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CEREAL SYSTEMS INITIATIVE FOR SOUTH ASIA IN BANGLADESH

SEMI-ANNUAL (OCT'14 – MAR'15) REPORT

MAY 2015

CEREAL SYSTEMS INITIATIVE FOR SOUTH ASIA IN BANGLADESH

SEMI-ANNUAL REPORT

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Submitted to

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ACRONYMS

ADO	Agriculture/aquaculture development officer
AFP	Axial flow pumps
AIN	Agriculture input and nutrition
ART	Adaptive research trials
BARC	Bangladesh Agricultural Research Council
BARI	Bangladesh Agricultural Research Institute
BDS	Bangladesh Development Society
BDT	Bangladeshi taka
BINA	Bangladesh Institute of Nuclear Agriculture
BMS	Bihango Mohila Sangstha
BMT	Bangladesh management team
BRRI	Bangladesh Rice Research Institute
BRAC	Bangladesh Rural Advancement Committee
CA	Conservation agriculture
CAF	Commercial aquaculture farming
CBO	Community-based organization
CDC	Collapsible drier case
CIMMYT	International Maize and Wheat Improvement Center
CoP	Chief of party
CSISA-BD	Cereal Systems Initiative for South Asia in Bangladesh
CSISA-MI	Cereal Systems Initiative for South Asia Mechanization and Irrigation
DAE	Department of Agricultural Extension
DoF	Department of Fisheries
DQA	Data quality assessment
DSR	Direct-seeded rice
EU	European Union
FOG	Financial Operations Guideline
FtF	Feed the Future
FY	Financial year
GIS	Geographic information system
GJUS	Grameen Jano Unnayan Sangstha
HAC	Hub administrative coordinator
HDO	Horticulture Development Officer
HH	Household
HYV	High-yielding varieties
iDE	International Development Enterprises
IFAD	International Fund for Agricultural Development
IFPRI	International Food Policy Research Institute
ILRI	International Livestock Research Institute
IR	Intermediate results
IRRI	International Rice Research Institute
ISWA	Integrated Social Welfare Association
IWD	International Women's Day
JCF	Jagoroni Chakra Foundation
LE	Linkage Event

LoA	Letters of Agreement
LSP	Local Service Provider
MAS	Mechanization of Agriculture System
M&E	Monitoring and evaluation
MYAP	Multiyear Action Plan
NDVI	Normalized difference vegetation index
NGO	Nongovernment organization
OSP	Orange sweet potato
PFT	Participatory farmer trials
PMEP	Project Monitoring and Evaluation Plan
PNGO	Partner nongovernment organization
PVC	Polyvinyl chloride
PVS	Participatory varietal selection
QPM	Quality protein maize
RFLDC	Regional Fisheries and Livestock Development Component
SACO	Social Advancement Community Organization
SDC	Society Development Committee
SMSPA	Small and Marginal Seed Producers Associations
SOP	**S**tandard operating procedures
SRSPDS	Sustainable Rice Seed Production and Delivery Systems for Southern Bangladesh
ST	**S**trip tillage
STRV	Stress-tolerant rice variety
SWSPAB	Southwest Seed Producers Association of Bangladesh
T. aman	Transplanted aman rice
TMSS	Thengamara Mohila Sabuj Sangha
ToT	Training of trainers
UDP	Urea deep placement
USAID	United States Agency for International Development
USG	United States government
WF	WorldFish

Executive Summary

The Cereal Systems Initiative for South Asia in Bangladesh (CSISA-BD) project is implemented through a partnership of three CGIAR centers, IRRI, CIMMYT, and WorldFish. CSISA-BD is funded by USAID's Feed the Future (FtF) initiative, and aims to test and disseminate new cereal system-based technologies that will raise family income by at least US$350 for 60,000 farming families. It is anticipated that an additional 300,000 farmers will adopt new technology through participation in field days and farmer-to-farmer information and technology transfer.

By the end of this reporting period, excluding the Sustainable Rice Seed Production and Delivery Systems for Southern Bangladesh (SRSPDS) project and the CIMMYT managed CSISA Mechanization and Irrigation (CSISA-MI) project, the project had **trained 130,446 farmers** and conducted **47,472 trials and demonstrations**. If farmers attending farmer field days and exchange visits are included then the project has **benefited 216,561 farmer**s. In addition the SRSPDS project was thought to have benefited a further 1,312,935 farmers through seed distribution (999,517 farmers), training and farmer field days and the CSISA-MI project has to date facilitated machinery services for 15,755 farmers. This data shows that the project has far exceeded it's original targets. In addition as can be seen from the section on lessons learnt and way forward has developed sets of technologies that have changed the face of agriculture in south west Bangladesh through variety change, new crops and cropping systems and the introduction of mechanized agriculture.

This semi-annual report covers the period 1st October 2014 through to 31st March 2015 and presents results from the 2014 monsoon season (aman season) and the 2014 / 15 dry season (Rabi season). Some of the main conclusion from the trials and demonstrations conducted during this period are

- Strip till planted wheat and new wheat varieties BARI gom29 and 30 give the best results in a trial conducted in all six hub sites.
- Storing maize in modified traditional grain store enabled farmers to store maize up to 9 months without substantial grain storage losses. This allowed them to take advantage of rising maize prices following crop harvest and this substantially improves farmers' income compared with selling maize immediately after harvest. For example storing for 3 months gave farmers an extra $25 / t while storing for 9 months gave farmers an extra $100 / t.
- 3,915 farmers (40%) women trained in aquaculture technology
- The project has developed a unique set of cropping pattern recommendations for vegetable production on pond, fresh water gher and saline water gher banks that will assist extension staff advice farmers on the best way of using this under utilized resource.
- Short duration aman rice varieties do not yield less than longer duration varieties. Growing these varieties allows farmers to plant wheat, maize, mustard, sunflower and lentil on time by mid November.
- BRRI dhan52 is still the most productive submergence tolerant variety available.
- BRRI dhan34 is the best aromatic rice variety available.
- BRRI dhan54 provides good yield and early maturity on aman season saline soils.
- Some locally grown aman season rice varieties yield almost as well as modern high yielding varieties.
- Relay intercropping mustard over standing rice as a means of rapidly establishing the crop after the aman rice in a rice mustard boro rice system is popular with farmers.

- 84 new Local Service providers were set up as machinery service providers, $105,074 was spent by the private sector on importing and marketing new machines and 6,682 farmers received services from LSPs. This includes 1,422 farmers buying crop harvesting services.

In the reporting period the project trained 17,108 farmers (30% women) and 32,308 farmers participated in farmer field days. The project presents results in this report from 323 trials and 6391 demonstrations harvested in this reporting period (mainly the 2014 aman rice crop and the 2015 wheat and mustard crops).

In addition to the normal Farmer Field Day program the project mounted farmer Field day for senior staff from key hub level partner institutions such as NARS, DAE, NGOs and private sector. These "stakeholder FFDs" were held in each hub with the objective of showing our partners the work the project has done, to hear farmer's opinions and to encourage key stakeholders to include the same technology in their trial and demonstration programs.

The project with funding from the south Asia region wide CSISA-south Asia project provided 7 grants totaling $110,000 in value to research institutes within the NARS or at the Bangladesh Agricultural University (BAU). These grants were used to conduct applied on-farm research on topics of mutual interest to both these institutes and CSISA-BD. The quality of research done by these research institutes was largely high showing that this approach to funding agricultural research can be very rewarding.

As the project draws to a close measuring the impact of the project in terms of technology adoption has become an important activity. A set of surveys that measure adoption of CSISA-BD promoted technology by farmers trained or participating in demonstrations or by farmers learning about this technology from CSISA-BD farmers have been designed. Surveys were conducted with 2012 and 2013 farmers in 2013 and 2014. Surveys of 2014 farmers and a survey of farmers interviewed for the project base line survey will be conducted in May and June 2015.

The project conducted hub level internal Data Quality Assessment (DQA) programs to ensure that the monitoring data reported by hub level staff is correct and accurate. The process ensures that a high standard of data collection and reporting is maintained and that the data reported to USAID by project management is accurate.

During the reporting period three separated groups of visitors from USAID Washington visited the project. These were: the USAID Assistant Administrator for Asia, Anne Aarnes and Bangladesh Mission Director, Janina Jaruzelski; Dr. Melissa Ho, Technical Division Director, Bureau of Food Security (BFS) USAID Washington and other members of the BFS and Dr. Rob Bertram, chief scientist and Dr. Biniam Lyob, Water and Irrigation Advisor from BFS, USAID Washington. The CSISA-south Asia review team visited the project in February 2015 but due to hartals it was only possible for the team to visit field activities close to Jessore town. The Global Rice Science Program (GRiSP) review team visited CSISA-BD rice program field activities in Satkhira District on the 30th March 2015.

The project lost 56 working days due to strikes (hartals) and blockades. Most of these losses occurred in February and March when 36 working days out of a possible 41 were lost. This had an impact on machinery sales and LSP training and on project supervision. Most trial and demonstration programs were completed but many Farmer Field days had to be cancelled.

1. INTRODUCTION

1.1 Background

The Cereal Systems Initiative for South Asia in Bangladesh (CSISA-BD) project is implemented through a partnership of three CGIAR centers, IRRI, CIMMYT, and WorldFish. CSISA-BD is funded by USAID's Feed the Future (FtF) initiative, and aims to test and disseminate new cereal system-based technologies that will raise family income by at least US$350 for 60,000 farming families. It is anticipated that an additional 300,000 farmers will adopt new technology through participation in field days and farmer-to-farmer information and technology transfer. This is one of several USAID FtF projects in Bangladesh that contribute to achieving "improved food security," the flagship development objective for the U.S. government's (USG) FtF strategy in Bangladesh.

