CCMCs. The SAAO from DAE also attends the meeting. The PO-MMC has to plan their operations, keep records of transactions, build relations with reputable traders and attempt to strengthen the business linkages through contractual agreements, keep track of product prices and demand, etc. in order for better marketing of their products.

The quality features upon which the PO-MMC are driving their market linkage approach are: (i) safety and quality assurance of the product ensured through sorting, grading, washing and proper packing (ii) larger amounts assembled by CIGs at the CCMC to attract bulk buyers, (iii) shelf life increased as diseased or rotten pieces sorted out and because these are washed and disinfected. The PO-MMC are able to highlight the advantages to the traders/buyers by emphasising that (i) they can save the costs of appointing a number of *farias* (collectors) to collect produces at farmers homes/fields scattered across the areas, (ii) get better product quality and (iii) their possible loss during transport and storage is minimized due to sorting out unhealthy pieces and better packaging using plastic crates instead of bamboo baskets, gunny or other sacks.

The PO-MMC therefore engages also in encouraging their fellow CIG farmers to assemble products of better quality, adopt the proper PHM practices to attract big buyers for better margin. In this regard the PO-MMC are also planning for contract farming as the CIG farmers are trained to grow and supply quality products.

The market linkage approach anchored around the CCMC tries an institution-building approach bringing together farmers through the CIGs and PO-MMC to link up with the traders/buyers/other market actors, who strive together to ensure food safety and quality in the value chain.

Objective

The objective of this assignment is to carry out the following studies

1. Estimation of the extent of uptake by farmers of the improved PHM practices for selected HVCs;
2. Estimation of the PH loss reduction as a result of the practices followed in the CCMCs; and
3. Estimation of the effect on farmers' income because of the value addition/PHM exercises at the CCMCs

Scope of the Studies

The studies will be conducted considering the listed CCMCs (and in applicable cases CPs) as its universe from which sampling may be carried out. CIG and PO members accordingly will also be sampled. The selected consultant will be provided with the following:

1. List of all the CIG farmers in the designated 30 project upazilas around the CCMCs/CPs;

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2. List of all PO members, in a similar format as above including identification of the executive members in various positions of the Market Management Committee (MMC);
3. List of the supply chain actors who are supportive and relevant to the POs, as may be classed into all kinds of input suppliers, traders/buyers (including contract buyers), processors, transporters, exporters, various repairmen, etc.;
4. List of all Commodity Collection and Marketing Centres (CCMC) including its key information, operational data and management system;
5. The base-line data collected after NATP-2 initiation from farmers and traders on PHM practices that can be used for possible analytical applications;
6. Relevant data so far collected from the CCMCs/CPs
7. Tutoring and/or mentoring of the Data Analyst or any other relevant staff of Hortex Foundation on the results of the studies and its dataset for any subsequent analysis as may arise from time to time;
8. Assist in hosting of the relevant information or outcomes in the website of Hortex Foundation;
9. Any other similar task that may become obvious in carrying out this assignment and as determined by the Managing Director, Hortex Foundation to be appropriate and relevant.

Approach and Methodology

The approach of the work has to take into consideration the context under which these studies are to be carried out and understand its utility during and after the project. The central reason to its value has to be well appreciated.

The methodology has to be detailed out by the selected consultant in consultation with Hortex Foundation. The Consultant will be required to make a comprehensive desk study to apprise her/him of the project and familiarize with its workings and designed outcome. In doing so, s/he may also seek suggestions from other Consultants and officials of the project. The final methodology will be determined and laid down by the consultant in consultation with the Monitoring and Evaluation Expert of NATP-2.

Selection Procedures

The Consultant will be selected using PPR 2008 and as per the World Bank Guidelines. Interested candidate may submit her/his complete Curriculum Vitae (CV) as an Expression of Interest (EOI) in the prescribed format with a recent passport-sized photograph, mentioning her/his expected remuneration. The EOI format can be obtained from Hortex Foundation, Sech Bhaban (3rd floor-western wing), 22 Manik Mia Avenue, Sher-e-Bangla Nagar, Dhaka 1207.

