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POSTHARVEST IMPACT/OUTCOME ASSESSMENT: ADOPTION OF IMPROVED HARVEST AND POSTHARVEST PRACTICES AND LESSONS LEARNED IN THE COLD CHAIN BANGLADESH ALLIANCE (CCBA) PROJECT

COLD CHAIN BANGLADESH ALLIANCE (CCBA) REPORT

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Postharvest Impact/Outcome Assessment:

Adoption of improved harvest and postharvest practices and lessons learned in the Cold Chain Bangladesh Alliance (CCBA) Project

Prepared for the USAID-funded Cold Chain Bangladesh Alliance (CCBA) by:

Dr. Lisa Kitinoja and Lizanne Wheeler
Postharvest Technology Specialists
The Postharvest Education Foundation
kitinoja@postharvest.org; lizanne@sonorapacific.com

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Executive summary

An assessment team visited Bangladesh during May 15-June 3, 2016 to review and evaluate the Cold Chain Bangladesh Alliance (CCBA) postharvest training program that focused on setting up collection centers for different vegetable crops, training farmers on best practices (depending on the crop), and providing marketing links and advice on improved marketing. The focus crops were brinjal (eggplant) and bitter gourd, but CCBA worked with 10 different vegetable crops in total. Eggplant and bitter gourd were selected since they were in season in May and therefore could be used for the focus of assessment, and because results for these crops can be similar to those that may be obtained for similar crops (eggplant is horticulturally similar to peppers, capsicum, chilies and tomatoes; bitter gourd is horticulturally similar to cucumbers, summer squashes such as zucchini and patty pan).

Overall, the farmers in the three collection centers visited and the farmers surveyed in the Jessore Region had adopted the majority of the improved harvest and postharvest practices being promoted by the CCBA project, especially if they were shown to be cost effective and if farmers received a small bonus in price when sorting/grading for better quality. Non-CCBA affiliated farmers had observed and adopted a few of the improved practices. The traders who purchased the crops of CCBA trained farmers reported that they were very pleased with the improved quality and reduced losses, which had improved their own profits, and asked for more farmers to be trained.

Several of the postharvest focused activities implemented by the CCBA project stood out as highly beneficial and practical for the target audiences of farmers and traders.

Lessons learned

1. Having a gathering place for the farming community at CCBA collection centers provided a simple and low cost way to reach target audiences on a regular basis.
2. Costs and benefits of individual improved practices for harvesting and postharvest handling had a large impact on adoption.
3. The management of collection centers needs to be better understood.

Recommendations for future projects

1. Standardize the harvest/postharvest training agenda and include more training on the basics to ensure that farmers and traders better understand the horticultural value chain and their role in reducing losses in the postharvest handling system.
2. Improve the training on pre-cooling to include more than dipping in cool water – this practice cannot be used for many crops (including bitter gourd), and can lead to increased decay problems for brinjal if the cap gets wet.
3. Expand the number and size of collection centers and add collection centers for farming communities that are producing many other types of horticultural crops.
4. Replicate this project in additional regions of Bangladesh and in many more countries.

Introduction

The Cold Chain Bangladesh Alliance (CCBA) is funded through the Global Development Alliance (GDA), USAID's model for public-private partnerships. USAID/Bangladesh and Winrock International partnered with Golden Harvest, a local food processing and transportation company, during the implementation of this project. The project was implemented in collaboration with World Food Logistics Organization/Global Cold Chain Alliance (WFLO/GCCA).

CCBA's goal was to increase the availability, access, and use of domestically-produced and nutritious foods (Development Object 2 in USAID/Bangladesh's Feed the Future Multi-Year Strategy) in an effort to sustainably reduce poverty and hunger. The CCBA project supported this overall goal through the following sub-component objectives:

Component 1: Increased capacity of small and marginal farmers to grow high value products
Component 2: Improved agricultural market efficiency and planning
Component 3: Increased private sector investment and capacity in cold chain management
Component 4: Increased compliance with international food safety standards

A recent programmatic and strategic lessons learned assessment (Ansari, April 2016) identified harvest and postharvest practices such as pre-cooling, use of plastic crates and shade as achieving some level of adoption among some pilot farmers and traders. This report focuses on efforts to document and measure the adoption and impact of these kinds of improved postharvest practices, and provides recommendations on the potential to replicate any positive outcomes and expand these further within horticulture value chains.

Postharvest impact and outcome assessment focus

During May 2016 a team of evaluators visited the Jessore Region and Dhaka in Bangladesh to conduct interviews, make field observations, take direct measurements and collect survey data on implementation of training programs, and harvest/postharvest handling practices for eggplant (brinjal) and bitter gourd on the farms, collection centers, during transport and at wholesale and retail markets.

Eggplant and bitter gourd were selected since they were in season in May and therefore could be used for the focus of the assessment, and because results for these crops can be similar to those that may be obtained for similar crops. Eggplant is horticulturally similar to peppers, capsicum, chilies and tomatoes; bitter gourd is horticulturally similar to cucumbers, summer squashes such as zucchini and patty pan.

CCBA office personnel and field staff provided information, documents, and guidance on identifying CCBA target groups, training topics, and representative project sites in the Jessore Region. This report describes the methodology, findings and lessons learned, and documents harvest/postharvest practices, CCBA training activities on improved practices, their adoption and outcomes regarding physical losses, quality and market prices, and impact on food availability and potential earnings.

Key assessment questions

1) **Activities and Participation:** What kinds of postharvest training was provided by CCBA in the Jessore Region (when, where, by whom, for whom, on what topics and technologies, harvesting or postharvest handling practices) during the project?

2) **Practice Changes:** What are the current harvest and postharvest handling practices in use by representative CCBA trained farmers/traders in the Jessore Region as compared with those used by representative untrained farmers/traders?

3) **End Results:** Are there any positive outcomes (reduced losses? improved market prices?) being reported by people in the Jessore Region who have adopted improved harvesting methods or improved postharvest practices?

4) **Impacts:** Are there any economic benefits being experienced by people in the Jessore Region who have adopted improved harvesting methods or improved postharvest practices? What are the related impacts on food availability and potential earnings?

5) **Theory of Action:** Can the documented practice changes, outcomes and impacts found for CCBA target groups be verified to have been due to the training and advisory activities implemented in the Jessore Region during the CCBA project?

Methodology/data collection

During May 2016 a team of evaluators visited the Jessore Region and Dhaka in Bangladesh to conduct interviews on CCBA training activities, make field observations of harvest/postharvest practices, take direct measurements and collect survey data on postharvest handling practices for eggplant (brinjal) and bitter gourd on the farms, collection centers, during transport and at wholesale and retail markets. Data collection instruments were made available in early May for review and verification, based upon field tested similar data collection instruments used for previous postharvest training project evaluations.

CCBA office personnel and field staff provided information, documents and guidance on identifying CCBA target groups, training programs and representative project sites. For each crop, six cross-cutting and overlapping methods were utilized by the assessment team for data collection, covering the entire value chain and its key actors.

The postharvest assessment team (Charity Hanif/Team Leader, Lizanne Wheeler/Fieldwork Lead and Lisa Kitinoja/Postharvest Technical Advisor and lead for reporting) was assisted by local postharvest specialists (Most. Sadia Arfin and Md. Faruq bin Hossain Yamin) and CCBA staff (Mustabshira Jannat/CCBA Monitoring Officer, Md. Shahadat Hossain/CCBA Field Coordinator for Jessore and Md. Obaidul/CCBA Assistant Field Coordinator for Jessore).

1. Interviews (crop value chain questionnaire)

Seventy-three (73) face-to-face interviews were conducted with key stakeholders, CCBA managers, staff, postharvest trainers, farmers, traders, resource people, and local postharvest experts. Both formal and informal interviews were conducted in the CCBA offices, collection centers and in the field, covering a wide range of topics and the full value chains and commodity

systems for brinjal and bitter gourd in the Jessore Region. Both CCBA trained farmers (25) and traders (3) and non-CCBA farmers (10) and traders (3) were interviewed at length by the assessment team.

2. Literature reviews, reviews of project documents

Published and unpublished documents on postharvest technology and food losses in Bangladesh were reviewed, and the CCBA staff provided confidential documents related to postharvest training, a refrigerated vehicle study, a BARI postharvest research study draft, and a recent brief on project lessons learned. Key documents include:

Ansari, Adnan (April 2016) Lessons Learned from CCBA Implementation

BARI (April 2016) Assessment of Postharvest Losses and Food Quality by Evaluating Postharvest Practices and Marketing Performances in Selected Vegetables Supply Chain in Bangladesh (DRAFT)

Siddiqui, A.B (June 2016) Cost-Benefit and Effectiveness of Refrigerated Trucks for Transportation and Marketing of Fresh Produce (DRAFT)

3. Field visits and observations

Field visits were made by the assessment team during May 15 through June 1, 2016 to Jessore, Gazipur and Dhaka to observe farm practices, collection center activities, packing and packaging materials, transport methods, wholesale operations and retail marketing of brinjal and bitter gourd. Field visits were made during the day (for farms and collection centers) and during business hours (early mornings, late evenings) for wholesale markets. Photos were taken to document postharvest practices and individual site characteristics.

4. Formal Surveys (CCBA training assessment questionnaire)

Survey questionnaires were used to collect data face to face via interviews on participation in postharvest training activities, reactions, outcomes and end results (25 CCBA trained farmers; 10 non-CCBA farmers; 3 CCBA trained traders; 3 non-CCBA traders) in the Jessore Region.

5. Measurements of postharvest losses and quality (worksheets)

Data on environmental conditions (temperature and relative humidity), harvesting practices, packing practices, produce quality, defects, volume losses and market value were collected for brinjal in the Jessore Region (three farms, three collection centers, and two wholesale and two retails markets). Produce samples were not followed from farm to market, but random selection and random sampling was practiced to increase the representativeness of the findings.

6. Simplified cost/benefit interviews and analyses using relative costs and relative benefits (worksheet)

To rapidly determine potential economic benefits for specific harvesting or postharvest handling practice changes for brinjal and bitter gourd, a simplified cost/benefit worksheet was used. In each of five cases developed for the Jessore Region, data on the relative costs of the traditional versus improved practice, estimations of % produce losses and local market value/kg were used to calculate potential benefits.

By considering only the differing costs between the two practices for a sample load (100 kg or 1000 kg, whichever is more appropriate for the farmer or trader), it is simple to calculate the additional market value of one load of the crop that is related to the change in the handling practice.

Annex 1 provides all the survey instruments and data collection worksheets used for the postharvest assessment study. Photos of the assessment team's observations are included in this report to illustrate the key findings. **Annex 2** provides a list of the people interviewed for the postharvest assessment.

Findings/outputs, outcomes, and impacts

The following are the key findings of the postharvest assessment study. Starting with training activities, linked to adoption and practice changes, leading to outcomes (reduced food losses and/or increased market value) and end results/impacts (i.e. increased profits and earnings, increased food availability).

Although the assessment team was planning on conducting a countrywide project assessment, time and resources allowed for a detailed assessment of harvest and postharvest practices in and around Jessore, where three collection centers have been successfully established by the CCBA project. CCBA field and support staff had limited time available to assist the team during the assessment, since the project was due to close and had started phasing out staff positions. Focusing on CCBA project activities implemented in the Jessore Region alone allowed the assessment team to concentrate their efforts and develop a detailed case study that will be useful for improving the collection centers in any other locations in Bangladesh and for planning future postharvest training projects.

Activities and Participation

What kinds of postharvest training was provided by CCBA in the Jessore Region (when, where, by whom, for whom, on what topics and technologies, harvesting or postharvest handling practices) during the project?

The CCBA records indicate that more than 700 training programs were provided for groups of farmers, traders and associated trainees (representatives of NGOs, local service providers, etc.) during 2014 and 2015 in the Jessore Region. A total of 6700 individuals participated in training programs offered in the Jessore Region, covering a wide range of crops.

Documentation of CCBA harvest/postharvest training activities in the Jessore Region

Training of Trainers. Early in the CCBA project a "training of trainers" program was implemented by resource people for groups of 30 to 35 farmer leaders who were slated to be involved in the collection centers.

Table 1 Training of Trainers on Post-Harvest Management in the Jessore Region

Date	Location	Type of Participants	Gender			Topic
			Male	Female	Total	
11/2/2014	Circuit House, Jessore	Research (7) Extension (11) College teacher (3) NGO (9)	30	5	35	Post-Harvest Management of HVC

24/11/2015	RARS, Jessore	Research (14) Extension (5) NGO (11)	28	2	30	Post-Harvest Technology of HVC

Farmer training. The typical training agenda for farmers/traders developed for and utilized for the CCBA project included production, Good Agricultural Practices (GAP), Integrated Pest Management (IPM), harvesting, postharvest, food safety and marketing training topics covered in a one day long, 6-hour workshop. General postharvest topics, including harvesting, sorting, grading, cleaning, washing and packing, were covered during about one to 2 hours. CCBA farmers had to have 0.25 to 0.35 acres of land to qualify for involvement in the collection centers.

There were 12 training programs offered on postharvest management for farmers, traders and others in the Jessore Region. Four of the programs focused on brinjal (eggplant) or bitter gourd.

Table 2 Training on Post-Harvest Management at Jessore Region

Date	Location	Type of Participants	Gender			Topic
			Male	Female	Total	
19/5/2015	Hurgati, Monirampur	Producers (17) Traders (3)	20	0	20	Postharvest management of eggplant
27/5/2015	Birnarayanpur, Sadar	Producers (25) Traders (5)	30	0	30	Postharvest management of bitter gourd
7/12/2015	Lebutota, Sadar	Producers	25	0	25	Management of post-harvest loss of cauliflower and cabbage
8/12/2015	Lebutota, Sadar	Producers	30	0	30	Management of post-harvest loss of cauliflower and cabbage
9/12/2015	Nongorpur, Sadar	Producers	28	2	30	Management of post-harvest loss of cauliflower and cabbage
13/1/2016	Fulsara, Chowgacha	Producers	30	0	30	Management of post-harvest loss of onion
14/1/2016	Fulsara, Chowgacha	Producers	30	0	30	Management of post-harvest loss of onion
18/1/2016	Hakimpur, Chowgacha	Producers	30	0	30	Management of Post-harvest loss of onion
20/1/2016	Fulsara, Chowgacha	Producers	29	0	29	Management of Post-harvest loss of carrot
20/1/2016	Lebutota, Sadar	Producers	37	0	37	Management of post-harvest loss of tomato
10/2/2016	Chalkidanga, Monirampur	Producers	30	0	30	Postharvest management of eggplant
11/2/2016	Chalkidanga, Monirampur	Producers	30	0	30	Postharvest management of eggplant

A marketing "training of trainers" program for 30 traders was offered by CCBA staff during one day in the Khajura wholesale market to introduce improved postharvest handling practices and

promote linkages with CCBA farmers and small-scale produce retailers in Dhaka. This training took place in December 2015 near the Khajura Bazaar. It covered produce collection (all vegetables) and improved handling. The training was conducted by CCBA staff (Md Nizam, CCBA marketing head and Md Shahadat, Jessore Field coordinator.

The general training agenda for postharvest technology provided to the assessment team by the CCBA project (available only in Bengali, verbally translated to English for the assessment team) was general enough to cover the majority of postharvest topics. The agenda included an introduction to postharvest technologies, common causes of damage, use of maturity indices, improved harvesting practices (tools, containers), sorting/grading, cleaning/washing, pre-cooling and use of the cold chain from farm to market. Illustrated training manuals (technical notes) were also developed and printed for each CCBA target crop including brinjal and bitter gourd. Use of chlorinated wash water was included in the original training agenda, but was not implemented because chlorine was difficult to source locally and considered too expensive to use.

Resource people/trainers were tasked with modifying the general training based upon the expressed needs of the local farmers at each of the CCBA training sites. In general, this is a beneficial practice, but if the target audiences have limited knowledge and understanding of the subject, they can focus prematurely on a specific handling technology or tool due to its perceived benefits. Rarely, however, can any single practice change be sufficient to reduce food losses in a system where many people handle the produce under hot tropical conditions. There are a wide range of preliminary, basic principles and general practices that can help farmers and traders to understand the foods they are handling and marketing, and to better protect them from sun and heat, rough treatment, handling damage and economic losses.

Training for brinjal and bitter gourd farmers in the Jessore Region took place at the collection centers. Twenty resource persons were included on a list of resource people for the Jessore region. Key informants told the assessment team that 30 participants were included in each training program, and they were provided with free lunch and a copy of the training manual. Each of the farmers affiliated with the collection centers reported attending one or more of these trainings when interviewed by the assessment team.

The field coordinator and assistant field coordinator visited the collection centers regularly to observe and reinforce the lessons of the training.

Practice Changes

This report documents the current harvest and postharvest handling practices in use by representative CCBA trained farmers/traders in the Jessore Region as compared with those used by representative untrained farmers/traders.

The planned harvest/postharvest related interventions for the CCBA project were focused around the concept of a **farmer-managed collection center**. These collection centers were established by CCBA on local farmers' land, and were outfitted with cement floors, shade covers, digital scales for weighing produce, stainless steel trays or cement tanks for washing/pre-cooling produce, and 13 kg capacity plastic crates. They each had access to deep tube wells and roads. The local farmers elected the leaders of the collection centers (members of a Management Planning Committee or MPC). The three collection centers in Jessore were of various styles and sizes, and served as a gathering place for local growers. One was focused on handling brinjal (Hurgati), and the other two were focused on handling bitter gourd. It was planned that ten groups of 30 farmers each be

linked to each collection center (300 users in a cluster) but as of May 2016 it was reported that the number of members were closer to 200 people per collection center.

Figure 1 Hurgati collection center, cement floor, large wash tank for brinjal

Figure 2 Nangapur collection center for bitter gourd

Figure 3 Birnarayonpur collection center for bitter gourd

Each of the collection centers in Jessore Region were outfitted with the harvest/postharvest tools and equipment listed below. Anyone visiting the collection center (CCBA farmers, non CCBA farmers, traders and transporters) can observe the use of improved postharvest practices.

Secateurs (cost = 180 taka) were introduced by the CCBA project to cut brinjal and bitter gourd from the plants, to reduce the damage traditionally from pulling, breaking caps, and pulling up plants when soil was wet. Traditional large sickles or scythes tend to cut plant parts (i.e. stab neighboring fruits or slice stem tissue) and cause unintentional damage. Secateurs were used for training, and some farmers used small knives or sickles.

Harvest trolley (cost = 500 taka) was used during the harvesting bitter gourd.