During the course of the project two sub-projects were established to scale out technologies found to be successful by the project. These were the Sustainable Rice Seed Production and Delivery Systems for Southern Bangladesh (SRSPDS) project and the CIMMYT managed CSISA Mechanization and Irrigation (CSISA-MI) project. The SRSPDS project facilitated the production and disseminations of rice varieties that are tolerant to soil salinity, submergence or drought to just under a million farmers. This project ended in December 2013. The CSISA-MI facilitates the dissemination of crop mechanization technology through partnerships with private sector machinery suppliers. This project will continue to 2018 and their work is reported in this report.

As a general rule, IRRI is responsible for implementing activities related to rice production, CIMMYT for wheat and maize production, and WorldFish for aquaculture and pond bank vegetable production. As all these crops and aquaculture activities form part of complex farming systems practiced by many of the farmers targeted by the project there has been considerable emphasis on the integration of activities within the project so that where ever possible IRRI, CIMMYT and WorldFish work with the same farmer or at least in the same community. This has led to the CSISA village concept when two or more CGIAR centres work together to promote technologies such as short duration aman season rice followed by wheat or maize or monsoon season fish production followed by saline tolerant rice varieties.

This report details results from the 2014 aman (Monsoon season rice crop), 2014 / 15 rabi crop (winter dry season crop) and harvests from the 2014 monsoon season and 2014 / 15 dry season aquaculture systems. The results of the 2015 Boro rice crop (winter dry season) and rabi season maize crop will be presented in the end of project report due in November 2015.

1.2 Impact of civil disturbance on project activities

During the reporting period 56 days were lost due to strikes (Hartals) and blockades called by political parties. In February and March 36 days out of a possible 41 working days were lost due to Hartals. On these days project staff either worked from their homes or, as was common in offices outside of Dhaka, from their offices. During a hartal or blockade project cars could not be used and so, to continue with their work many field staff hired local public transport or used motorcycles to visit farmers. As a result the hartals and blockades had very little impact on field work. It did though make it more difficult for project managers to supervise field work and a number of important visits had to be cancelled

The CSISA-MI project cancelled;

- 43 Service Demand Creation and Sales Planning Meetings (SDCSPM) with potential Local Service Providers (LSPs), farmers, private sector, public sector and others.

- 28 batches of training of which we can name Sub Assistant Agriculture Officers (SAAO) and BADC staffs, LSPs on Axial Flow Pump (AFP), AFP Business Plan for LSP, machinery operation and management for the LSPs, and training for SAAOs & SAEs on CSISA-MI technology.
- 50 meetings/workshops i.e. monthly meeting with partner NGO staff, workshop with DAE at Upazila level, meeting with dealers, bi-weekly meeting with RFL sales force, Business expansion meeting with LSPs, farmers, Private sector, farmers group meeting, linkage development workshop among LSPs, dealers and mechanics.
- 15 Farmers Field Day (FFD)/Farmers' rallies postponed.
- 15 cross/exchange visits for advanced LSPs for finding business prospects.
- 8 practical demonstrations on AFP in the field, where approximate 800 farmers were supposed to attend and cover hectares of land.

1.3 Visitors to the project

During the reporting period the project hosted a number of visits

1. USAID Assistant Administrator for Asia, Anne Aarnes and Bangladesh Mission Director, Janina Jaruzelski, visited Khanpur village, Khanpur Union, Maniramur Upazilla, Jessore District on the 27th October 2014 where the project was able to show the advantages of the cultivation of short duration Aman rice varieties and rapid harvesting the rice with a reaper and planting of maize and wheat using power tiller operated seeder by a local service provider.
2. USAID Washington team, led Dr. Melissa Ho, Technical Division Director, Bureau of Food Security (BFS) USAID Washington visited Jessore hub on the 11th November 2015. They visited Janata Engineering workshop in Sarojgonj Bazar, Chuadanga Sadar Upazila, Badpukuria village, Jhenaidah Sadar Upazila and the seed processing Unit of Ali Seed farm and members of the South Bengal Rice Seed Producers Association. Again the use short duration aman rice varieties, their rapid harvest using a reaper and planting of wheat using a PTOS were the main technologies displayed.
3. Dr. Rob Bertram, chief scientist and Dr. Biniam Lyob, Water and Irrigation Advisor, Bureau of Food security, USAID Washington visited Bangladesh on the 4th February 2015. Due to the insecurity in the country at the time they were not able to visit field sites but were able to discuss the project with the project management team during a daylong program in Dhaka.
4. CSISA phase 2 external review team visited Bangladesh from the 21st to 25th February 2015 to see the activities of the CSISA-BD program. Due to hartals it was only possible for the team to visit field activities close to Jessore town.
5. Global Rice Science Programme (GRiSP) review team visited CSISA-BD rice program field activities in Satkhira District on the 30th March 2015. GRiSP is a global rice research and development programme implemented by IRRI of which CSISA-BD is part.

1.4 Project objectives

The overall objectives of CSISA-BD are to increase household income of project farmers by $350 through increased on-farm productivity.

A revised Project Monitoring and Evaluation Plan (PMEP) were presented to USAID in November 2013. This includes the new results framework presented in Figure 1.

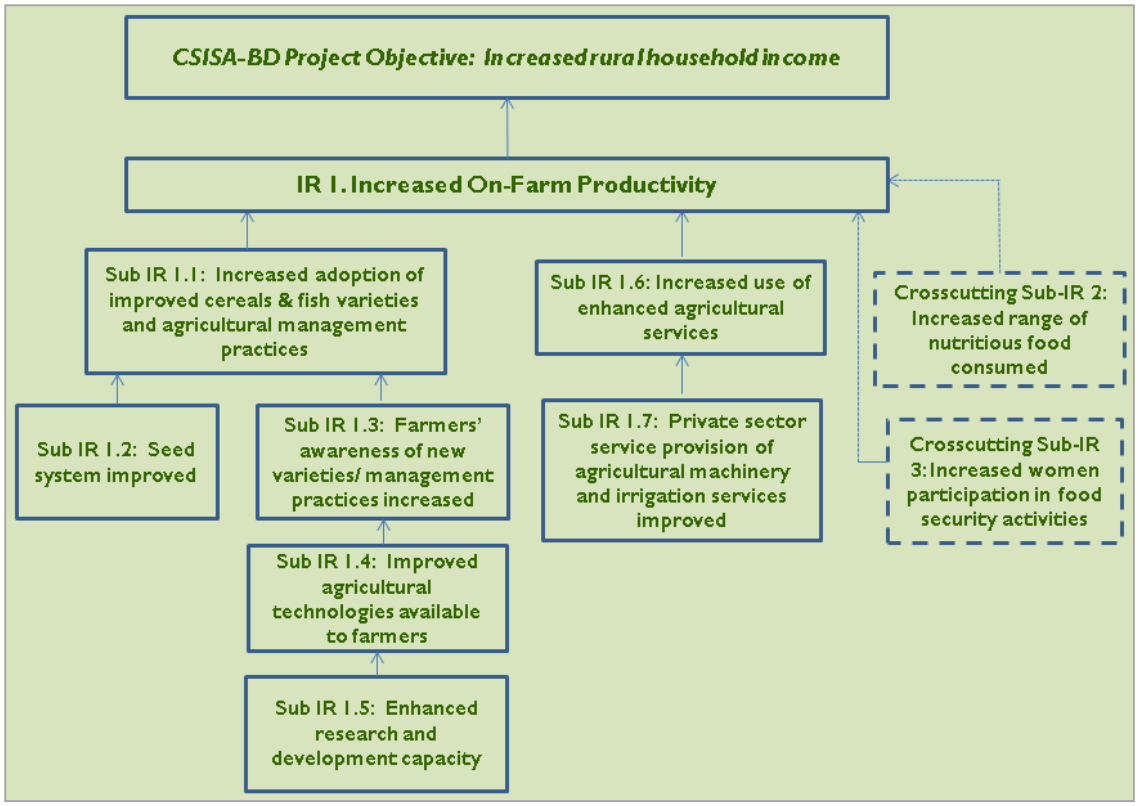

Figure 1: CSISA-BD Result Framework

1.5 Project area of operation

The project works in 31 districts (see Figure 2), 18 of which are in the FtF zone of influence in southwest Bangladesh and 13 are in north and northwest Bangladesh. This is two more than in the previuos year.