Qualifications required

The successful candidate should have the following qualifications:

1. A masters degree in agricultural/social Science or statistics with a minimum of 10 years relevant experience or a bachelors degree in any of the said disciplines with 15 years working experience in the relevant field.
2. S/he should have demonstrable experience of carrying out similar studies.
3. Demonstrate familiarity with different tools of analysis including most commonly used statistical analyses.
4. The skills, that goes without saying, in relevant computer applications and softwares including for statistical analysis of collected data, is a must
5. Must possess the ability to interact easily within an interdisciplinary team, respect the usual norms and build relationships with co-workers accordingly.
6. Have excellent analytical, writing and reporting skills.

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Deliverables and Schedule of the Assignment

Sl. No.	Milestone/ Deliverable	Time span	Date
1	Consultation for Design of the Studies	Within two weeks of Consultant appointment	15 February 2022
2	Inception Report	Within two weeks of design decision	28 February 2022
3	A Mid-term Report on progress and presenting partial results	Within ten weeks from Inception Report	08 May 2022
4	Draft Report of the Studies	Within eight weeks from Mid-term Report	28 June 2022
5	Final Report of the Studies	Within six weeks of the Draft Report	14 August 2022

Place of the Assignment

The selected Consultant will carry out his/her assignment at the offices of Hortex Foundation, Sech Bhaban (3rd floor- western wing), 22 Manik Mia Avenue, Sher-e-Bangla Nagar, Dhaka 1207. S/he may also work from her/his own place of work keeping constant contact with Hortex Foundation.

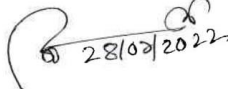
Supervision of the Assignment

The assignment will be supervised by the Monitoring and Evaluation Expert of the Project. However, final decision on any or all matters regarding the assignment rests with the Managing Director, Hortex Foundation.

Remuneration/fees for the Assignment

The remuneration/fees for the assignment are negotiable and limited by the provisions of the RDPP of the Government of Bangladesh.

Hortex Foundation reserves the right to accept or reject any or all EOIs.


28/07/2022

Annex -2***Estimation of Farmers' uptake of Improved Postharvest (PH) Management Practices with HVCs,
PH Loss Reduction, and Effect on their Income****Hortex Foundation***Questionnaire for HVC Producers****A. GENERAL INFORMATION OF THE RESPONDENT**

Sl no	Particulars	Code	Response
1	District		
2	Upazila		
3	Union		
4	Mouza		
5	Village		
6	Name of Respondent		
7	Relation to the Household head	1. HH himself/herself, 2. Spouse, 3. Father, 4. Mother, 5. Father-in-law, 6. Mother-in-law, 7. Brother, 8. Sister, 9. Grandfather, 10. Others (please specify)	
8	Name of CIG you belong to		
9	Name of CCMC where you aggregate your commodity		
10	Your Position in the CIG/CCMC	1. President; 2. Secretary; 3. Treasurer; 4. Vice-P; 5. Executive Committee Member, 6. General Member	
11	Contact number of respondent	Local Tel Number (Mobile) with prefix will be 13 digits, e.g. +880 1712918342	
12	Sex	1. Male, 2. Female	

Sl no	Particulars	Code	Response
13	Marital status of the respondent	1. Married, 2. Unmarried, 3. Widow/widower, 4. Separated, 5. Divorced	
14	Age	Year of birth (e.g., 1974)	
15	Final Education of the respondent?	0. Illiterate; 1. Primary; 2. Secondary; 3. Higher Secondary; 4. BA/graduate; 5. Vocational; 6. Diploma/Technical education; 7. NFE; 8. Pre-School	
16	Household Size	(In number) Number of household members who feed from same stove	
17	Male Adult member of HH	(In number) 18 + years	
18	Female Adult Member of HH	(In number) 18 + years	
19	Please tell us most significant services that you receive from your CIG/CCMC? Multiple choice in order from Top 1 to 5	1. Agregation at Commodity Collection and Marketing Center; 2. Sorting and Grading, 3. Cleaning and Washing, 4. Treatment, 5. Cooling, 6. Proper packing, 7. Better Market linkage, 8. Buisness Plan Preparation, 9. Transporation of produces, 10. Collective procurement of inputs, 11. Collective marketing of produces, 12. Farm advisory services, 13. Savings, 14. Loan; 15. Others (please specify)	