Figure 4 Trolley designed by the CCBA project, used for harvesting bitter gourd

Figure 5 Cement tank for washing brinjal (recirculation of water, use of wash water for irrigation)

Figure 6 Cement tank at Hurgati for washing brinjal

Stainless steel trays for washing/pre-cooling brinjal (cost = 500 Taka). CCBA staff reported that the produce temperature could be lowered by 5°C with a 15-minute dip in cool water. Adding hot fruits to the tray will quickly increase the water temperature. The relative humidity of the air during the time of treatment will also have a large effect on cooling capacity. If it is very humid weather, the water will not evaporate (which is needed to further cool the produce).

Figure 7 Stainless steel trays for washing with cool deep tube well water

Plastic crates (cost of used, secondhand = 200 Taka) capacity of 13 kg. Fifty (50) crates were supplied for eggplant collection center, 90 for the two bitter gourd collection centers). The plastic crates can be used at least 30 times. One trader interviewed for the assessment said that secondhand crates cost 130-150 Taka/crate and have a 1.5-month lifespan (used every other day with backhaul empty.)

Improved heavyweight baskets (cost = 200 taka) capacity of 30 kg to 40 kg. Farmers report they can be used 35 times.

Figure 8 Improved heavyweight baskets for brinjal

The following list of the training topics on improved harvest and postharvest practices being promoted by CCBA was drafted by the assessment team and was reviewed and updated by the Chief of Party on May 15, 2016 in the Dhaka CCBA office before the assessment fieldwork in Jessore began.[1]

Table 3 Comparison of adoption of improved harvest and postharvest practices in Jessore Region (brinjal)

Improved practices promoted by CCBA	CCBA trained pilot farmers (n= 14)	Non-CCBA affiliated farmers (n= 4)
Follow safe and good production practices (IPM)	93% report using this practice *	0% report using this practice
Harvesting at the proper stage and time (color, shape, fullness, etc.)	93% *	0%
Use of harvesting tools (secateurs, sharp knife)	93% *	0%
Keeping produce in the shade	100% *	25% (one person uses tree shade)
Careful handling	86% *	0%
Cleaning and washing	93% *	25%
Dipping or spraying water to pre-cool produce during packing of eggplant	43%	0%
Improved containers (plastic crates, heavyweight baskets)	71% Considered too expensive	0%

[1] Wrapping of produce in its own leaves to provide cushioning during packing and transport was also taught in CCBA postharvest training programs, but is not included in these tables because it is not a recommended practice for brinjal or bitter gourd.

Improved practices promoted by CCBA	CCBA trained pilot farmers (n= 14)	Non-CCBA affiliated farmers (n= 4)
Sorting and grading	64% *	25% (one person sorts out "worse produce" from "good produce")
Processing practices (adding value)	Considered to be the same practice as sorting/grading	
Three other practices were added by those interviewed		
Other: Using plastic tarps to sort/grade if cement floor is not available	50%	0%
Other: Use of digital scale to weigh produce before packing	30%	0%
Other: Use culls as cattle feed	50%	0%

* indicates the practices designated as most useful

CCBA trained farmers reported training laborers to harvest, pack and handle produce more diligently, using pre-cooling and plastic crates and meeting higher specifications for sorting/grading when market prices for brinjal are higher. There was a general understanding on why they should use a clean surface to do their sorting, grading, and packing activities, and they had adopted the use of plastic tarps if they could not use the cement floor of the collection centers. They reported training many others (laborers, neighbor farmers, non-CCBA farmers who visit the collection center) on the improved practices they were taught about by CCBA staff and resource persons. Even when CCBA trained farmers indicated they had been aware of an improved practice before they received the CCBA training, they told the assessment team that now they understood in terms of being better informed on the essential points of use, had observed the "best practices" during demonstrations at the collection centers, and fully understood **why** they should use the new practices. Therefore, their implementation was more consistent after the training.

Transport costs are charged per crate or basket, so farmers and traders preferred packing 15 kg in the plastic crates, which were designed to hold 13 kg. This practice leads to compression damage when crates are stacked. Improved heavyweight bamboo baskets holding 30 kg (100 Taka) were promoted as an alternative by the CCBA project, since farmers and traders considered the cost of plastic crates to be too high.

When brinjal prices are very low, the farmers tend to revert to using the huge traditional baskets, enlarged with jute sacks to twice or three times the original capacity and sewn closed. These containers can hold 200 kg to 500 kg, and are very difficult to lift.

Figure 9 Huge bamboo traditional baskets used for brinjal transport (holds 200 kg or more)

Many of the farmers interviewed by the assessment team reported that they had requested larger sized plastic crates for brinjal from the CCBA project, since the 13kg size was considered too small. Toward the end of the project, CCBA was in collaboration with a local manufacturer on the design of a larger plastic crate (holding about 50 kg) for the brinjal farmers. This would be a positive development, since the larger crate will be more protective than large baskets, and much easier to lift and stack.

Two of the collection centers in the Jessore Region are organized to handle bitter gourd. Harvesting trolleys for bitter gourd were added to the list of CCBA training topics when they were observed to be in use during site visits. Spraying with water for pre-cooling was not included in the topics list for bitter gourd, since wetting the produce can lead to high rates of decay (note: this can also be a problem for brinjal if the cap is wet since it allows for easy penetration of postharvest pathogenic fungi if present in the wash water).

Table 4 Comparison of adoption of improved harvest and postharvest practices in Jessore Region (bitter gourd)

Improved practices promoted by CCBA	CCBA trained pilot farmers (n=11)	Non- CCBA affiliated farmers (n=6)
Follow safe and good production practices (IPM)	100% report using this practice *	0% report using this practice
Harvesting at the proper stage and time (color, shape, fullness, etc.)	82% *	0%
Use of harvesting tools (secateurs/ sharp knife)	100% *	17% (one farmer uses a scythe to cut the fruit from the plant)
Using a harvest trolley or pallet to transport plastic crates from farm to shed	54%	0%
Keeping produce in the shade	100% *	17% use tree for shade
Careful handling	82% *	0% Although aware that rough handling will damage spines

Improved practices promoted by CCBA	CCBA trained pilot farmers (n=11)	Non- CCBA affiliated farmers (n=6)
Cleaning and washing	Not applicable	Not applicable
Improved containers (plastic crates, heavyweight baskets)	91% *	0%
Sorting and grading	100% *	0%
Processing practices (adding value)	Believed to be the same practice as grading to add value	none
Two other practices were added by those interviewed:		
Other: using a plastic tarp to sort/grade if cement floor is not available	50%	none
Other: composting culls (cannot feed bitter gourd to animals)	30%	none

* indicates the practices designated as most useful

The Birnarayonpur Collection Center leaders reported that the center had 280 plastic crates supplied by the CCBA project, but needed more. The farmer members were considering joining together in the near future to raise funds and make their own investment.

Figure 10 Improved containers (plastic crates) in use for packing bitter gourd

Figure 11 Huge enlarged baskets for bitter gourd arriving at the wholesale market in Dhaka

Farmers understood the need to use shade, but the collection centers in the Jessore Regions were too small to accommodate everyone. Adding roof extensions along the outer edges could increase the amount of time the facilities were could provide deep shade.

For both of the focus crops, the assessment team was informed that the farmers generally harvested only once per week, and so each farmer was using the collection center once per week. With 200 members using each collection center once per week, this would average 30 users or more per day. Often it would be more appropriate to harvest these crops twice (or even more often) per week, in order to obtain the best quality, size and maturity for marketing. If twice/week harvesting were promoted, more than 60 farmers would need to use the collection center each day, so the size of the collection centers would need to be designed to be much larger.

Farmers at the collection center often had to wait for the plastic crates to be delivered by the traders.

Plastic crates are successfully being used of mangoes and tomatoes, with the backhaul system implemented by traders, who return the empty crates to the growers (nested as a unit of 3 crates to save space). When this type of system is used, it helps to have a good supply of extra plastic crates on site for use by the farmers, so they can pack as needed, early in the morning, and are not forced to wait after harvesting and gathering at the collection center for the traders to bring them plastic crates for the day's packing.

Reactions and adoption of improved practices by farmers

Farmers in general indicated they were pleased with the CCBA training they had received, and were interested in additional training in IPM (use of pheromone traps), sorting/grading practices, and improving market access (how to reach and sell in regional or other distant markets). They requested more shade, more (and larger sized) plastic crates, more harvesting tools (secateurs or small curved, sharp knives), electricity for the collection centers, improved roads, and access to a small truck (2.5MT to 3MT capacity was considered the appropriate size for vehicles, perhaps owned by the collection center). There were no differences found between brinjal and bitter gourd farmers regarding their expressed needs and requests.

Brinjal

CCBA trained brinjal farmers were found to have adopted the majority of the improved harvest/postharvest practices being promoted by the CCBA project.

Table 5 Summary of practices used by CCBA trained versus non-CCBA trained brinjal farmers

Topic	CCBA trained pilot farmers (n= 14)	Non-CCBA affiliated farmers (n= 4)
Production	93% report follow safe and good production practices (IPM)	0% report using this practice
Harvesting	93% report harvesting at the proper stage/ time (color, shape, fullness, etc.)	Harvest takes place whenever there is a market
Harvesting tools	93% use harvesting tools (secateurs/ sharp knife)	Pull fruits from plants, uprooting entire plant, breaking stems, caps
Shade	100% keep produce in the shade	use tree shade if any
Careful handling	86% use careful handling	Not practiced
Cleaning/washing	93% report cleaning/washing	If they wash they use water from an open pond
Pre-cooling	43% Dipping for 15 min to 30 min is considered too long a delay	Sometimes sprinkle water on produce if it is hot
Improved containers	71% use crates or improved baskets; would prefer larger plastic crates	Use enlarged traditional baskets or huge jute sacks
Sorting/grading	64% sort into 2 grades	One farmer sorts out “worse produce, insect damaged” from “good produce”
Using a plastic tarp	50% use a plastic tarp to sort/grade if cement floor is not available	0% Use bare earthen surfaces or roadways
Weigh produce before packing	30% use a digital scale to weigh produce before packing	0%
Use culls as cattle feed	50%	0%

Pre-cooling via dipping the brinjal in cool water was one of the least adopted practices by the farmers, with only 43% of those interviewed indicating that they used the practices. They did use cool water for washing, and used the trays developed by the CCBA project, but they did not leave the produce in the tray long enough or change the water often enough to achieve adequate cooling. Overall they were pleased with the results, and reported that washing quickly in cool water helped to make the produce look “fresh.” When brinjal prices are higher, early in the

season, the ambient temperatures are also cooler. This was mentioned by a farmer to explain why pre-cooling wasn't more practiced.

Measurements of temperatures, produce quality and market prices of brinjal

The measurements of temperature, produce quality and observations of produce handling during harvest, collection center operations, transport, wholesale marketing and retail market sales provided the following summary findings for brinjal. Three replications (worksheets and/or observational checklists and direct questioning) were used for data collection for each operation or location. The end of the season (late May) was a time of lowest market prices, so the brinjal was not being graded at any point in the handling system. All the people involved in the crop value chain indicated that they were using quick and cheap practices rather than improved practices since the price was so low.

The table below shows the brinjal harvest/postharvest handling and marketing measurements and observations. It includes the results of data collection from three farms and three collection center users in the Jessore Region; from three traders/transporters, three wholesalers and two retail markets in Dhaka. Individual produce samples were not followed from the farms to wholesale markets.

Operation or location along the brinjal supply chain	Examples (random selection and random sampling of lots of 20 fruits)		
CCBA affiliated farms	Harvest at 8:20 am Air Temp = 33.7 °C RH =74% Sorted out (discards) = 10% Avg pulp temp = 31 °C Avg quality = moderate	Harvest at 12:40 pm Air Temp = 38.5C RH =66% Sorted out (discards) = 5% Avg pulp temp = 37C Avg quality = moderate	Harvest at 1:00 pm Air Temp = 38.1°C RH =53.4% Sorted out (discards) = 5% Avg pulp temp = 36.5 °C Avg quality = moderate
CCBA Collection Center in Hurgati	Sorting/packing starts at 8:45 am Air temp = 32 °C RH =76% Sorted out (discards) = 5% Avg pulp temp = 31 °C Avg quality= moderate Price = 6 taka/kg	Sorting/packing starts at 1:00 pm Air temp = 33.6 C Sorted out (discards) = 5% Avg pulp temp = 37C Avg quality= moderate Price = 6 taka/kg	Sorting/packing starts at 1:30 pm Air temp = 33.6 °C Sorted out (discards) = 5% Avg pulp temp = 37 °C Avg quality= moderate Price = 6 taka/kg
Traders/transport to local or regional markets	Very large baskets Roughly handled 11:00 am departure	Very large baskets (200 kg) Roughly handled 2:10 pm departure	Large jute sacks Lots of compression bruising observed 2:30 pm departure
Wholesale markets **CCBA produce mixed in with many others in large piles;**	Khajura bazaar Re-sorting during afternoon/evening.	Khajura bazaar End of season offering extremely low prices for brinjal (3 taka/kg).	

weighed and repacked into 5 kg lots	Arriving produce is taken out of containers and dumped into large piles (mixed with all received).	Arriving produce is taken out of containers and dumped into large piles (mixed with all received).	
Transport from local or regional wholesale market to Dhaka (6 to 10 hours)	Produce loaded into all types of containers, most extremely large. Trucks over-loaded (taking 2 or more times max load)	Transporters charge 1 to 2 taka/kg for transport	Produce loaded onto large open trucks, sometimes bulk, no containers at all.
Wholesale market	Kawran bazaar (Dhaka wholesale market) Received gunny sack (120 kg) in the evening 12:30 am Air temp = 28.9 °C RH = 71.9% Losses estimated at 5-10% Many compression bruises observed		
Retail markets	Supershop Agora 2:40 pm Air temp = 27.4 °C inside shop RH = 52.4% Sorted out before resale (discards) = 30% Avg Pulp temp = 22 °C Avg quality= poor Price paid = unknown (retailer did not disclose) (purchase 5 kg lots in polyethylene bags from wholesalers – they are not allowed to sort out poor quality fruits before purchase)	Norda bazaar (wet market) 5:15 pm Air temp = 32 °C RH = 81.9% Sorted out (discards) = 30% Avg Pulp temp = 28.5 °C in the shade Avg quality= poor Price paid for unsorted 5 kg lot = unknown (retailer did not disclose) Sales price (morning) = 40 taka/kg Sales price (end of day) = 25 taka/kg	

These limited measurements show that air temperatures during the postharvest period are high (32 to 33 °C), pulp temperatures were very high (up to 37 °C) and a lot of physical damage occurs during the handling chain from farm to final retail market. Wholesale sellers pass their damaged produce on to the retailers, who reported postharvest losses of 30%.

Bitter Gourd

CCBA trained bitter gourd farmers were found to have adopted the majority of the improved harvest/postharvest practices being promoted by the CCBA project.

Table 6 Summary of practices used by CCBA trained versus non-CCBA trained bitter gourd farmers

Improved practices promoted by CCBA	CCBA trained pilot farmers (n=11)	Non-CCBA affiliated farmers (n=6)
Follow safe and good production practices (IPM)	100% report using this practice	0% report using this practice
Harvesting at the proper stage and time (color, shape, fullness, etc.)	82%	They just "know" when the fruits are ripe
Use of harvesting tools (secateurs/ sharp knife)	100% Most prefer to use very small farmer designed knives	Pull produce by hand from plants to harvest
Using a harvest trolley or pallet to transport plastic crates from farm to shed	54%	Not used
Keeping produce in the shade	100% Being more diligent to reduce water loss and exposure to heat	Some use tree shade is available
Careful handling	82% report being more diligent, understand rough handling breaks the tips and spines of the fruits	Not practiced, although aware of how rough handling and packing will damage the fruits spines and tips
Cleaning and washing	Not applicable, understand they should not wet bitter gourd	Not applicable, understand they should not wet bitter gourd
Improved containers (plastic crates, heavyweight baskets)	91% use 13kg size plastic crates when they are available	Use 100kg + baskets
Sorting and grading	100% sort into 2 sizes	Not practiced
Using a plastic tarp to sort/grade if cement floor is not available	50%	Not practiced, use bare earthen surfaces or roadways
Use of culls for composting	30%	Not practiced

For both crops covered in the assessment, non-CCBA farmers were aware of some of the improved practices being used by CCBA trained farmers, and wanted to be trained on these practices.

CCBA trained farmers informally passed their training on the laborers and fellow farmers, either via showing them or allowing them to observe their use of improved handling practices.

Figure 12 Farmer trained women working to pack produce outside the collection center in Hurgati

Reactions and adoption of improved practices by traders

The 11 traders who were interviewed by the assessment team (5 CCBA affiliated and 6 non-CCBA) indicated that they had learned about improved practices either via participation in CCBA training or by watching and interacting with the farmers. The non-CCBA trained traders indicated during a focus group interview that they did not have time to attend training, but instead they had learned about these improved practices "by observing others". There were no significant handling differences reported by representatives of the two groups, who handled both brinjal and bitter gourd at various times.

Table 7 Summary of practices used by CCBA trained versus non-CCBA trained traders

Improved practices promoted by CCBA	CCBA trained traders (n=5)	Non- CCBA affiliated traders (n=6)
Harvesting at the proper stage/ time (color, shape, fullness etc.)	Traders provide the farmers with standards	Traders provide the farmers with standards
Use of Harvesting tools (secateurs/ sharp knife)	Have noticed improved quality when used by farmers	Have noticed improved quality when used by farmers
Keeping produce in the shade	Trying to be more diligent, use trees for shade	Use trees for shade
Careful handling	As much as they believe possible without slowing the distribution process down	As much as they believe possible without slowing the distribution process down
Cleaning/washing brinjal	Traders wash the produce if the farmers do not do so	Traders wash the produce if the farmers do not do so
Improved containers (plastic crates, heavyweight baskets)	13kg size plastic crates have been purchased by most of the traders; often use jute enlarged	13kg size plastic crates have been purchased by most of the traders; often use jute enlarged

Improved practices promoted by CCBA	CCBA trained traders (n=5)	Non- CCBA affiliated traders (n=6)
	baskets when they do not have enough crates	baskets when they do not have enough crates
Sorting/grading	Understand that sorted/graded produce often gets higher market prices	Understand that sorted/graded produce often gets higher market prices
Use a plastic tarp if sorting/grading on the open ground	Understand the need to use a clean working surface	Understand the need to use a clean working surface

One CCBA trained trader explained in great detail how he is using the knowledge and skills he gained from the training:

- **Sorting and grading:** he did not do this before receiving training and now he sees that other traders are also following his new practices.
    - He said most farmers do not grade or sort so he must:
        - Sand grade it before transporting to larger wholesale market.
        - He sends the best grades to Dhaka and the least to local markets (price and shelf life).
    - He grades into three grades (good shape, shriveled, infected):
        - Bitter gourd: grades by spine, size, glossy smooth.
        - Brinjal: skin smooth = no shrivel, shape, and size.
- **Cleaning/washing brinjal**: he will wash any brinjal that has not been washed by farmer.
- **Packing in plastic crates:** if he does not have enough crates he must use other containers.
    - He always uses crated for bitter gourd and spikey gourd.
    - For brinjal, he uses different sized: minimum 20 kg and maximum 200 kg.
        - Damage to eggplant using baskets is 10% to 17%; versus almost no damage if using plastic crates, but often there are not enough crates to use for brinjal.
    - Although he knows it is not a good idea, he stuffs the plastic crates with 15-17 kg instead of the 13kg that CCBA taught to him in order to reduce transport costs.
- **Overall best practices:** he said that in a perfect world he would like the farmers to do the following:
    - Stems should be longer, as to not dry out and have longer shelf life.
    - Use short blade/secateurs so not damage other fruit.
    - Gentle handling (so not break spines or have the stem poke the other fruit or bruise) so he has a longer shelf life and it is better to sell to Dhaka and receives more profits because he has more to sell and better condition.
    - Cooling: keep cool, remove field heat.
    - Wishes that farmers would use crates.
- **Reduced food losses**: brinjal example: 2 kg loss from 20 kg basket versus 0 kg loss if in crate.
- **Increased profits:** He sells to Dhaka (Kawran Bazaar) and says that the market is very responsive to his grading and sorting. They tell him that he has better quality than other. All his produce goes through an *Arrotdar* (who owns or rents a stall in big market and gets a commission of 1 taka/kg on all fruit that passes through).