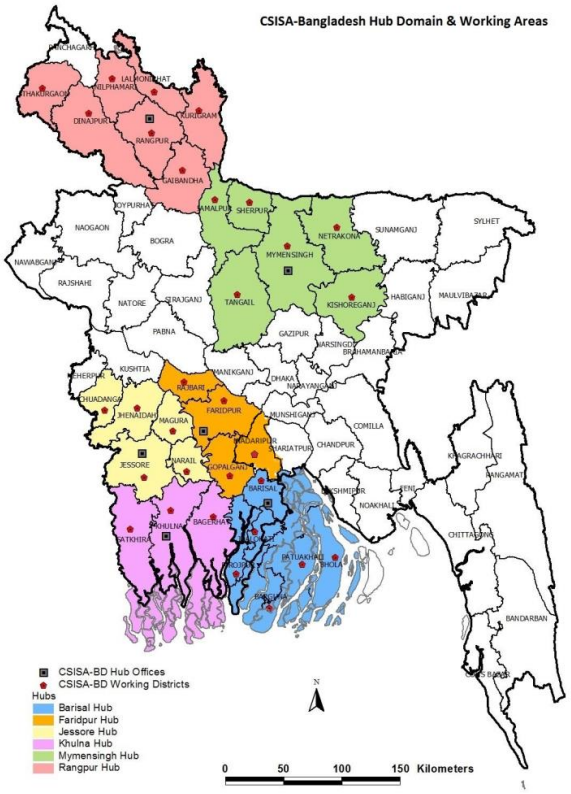

Figure 2: Map showing project area of intervention

Table 1: CSISA-BD coverage area up to year 5 (March 2015)

Hub Name	Year 1 coverage (FY11)		Year 2 coverage (FY12)		Year 3 coverage (FY13)		Year 4 coverage (FY14)		Year 5 coverage (FY15)	
	No.	District name	No.	District name	No.	District name	No.	District name	No.	District name
Jessore	3	Jessore, Jhenaidah, Narail	5	Jessore, Chuadanga, Magura, Jhenaidah, Narail	5	Jessore, Chuadanga, Magura, Jhenaidah, Narail	5	Jessore, Chuadanga, Magura, Jhenaidah, Narail	5	Jessore, Chuadanga, Magura, Jhenaidah, Narail
Khulna	3	Khulna, Satkhira, Bagerhat	3	Khulna, Satkhira, Bagerhat	3	Khulna, Satkhira, Bagerhat	3	Khulna, Satkhira, Bagerhat	3	Khulna, Satkhira, Bagerhat
Barisal	4	Barisal, Patuakhali, Borguna, Bhola	5	Barisal, Patuakhali, Borguna, Jhalokhati, Bhola	6	Barisal, Patuakhali, Borguna, Jhalokhati, Pirojpur, Bhola	6	Barisal, Patuakhali, Borguna, Jhalokhati, Pirojpur, Bhola	6	Barisal, Patuakhali, Borguna, Jhalokhati, Pirojpur, Bhola
Faridpur	0		3	Faridpur, Gopalganj, Rajbari	3	Faridpur, Gopalganj, Rajbari	3	Faridpur, Gopalganj, Rajbari	4	Faridpur, Gopalganj, Rajbari, Madaripur
Mymensingh	3	Mymensing, Jamalpur, Tangail	5	Mymensingh, Jamalpur, Tangail, Kishoreganj, Narsingdi	6	Mymensingh, Jamalpur, Tangail, Kishoreganj, Narsingdi, Sherpur	6	Mymensingh, Jamalpur, Tangail, Kishoreganj, Netrokona, Sherpur	6	Mymensingh, Jamalpur, Tangail, Kishoreganj, Netrokona, Sherpur
Rangpur	4	Rangpur, Dinajpur, Nilphamari, Kurigram	5	Rangpur, Dinajpur, Nilphamari, Kurigram, Gaibandha	6	Rangpur, Dinajpur, Nilphamari, Kurigram, Lalmanirhat, Gaibandha	7	Rangpur, Dinajpur, Nilphamari, Kurigram, Lalmanirhat, Gaibandha, Thakurgaon	5	Rangpur, Dinajpur, Nilphamari, Kurigram, Lalmanirhat
Total	**17**		**26**		**29**		**30**		**29**	

2 SUMMARY of FtF INDICATOR REPORT

4.5-4 Gross margin per unit of land, kilogram, or animal of selected product (crops / animals / fisheries and selected varies by country)

The actual gross margins will be reported based on data to be derived from the Technology Adoption and Impact survey (AIS) for Year 2, 3 and 4 farming households. This survey will be completed in August 2015 and results will be available in the end of project report.

4.5.2-2 Number of hectares under improved technologies or management practices as a result of USG assistance

CSISA-BD counts total area under improved technologies through two activities: Adaptive Research Trials (ART) and Demonstrations.

The area calculated is based on the area of demonstration and trial plot planted by the three CGIAR Centers. The data provided is therefore purely output data. Technology adoption resulting from demonstrations and farmer training will be captured from the annual technology adoption survey conducted by the project.

Table 2: Area (ha) under improved technology or management practices as a result of USG assistance in year 5 (Oct'14-Mar'15)

Activities Under Indicator	CSISA_BD				Activity Totals (CSISA-BD/ Excluding SRSPDS)		CSISA-MI		SRSPDS (FtF Zone)
	FtF Zone Hubs		N Hubs		FZ + N. Hubs		FtF Zone Hubs		
	Male	Female	Male	Female	Male	Female	Male	Female	
Adaptive Trials	*25*	*2*	*2*	*0*	*27*	*2*			
Demonstrations	*541*	*41*	*392*	*45*	*933*	*86*	*2896*	*119*	
Sub Totals in Year 5	*566*	*43*	*394*	*45*	*960*	*88*	*2896*	*119*	
CSISA-BD Project Total Area in Year 5	*609*		*439*		*1048*		*3015*		
Sub Totals in Year 4	*1,060*	*85*	*594*	*54*	*1,654*	*139*	*3502*	*82*	
CSISA-BD Project Total Area in Year 4	***1,145***		***648***		***1,793***		***3584***		
Sub Totals in Year 3	***1,232***	***108***	***698***	***54***	***806***	***162***			***46,436***
CSISA-BD Project Total Area in Year 3	***1,340***		***753***		***968***				***46,436***
Sub Totals in Year 2	*441*	*38*	*592*	*27*	*1033*	*65*			***139,645***
CSISA-BD Project Total Area in Year 2	***479***		***619***		***1,098***				***139,645***
Sub Totals in Year 1	*10*	*1*	*6*	*2*	*16*	*3*			
CSISA-BD Project Total Area in Year 1	***11***		***8***		***19***				
Sub Totals Up to Year 5	***3,309***	***275***	***2,284***	***182***	***4,469***	***457***	***6,398***	***201***	***186,081***
CSISA-BD Project Total Area	***3,584***		***2,467***		***4,926***		***6,599***		***186,081***

4.5.2-5 Number of farmers and others who have applied new technologies or management practices as a result of USG assistance

Participants under this indicator include farmers who have applied CSISA-BD-supported technologies and agricultural management practices for two activities: Demonstration and Adaptive Research Trials. During this reporting period 323 producers conducted adaptive research trials and 6,391 demonstrations giving a total of 6,714 producers applying new technologies. Table 3 shows the distribution of participating farmers applying new technologies and practices according to each project component and/or area, and by gender. In total during the life of the project to date 47,472 farmers have conducted trials or demonstrations. The SRSPDS project supported 999,517 farmers adopt new varieties of rice.

Table 3: USG supported producers applying new technology in year 5 (Oct'14-Mar'15)

Activities Under Indicator	*FtF Zone Hubs*		*N Hubs*		*Activity Totals (FZ + N. Hubs)*		*SRSPDS (FtF Zone)*
	Male	*Female*	*Male*	*Female*	*Male*	*Female*	
Adaptive Trials	*282*	*21*	*18*	*2*	*300*	*23*	
Demonstrations (Participatory Farmer Trial)	*3135*	*316*	*2630*	*310*	*5765*	*626*	
CSISA-BD Component Total in Year 5	***3417***	***337***	***2648***	***312***	***6065***	***649***	
CSISA-BD Project Total Area in Year 5	***3754***		***2960***		***6714***		
CSISA-BD Component Total in Year 4	***8,626***	***819***	***4,561***	***418***	***13,187***	***1,237***	
CSISA-BD Project Total Area in Year 4	***9,445***		***4,979***		***14,424***		
CSISA-BD Component Total in Year 3	***9,382***	***1,192***	***5,563***	***762***	***14,945***	***1,954***	***326,272***
CSISA-BD Project Total Area in Year 3	***10,574***		***6,325***		***16,899***		***326,272***
CSISA-BD Component Total in Year2	***3,928***	***657***	***4,344***	***387***	***8272***	***1044***	***673,245***
CSISA-BD Project Total Area in Year2	***4,585***		***4,731***		***9316***		***673245***
CSISA-BD Component Total in Year1	***49***	***25***	***26***	***19***	***75***	***44***	
CSISA-BD Project Total Area in Year1	***74***		***45***		***119***		
CSISA-BD Component Total	***25402***	***3030***	***17142***	***1898***	***42544***	***4928***	***999,517***
CSISA-BD Project Total Area	***28432***		***19040***		***47472***		***999,517***

4.5.2-7 Number of individuals who have received USG supported short-term agricultural sector productivity or food security training

Up to Year 4, for this indicator direct farmers were defined as those who received direct support from the project through either training or conducting demonstrations and trials. In 2014 the FtF indicator definition changed (revised indicator handbook October 2014). Thus for the current reporting period direct farmers are defined as those who received training. CSISA-BD has

provided direct training support to 17,108 farmers (30% women) (see below table, line 1)[1] More than 32,308 other farmers have had exposure to new varieties and technologies and seen results in the field through farmer field days and cross visits.

CSISA-BD has provided capacity building to 742 individuals including project staff and partner NGO's as part of its commitment to developing the agricultural sector in Bangladesh.

Under CSISA-MI a total of 4,765 farmers received short term support and 1,075 GOB, NGO and Private sector personnel received capacity building support. Among them around 5,218 are male and 622 are female.