B. LAND HOLDING OF THE HOUSEHOLD

SL	Parameter	Response (in decimal , use only number)	
		Before	After
1	Homestead area		
2	Water body		
	a) own pond		

SL	Parameter	Response (in decimal , use only number)	
		Before	After
	b) leased pond		
	c) Jalmahal		
3	Cropped land		
	a) Cultivated land – own		
	b) Land rented in (+)		
	c) Land rented out/mortgaged out (-)		
	d) Net cultivated area operated (a+b –c=d)		

C. ASSETS

C1. Immovable Assets

Sl. #	Description of asset	Quantity (No.)	
		Before	After
1	Pucca house		
2	Tin shed house		
3	Sanitary toilet		
4	Cattle shed		
5	Poultry Shed		
6	Solar energy panel		
7	Others _____		

C2: Movable assets

Sl. #	Description of asset	Quantity (No.)	
		Before	after
1	Agricultural Implements		

Sl. #	Description of asset	Quantity (No.)	
		Before	after
1a	Power Tiller		
1b	Thresher		
1c	Maize Sheller		
1d	Water Pump		
1e	(6-12) hp diesel Engines		
2	Television		
3	Engine boat		
4	Motorcycle		
5	Mobile phone set		
6	Instant Power Supply (IPS)		
7	Others _____		

D. Vegetables and Fruits Grown by the Respondents

Sl no	Name of Crop	Area (Dec)		Production (Mound or as appropriate)	
		Before	After	Before	After
	<i>Brinjal</i>				
	<i>Bitter gourd</i>				
	<i>Tomato</i>				
	<i>Summer Tomato</i>				
	<i>Sweet Gourd</i>				
	<i>Aromatic rice</i>				
	<i>Pointed Gourd</i>				
	<i>Lemon</i>				
	<i>Banana (cluster of plantains)</i>				
	Others (pls specify)				

E. Attendance in Training, Workshop and Group Meeting

	Have you or any member of your household received any training, attended workshop or discussion meeting on high value crop agriculture and marketing?	Yes-1 No-2		→
If yes, answer the following:				
Issue	Type of training*	Organized by**	Quality of training 1= Satisfactory, 2= Average, 3=Not useful	
1	Vegetable Production			
2	Fruit Production			
3	Post-Harvest Management			
4	Business Planning			
5	Value Chain Development			
6	Others Specify.....			
<p>* Code: 1= Training, 2=Field-day; 3=Workshops/Group discussions, 4=Field level follow ups (counselling), 5=Others (Specify)</p> <p>** Code: 1=DAE with support from Hortex, 2=CCMC-with support from DAE, 3=CCMC-with support from Hortex, 4= Others (specify)</p>				

F. PERCEPTION IN POST-HARVEST MANAGEMENT PRACTICES FOR FRUITS AND VEGETABLES**F1. General Perception on Vegetables and Fruits Production**

	Have you adopted HVC production technologies from above training?	Yes-1 No-2		→ 209
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If yes, please provide the following information: (FI: Ask the following questions and judge the answers of participant in a score range of 1-5 out of 5 for each question depending on the relevance with the key.)				
Sl. No.	Issues	Responses	Score (1-5)	Skip
1	Name some HV crops, vegetables and fruits	<i>Brinjal, Bitter gourd, Tomato, Summer Tomato, Sweet Gourd, Aromatic rice, Pointed Gourd, Lemon, Banana</i>		
2	How do you make a soil suitable for vegetable cultivation?	<i>The soil should be made fertile through use of vermi-compost or animal manure, lime and compost, which will enrich the soil, and make it suitable for vegetable cultivation</i>		
3	What are the compositions of Compost?	<i>Green and dry leaves and vegetative matter, straw, ash, cow-dung, poultry droppings, animal urine OR vermi-compost</i>		
4	What are the characteristics of a good quality seed	<i>Mature and properly ripen seed, good shape, bright color, free from disease and insect & pest attack, and collected from good plant</i>		
5	What would be the common size of a vegetable seedbed?	<i>Size: Length x breadth (10' X 4'), height (4-6") 10-12" wide and 6-9" deep drain encircled the seedbed</i>		
6	What is IPM?	IPM is an integrated disease and insect-pest management process by which disease and insect-pest attack to a crop is kept to a minimum level		
7.	What Irrigation scheduling to be maintained for common vegetables?	When and how much water to be added in different growth stages of vegetables and fruits		
8.	What special management practices to be beneficial for better vegetables and fruits production?	Polythene mulching, shedding, raised bed, platform, support etc.		