One Non-CCBA affiliated trader commented on the following regarding bitter gourd:

- **Overall better quality** from CCBA farmers: he noticed that the he saw differences from the CCBA producers. The closer he gets to the farmers land he more he noticed gentle handling (no rough packing or transport) so the bitter gourds had very little spine damage versus those that had been transported to the market by non-CCBA farmers.
- **Better profits:** he can receive higher profits with the better quality CCBA fruit so he thinks more farmers should be trained in improved harvesting and postharvest handling practices.
- **Shade:** he parks his uncovered truck under a tree until it is fully loaded (could be 4-5 hours while he waits for the farmers' produce).
- **Tools:** he had heard of the CCBA secateurs and finds the produce is better quality when they are used as there is no finger pressure damage.
- **Improved containers:** he has purchased 200 plastic crates that he lends to the farmers at no charge, but still must use plastic and jute sacks as he does not have enough plastic crates. He washes the crates once a week in his home or a pond.
- **Gentle Handling:** he says he takes better care of his produce than he does himself and he "protects the bitter gourd spines like a baby!"

The comparison of traditional practices and the improved practices implemented by pilot farmers and traders who received (or observed) CCBA postharvest training shows that those who were exposed to CCBA training have adopted many more of the promoted practices than those not trained by CCBA on harvesting, sorting/grading, washing/pre-cooling of brinjal, use of shade, packing and use of improved containers like plastic crates. Many of the traders reported that they have made investments in improved postharvest handling by purchasing their own plastic crates (from 200 to 500 pieces), but still feel that more crates are needed to help reduce produce damage and losses.

A full commodity system assessment / value chain report for brinjal and bitter gourd on the causes and sources of postharvest losses and quality problems were written in support of this assessment report.

Each of these reports was compiled from interviews, literature reviews, surveys and observations of the assessment team. For each crop, the assessment team described key postharvest handling practices and issues, and identified any research needs, extension/training needs and advocacy issues that can be incorporated into USAID and Winrock International's plans for future projects in Bangladesh and the South Asian region. (See Annex 3 for titles of the full reports; provided as pdf files).

Research needs, training needs and advocacy issues

The table below contains a summary of the research needs, training and extension needs, and advocacy issues identified during the assessment field work for brinjal and bitter gourd in the Jessore region and Dhaka, Bangladesh.

Table 8 Summary of the research needs, training/extension needs, and advocacy issues

	Brinjal	Bitter Gourd
Research needs	Varieties resistant to common pests Develop updated pheromone traps for evolving pests	Varieties resistant to common pests Develop updated pheromone traps for evolving pests
Training and extension needs	Training for non-CCBA farmers on improved harvest/postharvest practices Farmers are not aware of the over dose application of pesticides or safe levels of residuals; they can harvest before it is safe to do so Training for traders on gentle handling, improved containers Additional collection centers as a gathering place for postharvest training and demonstrations Linking farmers to postharvest extension services Linking farmers to transported, traders and markets	Training for non-CCBA farmers on improved harvest/postharvest practices Training for traders on gentle handling, improved containers Additional collection centers as a gathering place for postharvest training and demonstrations Linking farmers to postharvest extension services Linking farmers to transporters, traders and markets
Advocacy issues	Rural access to electricity Better access to real time prices and available supply and quality from farmers for the traders Improved rural roads Access to vehicles for improved transport (reefers, insulated boxes) Allow vehicles carrying fresh produce better access to ferry crossings, priority passage through transport checkpoints, entry curfew times into Dhaka (reduced time for travel, protect quality)	Rural access to electricity Better access to real time prices and available supply and quality from farmers for the traders Improved rural roads Access to vehicles for improved transport (reefers, insulated boxes) Allow vehicles carrying fresh produce better access to ferry crossings, priority passage through transport checkpoints, entry curfew times into Dhaka (reduced time for travel, protect quality)

Many of the needs and issues identified for brinjal and bitter gourd are also important to consider and incorporate when addressing the needs for the other key high value crops for CCBA, Feed the Future projects, and for horticultural development in Bangladesh in general. The practices used for improved harvest and postharvest handling for these two crops are very similar to those recommended for other important vegetable crops (i.e. peppers, hot chilies, tomatoes, cucumbers, zucchini, summer squash and other soft skin squashes and edible gourds) as well as for some of the major fruit crops (i.e. mangoes, guava, papaya, citrus fruits) produced in Bangladesh. Traders (including transporters who face serious delays and regulatory issues), wholesalers and retail marketers are important target audiences for future postharvest training efforts, since they are responsible for the transport and handling once the produce leaves the farms or collection centers.

End Results

The assessment process allowed the team to collect information on any positive outcomes (such as reduced losses or improved market prices due to higher quality or longer shelf life) being reported by people who have adopted improved harvesting methods or improved postharvest practices.

Many of the farmers interviewed for the assessment indicated that they were experiencing reduced losses. Ten of the 14 CCBA farmers interviewed (71%) brinjal farmers and none of the non-CCBA farmers reported they had reduced postharvest losses. Nine of the CCBA trained brinjal farmers reported increased profits from using improved harvest/postharvest practices, mainly due to washing in cool water, sorting/grading and use of improved (much smaller) containers. They reported using their increased earnings to purchase farm animals, build a house, school for their children or additional land for farming.

Seven of the 11 CCBA trained bitter gourd farmers interviewed (64%) and none of the four non-CCBA farmers reported that they had reduced postharvest losses. Five of the CCBA trained bitter gourd farmers described in detail how they had increased profits from using improved harvest/postharvest practices by having lower percentage losses and/or receiving higher market prices for the higher grade produce. One farmer reported that unsorted produce sold for 12 taka/kg, while produce sorted into two sizes sold for an average of 18 taka/kg.

Examples of reduced percentage losses reported by individual farmers after CCBA training on improved harvest/postharvest practices:

Brinjal farmers

- Estimates losses were reduced by 10%
- Losses reduced from 20% to 8-9%
- Losses reduced by 45%
- Losses reduced from 40 kg/200 kg load to 2k g/200 kg load
- Losses reduced from 20 kg/40 kg load to 5 kg/40 kg load
- Losses reduced from 120 kg/600 kg load to 20 kg/600 kg load
- Losses reduced from 20% to 8-9%

Bitter gourd farmers

- Losses reduced from 3-4 kg/50 kg to 0 kg losses after CBBA training
- Losses reduced from 40 kg/200 kg load to 2 kg/200 kg load
- Losses reduced from 8-10 kg/40 kg load to 0.5 kg/40 kg load
- Losses reduced from 120 kg/240 kg load to 5 kg/600 kg load
- Losses reduced from 12-13 kg/40 kg load to 1.5-2.5 kg/40 kg load

Traders were less willing to inform the assessment team of the details related to their business earnings or added profits, but admitted they had increased profits when buying from farmers who were using these improved harvest/postharvest practices, and especially when using improved containers that reduced damage during distribution. This is an example of a win-win situation, when both the traders and the farmers benefited financially when the farmers adopted improved harvest/postharvest practices.

It is apparent that CCBA produce was better handled in general compared to the handling by those using the traditional practices, but often after leaving the collection centers, the CCBA produce got mixed in with the traditional loads of other farmers. By the time the CCBA produce arrives via non-refrigerated, open loads at distant markets, it is likely that there would be no measureable difference in quality. Often, market prices/kg depended on supply and demand, with no extra value given for improved quality.

Produce was observed to be dumped, mixed into large piles and repacked at various later stages of the postharvest handling chain, especially at the wholesale markets. If it is possible to train an entire integrated chain of actors (farmers, traders and retailers) to use plastic crates or improved baskets from the farm to the final retail market, the overall produce losses and physical damage experienced in Bangladesh could be greatly reduced. An integrated postharvest handling system, including a collection center with adequate shade managed by the farmers, a good supply of improved containers at the collection center, and a small refrigerated truck managed by the traders, could be the focus for a future pilot project.

Impacts

The assessment team was able to determine whether any economic benefits being experienced by people who have adopted improved harvesting methods or improved postharvest practices, and the related impacts on food availability and potential earnings.

Interviewees provided an assortment of detailed information on the costs and results of their use of improved practices as compared to traditional practices, enabling the assessment team to make simple cost/benefit calculations. Costs for tools/supplies and market prices of produce vary somewhat depending on the location, market, seasonal time, holiday time (i.e. prices are higher during Ramadan) and the experience of the person providing the information.

The cases provided are meant to be examples, and anyone can enter their own crop, costs, and market prices to calculate the expected benefits of using improved harvest/postharvest practices.

CASE #1: Use of secateurs for brinjal harvest

The use of secateurs (small hand held cutters) was reported to have been adopted by nearly all the CCBA trained farmers. The secateurs cost about 180 taka each and have a long useful life if kept clean and oiled when in storage between seasons. The high market price for brinjal is 40 taka/kg and lowest price is 5-7 taka/kg toward the end of May. The following worksheet shows a positive return on investment (ROI) can be obtained in less than one season.

Table 9 ROI on the use of secateurs for brinjal harvest

Crop:	**Brinjal**	
Country/Region:	**Jessore, Bangladesh**	
Assumption:	**1000 kg harvest over the course of the season**	
	Current / traditional practice	**New / improved practice**
Description	Pulling fruit from plant, which damages both individual fruit and plants	Using secateurs to harvest brinjal

COSTS		
180 taka per pair of secateurs (4)	0	180 taka x 4 = 720 taka
Relative cost	0	+ 720 taka
EXPECTED BENEFITS		
% losses	5-10%	0%
Amount for sale	900-950 kg	1000 kg
Value/kg (average price)	23 taka / kg	25 taka / kg
Total market value	20,700 to 21,850 taka	25,000 taka
Market value minus costs	Maximum of 21,850 taka	24,280 taka
Relative profit for the season	---	+ 2,430 taka
ROI	---	Less than one season. Tools are fully paid for during the first season of use, so the next season's profits will increase to approximately 4,000 taka.

CASE #2: Use of secateurs for bitter gourd harvest

The use of secateurs (hand held cutters) was reported to have been adopted by nearly all the CCBA trained farmers. The secateurs cost 200 taka each and have along useful life if kept clean and oiled when in storage between seasons. The high market price for bitter gourd is 30 taka/kg and lowest price is 7 taka/kg toward the end of May. The following worksheet shows a positive ROI can be obtained in less than one season.

Table 10 ROI on the use of secateurs for bitter gourd harvest

Crop:	**Bitter gourd**	
Country/Region:	**Jessore, Bangladesh**	
Assumption:	**1000 kg harvest over the course of the season**	
	Current / traditional practice	**New / improved practice**
Description	Pulling fruit from plant: damages both individual fruit and plants	Using secateurs to harvest bitter gourd
COSTS		
200 taka per pair of secateurs (4)	0	200 taka x 4 = 800 taka
Relative cost	0	+ 720 taka
EXPECTED BENEFITS		
% losses	5-10%	0%
Amount for sale	900-950 kg	1000 kg
Value/kg (average price)	18 taka / kg	20 taka / kg
Total market value	16,200 to 17,100 taka	20,000 taka

Market value minus costs	Maximum of 17,100 taka	19,800 taka
Relative profit for the season	---	+ 2,700 taka
ROI	---	Less than one season. Tools are fully paid for during the first season of use, so the next season's profits will increase to approximately 3,000 taka.

CASE #3: Use of shade for cooling bitter gourd during sorting/grading and packing

Shade is known to provide a cooler environment for fresh produce, keeping it relatively cooler than produce that is exposed to the direct sun. Shade costs little or nothing, and the high market price for bitter gourd is 30 taka/kg and lowest price is 7 taka/kg toward the end of May. The following worksheet, using the average market price, shows a positive ROI can be obtained with every use.

Table 11 ROI on the use of shade for cooling bitter gourd during sorting/grading and packing

Crop:	**Bitter gourd**
Country/Region:	**Jessore, Bangladesh**
Assumption:	**100 kg harvest**

	Current / traditional practice	New / improved practice
Description	Store harvest (small pile) with no shade	Store harvest (small pile) in collection center or under a tree with shade
COSTS		
Use of shade	0	0
Relative cost	0	0
EXPECTED BENEFITS		
% losses	15%	3%
Amount for sale	85 kg	97 kg
Value/kg (average price)	18 taka / kg	20 taka / kg
Total market value	1,530 taka	1,940 taka
Market value minus costs	1530 taka	1940 taka
Relative profit for the season	---	+ 410 taka
ROI	---	410 taka added profit / 100 kg load with each use of shade

These relative cost/benefit worksheets can be used to compare expected outcomes if prices are low or moderate or high, for example, some improved practices may be cost effective when market prices are high, but will not add value if the market prices are low.

For Case #3, we can recalculate the costs and benefits for when bitter gourd can be sold at a high price (30 taka/kg) versus when it can be sold only at a low price (7 taka/kg) and determine whether the use of shade will provide any financial benefits. The following two worksheets show that relative profits are higher when the market prices are higher, and positive results are still obtained when prices are low, but in lower amounts. In all the examples, independent of market price, the worksheet show a positive ROI can be obtained with every use of shade.

Table 12 ROI on the use of shade for cooling bitter gourd during sorting/grading and packing when market price is high

Crop:	**Bitter gourd**	
Country/Region:	**Jessore, Bangladesh**	
Assumption:	**100 kg harvest when market price is high**	
	Current / traditional practice	**New / improved practice**
Description	Store harvest (small pile) with no shade	Store harvest (small pile) in collection center or under a tree with shade
COSTS		
Use of shade	0	0
Relative cost	0	0
EXPECTED BENEFITS		
% losses	15%	3%
Amount for sale	85 kg	97 kg
Value/kg (higher prices)	28 taka / kg	30 taka/kg
Total market value	2,380 taka	2,910 taka
Market value minus costs	2,380 taka	2,910 taka
Relative profit for the season	---	+ 530 taka
ROI	---	530 taka added profit / 100 kg load with each use of shade

Table 13 ROI on the use of shade for cooling bitter gourd during sorting/grading and packing when market price is low

Crop:	**Bitter gourd**	
Country/Region:	**Jessore, Bangladesh**	
Assumption:	**100 kg harvest when market price is low**	
	Current / traditional practice	**New / improved practice**
Description	Store harvest (small pile) with no shade	Store harvest (small pile) in collection center or under a tree with shade

COSTS		
Use of shade	0	0
Relative cost	0	0
EXPECTED BENEFITS		
% losses	15%	3%
Amount for sale	85 kg	97 kg
Value/kg (lowest prices)	7 taka / kg	7 taka/kg
Total market value	595 taka	1,940 taka
Market value minus costs	595 taka	679 taka
Relative profit for the season	---	+ 84 taka
ROI	---	84 taka added profit/ 100 kg load with each use of shade

CASE #4: Use of pre-cooling for brinjal (dipping in cool well water in a shallow metal tray)

The stainless steel dipping trays cost about 500 taka each and have along useful life if kept clean when in storage between seasons. The high market price for brinjal is 40 taka/kg and lowest price is 5-7 taka/kg toward the end of May. The following worksheet, using the average market price, shows a positive ROI can be obtained by the second use.

Table 14 ROI on the use of pre-cooling for brinjal

Crop:	**Brinjal**
Country/Region:	**Jessore, Bangladesh**
Assume:	**100 kg harvest**

	Current / traditional practice	New / improved practice
Description	No cooling	Pre-cooling with deep well water dip after harvest
COSTS		
1 metal tray @ 500 taka	0	500 taka
Relative cost	0	500 taka
EXPECTED BENEFITS		
% losses	10%	2%
Amount for sale	90 kg	98 kg
Value/kg (average price)	23 taka	25 taka
Total market value	2,070 taka	2,450 taka
Market value minus costs (1st load fully pays for tray)	2,070 taka	1,950 taka

Market value minus costs (1st load fully pays for tray)	2,070 taka	2,450 taka
Relative profit for 2nd load and subsequent loads	---	+ 380 taka
ROI	---	First use fully pays for pre-cooling tray; pre-cooling generates subsequent profits of 380 taka per 100 kg load

CASE #5: Use of improved containers for long distance transport of bitter gourd

One of the topics discussed in detail was transporting the bitter gourd from the smaller farmer market (i.e. Khajura market in Jessore) to the national wholesale market (i.e. Dhaka Kawran bazaar). Case #5 provides a comparative field trial using strong bamboo baskets (holding 250 kg and costing 300 Taka) versus second hand plastic crates (over packed to hold 15 kg and costing 180 Taka each) under conditions when the price of the produce is at the highest point of the season, and has a difference in market value based on quality. The following worksheet, using the average market price, shows a positive ROI can be obtained with the second use.

This case is intended to be more complex, where four grades were sorted out at the destination market, demonstrating the loss in market value due to the container during long distance transport.

Table 15 Produce sorted into 4 grades/market prices upon arrival

250 kg load	A grade = 40 taka/kg	B grade = 35 taka/kg	C grade = 25 taka/kg	D grade = 0 taka	Total market value
Bamboo basket	25% of total load	40%	30%	5%	---
	65 kg 2,600 Taka	100 kg 3,500 Taka	75 kg 1,875 Taka	12.5 kg 0 Taka	7,975 Taka
Plastic crates	65%	20%	12%	3%	---
	162 kg 6,480 Taka	50 kg 1,750 Taka	30 kg 750 Taka	7.5 kg 0 Taka	8,980 Taka

Each of these five cost/benefit determinations show a different type of practice, tool or crop, but all result in positive returns on investment – either immediately with every use, or achieving a positive ROI within one or two uses.