Table 4: Direct farmers received short term training support from CSISA-BD

	October, 2014 –March, 2015					October, 2010 - September, 2014					
	FtF Zone			Non-FtF Zone	CSISA-Total	FtF Zone				Non-FtF Zone	CSISA-Total
	Southern Hubs	CSISA-MI	FtF Total	Northern Hubs		Southern Hubs	SEED	CSISA-MI	FtF Total	Northern Hubs	
Male	*7,837*	*824*	*8,661*	*4,159*	*12,820*	*57,840*	*13,196*	*5,218*	*76,254*	*26,631*	*107,489*
Female	*3,768*	*112*	*3,880*	*1,357*	*5,237*	*22,111*	*4,114*	*622*	*26,847*	*8,970*	*37,152*
Producers	*11,605*	*493*	*12,098*	*5,503*	*17,601*	*78,359*	*17,032*	*4,765*	*100,156*	*34,979*	*135,135*
People in Government				*4*	*4*	*465*	*178*	*16*	*659*	*188*	*847*
People in private sector		*378*	*378*		*378*	*283*	*100*	*920*	*1,303*	*173*	*1,476*
People in civil society		*65*	*65*	*9*	*74*	*844*	*-*	*139*	*983*	*261*	*1,244*
Total	***11,605***	***936***	***12,541***	***5,516***	***18,057***	***79,951***	***17,310***	***5,840***	***103,101***	***35,601***	***144,641***

[1] This core group of constituents—initiated within CSISA-BD Project support through Trainings and Adaptive Trials in new/improved crop technologies and agricultural management practices—provides the basis for the scale-up of all subsequent activities under the project. From the pool of trained farmers, the project facilitates the selection of suitable individuals for Participatory Demonstrations, Field Days/Cross Visits and Workshops. These groups are now also forming the basis of crop marketing organizations through which farmers using production technology learnt through the project sell crops to buyers identified by the project.

† Direct farmers include farmers who participated mainly in ART's and Training; however, some farmers who were initiated through PFTs are also included here.

Table 5: Activity wise breakdown of USG supported short term training

Activities Under Indicator	FTF Zone Hubs				Northern Hubs				Total			
									CSISA-BD		CSISA-MI	SRSPDS
	Direct		Indirect		Direct		Indirect		Direct	Indirect	Direct	Direct
Gender	M	F	M	F	M	F	M	F			M	
1.Direct Farmers Supported	*7,837*	*3,768*			*4,146*	*1,357*			*17,108*		***493***	
2.Farmer Field Day			*8,728*	*5,703*			*2,971*	*1,444*		*18,846*		
3.Cross Visits (Farmers)			*76*	*15*			*8*	*0*		*99*		
4.Workshops (Farmers)			*91*	*57*			*18*	*5*		*171*		
5. Capacity building (GO/NGO/Private Sector)					*12*	*1*			*13*		***443***	
Subtotals (M&F) in Year 5	***7,837***	***3,768***	***8,895***	***5,775***	***4,158***	***1,358***	***2,997***	***1,449***	***17,121***	***19,116***	***936***	
Subtotals (M+F) in Year 5	***11,605***		***14,670***		***5,516***		***4,446***		**36,237**		***936***	
Project Total in year 5	***26275***				***9962***							
Sub Totals (M+F) in Year 4	***18,669***		***23,084***		***8,641***		***9,224***		***59,618***		***5840***	
Project Total In year 4	***41,753***				***17,865***							
Subtotals (M+F) in Year 3	***25,131***		***25,926***		***8,327***		***10,086***		***69,470***			***1,312,935***
Project Total In year 3	***51,057***				***18,413***							
Subtotals (M+F) in year 2	***14,882***		***13,562***		***6,703***		***10,150***		***45,297***			
Project Total in year 2	***28,444***				***16,853***							
Project Total in year 1									***5,939***			
Project Subtotals (M+F)	***70,287***		***77,242***		***29,187***		***33,906***		***216,561***		***6,776***	***1,312,935***
Project Total	**147,529**				**63,093**							

4.5.2-13 Number of rural households benefiting directly from USG interventions

For the current reporting period, 20,297 households have been benefited. Of this figure, 9,327 (from southern and northern hubs) are new households while 10,966 are continuing households. Among those new households 5,382 are from the FtF zone (Southern zone) and 3,945 households are from the Northern zone.

4.5.2-37 Number of Micro, Small and Medium Enterprises (MSMEs), including farmers, receiving business development services from USG assisted sources

During this reporting period a total of 198 MSME received business development services from the project of which 160 are micro enterprises, 35 are small enterprises and 3 are medium sized enterprises. Local Service Provider (LSP), who provides farmers with planting, harvesting and irrigation services, are considered to be running a small enterprise. During this reporting period the project assisted 84 LSPs establish a machinery service provision business bringing the total number of LSPs established by the project to date 389. A Dealer is considered to be running a medium sized enterprise. The project assisted new 8 dealers sell machinery to LSPs bringing the total number of dealers selling project promoted machinery to 35. During this reporting period the project signed an agreement with another machinery importer, Metal bringing the total of importers the project works with to 3. The other two are ACI and RFL.

CUSTOM Indicator 1 Value of private sector investment in agricultural machinery and equipment resulting from project interventions

During this reporting period $105,074 were invested in the purchase of agricultural machinery by importers, dealers and LSPs bringing the total invested to $915,142.

Table 6: Service wise investment by importer, dealers and LSPs in Year 5 (Oct'14-Mar'15)

Item	Achieved	Notes on investment breakdown[2]
Water conveyance	*44,939.12*	*During Oct'2014-Mar'2015 period the investment was* *Importers: US$ 44,939.12* *Dealers: US$ 27,200.20* *LSPs: US$ 24,412.28 (on AFP)*
Machine land preparation & planting	*30,393.85*	*During Oct'2014-Mar'2015 period the investment was* *Importers: US $ 30,393.85* *Dealers: US $ 23,679.10* *LSPs: US$ 25,642.55 (on Seed Fertilizer Drill Machinery)*
Machine harvesting & post-harvest operations	*29,741.19*	*During Oct'2014-Mar'2015 period the investment was* *Importers: US $ 388.35* *Dealers: US $ 18,757.28* *LSPs: US$ 29,741.19 (on Reaper Machinery)*
Totals	***105,074.16***	

CUSTOM Indicator 2 Number of farmers using improved agricultural services

During the current reporting period 6,682 farmer (299 women) purchased services from LSPs. This now brings the total number of farmers who purchased machinery services to 15,755. Among them around 2,294 farmer purchased irrigation services, 2,966 farmers purchased planting services and 1,422 farmers purchased mechanized harvesting services.

[2] We use US $ 1= 77.25 BDT for converting BDT into US $.

Table 7: Service wise farmers' coverage by gender in Year 5 (Oct'14-Mar'15)

Item	Achieved	Notes
Water conveyance	*2,294*	*Male farmers: 2,270* *Female farmers: 24*
Mechanized planting	*2.966*	*Male farmers: 2737* *Female farmers: 229*
Mechanized harvesting	*1,422*	*Male: 1376* *Female: 46*
Total	*6.682*	*Male: 6,383* *Female: 299*

SUCCESS STORY

Adopting Maize Cultivation Catapults Siddique's Income and Improves His Family's Welfare

Through CSISA-BD, CIMMYT has introduced new production technologies in maize to farmers in Barisal.

Photo: CSISA-BD Project

"I will continue maize cultivation because this will help me to provide better support to my children's education as well as to maintain my family"

– Siddique Hawlader, CSISA-BD maize farmer, Barisal Hub

Md. Siddique Hawlader lives in Kalikapur Village in Barisal District. Like other farmers of his village, he struggled to earn a living (in order to support his family of five) on income from only one Aman rice crop a year. Due to soil salinity conditions during the dry season, Siddique had to leave his land under fallow after harvesting rice. However, in 2012 the USAID-funded CSISA-BD project started working in this area to introduce maize cultivation using Conservation Agriculture (CA) methods. Ever since then, the life of Siddique (and of other farmers in the area) has changed for the better.

In January 2013, Siddique's wife Mafuja participated in a one-day training session on maize cultivation technology. Afterwards, she taught Siddique what she had learnt in the training and he successfully established maize (variety P3396) on his 10 decimals (0.04 ha) of land; he produced 292 kg (equal to 7.3 t/ha) and a net profit of $41. Due to the good initial experience growing maize, Siddique expanded his maize area by four times during the 2013-14 Rabi season. From 0.16 ha, he obtained 1,010 kg (equal to 6.2 t/ha) and a net profit of $145. During the past Rabi season (2014-15), he again cultivated maize on 0.16 ha of land – but this time using a seeder/fertilizer drill (SFD) and intercropping 0.08 ha of red amaranth within the maize.

After 30 days of the maize sowing date, he harvested all of the red amaranth, for which he obtained a profit of $133. While he has yet to harvest the maize, he calculated that this year he will get a net profit of $177 from his 0.08 ha of intercropped land, which is truly an excellent profit (more than $ 2,200/ha) for any location throughout Bangladesh.

The success of Siddique is very encouraging for all. He relates how his family's livelihood has improved due to this experience: "My daughter aged 18, has recently completed her SSC examination this year and hopefully there will be a good result because I was able to provide a private tutor to my daughter with the income gained from cultivating maize." He is happy, and says that he will continue maize cultivation because this will help him to provide better support to his 2 children's education as well as to maintain his family.

3 RESULT AND ACHIEVEMENT

This section presents the results and achievements of the project according to the intermediate (IR) and sub-intermediate results (Sub-IR) depicted in Figure 1. The report will present results in the following order:

- Scaling out and adoption of new technology: Sub-IR 1.1. Increased adoption of improved cereals and fish varieties/species and agricultural/aquaculture practices.
- Seed systems: Sub-IR 1.2. This will cover the seed multiplication activities of the project.
- Farmer training and demonstration: Sub-IR 1.3. Farmers' awareness of new varieties and management practices.
- Research: Sub-IR 1.4. Improved agricultural technologies available to farmers. This covers the work done by the project to validate and develop new technology.
- Mechanization and irrigation: Sub-IR 1.6. Increased use of enhanced agricultural services; and Sub-IR 1.7. Private-sector service provision of agricultural machinery and irrigation services improved; these relate to the activities of the CSISA-MI project.
- Enhanced research and development capacity (Sub-IR 1.5): ToT training for project staff and partners and postgraduate training for GOB staff.
- Cross-cutting Sub-IR 2, Range of nutritious food consumed, and Sub-IR 3, increased women's participation in food security activities, will be presented as separate sections.