F2. Perception on PHM Practices of Vegetables and Fruits Production

	Have you adopted PHM technology/practices from above training?	Yes-1 No-2		→
	If yes, please provide the following information: (FI: Ask the following questions and judge the answers of participant in a score range of 1-5 out of 5 for each question depending on the relevance with the key.)			
Sl. No.	Issues	Responses	Score (1-5)	Skip
1	What are the parameters that determined the quality and safety of fruits and vegetables?	The quality and safety of fruits and vegetables are largely determined by pre-harvest production factors including soil type, water quality, weather conditions, plant nutrition, use of pesticides, post-harvest handling, storage and processing		
2	What Good Agricultural Practices (GAP) that you have learnt from training?	Apply balanced fertilizer, apply recommended pesticide in proper dose, IPM, ICM		
3	What is your perception on crop maturity?	Harvesting of crops at proper maturity stage is of great importance for attaining desirable quality and shelf life. The level of maturity actually helps in selecting storage methods, estimating postharvest shelf life, selecting processing operations for value addition		
4	What is your perception of appropriate harvesting maturity of Tomato?	Size, color, maturity, price, market demand		
5	What is your perception of appropriate harvesting maturity of Brinjal?	Size, color, maturity, price, market demand		
6	What is your perception of appropriate harvesting maturity of Bitter Gourd?	Size, color, maturity, price, market demand		

7	What is your perception of appropriate harvesting maturity of Banana?	Size, color, maturity, price, market demand		
8	What is your perception of appropriate harvesting time of fruits and vegetables?	Size, color, maturity, price, market demand		
9	What is your perception on harvesting methods of vegetables?	Hand picking, use of harvesting tools, use crates for transporting and storage		
10	What is your perception on harvesting methods of fruits?	Hand picking, use of harvesting tools, use crates for transporting and storage		
11	What is your perception on field handling of harvested vegetables and fruits?	No need special care, tools and handling crate; dumping is ok for harvested crops; no need of immediate cleaning and washing; Need special care during harvesting		
12	What is your perception on appropriate aggregation place of harvested fruits and vegetables?	Crop field is enough for aggregation; air flow and sufficient light needed; facilities for sorting, grading, washing, packaging, transportation; Place should be easily accessible for marketing, No need for special place, field to market is best practice		

F3. Perception on Postharvest losses of fruits and vegetables at farm levels

Sl no	Name of Crop	Loss at farm level (%) [how much have to throw away]	
		Before	After
1	<i>Brinjal</i>		
2	<i>Bitter gourd</i>		
3	<i>Tomato</i>		
4	<i>Summer Tomato</i>		
5	<i>Sweet Gourd</i>		
6	<i>Aromatic rice</i>		
7	<i>Pointed Gourd</i>		
8	<i>Lemon</i>		
9	<i>Banana</i>		
10	Others (pls specify)		