Table 16 Summary of relative costs and benefits for individuals reporting adoption and use of improved harvest/postharvest practices

Case number, location, and crop	Traditional practice Relative cost Market value	Improved practice Relative cost Market value	Increased earnings per load and per kg	Return on investment
1. Using secateurs in Jessore Region to harvest brinjal (1000 kg per season)	Pulling brinjal from plant by hand Relative cost = 0 taka Market value = maximum of 21,850 taka	Cutting fruits to harvest with secateurs Cost for 4 secateurs = 720 taka Market value = 25,000 taka	2,430 taka/ 1000 kg or 2.4 taka/kg	**Positive** Tools are fully paid for during the first season of use, so the next season's profits will increase to approx. 4,000 taka
2. Using secateurs in Jessore Region to harvest bitter gourd (1000 kg per season)	Pulling bitter gourd from plant by hand Relative cost = 0 taka Market value = Maximum of 17,100 taka	Cutting fruits to harvest with secateurs Cost for 4 secateurs = 800 taka Market value = 20,000 taka	2,700 taka/ 1000 kg or 2.7 taka/kg	**Positive** Tools are fully paid for during the first season of use, so the next season's profits will increase to approx. 3,000 taka
3. Use of shade for bitter gourd (100 kg load)	No shade provided Cost = 0 taka Market value = 1,530 taka	Shade during sorting/grading and packing Cost = 0 Market value = 1,940 taka	410 taka /100 kg or 4.1 taka/kg	**Positive** Provides increased profits of 410 taka for every 100 kg load at average market price
4. Use of pre-cooling for brinjal (100 kg load)	No pre-cooling Cost = 0 taka Market value = 2,070 taka	Pre-cooling via cool water dip in metal tray Cost = 500 Market value = 2,450 taka	380 taka/100 kg or 3.8 taka/kg	**Positive** First use fully pays for pre-cooling tray; pre-cooling generates subsequent profits of 380 taka per 100 kg load
5. Transportation from Khajura / Jessore to Dhaka Kawran for bitter gourd (250 kg load)	Bamboo basket (250 kg) Cost = 300 taka Market value = 7975 taka	Plastic crates (17 each holding 15 kg) Cost = 3000 taka Market value = 8980 taka	1,300 taka/250 kg load or 5.2 taka/kg	**Positive** Plastic crates fully paid for on second use, followed by 1,300 taka per load added earnings (crates can be used 28 times more)

Theory of Action

During the postharvest assessment study, the team complied information to relate the documented practice changes, outcomes and impacts in order to verify that they have been due to the activities implemented during the CCBA project.

Many of the harvest and postharvest practices being promoted by the CCBA project via training and demonstration at the collection centers in the Jessore Region have been documented during the assessment. It is clear from the many farmer and trader interview responses that most of those who received CCBA training have been using what they learned and have been passing it along to others (laborers, neighbor farmers, and fellow traders).

However, there are many similar projects and programs in Bangladesh (currently being implemented or in the near past) where postharvest training was provided. Each of these postharvest horticulture marketing projects and programs have been providing practical training on the use of shade, pre-cooling methods, plastic crates, simple cool storage structures and more.

Examples include:

- USAID AVRDC-World Vegetable Center Postharvest Project (2013-present)
- The Postharvest Education Foundation (USA)/Amity University (India) postharvest training-of-trainers program for South Asia (2012-present)
- Feed the Future Horticulture Innovation Lab research and extension projects
- Bangladesh Agricultural Research Institute's extension programs including the BARI Agro Tech Park
- The Netherlands NGO Solidarity links farmers in the Jessore region directly to retail marketers in Dhaka.

It may be possible for a future postharvest oriented project planned by USAID to collaborate with one or more of these active projects, share ideas and/or training venues.

Conclusions and Lessons Learned

Several of the postharvest focused activities implemented by the CCBA project stood out as highly beneficial and practical for the target audiences of farmers and traders.

Having a gathering place for the farming community at CCBA collection centers provided a simple and low cost way to reach target audiences on a regular basis. The site could be a simple shed or a more modernized cement structure, but as long as it provided shade (via a wide roof, tarpaulin, or natural covering), a clean working surface (cement floor), space for demonstrations of improved practices, and was located where farmers, transporters and traders could reach it easily, the CCBA collection centers were well received and appreciated.

Farmers understood the need to use shade, but the three collection centers in the Jessore Region were too small to accommodate everyone. Adding roof extensions along the outer edges could increase the amount of time each day that the facilities could provide deep shade.

The size of the collection centers provided for the CCBA project were quite small, which may explain why fewer members were using the centers (about 200) than originally planned (300). The assessment team observed crowded working conditions during the sorting/grading and

packing of produce, and situation where later arriving members had to work outside under nearby trees or on the open ground in the direct sun.

Costs and benefits of individual improved practices for harvesting and postharvest handling had a large impact on adoption. Often the market price affected whether the practice was being used – for example, when the price of brinjal is high, using plastic crates holding 13kg to protect the produce and its market value was considered to be cost effective, but when the market price is low, the farmers and traders reverted back to using huge sacks and traditional baskets holding 200 kg or more.

The management of collection centers needs to be better understood. The Management Planning Committee (MPC) was set up for each collection center, and each MPC has a charter (available in Bangla) wherein each of the persons has fixed responsibilities and role. The MPC have a bank account and they collect money from the members to buy additional crates and transport. The assessment team was told that the collection centers were designed to work like a cooperative, but additional information and details on outcomes would greatly enhance CCBA project reporting.

It is highly probable that the reported adoption of improved harvest/postharvest practices by CCBA trained farmers and traders, and non-CCBA participants who observed those who had been trained, indicates that the CCBA project was responsible for the majority of the learnings, practice changes and positive outcomes (reduced food losses, increased profits). It was sometimes difficult for the assessment team to track the implementation of postharvest training after the fact, since training on harvest/postharvest was mixed in with general training on production, IPM, food safety and many other topics.

It would have been a good practice to be aware of similar trainings by other organizations, in order to ensure that adoption is not caused by the training activities of other projects and programs.

Recommendations for future projects

1. Standardize the harvest/postharvest training agenda and include more training on the basics to ensure that farmers and traders better understand the horticultural value chain and their role in reducing losses in the postharvest handling system.

Farmers should be asked about their special interests, and trainers can spend time addressing these, but their interests alone should not guide the training since the farmers often have limited knowledge and understanding of key principles of postharvest biology and innovative postharvest handling practices.

2. Improve the training on pre-cooling to include more than dipping in cool water – this practice cannot be used for many crops (including bitter gourd), and can lead to increased decay problems for brinjal if the cap gets wet.

It is recommended that pre-cooling via evaporative forced air cooling be incorporated into future project proposals, since this is a low cost method that could be utilized via a low cost solar powered fan added to a “cool wall” made of wetted wood fiber or charcoal. Such as pre-cooling system does not get the produce wet, and can be used for many types of tropical and sub-tropical fresh produce, from fruits to vegetables to herbs.

3. Expand the number and size of collection centers and add collection centers for farming communities that are producing many other types of horticultural crops.

Many of the needs and issues identified for brinjal and bitter gourd are also important to consider and incorporate when addressing the needs for the other key high value crops for CCBA, Feed the Future projects, and for horticultural development in Bangladesh in general. The practices used for improved harvest and postharvest handling for these two crops are very similar to those recommended for other important vegetable crops (i.e. peppers, hot chilies, tomatoes, cucumbers, zucchini, summer squash and other soft skin squashes and edible gourds) as well as for some of the major fruit crops (i.e. mangoes, guava, papaya, citrus fruits) produced in Bangladesh.

Larger sized collection centers, with more shade, more tools and more plastic crates, will allow for a larger number of members to participate and successfully use the facilities to protect produce quality, reduce postharvest losses and improve food safety.

Traders (including transporters, wholesale and retail marketers) are an important target audience for future postharvest training efforts, since they are responsible for the handling and transport once the produce leaves the farms or collection centers. Significantly more can be done for these critical stakeholders. CCBA had a strong focus on farmers and fewer resources to work with the rest of the value chain.

In the future, horticulture harvest and postharvest projects may want to take a closer look at the mangoes value chain, tomatoes, lychees, capsicum peppers, potatoes, onions, and Chinese leafy vegetables. These high value crops present a good opportunity for branding, and CCBA personnel informed the assessment team that these products have good margin compared to other vegetable crops.

4. Replicate this project in additional regions of Bangladesh and in many more countries.

Participants in the project appeared to have a positive experience with the training workshops, collection center demonstrations and sample tools, and have adopted many of the new and improved harvest/postharvest practices that were introduced during the CCBA project. The fact that traders have made investments in plastic crates and are advocating for training more farmers in improved harvest/postharvest practices is a sign that the project hit the mark and influenced real change.

Annex A. Data collection instruments and worksheets

Informed consent template

Informed Consent Form – CCBA Postharvest Practices Survey

My name is Charity Hanif and I am working with Winrock International. We are gathering information about postharvest practices. Our study is funded by the United States Agency for International Development ("USAID"), an agency that provides economic, development, and humanitarian assistance around the world. The expected benefits of this study are to understand and measure the impact of improved postharvest practices in horticultural products.

Any information provided that can identify a person, such as your name or address, will be kept strictly confidential by Winrock and its employees, to the maximum extent permitted by the laws of the United States of America and the laws of Bangladesh. The non-identifying data will be used for statistical purposes only and may be used in future research studies.

Your participation is voluntary and you may choose not to answer any or all questions for any reason. There will be no consequences for deciding not to participate. You may contact A.B. Siddiqui at 986-1335 or Suite# F1, House # 10, Road # 16/A Gulshan-1, Dhaka-1212, if you have questions, concerns or complaints about the study or your rights as a participant.

If you have any questions for me, please feel free to ask at any time. I can be reached at:

Winrock CCBA Head Office
Address: Suite #F1, House #10, Road #16/A Gulshan-1, Dhaka-1212
Telephone: 986-1335

Do we have your permission to continue with this study at this time?

I, _____, on behalf of my household, voluntarily agree that members of my household may participate in this Project.

_____ _____
Signature Date

Informed Consent Form – CCBA Postharvest Practices Survey

My name is Lizanne Wheeler and I am working with Winrock International. We are gathering information about postharvest practices. Our study is funded by the United States Agency for International Development ("USAID"), an agency that provides economic, development, and humanitarian assistance around the world. The expected benefits of this study are to understand and measure the impact of improved postharvest practices in horticultural products.

Any information provided that can identify a person, such as your name or address, will be kept strictly confidential by Winrock and its employees, to the maximum extent permitted by the laws of the United States of America and the laws of Bangladesh. The non-identifying data will be used for statistical purposes only and may be used in future research studies.

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Do we have your permission to continue with this study at this time?

I, _____, on behalf of my household, voluntarily agree that members of my household may participate in this Project.

_____ _____
Signature Date

Face to face interviews (commodity systems assessment questionnaire)

Crop value chain assessment for the Cold Chain Bangladesh Alliance project

Lisa Kitinoja, April 2016

Consider the entire commodity system, from planning and production to processing and marketing, but focus more on the **postharvest and marketing** aspects. Don't worry too much about actual total costs for production or marketing, but try to determine the **relative costs** of any potential or observed changes in handling or marketing practices.

For each crop of interest, begin collecting data via interviews, literature review, observation, etc. Speak with project colleagues and read existing documents. You can ask some of the questions of farmers (those related to production), marketers (about postharvest handling and marketing), and researchers, project staff and/or extension workers (about the entire system). Focus in on those questions related to the information that you most want to find out more about. Data sources can be published articles or unpublished documents, review articles, interviews, observations or measurements.

CROP # 1 _____

Components 1 - 7: **Pre-Production**

(Date sources include extension workers, researchers, project staff)

1. Importance of the crop. What is the relative importance of the crop? Base your estimate of importance on information on number of producers, amount produced, area of production, and/or market value.

2. Governmental policies. Are there any laws, regulations, incentives or disincentives related to producing or marketing the crop? (e.g., existing price supports or controls, banned pesticides or residue limits)

3. Relevant institutions. Are there any organizations involved in projects related to production or marketing the crop? What are the goals of the projects? How many people are participating?

4. Facilitating services. What services are available to producers and marketers (for example: credit, inputs, technical advice, subsidies)?

5. Producer/shipper organizations. Are there any producer or marketer organizations involved with the crop? What benefits or services do they provide to participants? At what cost?

6. Environmental conditions. Does the local climate, soils or other factors limit the quality of production? Are the cultivars produced appropriate for the location?

7. Availability of planting materials. Are seeds or planting materials of adequate quality? Can growers obtain adequate supplies when needed?

Components 8 - 11: **Production** (Data sources include farmers, extension workers, project staff)

8. Farmers' general cultural practices. Do any farming practices in use have an effect on produce quality (irrigation, weed control, fertilization practices, field sanitation)?

9. Pests and diseases. Are there any insects, fungi, bacteria, weeds or other pests present that affect the quality of produce?

10. Pre-harvest treatments. What kinds of pre-harvest treatments might affect postharvest quality (such as use of pesticides, pruning practices, trellising, thinning)?

11. Production costs. What are the costs of any proposed alternative methods?

Components 12 - 21: **Postharvest**

(Data sources include farmers, extension workers, marketers, processors, project staff)

12. Harvest. When and how is produce harvested? by whom? at what time of day? Why? What sort of containers are used? (if possible, take photos). Is the produce harvested at the proper maturity for the intended market? What is the temperature at harvest time? What amounts and types of losses are observed/reported?

13. Grading, sorting and inspection. How is produce sorted? by whom? Does value (price) change as quality/size grades change? Do local, regional or national standards (voluntary or mandatory) exist for inspection? What amounts and types of losses are observed/reported? What happens to culled produce?

14. treatments. What kinds of postharvest treatments are used? (Describe any curing practices, cleaning, trimming, hot water dips, etc.) Are treatments appropriate for the product? (if possible, take photos).

15. Packaging. How is produced packed for transport and storage? What kind of packages are used? Are packages appropriate for the product? Can they be reused or recycled? (if possible, take photos).

16. Cooling. When and how is produce cooled? To what temperature? Using which method(s)? If temperature measured during cooling? Are methods appropriate for the product? If produce is not cooled. What is the ambient temperature range during the postharvest period?

17. Storage. Where and for how long is produce stored? In what type of storage facility? Under what conditions (packaging, temperature, RH, physical setting, hygiene, inspections, etc.)? Is the temperature measured while the produce is in storage? (if possible, take photos).

18. Transport. How and for what distance is produce transported? In what type of vehicle? How many times is produce transported? How is produce loaded and unloaded? (if possible, take photos).

19. Delays/ waiting. Are there any delays during handling? How long and under what conditions (temperature, RH, physical setting) does produce wait between steps?

20. Other handling. What other types of handling does the produce undergo? Is there sufficient labor available? Is the labor force well trained for proper handling from harvest through transport? Would alternative handling methods reduce losses? Would these methods require new workers or displace current workers?

21. Agro-processing (if any). How is produce processed (methods, processing steps) and to what kinds of products? How much value is added? Are sufficient facilities, equipment, fuel, packaging materials and labor available for processing? Is there consumer demand for processed products?

Components 22 - 26: **Marketing**

(Data sources include farmers, traders, wholesale marketers, retail marketers, consumers, extension workers, project staff)

22. Market intermediaries. Who are the handlers of the crop between producers and consumers? How long do they have control of produce and how do they handle it? What amounts and types of losses are observed/reported? Who is responsible for losses /who suffers financially? Is produce handled on consignment; marketed via direct sales; move through wholesalers?

23. Market information. Do handlers and marketers have access to current prices and volumes in order to plan their marketing strategies? Who does the recordkeeping? Is information accurate, reliable, timely, and useful to decision makers?

24. Consumer demand. Do consumers have specific preferences for produce sizes, flavors, colors, maturities, quality grades, packages types, package sizes or other characteristics? Are there any signs of unmet demand and/or over-supply? How do consumers react to the use of postharvest treatments (pesticides, irradiation, coatings, etc.) or certain packaging methods (plastic, Styrofoam, recyclables)?

25. Exports. Is this commodity produced for export? What are the specific requirements for export (regulations of importing country with respect to grades, packaging, pest control, etc.)?

26. Marketing costs. Do handlers/ marketers have access to credit? Are prevailing market interest rates at a level that allows the borrower to repay the loan and still make a profit? Is supporting infrastructure adequate (roads, marketing facilities, management skills of staff, communication systems such as telephone, FAX, e-mail services)? What are the costs of any proposed change in marketing practices?

Overall, for the crop:

Reported by:	What is the range of estimated losses (%)?	Causes of losses?	What are their reported/requested training needs?	What are the advocacy issues* that they believe could reduce losses and/or improve incomes?
farmers				
traders				
marketers				
Extension agents				
other				

* such as missing infrastructure, roads, power, credit, etc.

Overall, for the crop:

If known:

Reported by:	What is the range of market prices/kg?	Lowest price/kg? When (month) Where? Buyers?	Highest price/kg? When (month) Where? Buyers?
farmers			

traders			
marketers			
Extension agents			
other			

Literature reviews

Key documents include:

Ansari, Adnan (April 2016) Lessons Learned from CCBA Implementation

BARI (April 2016) Assessment of Postharvest Losses and Food Quality by Evaluating Postharvest Practices and Marketing Performances in Selected Vegetables Supply Chain in Bangladesh (DRAFT)

Siddiqui, A.B (June 2016) Cost-Benefit and Effectiveness of Refrigerated Trucks for Transportation and Marketing of Fresh Produce (DRAFT)

Formal Surveys (CCBA training assessment questionnaire)

Survey on CCBA training programs or outreach efforts/ Kitinoja 2016

Participant interview schedule: (target = 20 local clienteles who participated in past training programs **and** 10 people who did not participate -- across the value chain – farm, trader, marketers)

Interview done in person (face to face) _____ by telephone_____ or by email _____

Date of interview_____ Interviewer_____

1) Demographic information

Training Participant name _____ Age_____

Current Affiliation _____ Male _____/ Female _____

Location _____

Are you? A farmer ____ packer____ w/s marketer____ retail marketer_____

extension worker _____ Other_____ (please specify)_____

Your replies to these questions will assist us to improve the project and its training and postharvest demonstration programs, and help us to develop future postharvest projects. None of your responses will be linked with your name in our reports.

TRAINING PROGRAMS

2) When and where did you participate in a postharvest training program (if any)?