3.1 Increasing On-Farm productivity (IR 1)

This report details results from the development and promotion of new technologies in rice based farming systems from the 2014 aman (Monsoon season rice crop), 2014 / 15 rabi crop (winter dry season crop) and harvests from the 2014 monsoon season and 2014 / 15 dry season aquaculture systems. The results of the 2015 Boro rice crop (winter dry season) and rabi season maize and sunflower crops will be presented in the end of project report due in November 2015.

3.1.1 Adoption of improved cereals and fish varieties and agricultural management practice (Sub IR 1.1)

In the following sections (3.1.3 and 3.1.4), the work of the project testing new varieties and technologies and carrying out demonstrations and training farmers on the use of the best of these technologies will be described. This work should result in farmers adopting new varieties and technologies. To measure this adoption the project has engaged in a series of annual surveys that return to a sample of farmers who received training or conducted a demonstration or trial in the previous year. Thus is October 2013 the project surveyed a sample of farmers who received training and conducted demonstrations or trials in 2012. In 2014 the project surveyed 2013 farmers and farmers who the 2012 farmers reported to have adopted technology promoted by the project but who had not received training or conducted trials or demonstrations. In 2015 the project will survey a sample of 2012. 2013 and 2014 farmers and a sample of farmers who participated in the project baseline survey conducted in 2012.

Some preliminary result describe in below section for rice, maize and wheat and aquaculture. More details result will be described in end of project report.

RIce

Out of 424 sampled farmers 414 (98%) project farmers received rice production training and 82 farmers (19%) conducted rice related demonstrations or trials in year 3. Of these farmers 82% claimed to have applied the technology in year 4 partly and 18% fully.

Table 8: Application of improved technologies and/or management practices by sampled Year 3 CSISA-BD farmers (N = 424).

Variable	Ref. n	% of N	FA* (no.)	FPA* (no.)
Received training support (Y3)	414	98%	--	--
Aggregate application of training† in the following year (Y4)	405	98%	64	341
Received demo trial support (Y3)	82	19%	--	--
No. of demo-trial farmers applied technology in year 4	73	89%	21	52
Received training, demo trial support from IRRI (Y3)	414	98%	--	--
No. of training, demo-trial farmers applied technology in year 4	406	98%	74	332

* FA = full application of improved technologies/management practices; FPA = full + partial application

Year 3 farmers were also asked about the application of the rice varieties they used in last 12 months (i.e. in year 4). As per their response (table 9) it was found that out of 424 sampled farmers only 5% farmer used aromatic rice varieties (BRRI dhan34); 45% sampled farmer used short duration rice varieties; 7% and 8% sampled farmer respectively used saline tolerant and submergence tolerant rice varieties.

Table 9: Rice varieties applied in year 4 by sampled farmer of year 3

Technology/mgt. practice	No.	%	T. Area (ha)
Saline-tolerant rice (BINA 8, 12; BR-41,47,53,54)	27	7	9.1
Submerge-tolerant rice (BR-51,52)	33	8	17.5
Short duration rice (BINA 7; BR-33,39,49,56,57)	186	45	67.3
Aromatic rice (BR-34)	20	5	3.8

Maize and Wheat

Demographics: A total of 438 out of the 439 respondents confirmed that they received training in maize or wheat production and of these 19% conducted maize or wheat trials or demonstrations. In terms of farmer gender, 387 (88%) are male and 52 (12%) are female. The mean and median age of the respondent farmers was 42.6 years and 42 years, respectively, ranging from a minimum of 18 years to a maximum of 80 years. On average, the Maize and wheat farmers own 154 decimals (0.62 ha) of land, with total land area used (includes land leased in or share-cropped) being 204 decimals (0.83 ha).

Table 10 shows that 85% (373 farmers) of the farmers fully or partially applied, in the same year (i.e. Year 3), what they learned from the training event that they attended. The percentage drops slightly (82%) when asked about application of what they learned in the following Rabi

season (Year 4, 2013-14). On the other hand, 87% of the farmers fully or partially applied what they learned from their on-farm demo or trial in the following year.

Table 10: Application of improved technologies and/or management practices by sampled Year 3 CSISA-BD farmers (N = 439).

Variable	Ref. n	% of N	FPA* (no.)	FPA* (%)
Aggregate application of training† in the same year (Y3)	--	--	373	85%
Aggregate application of training† in the following Rabi season (Y4)	--	--	360	82%
No. of demo/trial farmers; adoption of tech. in Y4 based on a demo/trial	82	19%	71	87%
No. of maize farmers; application (in Y4) of most useful thing learned	312	71%	219	70%
No. of wheat farmers; appl. of most useful thing learned	260	59%	188	72%

* FA = full application of improved technologies/management practices; FPA = full + partial application

† Refers to the application of technologies/management practices learned in a maize or wheat training event

Year 3 farmers were also asked about the application of the most important/useful thing they learned from the training they attended. Table 10 indicates that 219 of 312 maize farmers (70%) stated that they fully or partially applied the most important/useful thing learned, whereas 188 of 260 wheat farmers (72%) reported the same thing. Table 11 ranks the most important/useful technologies and management practices learned by farmers in terms of the six most frequently listed items.

Table 11: Ranked list of most important/useful improved technology or management practice learned by Year 3 CSISA-BD farmers

Maize (n = 314)			Wheat (n = 259)		
Technology/mgt. practice	**No.**	**%**	**Technology/mgt. practice**	**No.**	**%**
Cultivation methods	255	81%	Cultivation methods	199	77%
Line sowing / seed & row spacing	20	6.4%	Line sowing / seed & row spacing	22	8.5%
Fertilizer application rate	10	3.2%	Fertilizer application rate	15	5.8%
Fertilizer-timing of application	6	1.9%	Fertilizer-timing of application	5	1.9%
Fertilizer-other	6	1.9%	Irrigation-timing and/or rates	5	1.9%
Intercropping with maize	5	1.6%	Fertilizer-other	3	1.2%

Aquaculture

A total of 362 respondents involved in aquaculture activities were interviewed of which 236 (65%) are male and 126 (35%) are female. Out of 362 sampled farmer, 297 (82%) sampled farmer received support from only WorldFish under CSISA-BD and 65 (18%) farmer received support from WorldFish and other CG center (IRRI and CIMMYT). Out of the sampled farmers 98% received training on improved aquaculture and 11% participated in aquaculture demonstration and trial in project year 3.

Table 12 shows that 23% of sampled farmers claimed to have followed fully applied the improved technology in year 4, whilst 257 (77%) sampled farmers only partly applied the technology. On the other hand 88% of aquaculture farmers conducting demonstrations applied improved technology.

Table 12: Application of improved technologies and/or management practices by sampled Year 3 CSISA-BD WorldFish farmers (N = 362).

Variable	Ref. n	% of N	FA* (no.)	FPA* (no.)
Received training support (Y3)	353	98%	--	--
Aggregate application of training† in the following year (Y4)	334	95%	77	257
Received demo trial support (Y3)	41	11%	--	--
No. of demo-trial farmers applied technology in year 4	36	88%		36
Received training, demo trial support from WF (Y3)	353	98%	--	--
No. of training, demo-trial farmers applied technology in year 4	334	95%		

* FA = full application of improved technologies/management practices; FPA = full + partial application

Table 13 shows that in the subsequent year (project year 4) 96% of farmers continue to apply fully or in part the technology they had learnt in the previous year. Among those 34% farmer fully applied the technology, 62% applied technology partially and rest of 4% didn't apply.

Table 13: CSISA-WorldFish farmer applied the improved aquaculture technology in year 4

	Overall (n=358)			Pre Stocking (n=342)		Post Stocking (n=342)	
Technology/mgt. practice	No.	%	Area (ha.)	No.	%	No.	%
Fully applied	121	34%	37	70	21%	68	20%
Partially applied	220	62%	52	271	79%	271	79%
Not applied	17	4%		1	-	3	1%

Stakeholder Farmer Field Days: Farmer's field days were organized in every hub for representatives of key stakeholders from within the hub zone of influence. The objective of these FFDs was to ensure that our stakeholder partners were aware of the main technologies the project was promoting and could meet farmers who had adopted these technologies. Through this it is anticipated that successful technology will be included in the programs of our main partners such as the Department of Agricultural

Figure 3: Stakeholder FFD

Extension (DAE). This will further extend the dissemination of successful CSISA-BD validated technology.

Premium quality rice: The market for fine grained and aromatic rice represents approximately 28% of the total rice market (aromatic rice representing 10% of the total rice market). As incomes in urban Bangladesh rise allowing families to spend money of higher value foods this share of the market is thought to be rising by 5% a year[3]. Fine grained rice has a market price that is 40% higher than coarse grained rice and 15 to 30% more than medium grain rice. Aromatice rice rice can command a price that is three times that of coarse grained rice. CSISA-BD has been promoting the production of BRRI dhan50 a "basmati" type fine grained rice since the 2011 season. This boro season high yield potential BRRI variety produces also the same grain yield as standard boro varieties such as the medium to fine grained BRRI dhan28 but because of the higher market price it gains the profit for farmers is 10% to 30% higher than from BRRI dhan28. Farmers initially had difficulty marketing this variety as village millers operating steel roller Engleberg mills could not mill this variety without incuring losses due the high proportion of broken grains produced when they milled with their machines. CSISA-BD staff worked with millers to develop techniques that would allow them to mill with an acceptable level of broken grains[4]. The demand for BRRI dhan50, locally known as "Banglamati" has rapidly increased from 11,018 hectars planted in 2011 to 31,377ha (81% in Jessore region) planted in 2015[5]. As part of a program to continue the dissemination of seed and promotion of this variety BRRI dhan50 featured in 1,449 demonstrations in Jessore hub.