	Do you perceive that adopting above PHM practices reduced post-harvest loss?	Yes-1 No-2		→ 209
If yes, please provide the following information: (FI: Ask the following questions and judge the answers of participant in a score range of 1-5 out of 5 for each question depending on the relevance with the key.)				
Sl. No.	Issues	Responses	Score (1-5)	Skip
1	Could you please tell factors those contributing to the postharvest losses of fruits and vegetables at farm level?	Insect infestation, Diseases infection and rotting, Cracking, abrasion or bruising damage, Damaged due careless harvesting, loading and unloading during transport and storage;		
2	What is your perception on the ways of reduction of postharvest losses of fruits and vegetables?	Receiving of Fruits and Vegetables at CCMC; use sorting, grading, cleaning, washing, treatment, cooling, packaging; transportation and storage in crates;		
3	What are the methods of treatment to control microbial contamination and rotting?	Wash and dry the fruits/vegetable; hot water treatment; Sanitizing uses chemicals or heat		
4	What is Chitosan?	How to use and when to use		
5	How you increase shelf life of Banana?	Ripen with heat treatment; keep in cool and ventilated place; discard rotten and damaged ones;		
6	How you increase shelf life of tomato?	Packing in crates; keep in cool and ventilated place; discard rotten and damaged ones;		
7	Tell some best practices of packing vegetables and fruits	Packing in crates; corrugated paper boxes; paper/plastic covering during transportation and storage;		

F4. Implementation of improved PHM practices for fruits and vegetables

Sl. No.	Issues	Responses	Yes	No	Answer, if yes
1	Do you practice sorting/grading for fruits and vegetables?	Sorting/grading depending on size, color, ripening;			
2	Do you practice washing, for fruits and vegetables?	washing ringing with clean water and dry			
3	Do you practice packaging for fruits and vegetables?	Use crates, paper cartoons, rapping with paper/plastic			
4	Do you practice good transportation method for fruits and vegetables?	Use crates, paper cartoons			
5	Do you have any idea about washing water quality?	Ringing with clean water and dry; anything to be used			
6	What are the benefits of using plastic crates as packaging containers?	protect from abrasion or bruising damage; protect damage from pressure; helps aeration during transport and storage; provide longer shelf life; no use			
7	What percentage of CIG/CCMC farmers is using plastic crates in your locality?				
8	How many non-CIG farmers adopted IMPH practices by following the CCMC-based practices in your locality?				

G. Income and Expenditure

Sl no	Particulars	Code	Response	
			Before 2018	After
1	What is annual total income of your HH?	In Taka/year (Note for Investigator: use your diary to estimate income from all sources, primary, secondary and others. Better first calculate seasonal and/or month then sum for annual)		
2	What are the primary sources of income of your HH?	1. Paddy; 2. Vegetables; 3. Fruits; 4. Pulses, 5. Medicinal Plants; 6. Dairy; 7. Cattle fattening; 8. Goat rearing; 9. Scavenging poultry; 10. Poultry (broiler); 11. Poultry (layer); 12. Pond fish culture; 13. Fingerling nursery; 14. Agricultural labor; 15. Service (job with Govt or NGO); 16. non farm business; 17. Non-farm labor; 18. Agri-Processing; 19. Remittance; 20. others (specify).		
3	What is the income from this source?	In Taka/year		
4	What are the secondary Sources of income of your HH?	1. Paddy; 2. Vegetables; 3. Fruits; 4. Pulses, 5. Medicinal Plants; 6. Dairy; 7. Cattle fattening; 8. Goat rearing; 9. Scavenging poultry; 10. Poultry (broiler); 11. Poultry (layer); 12. Pond fish culture; 13. Fingerling nursery; 14. Agricultural labor; 15. Service (job with Govt or NGO); 16. non farm business; 17. Non-farm labor; 18. Agri-Processing; 19. Remittance; 20. others (specify).		
5	How much is your income from secondary source(s)?	In Taka/year		

6	What is your yearly Household Food-expenditure?	In Taka/Year		
7	What is your yearly Household non-food expenditure ¹ ?	In Taka/Year		
8	What is your Annual Household Savings (Tk)?	In Taka/Year		

¹Non-food expenditure includes - Housing Utilities (including water, electricity, gas and other fuels); Expenses on travel for leisure; Communication (cell phone, internet, postal); Wages to non-agricultural labor; House Rent (if rented-in in town other than own home in village); Personal care products (soap, shampoo, toothpaste etc.); Household cleaning products (dish soap, toilet cleansers, etc.)