	When (month/ year)	Duration (# of days)	Location	Topic(s)	*Provided by?
1					
2					
3					
4					
5					

*Was the training provided by CCBA? If not, who provided the training (possibilities may include AVDRC, World Veg Center, BARI, Hort Innov Lab, others)

4) What postharvest **topics** have you been trained in? (LISTED any known CCBA topics/training demos in this table, based on input from COP and CCBA staff and resource persons)

Demonstration or training topics	YES Mark(x)	Which of these are the most useful to you? (mark x)	Which are the least useful/least practical?(mark x)
Follow safe and good production practices (IPM)			
Harvesting at the proper stage/ time (color, shape, fullness etc.)			
Use of Harvesting tools (secateurs/ sharp knife)			
Keeping in shade			
Careful handling			
Cleaning/washing			
Improved containers (crates, baskets)			
Sorting/grading			
Wrapping with leaves in case of cauliflower/ cabbages			
Spraying water to keep product cool during packing of egg plant			
Processing practices (adding value)			

5) Are you using any of the information that you learned about in the CCBA training programs?

YES ___/ NO___

Demonstration or training topics	If YES, mark with an X	Have you invested in a new postharvest practice/tool/ handling method?
Follow safe and good production practices (IPM)		
Harvesting at the proper stage/ time (color, shape, fullness etc.)		
Use of Harvesting tools (secateurs/ sharp knife)		
Keeping in shade		
Careful handling		
Cleaning/washing		
Improved containers (crates, baskets)		
Sorting/grading		
Wrapping with leaves in case of cauliflower/ cabbages		
Spraying water to keep product cool during packing of egg plant		
Processing practices (adding value)		

If you marked any of the topics/demos investments with a YES, please give us a few more details:

How are you using what you have learned?

How much have you invested?

Do you work in cooperation with others?

Have you reduced food losses?

Have you increased your profits?

What additional training (topics) do you think are needed?

If you answered NO, what keeps you from adopting and/or using improved postharvest practices/technologies?

6) If the CCBA project did not exist, where would you go to get training in postharvest handling/food processing, and to find postharvest demonstrations and advice?

SERVICES (cleaning, sorting/grading, packing, pre-cooling, cold storage, cool transport, etc.)

7) Are you aware of any services being offered by the CCBA? YES ____ / NO ____

If YES, please describe:

Service	details	What is the fee? (if known)

Do you think these services are beneficial? YES_____ / NO _____

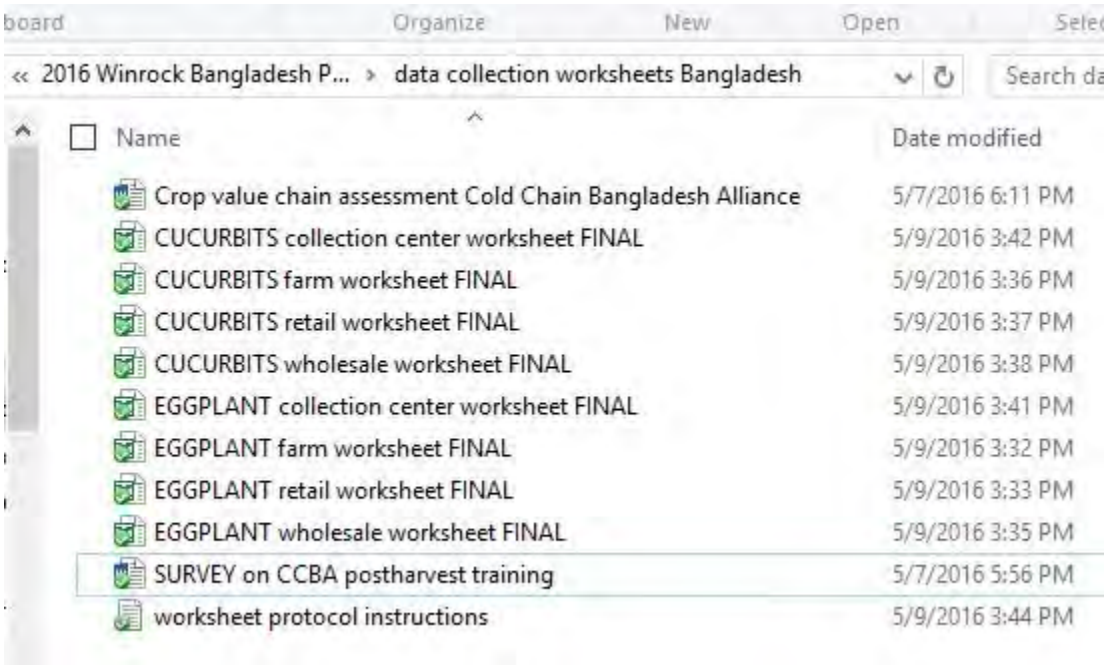
If yes (or no), why?

What additional services do you think are needed?

Where would you have to go to purchase any needed postharvest goods, tools and supplies?

Measurements of postharvest losses and quality worksheet

Data collection worksheets in MS Excel and data collection protocols were used for farm, collection center and market measurements. (screenshot of files, available via dropbox link).



Simplified cost/benefit worksheet

Complete for any observed IMPROVED postharvest handling technology or practice:

Assume harvest 100 kg or 1000 kg Crop_____ Country/Region_____

	Current Practice	New Practice
Describe:		
COSTS		
Relative cost		

EXPECTED BENEFITS		
% losses		
Amount for sale		
Value/kg		
Total market value		
Market value minus costs		
Relative profit		
ROI		

Annex B. List of the people interviewed

DATE	NAME	AFFILIATION	LOCATION
15-May	Dr. A. B. Siddiqui	CCBA, Chief of Party	Gulshan-1, Dhaka
15-May	Mustabshira Jannat	CCBA, Monitoring Officer	Gulshan-1, Dhaka
15-May	Md. Shahadat Hossain	CCBA, Field Coordinator Jessore	Gulshan-1, Dhaka
15-May	Dr. Monirul Haque	CCBA, Supervisor	Gulshan-1, Dhaka
16-May	Md. Rabiul Islam	CCBA Hurgati Collection Center: Farmer (Brinjal)	Hurgati, Jessore Region
16-May	Md. Jahangir	CCBA Hurgati Collection Center: MPC Secretary: Farmer (Brinjal)	Hurgati, Jessore Region
16-May	Md Nazmul Huda	CCBA Hurgati Collection Center: MPC President: Farmer (Brinjal)	Hurgati, Jessore Region
16-May	Md Josim Uddin	CCBA Hurgati Collection Center: Farmer (Brinjal)	Hurgati, Jessore Region
16-May	Md. Jabbar	CCBA Hurgati Collection Center: Farmer (Brinjal)	Hurgati, Jessore Region
16-May	Md. Monirul Islam	BARI, Scientific Officer, (Resource Person)	RARS, Jessore
17-May	Md. Sree Chitta Kumar Ghosh	CCBA Birnaryonpur Collection Center: Farmer (Bitter Gourd)	Birnaryonpur, Jessore Region
17-May	Md Abdul Alin	CCBA Birnaryonpur Collection Center: MPC Secretary: Farmer (Bitter Gourd)	Birnaryonpur, Jessore Region
17-May	Md. Mofizur Rahman	CCBA Birnaryonpur Collection Center: Farmer (Bitter Gourd)	Birnaryonpur, Jessore Region
17-May	Md. Abdul Kashem	CCBA Birnaryonpur Collection Center: Farmer (Bitter Gourd)	Birnaryonpur, Jessore Region
17-May	Md. Sanar Uddin	CCBA Birnaryonpur Collection Center: Farmer (Bitter Gourd)	Birnaryonpur, Jessore Region
17-May	Md. Sukumar Ahush	CCBA Birnaryonpur Collection Center: Farmer (Bitter Gourd)	Birnaryonpur, Jessore Region
17-May	Md. Mofizul Moller	CCBA Birnaryonpur Collection Center: MPC VP: Farmer (Bitter Gourd)	Birnaryonpur, Jessore Region
17-May	Md. Amzad Ali	Non CCBA: Farmer (Bitter Gourd)	Birnaryonpur, Jessore Region
17-May	Md. Robel Hossain	Non CCBA: Farmer (Bitter Gourd)	Birnaryonpur, Jessore Region
17-May	Md. Upananda Ahesh	Non CCBA: Farmer (Bitter Gourd)	Birnaryonpur, Jessore Region

17-May	Md. Abdul Wahab	Non CCBA: Farmer (Bitter Gourd)	Birnaryonpur, Jessore Region
17-May	Md. Boslur Rahmen	Non CCBA: Farmer (Bitter Gourd)	Birnaryonpur, Jessore Region
17-May	Md. Rasel Kabir	Non CCBA: Farmer (Bitter Gourd)	Birnaryonpur, Jessore Region
17-May	Md. Ayub Ali	Non CCBA: Trader (Bitter Gourd)	Birnaryonpur, Jessore Region
18-May	Md. Abdul Ruddas	CCBA Hurgati Collection Center: Farmer (Brinjal)	Hurgati, Jessore Region
18-May	Md. Aminur	CCBA Hurgati Collection Center: Farmer (Brinjal)	Hurgati, Jessore Region
18-May	Md. Mojaffar	CCBA Hurgati Collection Center: Farmer (Brinjal)	Hurgati, Jessore Region
18-May	Md Shameem	CCBA Hurgati Collection Center: Farmer (Brinjal)	Hurgati, Jessore Region
18-May	Md. Ruhul Amin	CCBA Hurgati Collection Center: Farmer (Brinjal)	Hurgati, Jessore Region
18-May	Md. Azad	CCBA Hurgati Collection Center: Farmer (Brinjal)	Hurgati, Jessore Region
18-May	Md. Atiar Rahman	CCBA Hurgati Collection Center: Farmer (Brinjal)	Hurgati, Jessore Region
18-May	Md. Abu Taher	CCBA Hurgati Collection Center: Farmer (Brinjal)	Hurgati, Jessore Region
18-May	Md. Sharikul Islam	CCBA Hurgati Collection Center: Farmer (Brinjal)	Hurgati, Jessore Region
18-May	Md. Rabiul Islam	Non CCBA Farmer (Brinjal)	Hurgati, Jessore Region
18-May	Md. Rubel Hosan	Non CCBA Farmer (Brinjal)	Hurgati, Jessore Region
18-May	Md. Shaddam	Non CCBA Farmer (Brinjal)	Hurgati, Jessore Region
18-May	Md. Rabiquzzaman	Non CCBA Farmer (Brinjal)	Hurgati, Jessore Region
19-May	Md. Enamul Kabir	CCBA Nangapur Collection Center Farmer: (Bitter Gourd)	Nangapur, Jesssore Region
19-May	Md. Obaidul	CCBA Assistant Field Coordinator: Jessore	Nangapur, Jesssore Region
19-May	Md. Jony	CCBA Nangapur Collection Center Farmer: (Bitter Gourd)	Nangapur, Jesssore Region
19-May	Md. Yar Ali	CCBA Nangapur Collection Center Farmer: (Bitter Gourd)	Nangapur, Jesssore Region
19-May	Md. Ranju	CCBA Nangapur Collection Center Farmer: (Bitter Gourd)	Nangapur, Jesssore Region

19-May	Md Abu Sayed	CCBA Trader: Co Chairman Khajura Bazaar Association (Wholesale)	Khajura Bazaar Jessore Region
19-May	Md. Kalam Khan	CCBA Trader: Member Khajura Bazaar Association (Wholesale)	Khajura Bazaar Jessore Region
19-May	Md. Faruk	CCBA Trader: Member Khajura Bazaar Association (Wholesale)	Khajura Bazaar Jessore Region
19-May	Md. Sharifal Islam	Non CCBA Trader: Member Khajura Bazaar Association (Wholesale)	Khajura Bazaar Jessore Region
19-May	Md. Binoy Bisivas	Non CCBA Trader: Member Khajura Bazaar Association (Wholesale)	Khajura Bazaar Jessore Region
22-May	Most. Sadia Arfin	Postharvest Specialist, BARI, Scientific Officer, Postharvest Technology	Dhaka
22-May	Md. Faruq bin Hossain Yamin	Postharvest Specialist, BARI, Scientific Officer, Postharvest Technology	Dhaka
25-May	Md Abu Islam	Non CCBA Trader Gazipur Bazaar	Gazipur
25-May	Dr. Md. Rafiqul Islam Mondal	BARI, Director General	Joydepur, Gazipur
25-May	Engr. Dr. Md. Israil Hossain	BARI, Chief Scientific Officer & Head Farm Machinery & Postharvest Process	Joydepur, Gazipur
25-May	Engr. Dr. Md. Miar Uddin	BARI, Chief Scientific Officer & Head Postharvest Technology	Joydepur, Gazipur
25-May	Dr. Md. Mizanur Rahman	BARI, Senior Scientific Officer Postharvest Technology	Joydepur, Gazipur
25-May	Dr. Md Abu Taher Masud	BARI, Cucurbit and Tomato Breeding	Joydepur, Gazipur
26-May	Md. Ashfaq Ahmed	CCBA Staff: Training	Gulshan-1, Dhaka
26-May	Md. Alam	Manager Bashar Agro Food Products handled CCBA product	Gulshan-1 Dhaka
26-May	Md. Adrul	Receiving Manager Agora Supershop	Gulshan-1 Dhaka
26-May	Md Hossain	Trader Norda Bazaar	Norda District, Dhaka
27-May	Assistant for Md. Afjal	Trader Kawran Bazaar (affliated with Md. Sayed: CCBA Trader)	Kawran Bazaar, Dhaka
27-May	Assistant for Md. Mostofa	Trader Kawran Bazaar (affliated with Md. Sayed: CCBA Trader)	Kawran Bazaar, Dhaka
27-May	Md. Zakir	Non CCBA Trader Kawran Bazaar	Kawran Bazaar, Dhaka
29-May	Dr. A. B. Siddiqui	CCBA, Chief of Party	Gulshan-1, Dhaka
29-May	Md. Shahadat Hossain	CCBA, Field Coordinator Jessore	Gulshan-1, Dhaka

30-May	Dr. A. B. Siddiqui	CCBA, Chief of Party	Gulshan-1, Dhaka
30-May	Md. Shahadat Hossain	CCBA, Field Coordinator Jessore	Gulshan-1, Dhaka
31-May	Md Nizam Chowdhury	CCBA head of Marketing	Gulshan-1, Dhaka
31-May	Dr. A. B. Siddiqui	CCBA, Chief of Party	Gulshan-1, Dhaka
31-May	Md. Shahadat Hossain	CCBA, Field Coordinator Jessore	Gulshan-1, Dhaka
1-Jun	Dr. A. B. Siddiqui	CCBA, Chief of Party	Gulshan-1, Dhaka

Annex C. Commodity system assessment / crop value chain reports for brinjal and bitter gourd: causes and sources of postharvest losses and quality problems

The following two reports are compiled from formal and informal interviews, surveys, literature reviews, and direct observations of the evaluation team. For each crop, the evaluation team has described key postharvest handling practices and issues in Bangladesh, and identified any research needs, extension/training needs and advocacy issues that can be incorporated into Winrock International's plans for future projects in Bangladesh and the South Asian region.

Commodity System Assessment (CSA): Brinjal in Bangladesh May-June 2016

Lizanne Wheeler, Charity Hanif, Lisa Kitinoja and Most. Sadia Arfin
Compiled notes and observations for the CCBA Project

Brinjal (cv. BARI Begun-6) harvested near the CCBA Hurgati collection center

Pre-Production

Component 01: **Importance of the crop**

Brinjal (Solanum melongena L.) belongs to the family Solanaceae. It is also known as eggplant, aubergine and aurbagin. In Bengali it is called 'Begun'. Year round availability, area coverage and total production makes it a popular and important vegetable of Bangladesh.

Area and production of Brinjal (2009-2010)

	Season	Total area under cultivation of brinjal (in acres)	Production (in metric tons)
Bangladesh	Rabi Brinjal	71047	216182
	Kharif Brinjal	44377	125080

Source: Bangladesh Bureau of Statistics, Year Book, 2010

Brinjal is eaten as part of the regular diet of the Bangladeshi people due to its distinct color, size, shape and taste.

Wide range of genetic diversity of Brinjal is present in Bangladesh.

High Yielding Varieties and local cultivars of Brinjal in Bangladesh include:
BARI Begun-1 (yields 50-60 t/ha)
BARI Begun-2 (70-75 t/ha)
BARI Begun-4 (50-55 t/ha)
BARI Begun-5 (40-50 t/ha)

BARI Begun-6 (45-50 t/ha)
BARI Begun-7 (35-40 t/ha)
BARI Begun-8 (20-25 t/ha)
Shingnath (40-45 t/ha)
Islampuri (20-25 t/ha)
Khotkhotia (25-30 t/ha)
Dohazari (25-30 t/ha)
Source: Vegetable production training manual (Bangladesh Agricultural Research Institute, 2009)

Component 02: **Governmental policies**
There are no Governmental policies specifically related to cultivation of Brinjal.

Component 03: **Relevant institutions**
Agencies and their Responsibilities or Project Goals

- Ministry of Agriculture -- Planning and Monitoring National Agricultural Technology Project (NATP) - Increase production
- Bangladesh Agricultural Research Council -Planning, Coordination and Monitoring, NATP Technology development and increase crop production, Transfer modern technologies and adaptation
- Department of Agricultural Extension (DAE) -Production, Processing and Marketing Implementation
- Bangladesh Agricultural Research Institute - Research Implementation, Variety/ Technology Development (examples: HYV Brinjal variety development; Bt. Brinjal variety development)
- Bangladesh Agricultural Development Corporation --Seed production and Marketing Implementation, Quality seed production and distribution
- Agricultural Universities- Research Variety/ Technology Development
- HORTEX Foundation - Export development

Source: Department of Agricultural Extension

Farmer interviews found CCBA linked producer with DAE (Department of Ag Extension) and received DAE training. CCBA producer would hope that the Upzilla Ag Officer and/or DAE would provide advice or training; but hasn't so far.
Non-CCBA farmers noted no link with BARI or DAE. They go to older or more experienced farmers for advice.

Component 04: **Facilitating services**
Inputs:
Seed: Bangladesh Agricultural Development Corporation, Bangladesh Agricultural Research Institute Private Seed Companies (ACI, Lal Teer, Suprim, Gatco, Metal etc.)
Fertilizers: Bangladesh Agricultural Development Corporation
Irrigation: Bangladesh Agricultural Development Corporation, Ministry of Agriculture
Postharvest tools (baskets, crates, secateurs, and plastic sheeting) can be purchased in Khajura Bazar or Jessore.