There are a large number of traditional locally grown varietics that are strongly aromatic. The most common of these in northern Bangladesh is a variety called Chinigura. A selection from this variety that has a shorter stature and capacity to respond to moderate applications of fertilizer than the original Chinigura was made by BRRI and released as BRRI dhan34 in 1997. This variety, because of it's higher grain yield than locally grown aromatic varieties and high price has been adopted widely in north western Bangladesh where farmers grow this variety for food companies through contract growing schemes. This variety, however, was not commonly grown in south west Bangladesh where other aromatic varieties are more commonly grown. The project has been comparing this variety with locally grown varieties through field trials (see section 3.1.4) and demonstrations. These have consistantly been show that BRRI dhan34 will yield more than locally grown aromatic varieties. During the 2014 aman season the production of this variety was demonstrated on 342 farms.

Rice Crop Manager: The web based Rice Crop Manager (RCM) tool gives farmers field specific rice crop management recommendations including a fertilizer recommendation. To promote the use of this farmer advisory tool CSISA-BD has been providing farmers with printed readouts of the recommendations provided on the internet by the RCM program. During this reporting period CSISA-BD provided 2,065 farmers with their readout which many farmers call their fertilizer "prescription".

[3] Bangladesh Rice value Chain Analysis and Strategy, Bill and Melinda Gates Foundation, February 2013

[4] Report on BRRI dhan50 stakeholder workshop, Dakbangla bazaar, Jhenaidah District, CSISA-BD, September 2014

[5] Data based on seeds sales from BADC seed agents

SUCCESS STORY

Sunflower – a profitable crop for saline soils

A million hectares of land in Bangladesh is prone to salinity resulting in much of this land being under utilized in the dry season. Sunflower is one of the few crops that can withstand high levels of soil salinity. It also produces a high quality cooking oil that is in high demand CSISA-BD, has been assisting farmers cultivate sunflower on the coastal region of Bangladesh for 3 years

'Sunflower cultivation has shown me the way of using fallow land and has increased my family income.'

Akhil Halder(38), a sunflower farmer, Pankhali, Dacop , Khulna

Akhil Halder(38), a farmer, from Pankhali village of Dacop Union of Khulna district could only grow low yield potential local varieties of monsoon season on his due to salinity problems in the dry season

In 2012, Halder received training from USAID supported CSISA-BD project in salt-tolerant hybrid sunflower variety (hysun33). He was taught how to use a dibbling method for planting the crop which allowed him to sow the sunflower without having to wait for the soils to dry after the monsoon season rice harvest. This allowed him to plant the crop early and utilize residual moisture from the monsoon and escape salinity that occurs in the second half of the dry season and avoid early monsoon storms that occur at the end of the dry season. In the first year (2012) he grew sunflower as a test on 0.06 ha. He harvested 100 kg of seed from which he extracted 30 liters of oil at the local oil mill. This was enough oil for his family for the whole year. In the next year (2013) he planted 0.4 ha of sunflower and harvested 920 kg. He sold the crop and earned a profit of $320. Finally, last year (2014) he planted 0.5ha, harvested 1,300 kg. and made a profit of $505. This included $38 when he sold the sunflower stalks for fuel. With a grain yield of over 2.5 t/ha produced on saline soils with only a single irrigation this experience shows how land previously thought to be worthless for dry season cultivation can be brought into highly productive use by applying appropriate, yet low cost and simple technology

Well over a 1,000 farmers like Halder are now applying this technology to produce sunflower on saline soils thanks to assistance provided by the USAID funded CSISA-BD through the FtF initiative.

3.1.2 Seed System

This section recognizes the importance of good seed supply systems and the key role the private sector can play in ensuring farmers have access to the best varieties. Two activities related to seed production will be presented in this report: the multiplication of new varieties of wheat by farmer's groups and assistance to hatchery owners to produce quality fish seed.

Maize and Wheat

Wheat Seed Production: Wheat seed production of new varieties is one of the key activities undertaken by CSISA-BD. This benefits project farmers directly by increasing their income, but it also helps resource poor farmers to access quality seed of their preferred varieties at an affordable price. In the 2015 14.4 tonnes of the recently released high-yielding and stress-tolerant wheat varieties BARI Gom 25, 26, 27, 28, 29, and 30 were multiplied by CSISA-BD farmers in the 2014-15 Rabi season in Mymensingh and Faridpur hubs (Table 14). Farmers were trained on the importance of quality seed production and on best production and preservation practices. Marketing workshops were also held to link farmers to seed markets. This program contributes to ensuring farmers beyond the project gain access to these new wheat varieties that have stress tolerance traits such as: terminal heat tolerance, salinity tolerance, and stem rust tolerance.

As mentioned above, CSISA-BD facilitates relationships between producers and seed dealers. In Mymensingh Hub, CSISA-BD has worked with two companies, *Joint Agro Business Centre* (JABC) and Kishan Agro Service to produce seed on a contract basis by farmers 10 village marketing groups. JABC provides farmers with training with assistance from CSISA-BD and sells the seed in 10 kg and 20 kg packs. In Faridpur Hub, farmers supply the Bangladesh Agricultural Development Corporation (BADC) with seed for sale through their network of rural seed retailers.

Table 14: Wheat seed production (tons) by CSISA-BD farmers, 2014-15 Rabi season

Variety	Area (ha)	Production (tons)	Estimated Production Used as Seed (tons)	Seed marketing strategy (where / how is it sold?)
BARI Gom 25	0.38	1.75	1.75	1. Through BADC, and farmer-to-farmer channels, in Faridpur Hub. 2. Via Joint Agro Business Centre (JABC), Kishan Agro Service, and farmer-to-farmer in Mymensingh Hub.
BARI Gom 26	2.05	8.48	5.50	
BARI Gom 27	0.52	1.97	1.35	
BARI Gom 28	1.9	7.08	4.48	
BARI Gom 29	0.26	0.99	0.81	
BARI Gom 30	0.13	0.63	0.46	
Total	5.24	20.98	14.35	

SUCCESS STORY

A women seed entrepreneur growing BRRI dhan50 (Banglamati)

Expanding Women managed Businesses. The story of Nasrin Nahar: A women seed entrepreneur growing BRRI dhan50 (Banglamati)

"First time I was afraid and felt shy how high class society of workshop will accept me but I was praised and honored as a women entrepreneur and encouraged to strengthen my seed business and go ahead."

Nasrin Nahar rouging her seed plots with her contract grower

Nasrin working in her office

"I want to see my Utsab Seed Farm as a national institution in Bangladesh as an encouragement other women. I shall not be alive but Utsab Seed Farm will sustain in the "I want to see my Utsab Seed Farm as a national institution in Bangladesh as an encouragement to other women. I dream that women agriculturist and other women will work and involved in my institution. I shall not be alive but Utsab Seed Farm will sustain in the long run with many women"

Nasrin Nahar started her seed business, Utsab Seed Farm, Jessore in 2006. Initially she produced 7 to 10 tonnes annually of seed of popular varieties such as BRRI dhan28 and BR 11 through 7 contract growers. Since then her business has expanded and now she produces seed of six varieties through 26 contract growers.

In 2009 she obtained 20 kg of the fine grained basmati type BRRI dhan50 from BRRI plant breeders. She produced 20 tons of seed but could only sell one tone. In 2011 she joined the Small and Medium Seed Producers Association (SMSPA) in Jessore and through this began to work with CSISA-BD. Through participation in farmer field days and rice production training she observed that "Farmers are getting a higher price for BRRI dhan50 than other varieties and millers are getting more experience of milling it". She could see the potential for marketing BRRI dhan50. In 2014 she produced 12 tons of BRRI dhan28 certified seed and sold 8 tons but 4 tons remained unsold. She also produced 8 tons of BRRI dhan50 certified seed but, unlike the BRRI dhan28 seed she was able to sell all of this seed.

In 2013 she participated in the CSISA-BD organized Women Entrepreneurship Workshop held in Khulna where she made useful links with other seed companies, supermarkets and banks. One link led to her being able to obtain bank loans to finance an expansion of her seed business. She said of the workshop "First time I was afraid and felt shy how high class society of workshop will accept me but I was praised and honored as a women entrepreneur and encouraged to strengthen my seed business and go ahead."

"Programs that focus on women entrepreneurs can help them expand by linking them with finance institutions and markets". Women Agricultural Fairs that display products produced by women such as packaged and branded seeds, puffed rice, flattened rice, pop rice and other products would be of considerable help with expanding their businesses." Another approach she suggests is to conduct exchange visits, develop contract grower schemes and machinery hire service business with women.

3.1.3 Farmers' awareness of new varieties/management practices (Sub IR 1.3)

Farmers' awareness of new varieties and technologies is raised from training exercises that involve formal village-level training, practical demonstrations of the application of new technology, farmer field days in which farmers from the village visit demonstration plots to see the results of the application of new technology, and exchange visits in which farmers travel to another village to see demonstrations. This section presents results from demonstrations, field days, and training events. In many cases, data collected from demonstration plots is used to verify that the technology demonstrated is superior to the farmers' practice. Demonstrations therefore also have a research value and this is reflected in the type of data presented in the following section.