Annex -3***Estimation of Farmers' uptake of Improved Postharvest (PH) Management Practices with HVCs, PH Loss Reduction, and Effect on their Income******Hortex Foundation*****Instrument V: KII Checklist for DAE****Name:****Cell:****Address:****District:**

1. Please brief the scenario of postharvest management practices and postharvest loss reduction activities of high value crops in your working Upazila/area including cropping pattern, tentative land coverage by each cropping pattern, and productivity. Could you please share 2016 **Annual Upazila Agriculture Report** with us?
2. What is the postharvest loss of different crops as you perceived or measured? Is there any study, could you please share with us?
3. What types of agriculture machinery/technologies are available in this area for postharvest loss reduction and management? Are there any local facilities for doing the postharvest loss reduction activities?
4. Are there any program/project implemented in the village and Upazila (government, NGO or private sector) on postharvest loss reduction and management of vegetables and fruits? Please brief about their activities.
5. How many extension service providers are working in the village and Upazila (government, NGO or private sector)?
6. How many extension service providers trained through Hortex foundation?
7. What is your key role for postharvest loss reduction activities?
8. Brief about qualifications/training as extension service providers
9. At your perception what will be the impact of postharvest management and loss reduction activities on producers' income?
10. Suggestions/recommendation for postharvest loss reduction and management and how it will generate income for producers?

Annex -4

Estimation of Farmers' uptake of Improved Postharvest (PH) Management Practices with HVCs, PH Loss Reduction, and Effect on their Income

Hortex Foundation

Instrument V: KII Checklist for aggregators/Arot

Name:

Cell:

Address:

District:

1. Please describe the activities practiced on postharvest management and postharvest loss reduction activities of vegetables and fruits at your business or service level.
2. What are the postharvest losses of different vegetables and fruit crops as you perceived or measured? Please describe how you handle the circumstances.
3. What types of agriculture machinery/technology do you use to reduce postharvest loss and improve the management?
4. What is your key role for postharvest loss reduction activities?
5. At your perception, what will be the impact of postharvest management and loss reduction activities on producers' income as well as you?
6. Suggestions/recommendation for postharvest loss reduction and management and how it will generate income for producers.

Annex -5***Estimation of Farmers' uptake of Improved Postharvest (PH) Management Practices with HVCs, PH Loss Reduction, and Effect on their Income****Hortex Foundation***Timelines of modern crop varieties adopted in the study areas**

Crop varieties	Year of Adoption	In most recent season, area coverage (Acre)
HYV Aus Rice:		
HYV Aman Rice:		
HYV Boro Rice:		
Hybrid Boro Rice		
Wheat:		
Potato:		
Oilseed:		
Vegetables:		
Fruits		

Month-wise agricultural activities of selected village

Month	Agricultural Activities (Sample)
Baishakh	
Jaistha	
Ashar	
Sraban	
Bhadra	
Ashwin	
Kartik	
Agrahayan	
Poush	
Magh	
Falgun	
Chaitra	

Timelines of modern postharvest loss reduction tools, equipment, technology and machines adopted for vegetables and fruits in the selected village

Technologies	FGD Site		
	Year of adoption	Technologies and machines	Before 20.....

Preference ranking of present and future postharvest loss reduction technologies for vegetables and fruits as perceived by the farmers of the study sites

Operation	Use at present	Score	Rank	Future expectation	Score	Rank
Harvesting time						
Grading						
Washing						
Packaging						
Transportation						
Storage						
Others						

Postharvest loss of vegetables and fruits as perceived by the farmers of the study sites

Operation	% loss
Harvesting time	
Grading	
Washing	
Packaging	
Transportation	
Storage	
Others	

Other discussion points:

1. What is the total HV cropped area in particular vegetables and fruits in your village in most recent year?
2. What is the level and nature of existing service provisions of public and private sectors to target farmers in relation to vegetable and fruits production and postharvest management,

and the number of extension service providers in area (government, NGO or private sector)?

3. What sorts of constraints/limitation exists to produce/process of vegetables and fruits in relation to postharvest loss? How can you overcome the problems?
4. What is the Willingness to Pay for getting postharvest loss reduction technologies?
5. What sorts of constraints/limitation exists related to postharvest loss reduction technologies? How can you overcome the problems?
6. What is the impact of PHM practices of vegetables and fruits on the income and livelihoods of the farmers?
7. Recommendation and suggestion from farmers