Technical advice: Department of Agricultural Extension, Bangladesh Agricultural Research Institute Private Seed Company (ACI, Lal Teer, Suprim, Gatco, Metal etc.), NGOs
CCBA affiliated farmers and traders get advice form the CCBA project

Non-CCBA farmer uses pesticide seller for information and advice. These ag input dealers send a field rep/supervisor out to the field to diagnose/advise.
Non-CCBA farmers noted their networks of transporters, pesticide applicator and pesticide sellers, share transport hire with other farmers.

Subsidies: Ministry of Agriculture
Credit: Bangladesh Agricultural Development Bank, NGOs- Micro credit (Gramin Bank, ASA, PROSHIKA, BRAC etc.)

Transportation: (Truck service) Bangladesh Road Transportation Corporation

Component 05: **Producer/shipper organizations**
Producer/shipper organizations in Jessore region include a collection center in Hurgati managed by farmers under the CCBA project. Producers are loosely linked with traders and transporters.

Component 06: **Environmental conditions**
The environmental conditions of Bangladesh are suitable for Brinjal cultivation.
Source: Vegetable production training manual (Bangladesh Agricultural Research Institute, 2009) and Fertilizer Recommendation Guide (Bangladesh Agricultural Research Council, 1997)

Component 07: **Availability of planting materials**
Private seed companies are multiply seeds of BARI varieties/ popular local cultivars and some imported varieties.
Seeds of Bangladesh Agricultural Development Corporation is available
Quality seeding production nurseries are available; seedlings are sold in local market over the season.

Production
Component 08: **Farmers' general cultural practices**
Farmers try to maintain soil moisture at field capacity level. They irrigate Brinjal fields at 7-8 days intervals in winter and 6-7 day intervals during summer, with this they ensure proper drainage.
Most of the farmers follow clean cultivation and crop rotation practices to avoid Pest and disease.

CCBA producers noted that they used to leave damaged fruit and plants in the field; but now remove from the field. Fed culls to the cattle and livestock.
CCBA farmers noted production training as most important.

Component 09: **Pests and diseases**
Table 06. Major disease and insect of Brinjal in Bangladesh

Diseases
- Phomopsis Bight
- Wilt

Insects
- Brinjal shoot and fruit borer
- Leaf hopper
- Epilacna beetle

- White fly

CCBA introduced pheromone traps which farmers reported had reduced pest damage in both crops. Some communities had abandoned eggplant production due to pest damage prior to CCBA. The introduction of pheromone traps encouraged them to re-enter eggplant production.
Pheromone traps were most valuable new practice.
Non-CCBA farmers were curious about the pheromone traps and assumed they were expensive.

Component 10: **Pre-harvest treatments**
To increase flower/fruit production liquid micro nutrient solution and PGRs are applied.
Growth regulators (PGRs) are applied over the flowering stage which increase effective flower and promote fruit growth.
Removal of buds below the first branch can increase number of fruits, individual fruit weight, total production and fruit quality of Brinjal.
Farmers are not conscious about the overdose applications of pesticide. They apply pesticide at 45 days interval. They mixed several pesticides together and use it. Farmers call this mixture as "Costello". This can be a food safety danger, since in the most cases Brinjal are harvested within the residual time.
In some cases limited use of sex pheromone trap and biological control measure were observed.
Fruit thinning usually is not practiced but farmers remove the older and diseased leaves.

Non-CCBA farmer noted that losses are high. He noted insect damage, nutrient deficiency, and rain damage. He loses 5 mon (40kg) or 200kg total from his .14 acre of eggplants/season.

Three Non-CCBA farmers reported examples of their estimated losses due to insect damage and rain damage:
.84 acre 3,000kg production; with a loss of 850kg (28%)
.42 acre 1800kg production; with a loss of 550-560kg (30%)
.62 acre 2400kg production; with a loss of 800kg (33%)

Component 11: **Production costs**
Farmers often do not estimate their production costs stepwise. They only estimate the total cost of production and total income, and then calculate either they have profit or loss.
Profit / loss estimation (as per farmers' rule):

Net income (Tk/ Decimal) = total income – total cost of production (excluding labour cost)
= 2,500 Tk – 1000 Tk = 1500 ± 500 Tk

* For example when average Wholesale market value of Brinjal = 15 Tk/kg

Postharvest
Component 12: **Harvest**
5-6 month harvest (Feb through June)
Harvesting time of Brinjal depends on the distance of wholesale and local markets
Farmers harvested their produce at the cooler part of the day early in the morning or at evening.
For wholesale market, distant producer harvested between 4 to 6 pm before the day and nearest producer harvested at the morning between 5 to7 am.
Producers harvest Brinjal at the morning between 5 to 9 am for local market.
Generally farmer himself and his family members engaged in harvesting operation.

Harvested fruits are gathered between the rows at first then gunny bags are used to carry harvested produce
Farmers measure the maturity by eye estimation and experience. Sometimes Maturity of the fruit is checked by pressing the thumb against the side of the fruit.

CCBA trained farmers train labor to pack and handle produce; more diligent and higher specifications when prices are higher
CCBA farmers know where to find secateurs in local markets.
CCBA farmer comment - Market demand for medium size with good green coloring (maturity based on size and color).
Non-CCBA farmers called 'good looking' fruit a maturity index (based on their experience).
Non-CCBA farmer noted using a hand sickle early in the season to protect the plants.
Use of the hand sickle resulted in damage and cuts on other fruit.

Towards end of season – when they will be pulling the plants out soon – they (CCBA and non-CCBA) harvest by hand as they don't worry about plant damage.

Component 13: **Grading, sorting and inspection**
After harvesting farmer himself sorted the produce based on size, shape, color, disease status and insect infestation.
Value/price differs according to the quality and size of the fruits.
Grade Quality * Price (Wholesale market) examples:

- Grade A High 17-20 Tk/kg
- Grade B Medium 14-15 tk/kg
- Grade C Low 11-12 tk/kg
- Grade D Damaged 3-5 tk/kg

* Farmers selling price at wholesale market varies widely at different points in the season. When brinjal market supplies are very high, prices can be extremely low.

There are no local, regional or national standards (voluntary or mandatory) exist for inspection.
Damaged fruits are sold at very lower price in local market after removing the damaged portion. The poorest people are the consumer of that produce.

Farmer interview: Trader brings scales and production is now sold by weight.

Using plastic sheeting for sorting surface.

Where there are collection centers, the size is limited – farmers continue to grade, sort, and pack near their farms and/or need to stagger their utilization of the formal collection center shade and water. Some of the staggering though occurs naturally as the necessary shipment times vary between the different markets – with the local and district markets starting earlier and the Kulna and Dhaka markets either afternoon/evening and/or overnight.

One CCBA farmer noted that they were trained to grade and they came up with their 3 grades.
CCBA farmer noted 3 grades in early season: Best, Okay, and '2nd grade' (with slight blemishes). Best is perfect; okay is pretty darn good, but not perfect; 2nd grade has some blemishes, but no significant damage.
Grading resulted in higher overall price (no estimate of average difference was provided)

Non-CCBA farmer noted 2 grades. Sorts into good and worse; based on damage. Doesn't grade by size or color. Other non-CCBA noted good versus insect damage.
Non-CCBA farmers noted traders don't give them feedback on grading, sorting, or market demand.
Field (or immediately after harvest) grading will remove overmature, blossom end rot, and loose/split at calyx end (due to over fertilization.)

Component 14: **Postharvest treatments**
Farmers dip the produce in water bucket/drum for cleaning after harvest and water splash is used further from wholesale market to retailer to keep the fruits clean, fresh, shiny and attractive.
In retail markets, retailers apply a small amount of mustard oil to enhance the shine of fruits.

Gentle handling – level of gentle handling really depends on the price/margin (both CCBA and non-CCBA farmers)
CCBA farmers are now using deep well for washing and handling; before using deep well or pond water, whatever was convenient. Non-CCBA noted they use an open pond.
CCBA farmer noted they handle more gently earlier season, when the fruits are softer. The fruit gets tougher (skin) as the season progresses.
The washing/cleaning is running through water. One CCBA farmer noted it is a new practice, but many other CCBA and non-CCBA farmers noted that it isn't an uncommon practice outside of CCBA. Use of clean water is the new practice.
Pre-cooling and use of secateurs were the new practices. Most everything else had been practiced before but now doing with more diligence.

Non-CCBA farmer said that he uses shade and then cleans/washes as he is packing.
Non-CCBA farmers noted that their practice is to place the product on grass in the shade after harvest – not on dirt or in mud.

Component 15: **Packaging**
Brinjal is traditionally packed 50 kg or more in used nylon bags, bamboo baskets and gunny bags.

Plastic Crates may not always be large enough for what they were harvesting; increase labor during packing; and more expensive labor during loading/transport. Farmers and traders report that they want 40-50kg capacity crates to be more practical

Non-CCBA producers are interested in crates – believe they might save their produce; but have no experience.

Use Jute and/or baskets depending on product and/or price
At times CCBA producers put a 200kg bamboo basket inside the jute bag; with extended packing in bag on top. Other times they placed a damp jute bag inside the bamboo basket.
Farmers (CCBA and non-CCBA) noted that one packs eggplants tight (being a bit rough in packing bags and baskets) for less jostling on rough roads. Also is a bit rough to get many in one basket.

Bamboo baskets and crates seem readily available to purchase and CCBA farmers said they were informed where to find them.

CCBA shared tools were often reported as being kept at the home of the President and needed to be borrowed.

Many CCBA and other farmers noted that spraying water on packed fruit (or adding water over a packed basket/bag of eggplant) was already known; but now CCBA farmers use clean water.
Non-CCBA noted adding water/spraying only when very hot.

Improved containers based on market demand (traders and type of transport used):
Kulna wants packed in baskets
Dhaka – in crates when price is high
Sylhet – in Jute bags.
This non-CCBA farmer uses a large jute bag – 200kg.
Jute bag costs 50tk/bag and only can be used twice (according to a trader.) Buyer deducts 1kg from jute bags automatically (to compensate for loss.)
Large bamboo basket was 8-9kg; the small bamboo basket was 3kg, and the metal bowl was 1kg.

Component 16: **Cooling**
Cooling is recommended for keeping quality, freshness and shelf life of the commodity but no such treatment is traditionally used at any of the farms, wholesale markets or retail markets.
In wholesale and retail market, trader apply sprinkling water on the produce to keep it cool and fresh.

Observation: Many said they used pre-cooling and/or shade but then reported only washing and/or not shifting with shifting sun (as shade moved) and/or the shaded areas are already full.

Shade was a practice they already knew about (CCBA training covered this topic). Non-CCBA farmer also noted using shade to reduce temperatures.

Pre-cooling – CCBA farmer noted it is necessary for a better price.
CCBA farmer noted that early harvest they hire labor for pre-cooling; when prices are higher. Later harvest; main season when prices are low – they wash the fruit themselves.
Only pre-cool for 5 minutes in January-February. Higher prices, but cooler ambient temperatures. They don't remember how long they were trained to pre-cool.
A CCBA farmer noted that pre-cooling with water actually means changing the water (as the water absorbs field heat.) Leaves 10-15 minutes to cool.

Component 17: **Storage**
Storage facilities are absent for Brinjal in Bangladesh. If kept it under shade at ambient condition they can be kept for 1-2 days in summer and 2-3 days in winter season without any apparent damage.

CCBA farmer noted that he had never heard of any vegetables in cold storage other than potato.

Component 18: **Transport**

- Van, Rickshaw, three wheeler are used for short distance transportation of produce. Transport time below 1 hour.
- Mini trucks are generally used for medium distance transport within the district. Transport time below 2 hours.

- Heavy trucks are generally used for long distance transport within the country. Transport time below 12 hours.

Various types of produces are loaded together in a vehicle, which are usually overloaded (carrying 2 or 3 times as much as their rated capacity). After loading the top covered by triple/ non perforated polythene. During loading and unloading iron hooks are used. Produce was often handled roughly and arrives damaged.

Farmer interview: personally rented 3 wheel 'van' to send product from collection center to market
Farmer interview: 3 Ton truck needed; 3 Ton truck most appropriate due to the size of road; otherwise the truck parks further away and they use the bicycle and 3-wheeled 'vans' to ferry from farms and collection points to the truck. One CCBA farmer noted that a covered truck would be ideal.
USAID assisted with road surfacing for key market access road for Hurgati

Many CCBA farmers noted coming together to hire a truck together to take their product to market. Still selling as individuals. They would still each go with their product most of the time to sell; but would jointly hire the vehicle. One CCBA farmer noted that aggregated hiring of transport also not a new practice.

One non-CCBA farmer always uses the same transporter to ship to Kulna and ships with the same 5 farmers on aggregated transport hire.
Non-CCBA farmer noted that transport cost into Kulna market an obstacle.
One non-CCBA trader spoken to rents truck transport. Can rent a 6 ton, 8 ton, or 10 ton truck, depending on how much he is moving. He goes into Dhaka market. Uses a rented Nosiman to ferry product from collection center to the larger truck, which is too large for the road to get to the collection center set off of a smaller rural road.

Component 19: **Delays/ waiting**

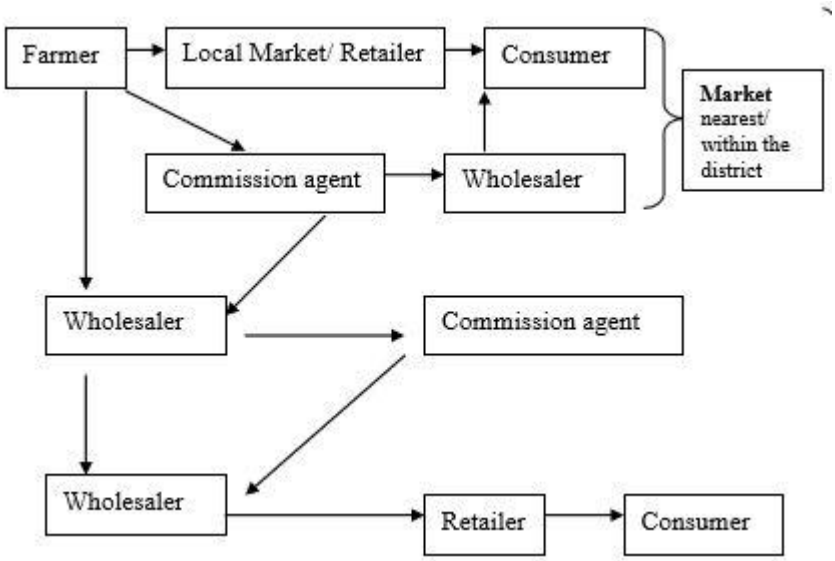
- Farm to local market: Negligible delays
- Farm to wholesale market: Below 2 hours to arrival of the produce and purchase by the wholesaler
- Wholesale market to distant wholesale market 2-8 hours between arrival of the produce and purchase by the wholesaler
- Distant wholesale market to retail market 2-3 hours from arrival of the produce and purchase by the retailer
- Retail market 8-10 hours until purchase by the consumer

When transport delays or stops occur, may sit in high heat.

Component 20: **Other handling**
Poor handling practices reduce the quality of the produces due to scarcity of well-trained labor. Supporting infrastructure is inadequate.

Component 21: **Agro-processing**
There are no separate units for agro processing of Brinjal
Bangladesh Agricultural Research Institute develop a technology of Brinjal pickling production. Some agro processing industry are testing the market.

Marketing
Component 22: **Market intermediaries**
The marketing chain for Brinjal is very long and involves 3-6 intermediaries
Basically middlemen are responsible for losses due to poor postharvest handling. Finally consumers are suffering financially.
Supply chain of Brinjal involves the following types of intermediaries:



Broker commission (for us of stall to sell) is 1tk/kg. Standard in Kulna and Karwan Bazar (Dhaka.) Kulna stalls are owned by wealthy men, then rented to Arotdar (the brokers) who then collect commissions from farmers who sell from them.

Trader linkages facilitated by CCBA program – introduced traders to CCBA communities and took CCBA farmers to meet traders and brokers within the main district markets.

Khajura market requires traders to be members of a traders' association. 62-63 members; 10 in leadership. Traders pay 10tk/mon (40kg) traded through the market. 10% of that goes to the Government for the market and market services and 5% goes to UNO (some government body who holds as a savings.

One of the CCBA traders noted that use of secateurs (and/or small blades) very important to reduce damage to the other fruit.

Both CCBA and non-CCBA traders noted that more scales and larger scales are important for the market. 300-500kg capacity of scales. Traders said that often the farmers come into the market without having weighed their product.

Non-CCBA trained farmers mentioned that Khajura market will soon have some shade constructed. Some traders will share transport hire when they can't fill a truck themselves.

Traders noted they don't have time for training – learn from other another.

Component 23: **Market information**
Handlers and marketers are planned their marketing strategies by current market information. They collect recent information via direct contact with the agent/ wholesaler/ retailer using cell phones. Marketing Department (Ministry of Trade), Marketing Wing (Department of Agricultural Extension), Bangladesh Bureau of Statistics and FAO gather the market information but in most cases their information are not consistent and can be confusing.
Tend to head to local and/or regional markets versus larger distance markets when prices are lower.

Market access and reliability were cited by CCBA farmers as important bottlenecks or areas for additional training. Program did offer valuable linkages (introductions, farmer tours of markets and individual introductions to traders, and similar linkages, as noted by the farmers.) But additional timely seasonal intelligence seemed to be being requested.

Farmers use their cell phone to call traders in advance of the day they intend to market in order to decide which market to send to their product (because the time of harvest and shipment depends on the target market.)

One CCBA farmer noted that going to Dhaka Kawran market directly after his produce was used in the refrigerated truck study.

One non-CCBA farmer usually goes to Kulna, Jessore, and Munirapur district market. He has gone to Karwan in Dhaka 3 times. This farmer has his own van as a side business (but his typical markets are outside the range of his van.)

One CCBA- trained trader noted he graded eggplant by skin smooth, no shrivel, shape, and size. Generally 3 grades. This CCBA trained trader sells the best and medium grades to Dhaka market. The bottom grade sells into local markets. CCBA farmer produced product has a longer shelf life, makes better grades. He packs the eggplant into various size eggplant baskets including 20kg up to 200kg. In a basket, he might lose 2kg of 15kg (13%). He doesn't lose any in crates. Unfortunately only 1 size crate is available and it is a bit small for eggplant. Says the that the market in Dhaka has been very responsive to his grading and sorting. Other traders in Khajura market have watched his grading and sorting and started to follow. He uses the same Arodar (only 1.)

In rating the farmer practices – he prioritizes (in order or preference): secateurs, (stem long so it doesn't dry out), gentle handling, and removing the heat. In packing – don't poke the stem into the other fruit.