Figure 4: Farmer's Training using a power point projector

The training in most cases now utilizes a combination of practical demonstrations, power point presentations, short videos and a small hand out. The use of PowerPoint presentations and videos has been made possible by the provision of power point projectors to project partners and to the increasing coverage of electrification in rural Bangladesh. The power point presentations and most of the videos are made by project staff or CSISA-BD partner organizations. Though often not of the highest technical quality, these locally made presentations "get over the message" for little cost.

In this six month reporting period CSISA-BD trained 17,108 farmers, conducted trials and demonstrations with 6,714 farmers, and, through participation in training, trials, and demonstrations, benefited 20,297 rural households. This brings the total number of new households that have benefited directly from the core project during this six month reporting period (excluding CSISA-MI activities) to 9,327.

Rice

Cropping System Intensification:

Aman Rice – Mustard – Boro Rice demonstration: This is a continuation of the demonstrations of cropping systems that intensify two rice crops a year systems. This new system involves the planting of short duration aman rice varieties so that the time between aman rice harvest and boro rice transplanting increases from 60 to 90 days. This gives farmers enough time to plant an 85 day mustard crop between the two rice crops. As reported in last year's annual report this adds between $100 and $700 / ha to the farmer's annual income. This year 4,183 demonstrations were conducted of this system. As the boro rice crop has yet to be harvested for this cropping system the full results from this demonstration will be presented in the next report.

In districts covered by Barisal, Faridpur and Mymensingh hubs growing mustard between Jute and aman rice crops is common. Normally farmers grow low yield potential short duration mustard varieties such as Tori 7. However, the time between the harvest of the aman crop in November and the planting of the Jute crop in March is sufficient to grow long duration, high yield potential mustard varieties. Demonstrations showing the advantage of growing these new

varieties were mounted by to 34 farmers in Faridpur hub. The new variety, BARI sarisha11 gave an average grain yield of 2.1 t/ha worth after deducting production costs $885 / ha. In Mymensingh Hub 329 demonstration of the variety BARI sarisha15 gave a grain yield of 1.26 t/ha, 38% more than the locally grown mustard variety Tori7.

In many parts of Bangladesh the land is submerged under water in the monsoon to a depth that is too deep to plant aman rice. This land is used to grow a single crop of boro rice but could, in some areas where the water recedes by mid November, be used to grow a short duration crops such as mustard. In this system there is not enough time to wait for the land to dry sufficiently to allow it to be tilled after the aman rice has been harvested. Instead mustard seed is broadcast immediately after rice harvest without any tillage so that it germinates on the mud. High oil yield variety, BARI sarisha15, was used in these demonstrations. For very little extra work those farmers who adopted this technology gained between $513 and $335 / ha additional income from the mustard crop. This technology has been demonstrated to 93 farmers in Faridpur hub (Bhanga and Gopalganj upazilas)

Figure 5: Relay cropped mustard growing through rice stubble in Jessore District.

In Jessore and Khulna relay sowing mustard over standing aman rice crops two week before it is harvested so that the mustard germinates in the mud under the rice crop has been demonstrated. The system is popular with farmers as they are able to establish the crop for little cost and the mustard matures much earlier than mustard planted by conventional tillage methods. This allows farmers to plant their Boro rice crops on time. Another variation on this system has been the cultivation of short duration, premium quality Tori7 mustard between premium quality aman rice BRRI dhan34 and boro rice BRRI dhan50. This "premium quality" cropping system is providing an income that is $1,000 / ha more than lower quality rice – rice systems. Results from these demonstrations will be presented in the next reports when the boro rice crop has been harvested.

In many places water for irrigation is difficult to obtain either because the groundwater is saline or fresh water from ponds or canals is too far away for it to be economic to pump it to these fields. Under these situations the project has demonstrated a cropping system that involves growing a short duration aman variety such as BINA dhan7 or BRRI dhan56 followed by a high yield mustard variety such as BARI sarisha15 or lentil. These crops can then be followed by a late dry season crop of mungbean. In these demonstrations planting Lentil and Mungbean with a power tiller operated seeders (PTOS) and the use of new BARI varieties with good disease resistance has proved to be very popular with the 108 farmers participating in these demonstrations.

Rice – Sunflower: This is the third year in which sunflower on saline soils in coastal Khulna and Barisal divisions has been promoted. This cropping system involves the cultivation of saline tolerant aman season rice followed by early, dibble planting of saline soils tolerant sunflower. In 2014 1.263 farmers participated in sunflower demonstrations. This year inputs for 644 demonstrations were conducted in the anticipation that many farmers who had received seed for demonstrations in 2014 would buy their own seed from local stockiest. As in 2014, farmers received training in the use of dibbling planting methods and the correct use of fertilizers. As

traders have developed links with farmers and oil expellers have developed markets for sunflower oil marketing of the crop has improved and most farmers are now able to sell their crop to local traders.


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Figure 6: Media coverage of sunflower production in Satkhira District in national newspapers

Promotion of new rice varieties: Demonstrating new varieties in block of 20 to 30 farmers has been found to be a very effective way of generating acceptance of these varieties. In the 2014 aman season 861 demonstration of submergence tolerant varieties (861 farmers), 289 demonstrations of saline tolerant varieties and 304 demonstrations of aromatic BRRI dhan34 were conducted. Demonstration of short duration varieties, principally BINA dhan7 but also BRRI dhan56 and 57, were conducted as part of the cropping system demonstrations describerd above.

Training in Good agronomic practices: Training in ten good agronomic practices that include good choice of variety and seed source, seedbed preparation, correct spacing, transplanting in lines, weed control, irrigation, and the use of Rice Crop Manager (RCM) to apply the correct fertilizer rates forms the basis for all training given to farmers on rice crop production. This package of technology was demonstrated on all cropping system and variety demonstrations and in 378 GAP demonstrations and 4,130 farmers received GAP training.

Figure 7: Farmer Field Day, Satkhira District

Oilseed and Mungbean training: Training in the production of mustard was given to 560 farmers, sunflower to 1,480 farmers, sesame to 121 farmers and mungbean to 74 farmers

Farmer Field Days: A total of 100 farmer field days attended by 7,994 farmers and representatives from partner organizations including the DAE were conducted during the reporting period. These mainly focused on aman rice, mustard, sunflower and lentil production but they also included rice transplanter demonstrations.

Maize and Wheat

CSISA-BD raises the awareness, knowledge, and skills of farmers by orienting them on the cultivation of various crops within maize and wheat-based cropping systems via training and demonstrations, FFDs and exchange visits.

Table 15 presents data for several key interventions implemented by the CSISA-BD maize and wheat program under IR1 (On-farm productivity increased). From October 2014 to March 2015, 623 on-farm demonstrations were conducted and 2,247 farmers were trained (21% females) under these six interventions alone.

Table 15: Selected Year 5 Maize- and Wheat-based interventions for increasing on-farm productivity

Interventions	Training of farmers			Demonstrations		FFDs/EVs
	Year 5 target	Achieved	No. of women	No. conducted	Area (ha)	No. of participants
Maize for income generation and human consumption	1,229*	1,239*	232*	142	16.8	254
New stress-tolerant and rust-resistant wheat varieties	425	523	138	117	15.7	650
CA demonstrations	180	189	40	97	12.8	280
Intercropping different economic crops with maize	204	62	15	101	5.4	438
Increased production and supply of quality wheat seed	120	149	29	42	5.1	300
Best practices for cereal-based cropping systems	30	85	9	124	16.2	--
Total	**2,188**	**2,247**	**463**	**623**	**72.0**	**1,922**

* Includes refresher training that targeted 364 farmers; with 454 achieved, of which 77 were women.

Demonstration effect of maize storage: With awareness and encouragement obtained from CSISA-BD, farmers in the Chuadanga area are storing maize grain in a small silo ("gola" in Bangla) that is traditionally used to store paddy. Golas are made locally, typically of bamboo for the sides and tin for the roof; the capacity of each averages between 6 and 10 tons, but the range is 2 to 20 tons. They are usually perched 0.5-0.75 m above the ground to avoid water damage from local flooding. As shown in Figure 8 & 9, golas have a small opening to load/unload the grain, and to observe quality over time. High temperatures (approximately 38-44 degrees Celsius) reached inside the gola after only a few hours of sunshine help to maintain grain quality

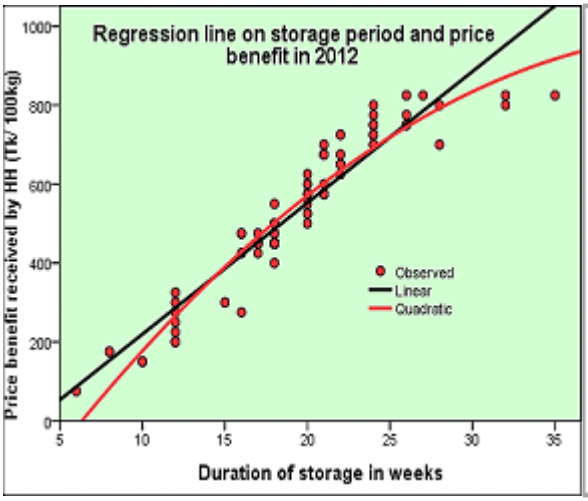
Figure 9: Outside view of a bamboo gola

Figure 8: Inside view with stored maize grain

by killing insects and their larvae and eggs. With technical and financial assistance from CSISA-BD (BDT 3,000 per gola, on average), more than 60 demonstration farmers in Chuadanga improved their golas by fitting the floors with tin sheets in order to prevent post-harvest losses from rodents, insects, and even theft. These demonstrations help raise awareness among farmers about the potential of golas, for it is commonly thought that maize grain cannot be stored like paddy in traditional storage bins, leading farmers to sell it as quickly to avoid pest damage. Since maize is almost never consumed at the household level in Bangladesh, most farmers sell immediately after harvest when prices are lowest. If they could store maize grain for one or two months when prices start to rise then they would gain more income.