Non-CCBA trained traders in Khajura bazar noted that if they could tell the farmers something they would ask for shape, low water loss, good quality, and low stress.
These non-CCBA traders noted that most of the loss they see is between the farm and themselves due to bumpy roads, pressure, and handling.
Non-CCBA traders noted that eggplant has a 6 month harvest season with an average price of 30tk/kg over that season with a maximum price of 100tk/kg (noted Ramadan prices.) Average daily volume was roughly 50 mon (40kg) or 2,000kg/day of trading.

Ramadan is a peak veg season with high prices. Try to hold out, even if it is past its prime.
Last year one farmer reported getting 45tk/kg during Ramadan.

The day we were there to observe, the ungraded price (no premium for graded) was 3-5tk/kg. There may occasionally be premiums by variety, but Hurgati where we visited only produced one variety, a local variety.

Component 23: **Consumer demand**
In case of Brinjal region specific varietals preferences is observed. Some of the varieties have common preferences.
Consumer preference depends on produce characteristics (sizes, flavors, colors, maturities, quality grades) and purchase ability.
Retail price become high 60- 80 Tk/ kg during early and late season but in season 25-40 Tk/kg.
Frequent insecticide application makes health and environmental hazards. Residue or food safety inspection is limited / absent in the market. Though it is unseen but in Bangladesh most of the perishable commodities are treated with harmful or toxic chemicals. Consumers are conscious about the hazard, sometimes they react but they are bound to purchase it because they have no alternatives.

Component 25: **Exports**
None of the contacted farmers are related to export of Brinjal.

One CCBA trained trader noted that the previous year his nephew took his product for export to the diaspora market in the Middle East.

Component 26: **Postharvest and Marketing costs**
Farmers and traders were quite informative. So, postharvest and marketing cost related information is unavailable.

The handlers/ marketers have access to credit / Bank loan with 15-18 % interest. Some of them collect money from merchant man (Mohajon) 10 Tk/ 100 Tk/ day. They still make a profit about 1000-3000 taka/ day and repay the loan with interest at the end of the day.

Supporting infrastructure is not adequate. Most of the wholesale market situated at open ground near the road side.

Roads condition is quite good but rough. Marketing facilities and management skills of staff are limited. Cell phone communication is available there.

General Observational Notes: Poor handling practices reduce the quality of the produce. Cool chain management is typically totally absent. Proper market management, infrastructure development, health safety rules, a consistent quality grading system and temporary storage facilities would be welcome developments for the region and for Bangladesh in general.

Commodity System Assessment (CSA): Bitter Gourd in Bangladesh May-June 2016

Lizanne Wheeler, Charity Hanif, Lisa Kitinoja and Md. Faruq bin Hossain Yamin
Compiled notes and observations for the CCBA Project

Pre-Production
Component 01: **Importance of the crop**
Bitter gourd (Momordica charantia) belongs to the family Cucurbitaceae. Other English names are Bitter melon and Bitter cucumber. In Bengali it is called 'Korola'. Bitter gourd is the only bitter tasting vegetable of Bangladesh, widely produced and popular all year.

Area and production of Bitter gourd (2009-2010):

- Total area under cultivation: 22143 acres
- Production: 41419 in metric tons

Sources: Bangladesh Bureau of Statistics, Year Book, 2010

Bitter gourd has medicinal value. It is used as medicine for Diabetics, Skin diseases and Asthma patients. A 2014 review shows evidence that bitter gourd, when consumed in raw or juice form, can be efficacious in lowering blood glucose levels. Ref: Bachok, M. F.; Yusof, B. N.; Ismail, A; Hamid, A. A. (2014). "Effectiveness of traditional Malaysian vegetables (ulam) in modulating blood glucose levels". Asia Pacific Journal of Clinical Nutrition 23 (3): 369–76.

High yielding varieties of Bitter gourd are limited in Bangladesh.

- BARI Korola-1 (Open pollinated Variety)
  Yield 25-30 t/ ha

- Gaz Korola (Open pollinated Variety)
  Yield 20-25 t/ha

- Tia (Hybrid Variety)
  Yield 30-35 t/ha

Component 02: **Governmental policies**
There are no Governmental policies regarding Bitter gourd.

Component 03: Relevant institutions

- Ministry of Agriculture
- Bangladesh Agricultural Research Council
- Department of Agricultural Extension
- Bangladesh Agricultural Research Institute
- Bangladesh Agricultural Development Corporation
- Agricultural Universities
- HORTEX Foundation
- Bangladesh Institute of Nuclear Agriculture

Source: Department of Agricultural Extension (DAE)

Component 04: **Facilitating services**
Facilitating services provider of Bitter gourd
Inputs:
Seeds: Bangladesh Agricultural Development Corporation
Bangladesh Agricultural Research Institute Private Seed Company (ACI, Lal Teer, Suprim, Gatco, Metal etc.)

Fertilizers: Bangladesh Agricultural Development Corporation

Irrigation: Bangladesh Agricultural Development Corporation
Ministry of Agriculture

Technical advice:
Department of Agricultural Extension
Bangladesh Agricultural Research Institute
Private Seed Company (ACI, Lal Teer, Suprim, Gatco, Metal etc.)
NGOs

Subsidies: Ministry of Agriculture
Credit: Bangladesh Agricultural Development Bank
NGOs- Micro credit (Gramin Bank, ASA, PROSHIKA, BRAC etc.)

Transportation (Truck service): Bangladesh Road Transportation Corporation
Source: Department of Agricultural Extension (DAE)

Farmer interview: CCBA linked producer with DAE (Department of Ag Extension) and received DAE training
CCBA farmers noted a hope that some other organization or public institution would step in, but value the high quality of CCBA training.
CCBA Field Coordinator linked them with Ag Field Block Supervisor and various Resource persons.

Non-CCBA farmers noted they would go to DAE or nearby farmers for advice and/or information.

Some farmers reported socially gathering within the community at a chai shop or other venue to share relevant farming and marketing information every 10-15 days.

One farmer noted that soil testing availability would be useful and important service.

Component 05: **Producer/shipper organizations**
The CCBA project has set up 2 collection centers for bitter gourd in the Jessore region.

Market Planning Committee (MPC) of the collection center
Secretary responsible for organizing monthly MPC meetings. Last meeting of the Birnarayanpur Collection Center included a discussion of selling more into Dhaka's Kawran Bazaar – make more connections and let traders know about their production.

Member of MPC committee says can take the assets home (crates and secatuers); but will loan if asked.
Birnarayanpur noted a need for a better/deeper tube well as water not sufficient (but bitter gourd doesn't require cleaning/washing/pre-cooling – so not sure of context of comment.)

Component 06: **Environmental conditions**
The environmental condition of Bangladesh is suitable for Bitter gourd cultivation.
Source: Fertilizer Recommendation Guide (Bangladesh Agricultural Research Council, 1997)

Component 07: **Availability of planting materials**
Farmers use hybrid seeds of East West Seed Company named Tia, which is available.
Production

Component 08: **Farmers' general cultural practices**
Plants are grown on raised beds to avoid water logging during rainy season. They are watered at 6-7 day's interval in winter, 5-6 days interval during summer and no irrigation in the rainy season.
Most of the farmer follow clean cultivation.
Trellis height is maintained 1-1.5 m.

Nutrient deficiencies cited by non-CCBA farmers as a cull factor – small and curved fruit.
Field cleaning included placing culls in a compost pile/hole alongside the bank (or bury with manure)

One CCBA member did the composting of culls – burying with manure and left for 2 months; and then used in his nursery.
One CCBA farmer mentioned producing his own seedlings from his retained seed, in a nursery. Transplants out in February. Starts harvest in April. Finished his harvest in June/July.
One CCBA farmer says that post-CCBA he has almost uniform (99%) fruit coming from the field. He uses Pheromone traps and fertilizer – no curly and uniform size.
One CCBA farmer noted that lower rate of curly fruits due to production practices.
One CCBA farmer said additional training in fertilizer and pesticide dosage is critical.

Component 09: **Pests and diseases**
Table 08. Major disease and insect of Bitter gourd

Disease

- Powdery mildew

Insect

- Fruit fly
- Red pumpkin beetle

CCBA introduced pesticide free pheromone traps which farmers reported had reduced pest damage in both crops.
Non-CCBA reported 2-3kg loss from 40kg production due to infected fruit (fruit fly and insects) and nutrient deficiency (another CCBA farmer reported the same loss rate, but due to damage to spines during harvesting and handling)

One CCBA noted 5 kg loss from 50kg. Insect damage cited as main source of loss.
One CCBA noted loss was 40kg from 200kg; now 2kg per 200kg due to pheromone trap and the field cleaning.
One CCBA noted 150kg loss from 1600kg; after CCBA loss of 1.5kg from 1600kg. Complete reduction of insect damage. Remaining loss was from sun damage, from those few fruit exposed to the sun.
One CCBA noted 8-10kg from 40kg loss before; now .4-.5 kg from 40kg. (noted insect and production impacting uniformity in field.)
One CCBA farmer noted .33 acres. Before 120kg from 240kg. Now 5 kg from 600kg.

Component 10: **Pre-harvest treatments**
Growth regulators and liquid micro nutrient solution are commonly used to make plant healthy and to increase flower/fruit production.
Farmers apply pesticide 7-10 day's interval in addition to sex pheromone trap and baiting
Farmers remove the older, diseased leaves and infested fruit.
Lower side branches are removed to reduce pest and disease.

Component 11: **Production costs**
Most of the farmers are uneducated so they calculate their profit or loss simply, by recording how much money they invest and how much they earn per season.
Net income (Tk/ Decimal) = total sale (Tk) – total invested (Tk) (*excluding labour cost).
= 5,000 Tk – 2,000 Tk = 3,000 ± 500 Tk

Bitter gourd requires a trellis for production. High labor cost to put up the trellis. Without proper construction and/or maintenance may result in sunburn. (Sunburned become immediate culls)
Increased production profits by 2xs – production based, not necessarily post-harvest related (CCBA reported farmers)

Another farmer reported yield increases - .33 acre from 320kg/week to 600kg/week as his profit increases. Another reported revenue increase from .33 acre. From 5-10,000 tk to 20-25,000tk. Mostly production related, although grading into sizes has resulted in some revenue increase.

Profit from another CCBA farmer. .33 acre 4,000kg average yield before; 6500kg average yield after. Sometimes traders now come to him due to the higher volume.

Profit from another CCBA farmer. .66 acre – before 1,000; after 20,000. Investing profits in land and bought a cow.

IPM training most requested and most often the non-CCBA training that farmers reported receiving. One CCBA farmer noted that previously spent 300tk/week on pesticides. Now less than 70-100tk/week.

Postharvest
Component 12: **Harvest**
Harvesting time of Bitter gourd depends on the Type of market and distance from the farm.

Harvesting times for

- Local market (Nearest): Early in the morning before 9 am
- District market: After 4 pm before the day
- Wholesale market (Nearest): Early in the morning before 7 am
- District wholesale market: After 4 pm before the day

Harvesting is done by the farmer himself and his family members.
Harvested fruits are collected in bamboo basket then gunny bags or second hand corrugated paper boxes are used to carry harvested produce.
Farmers measure the maturity by eye estimation and experience.
CCBA trained farmers train labor to pack and handle produce; more diligent and higher specifications when prices are higher.

CCBA farmers know where to find secateurs in local markets.

Non-CCBA reported harvesting by hand and/or using a larger hand sickle (and CCBA reported the same as a previous practice.)

One CCBA farmer designed a sharp, short bladed knife and had it made by a local knife maker. Other group farmers also bought his design. They preferred to secateurs due to labor efficiency (secateurs took a bit longer to use.) Short blade was to not damage other fruit.

The other collection center used secateurs. Some purchased and others borrowed from collection center. In one collection center the farmers themselves got the secateurs directly from CCBA as individuals. Secateurs do require hirer labor, so some noted that they use secateurs less when price/margin goes down.

One farmer reported using scissors before getting secateurs (given to him by the project.)

CCBA shared tools were often reported as being kept at the home of the President and needed to be borrowed.

Due to the trellising, labor higher for bitter gourd. They have to move under the trellis and may push the metal bowl or basket under the trellis along the uneven ground or squat down with the basket on their head, quickly cutting and placing directly into the vessel.

CCBA farmers harvested into metal bowls or small baskets; previously used jute bags which damaged spines. Other CCBA farmers developed a pull cart for crates and harvests into the crate (one other guy dragged a pallet through the aisles with crates on top.) The little cart was 500tk to build and took 2 hours of labor to construct.

Secateurs cost 200tk (available from Jessore and Khajura market)

Time of day dependent on what market the product is intended for OR earlier in the day when it is cooler.

One market – Gupolgong market (sp?) requires harvest at 6am, collection by 8am and then market by 1pm.

Khajura starts at 8am, so harvest starts by 5am. He calls transport (Nosiman) as soon as he finishes (always very close.)

Maturity index – still unclear – but we were told about size, shape, and density of the spines, as well as color, shape, and size of fruit; also looking for glossy fruit.

Another CCBA farmer noted a length of 9" with immature having dense spines and mature having less dense spines. Also looks for color.
Another farmer preferred 7-8" as length of fruit.

Different times/week for harvesting. Some harvest 1x/week. Others harvest 2x week (based on maturity, volume for marketing, and collection center schedule). One noted that early season only harvests 1x/week but mid-season 2x a week.

Component 13: **Grading, sorting and inspection**
After harvesting farmer himself sorted the produce based on size, shape, disease status and insect infestation.

Farmer interview: Trader brings scales and production is now sold by weight.
Using plastic sheeting for sorting surface (both CCBA and non-CCBA farmers reported)

Where there are collection centers, the size is limited – farmers continue to grade, sort, and pack near their farms and/or need to stagger their utilization of the formal collection center shade and water.

Some of the staggering though occurs naturally as the necessary shipment times vary between the different markets – with the local and district markets starting earlier and the Kulna and Dhaka markets either afternoon/evening and/or overnight.

Sorting and grade depends on trader demands. Non-CCBA farmers noted some size grading demanded by traders.

Plastic sheeting available for purchase to use for a sorting and handling surface. Cost ~180-200tk/kg. (1-1.5kg size usually purchased.) Some reported using cement bags that had been sewn together as a surface.

One noted particularly use of plastic sheeting in rainy season.

At least one CCBA farmer reported sorting by size and getting a 5tk/kg difference between large and medium/small size grades. (Another CCBA farmer noted a 2-2.5tk/kg difference in price between larger and medium/small sizes.)

CCBA farmer reported harvesting all that is mature (spines size, shape, and density) and then grades after harvest.

All CCBA bitter gourd farmers reported being trained in 3 grades, but were using 2 sizes for grading. Another graded by size as well as maturity (smoother spines, lower spine density) and that darker green have been in the sun; lighter is a higher quality.

Non CCBA farmers reported not grading by size.

One CCBA farmer said that average price before CCBA and sorting and grading was 12tk/kg; now with sorting and grading average price is 18tk/kg.

One CCBA farmer does 4 grades: large, medium, curled/sickled, and the cull.
One day we were speaking to farmers they said that normally they do grade, but that the day's market demand wasn't providing any differentiated pricing.

One non-CCBA trained trader used 4 grades – 10", 7", 6" and cull. He preferred the black/dark green color. Paid 20tk/kg for darker color; 17tk/kg for the lighter one.
Another trader paid 20tk for the 10", 15tk for the 8" and 10tk for the 6".

Value/price differs according to the quality and size of the fruits.

Examples of market value and prices according to the quality and size of the Bitter gourd

Grade	Quality	* Wholesale market Tk/kg	Urban retail market Tk/kg
A	High	30-35	45-50
B	Medium	28-30	38-42
C	Low	20-25	35-38
D	Damaged	5-7	12-15

* Farmers' selling price

There is no local, regional or national standards (voluntary or mandatory) exist for inspection.
Damaged fruits are also sold at much lower prices. After removing the damaged portion the retailer sell the fruits. The poorest people are the consumers of that produce.

Component 14: **Postharvest treatments**
Water splash is used to keep the fruits clean and fresh.

Gentle handling – level of gentle handling really depends on the price/margin (all farmers reported this). All farmers reported the need to be gentle due to the delicate spines which damaged the bitter gourd.

Crushed spines allow water and bacteria to enter which can result in culling required.

CCBA farmers noted that before they knew to handle gently, place in shade, how to cull, but almost all said now they understand why and are much more diligent.

Component 15: **Packaging**
Bitter gourd is packed 20 kg or more in second hand corrugated paper boxes, bamboo baskets or gunny bags. Plastic crates have been introduced by various projects, but are being used mainly when market prices are high.


Plastic crates in use in CCBA collection center

Bamboo baskets and crates seem readily available to purchase and CCBA farmers said they were informed where to find them.

Increases labor costs during packing; and more expensive labor during loading/transport

Use Jute and/or baskets depending on product and/or price (Jute less frequently used)

Pick into a metal bowl or basket. Then put into a larger basket. Finally pack into crates when traders bring crates or put in bamboo baskets or jute bags.

Khajura market has an option to rent the crates. Crate rental is available for 2 days. You pick them up one day and return the next when you bring the produce back to market. 10tk/crate (2 days)

Non-CCBA farmers noted that crates have a higher labor cost for packing and handling as well as higher transport cost/kg.

Bamboo basket 200-250-300tk/basket (depends on size) (small bamboo basket for 100tk (large basket for 400tk

Sometimes line the bamboo basket, crates, and even jute with banana leaves and/or jute bags.

Crates were 150-180tk/crate. (one even said 230tk/crate) CCBA farmers purchased from Jessore or Khajura market. Some noted cost of crates as inhibiting adoption.

Occasional sharing of crates between farmers (usually for harvesting not for marketing.) Others noted no crate sharing, but some basket sharing.

Birnarayanpur CC has 280 crates (CCBA provided.)
One trader said that crates cost 130-150tk/crate and have a 1.5month lifespan (used every other day with backhaul empty.)

One farmer brought his bitter gourd to collection center and had a main pile and two laborers. He would weigh out 15kg and have the laborers neatly (horizontally) in the crates (15kg/crate.)
CCBA trader stated: Bitter Gourd only goes to Dhaka in crates: brinjal in basket: size between 20-200kg

Crate size is 21" x 14" x 11" depth. Vents on all sides and bottom.

6 different baskets: All but 1 is a heavy bamboo.
31" diameter x 14" high
25" diameter x 13" high
26" diameter x 12" high
22" diameter x 12" high
15" diameter x 6" high
28" diameter x 10" high (flimsy

Component 16: **Cooling**
Cool chain management is totally absent.
In wholesale and retail market, trader apply sprinkling water on the produce to keep it cool and fresh.

Bitter gourd is damaged with water, so no washing or pre-cooling
Observation: Many said they used shade but then reported not always shifting with shifting sun (as shade moved) and/or the shaded areas are already full

Non-CCBA know that sun can be dehydrating and so do use shade.

Harvests and places under a tree. Uses large loose leaves to cover when/as tree shade unavailable
Many reported knowing about shade prior to CCBA but reported they are more diligent now and may use large leaves if shade moves or not available

Component 17: **Storage**
Storage facilities are absent for Bitter gourd in Bangladesh. If kept it under shade at ambient condition they enable to stay 1-2 days without any apparent damage.

One BARI training a CCBA farmer attended showed a multimedia presentation including cool storage. He assumes the product is going into the international market.
There was some interest to understand potential for storing . . . maybe up to 6 weeks, but no background on what might be possible . . . store from high season to end or shoulder season. One CCBA

farmer approached the owner of a cold storage currently being used for potatoes. He was told that he wouldn't consider renting to anyone but for potatoes. Interest in understanding potential, if any for delayed marketing from high of season.

Component 18: **Transport**
Transport of Bitter gourd depends upon the distance to markets.

- Short distance- within the farm or marketplace: Van, Rickshaw, three wheeler (Below 1 hour)
- Medium distance- within the district Mini trucks (Below 2 hours)
- Long distance- within the country Heavy trucks (Below 12 hours)

Various type of produces are loaded together in a vehicle. After loading the top covered by triple/ non perforated polythene. During loading and unloading iron hooks are used.

Farmer interview: personally rented 3 wheel 'van' to send product from collection center to market

Farmer interview: 3 Ton truck needed; 3 Ton truck most appropriate due to the size of road; otherwise the truck parks further away and they use the bicycle and 3-wheeled 'vans' to ferry from farms and collection points to the truck.

3 wheeled bicycle was a van (flatbed back) – could be used from collection center to the truck for transloading and/or into the local markets.

Nosiman (higher capacity) could go local and/or Khulna market
Trucks only were used into Dhaka.

Many farmers reported road conditions as challenging. Also need more transport/logistics availability
One non-CCBA trader spoken to rents truck transport. Can rent a 6 ton, 8ton, or 10 ton truck, depending on how much he is moving. He goes into Dhaka market. Uses a rented Nosiman to ferry product from collection center to the larger truck, which is too large for the road to get to the collection center set off of a smaller rural road.

This non-CCBA trader leaves his truck uncovered until fully loaded, but under a tree. He is loaded by 2-3pm. Reaches Karwan Bazar in Dhaka by midnight and uses the same Arotdar (broker.)
CCBA trader: farm to Dhaka table takes max. 3 days…max shelf life!
CCBA trained trader noted that a 3T truck could fit 200-150 crates. (220 crates according to someone else.)
Nosimon costs 500T from Nongopur collection center to Khajura.

Component 19: **Delays/ waiting**
Table 09. Delays/ waiting during handling Type of market
Farm to local market: Negligible
Farm to wholesale market: Below 2 hours between arrival of the produce and purchase by the wholesaler
Wholesale market to distant wholesale market: 2-8 hours between arrival of the produce and purchase by the wholesaler
Distant wholesale market to retail market 2-3 hours between arrival of the produce and purchase by the retailer

Retail market 8-10 hours until purchase by the consumer

Component 20: **Other handling**
Supporting infrastructure is inadequate. Untrained labor and poor handling practices reduce the quality of the produces

Component 21: **Agro-processing**
There is no separate unit for agro-processing of Bitter gourd.
CCBA taught the women whose husbands were affiliated with the centers to make pickles

Marketing
Component 22: **Market intermediaries**
2-6 intermediaries are involves in the chain of Bitter gourd marketing.
Basically middlemen are responsible for losses due to poor postharvest handling. Finally consumers are suffering financially.

Selling into Karwan Bazar (Dhaka) and Gopal have higher prices as key destination markets, but you need a full truck.

Trader linkages facilitated by CCBA program – introduced traders to CCBA communities and took CCBA farmers to meet traders and brokers within the main district markets.

Broker commission (for us of stall to sell) is 1tk/kg. Standard in Kulna and Karwan Bazar (Dhaka.) Kulna stalls are owned by wealthy men, then rented to Aodar (the brokers) who then collect commissions from farmers who sell from them.

Some traders come to the collection centers to purchase product. In bitter gourd they often bring crates to pack the product they buy into.

Non-CCBA trader lives near the collection center and already knew/knows the farmers.
The non-CCBA trained trader practices gentle handling as well – it is all about undamaged spines. Uses plastic crates – he has 200 crates himself (CCBA provided 30.) When full, he uses jute bags for any extra fruit. He washes his crates once a week at his house or a pond. He will loan out the crates for farmers to pack into.
The non-CCBA trader is interested in more business training for himself.

Khajura market requires traders to be members of a traders' association. 62-63 members; 10 in leadership. Traders pay 10tk/mon (40kg) traded through the market. 10% of that goes to the Government for the market and market services and 5% goes to UNO (some government body who holds as a savings. This provides structure, organization and safety

One of the CCBA traders noted that use of secateurs' (and/or small blades) very important to reduce damage to the other fruit.

One CCBA noted an average day of Khajura trading (the day of the interview included) (volumes) and this was sent on a truck to Dhaka Karwan Bazar:

- 35mon (40kg/mon) eggplant
- 50mon (40kg/mon) bitter gourd

- 1600kg taro
- 1600kg hairy gourd
- and 300kg of random other small products.

The CCBA farmer who labeled himself an early adopter has been using plastic crates for 30 years. Currently has 30 crates that he bought at 130-180tk/crate in Jessore (origin India.) He buys 1000-1500 crates each season. Pays 1,000tk transport for crate backhaul from Dhaka. Uses crates for bitter gourd and hairy gourd; bamboo baskets for other crops. He says he does no grading or sorting; sees no added value. He would lose 50% of bitter gourd packed in jute, but loses none in plastic crates.

The CCBA trader training was only once and had 30 participants (15-20 were traders.)

Both CCBA and non-CCBA traders noted that more scales and larger scales are important for the market. 300-500kg capacity of scales. Traders said that often the farmers come into the market without having weighed their product.

Non-CCBA trained farmers mentioned that Khajura market will soon have some shade constructed. They used 2 grades; when prices are good, he even sells the culls. Has used plastic crates for 2-3 years for bitter gourd. (Good presentation of product.)

Non-CCBA trained traders will use paper lining of crates for certain products to protect.
These non-CCBA trained traders will buy bitter gourd when price is average or high due to crate and transport costs.

Some traders will share transport hire when they can't fill a truck themselves.
Traders noted they don't have time for training – learn from other another.

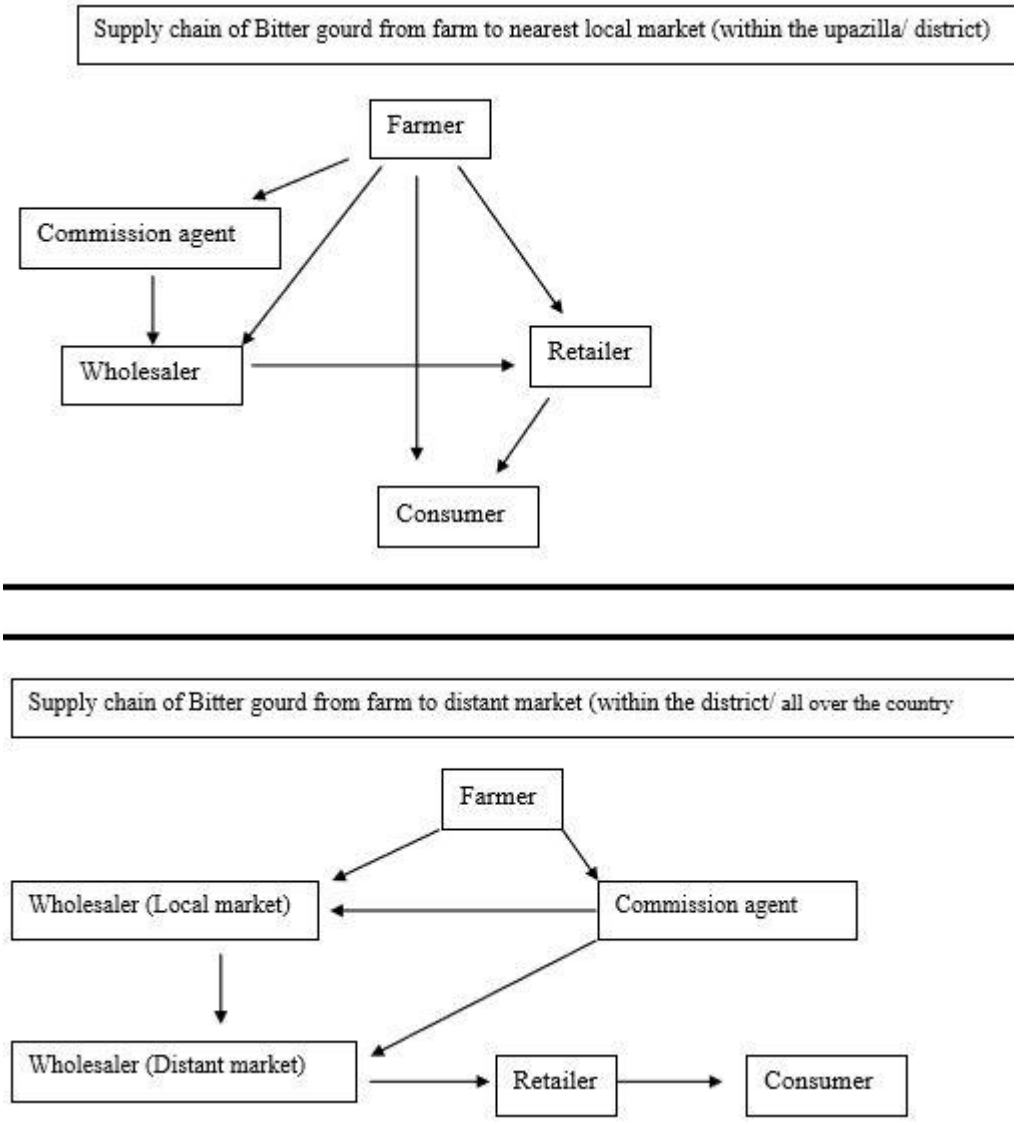
Information on Prices: Prices are higher earlier in the season.
Unclear how price may differ based on volume of trade – does higher volume interest better price?

Price premium may be about 5tk/kg for graded by size (larger versus medium/small)

May 17 the price was 17.5tk/kg; all sizes (no differentiated price that day for graded; but reported that normally there is.)

One farmer noted that the beginning of the season has 20tk/kg for him.

Supply chain of Bitter gourd involves the following intermediaries:



Component 23: **Market information**
Handlers and marketers collect current market information from different market by cell phone communication and planned their marketing strategies.

Dissimilar data observed in published market information among Marketing Department (Ministry of Trade), Marketing Wing (Department of Agricultural Extension), Bangladesh Bureau of Statistics and FAO.

Tend to head to local and/or regional markets versus larger distance markets when prices are lower. Market access and reliability were cited by CCBA farmers as important bottlenecks or areas for additional training. Program did offer valuable linkages (introductions, farmer tours of markets and individual introductions to traders, and similar linkages, as noted by the farmers.) But additional timely seasonal intelligence seemed to be being requested.

Farmers use their cell phone to call traders in advance of the day they intend to market in order to decide which market to send to their product (because the time of harvest and shipment depends on the target market.)
One non-CCBA farmer noticed some difference between CCBA farmer production and non-CCBA farmer production. The CCBA farmer production was noted as having fewer damaged spines due to gentler handling and because the packing location was close to the farmer land. For CCBA production he gets 800tk/mon (40kg) and non-CCBA he gets 650-700tk/mon (40kg.)

One CCBA trained trader noted that he graded bitter gourd by spine, size, glossy, and smooth. Generally 3 grades. He says that most farmers don't grade and sort. His own grading was a new practice he picked up from the CCBA training. Since he took the class, he has been visited 10-15 times by CCBA staff.
This CCBA trained trader sells the best and medium grades to Dhaka market. The bottom grade sells into local markets. CCBA farmer produced product has a longer shelf life, makes better grades. Always does bitter gourd and hairy gourd in crates. Was given 200 crates from CCBA; he bought another 500 himself. Says the that the market in Dhaka has been very responsive to his grading and sorting. Other traders in Khajura market have watched his grading and sorting and started to follow. He uses the same Arotdar (only 1.)

Another CCBA trained trader noted that he has been using crates for 10 years and while it isn't a new practice, he understands the how and why better.

In prioritizing farmer practices, he prioritized gentle handling as most important.

The non-CCBA trained traders at Khajura market will go to the farm and tell the farmers (and pay) how they want high value product handled, including bitter gourd and mango. They will invest more time and effort to get the product right when the value is there.
Khajura traders sell into Dhaka, Borisal, Kulna, Faridpur, and Chittigong.

These non-CCBA traders noted that most of the loss they see is between the farm and themselves due to bumpy roads, pressure, and handling.

The non-CCBA trained traders reported bitter gourd has a 3 month harvest period with an average price of 30tk/kg with a high of 100tk/kg (Ramadan 2015 price.) Average daily traded volume of bitter gourd was 30mon (40kg/mon) or 1200kg/day traded volume.

One farmer was taking his bitter gourd to Gupolgong (sp??) market 200km, roughly 6 hours depending on the ferry. Had it in crates and it was an open truck. Graded into 2 sizes (good and medium) normally, but not that day because the price is the same for each grade.

Component 24: **Consumer demand**
Consumer preference depends on produce characteristics (Bitterness, sizes, colors, maturities, quality grades).

Consumers purchase ability is important factor to have quality grades. Retail price become high 80- 100 Tk/ kg during early and late season but in season 35-50 Tk/kg.

Fruit fly infestation is the major problem of Bitter gourd production. They try to control it by integrated pest management approach, insecticide, sex pheromone trap and bating but Fruit fly infestation become uncontrolled. So, they use more and more insecticide frequently for that consumers are suffering toxicity.

At present consumers are conscious about the hazard, they prefer chemical free produce. But lack of food safety inspection and appropriate insecticide alternatives grower/trader take this unfair chance.

The Gupalgang district market prefers the small bitter gourd and pays 1-2tk/kg more for the smaller size.

Component 25: **Exports**
None of the contacted farmers are related to export of Bitter gourd.

One CCBA trained trader noted that the previous year his nephew took his product for export to the diaspora market in the Middle East.

Component 26: **Postharvest and Marketing costs**
Farmers and traders calculate only profit or loss. They never maintain any documents of postharvest and marketing cost. So, related information is unavailable.

Bank loan is available, the handlers/ marketers have access to credit with 15-18 % interest and merchant man (Mohajon) lends money@ 10 Tk/ 100 Tk/ day. They still make a profit about 1-3 thousand taka/ day and repay the loan with interest at the end of the day.

Most of the wholesale market situated at open ground near the road side or under a large tree. Supporting infrastructures are inadequate. Roads condition is quite good. Information communication depends on Cell phone.

Marketing facilities and management skills of staff are insufficient.

General Observational Note (Faruq): Excessive pesticide application control and food safety inspection strengthening are urgently needed.

Annex D. Scope of Work

Scope of Work for Lisa Kitinoja (Ma –June 2016)

TITLE:	Senior Advisor – CCBA Documenting Post-Harvest Activities and Impact
LOCATION:	Dhaka, Bangladesh
EXPECTED DATES:	Eight (08) days between May 1, 2016 and June 25, 2016

PROGRAM SUMMARY:

The Cold Chain Bangladesh Alliance (CCBA) is funded through the Global Development Alliance (GDA), USAID's model for public-private partnerships. USAID/Bangladesh and Winrock International are partnered with Golden Harvest, a local food processing and transportation company, to implement this project. CCBA's goal is to increase the availability, access, and use of domestically-produced and nutritious foods (Development Object 2 in USAID/Bangladesh's Feed the Future Multi-Year Strategy) in an effort to sustainably reduce poverty and hunger. The CCBA project supports this overall goal through the following sub-Component objectives:

Component 1: Increased Capacity of Small and Marginal farmers to Grow High Value Products

Component 2: Improved Agricultural Market Efficiency and Planning

Component 3: Increased Private Sector Investment and Capacity in Cold Chain management

Component 4: Increased Compliance with International Food Safety Standards

The project is implemented in collaboration with World Food Logistics Organization/Global Cold Chain Alliance (WFLO/GCCA).

CCBA aims to build Bangladeshi farmers' capacity to grow and provide high value vegetables for the Golden Harvest product lines and to reduce post-harvest losses and establish cold chain entry at the field level. Simultaneously the project provides technical assistance for Golden Harvest's cold chain investments and build capacity in cold chain management to support both farmer and Golden Harvest activities.

However, the project has had to respond to several changes. The first adjustment was that Golden Harvest's interest shifted from the vegetable value chain to the dairy value chain for products such as ice cream. The frozen vegetable value chain did not present sufficient market opportunities and has been dropped. The second adjustment was that USAID requested the project to begin working in the Feed the Future zones, which are separate from the areas where Golden Harvest is operating and buying products. The project is training farmers in the Feed the Future zones and working to make some market links with supermarket buyers operating in those zones.

A recent lessons learned activity identified harvest and post-harvest practices as achieving some level of adoption among some pilot farmers and traders. Documenting and measuring the adoption, impact, and qualifying the potential to replicate this further within the horticulture value chain are important outcomes of the CCBA activity.

KEY TASKS:

The Senior Advisor will review the project documents and adapt questionnaires to be used by the technical consultants in the field. The Senior Advisor will identify the methodology to be used to measure and document the adoption and impact of CCBA introduced harvest and post-harvest practices along the value chain. Both CCBA direct beneficiaries and control non-beneficiaries will be interviewed and product analyzed to understand the CCBA impact and potential for replication by other investments or activities.

The Technical Consultants will use the questionnaires developed by the Senior Advisor to conduct the fieldwork to understand, quantify, and document the CCBA experience for a detailed lessons learned report.

The Senior Advisor will provide all technical deliverables except the report to the Team Leader in advance of the field travel, tentatively scheduled for May 15-June 2, 2016.

DELIVERABLES:

- Post-harvest impact questionnaire/survey template.
- Worksheets for collection of data related to cost/benefit information (adoption and potential changes in incomes).
- All deliverables must be submitted in MS Office format.
- Questionnaire/survey and worksheets should be submitted to the technical consultants in advance of field work.
- Lessons learned report documenting and measuring the CCBA harvest and post-harvest practices, their adoption, and impact.
    - First draft due June 13, 2016. Comments/formatting due by June 15, 2016. Final draft due June 20, 2016.
    - The report should be provided in MS Office Format (Word).
    - The report should include annex with methodology, survey tool, and people interviewed.