A recent survey (n=109) of Chuadanga farmers conducted by CSISA-BD showed that 80% of maize produced is stored for at least a month (and up to 43 weeks in some cases). Golas were

the most preferred storage device for maize and were used by 62% of the respondent households. Jute sacks (55%) were the next most preferred option (many farmers use Jute sacks in addition to storage in golas). Figure 10 & 11 indicates that, on average, each household earned a profit of approximately BDT 30,411 (US$ 390) in 2012 followed by BDT 24,633 ($ 316) in 2013 and BDT 10,160 ($ 130) in 2014 through storing maize. Using data on maize storage for 2012, Figure 10 also shows that the longer the maize was stored the more the farmer earned. They report using their increased profits to improve their livelihoods by purchasing land that they mortgaged, investing in business, and deposit as savings, buying agricultural inputs and spending on other family needs (school fees, books, stationeries for their children).



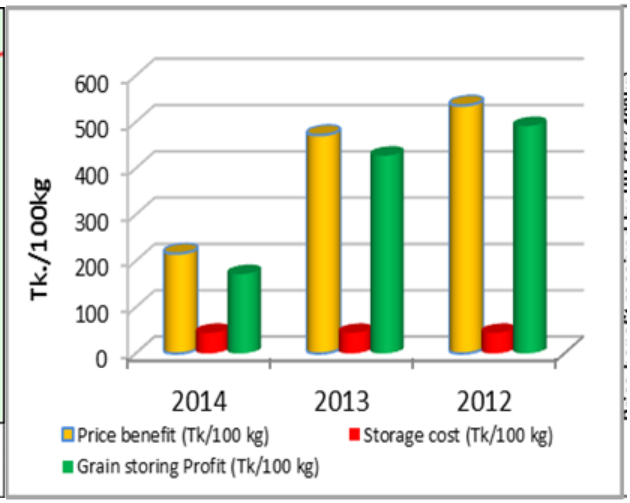


Figure 10: Storage price-duration relationship, 2012 ***Figure 11: Storage economic data, 2012***

Aquaculture

CSISA-BD provides 10 hours of training spread over two days for aquaculture farmers. This is followed by participatory farmer trials (PFT)/demonstrations in which farming households and value chain actors observe the trial activities and results on their own farm or in their own village. Linkage events (or farmer field days) are held to share PFT results with farming households along with all possible value chain actors, NGOs, and other stakeholders. Project staff and partner extension staff lead "Coaching for the Farmers" sessions once a month which includes one session provided by the Upazila Fisheries Officer. This approach has strengthened the adoption process compared to the previous years when only one training course per year was given, followed by a refresher course in succeeding years.

Figure 12: Conducted basic farmers training

Table 16: Activities for increasing aquaculture productivity during reporting year

Interventions	Training of farmers			Demonstrations and Trials		LEs/EVs	
	Year 5 target	Achieved	Women (%)	No. conducted	Area (ha)	No. of Direct participants	No. of Indirect

							participants
Improved pond-based aquaculture technologies	3300	1939	22	8	1.28	2751	5441
Improved rice field/gher-based aquaculture technologies	1450	995	18	7	1.33	751	2105
Household-based aquaculture and horticulture	1000	956	100	2	0.18	763	1272
Total	5750	3890	40	17	2.79	4265	8818

Farmer training: During this reporting period, 3,890 new farmers (40% women) attended a two-day training course on different improved aquaculture-agriculture technologies. A total of 155 courses have been facilitated by project and partner staffs. Each course includes different participatory methods and hands-on activities, as well as sessions on gender and family nutrition.

Table 17: Summary of farmer training on aquaculture in during October 2014 to March 2015

Technology	No of batches	No. of man	No. of women	Total
Improved carp-tilapia and/or pangus polyculture in ponds	2	50	0	50
Household based pond aquaculture and horticulture on dyke	38	3	953	956
Improved carp polyculture in pond and horticulture on dyke	71	1367	424	1791
Improved carp and shing Catfish) polyculture in Pond and horticulture on dyke	1	25	0	25
Improved farming of prawn and carp in freshwater gher and horticulture on dyke	15	331	47	378
Improved farming of tilapia in pond and horticulture on dyke	3	66	7	73
Improved rice-fish farming with dyke cropping	14	303	35	338
Improved Shrimp farming by stocking PCR tested PL in brackish water Gher system	11	181	98	279
Total	**155**	**2326**	**1564**	**3890**

Refresher training for fish farmers: Farmers who have participated in CSISA-BD activities in Year 4 received refresher trainings in Year 5. This provided an opportunity to respond to problems faced by farmers when implementing technologies learned in the first training course and to determine the extent to which they have been able to adopt the new technology. During this reporting period, 211 refresher courses were conducted with 4,889 participants, 40% of them were women farmers.

Coaching for fish farmers: CSISA-BD has designed this extension approach to help trained farmers keep in touch and gain advice while actually implementing what they have learnt. These sessions are held mainly at the site of the PFT pond. During project year 5 coaching sessions have also been provided to Year 3 direct farmers. These are usually organized by the partner NGOs staffse and Department of Fisheries (DoF) staffs are invited to facilitate one session. A total of 183 sessions were conducted in the reporting period attended by 4,066 farmers (45% women).

Table 18: Summary of refresher training for fish farmers during October 2014 to March 2015

Technology	No. of batches	No. of men	No. of women	Total
Improved carp-tilapia and/or pangus polyculture in pond	8	167	0	167
Household based pond aquaculture and horticulture on dyke	40	4	963	967
Improved carp polyculture in pond and horticulture on dyke	95	1678	494	2172
Improved carp and shing (catfish) polyculture in Pond and horticulture on dyke	5	107	10	117
Improved farming of prawn and carp in freshwater gher and horticulture on dyke	27	394	242	636
Improved farming of fresh water prawn and carps in pond and horticulture on dyke	4	31	67	98
Improved farming of tilapia in gher and horticulture on dyke		60	34	94
Improved farming of tilapia in pond and horticulture on dyke	10	174	49	223
Improved rice-fish farming with dyke cropping	9	188	20	208
Improved Shrimp farming by stocking PCR tested PL in brackish water Gher system	9	141	66	207
Total	**211**	**2944**	**1945**	**4889**

Aquaculture linkage events: After the PFTs are completed, "Linkage Events" are organized during which value chain actors such as NGOs, banks, extension service providers and farmers are linked. The event provides the platform to display and present the results from the PFT to wider audience/stakeholders with the expectation that they will disseminate the same technology to their clients or invest as market actors. During this period, 183 linkage events have been organized, involving 4,265 direct and 8,818 indirect famers, 26 GoB officials, 147 market actors and 57 NGO staffs.

Mechanization (CSISA-MI)

CSISA-MI trained 936 (112 women) LSPs, mechanics, private sector actors and farmers.

As part of developing targeted financial services to support the supply chain for agricultural mechanization products, CSISA-MI signed MoUs with Micro Finance Institutes Jagaroni Chakra Foundation (JCF), TMSS and Rural Reconstruction Foundation (RRF) to ensure that LSPs have access to small-scale and low interest loans for the purchase of reaper machines.

Figure 13: LSP demonstrating agri. machinery equipments

CSISA-MI also aims at improving the capacity of the public and private sectors to ensure stronger science-led interventions, value chains for agricultural machineries and pumping

equipment, and better services to farmers. As such, CSISA-MI strengthens relationships at the national as well as field level with the relevant government institutes and other partner organizations.

In this regard CSISA-MI is also working with the Bangladesh Agricultural Development Corporation (BADC). They have received a grant worth $1.5 million from USAID to clean and rehabilitate irrigation canals to improve access to surface water irrigation in Barisal District. The project currently is excavating 50 km of canal systems, and installing sluice gates in strategic locations, in collaboration with CSISA-MI's engineers and irrigation scientists. Following rehabilitation, BADC will procure 40-50 AFPs for farmers to improve their ability to access water.

Figure 15: After excavation of a canal - Gournadi upazila, Barisal district

Figure 14: Canal excavation

CSISA-MI has also been coordinating activities with the extension staff of the Department of Agriculture Extension (DAE). CSISA-MI provided DAE staff with information on the use of surface water irrigation and advanced agricultural machineries. In addition, CSISA-MI continues to collaborate with Bangladesh Agricultural Research Institute (BARI) to test and refine two-wheel tractor based agricultural machinery and irrigation pumps. Importantly, CSISA-MI is facilitating the testing of new domestically produced AFP prototypes at BARI for quality control assurance and developing capacity of RFL in producing the pump locally.

SUCCESS STORY

How the CSISA-BD\CSISA-MI Link Increased Yunus's Knowledge and Income

CSISA-BD & CSISA-MI provides training on new wheat technologies using machines which improve the livelihoods of farmers and LSPs in Faridpur.

Photo: CSISA-BD personnel

"I am very grateful to CSISA-BD for the knowledge and guidance provided in working with CA machineries and for helping me to become a better LSP."

– Yunus Sardar, CSISA LSP located in Faridpur Hub

Yunus Sardar, a farmer and a Local Service Provider (LSP) lives in Bara Bazar Village in Rajbari District. In this locality there is a shortage of two-wheel tractors (2WT or "power tiller") to meet the land preparation demand. The 2WT owners first plough their own land and then service the land of other. Often the 2WT owners hire an operator under a daily-basis system for the machine operation.

Yunus is 45 years old, with primary level education and is landless. He used to work as a power tiller operator earning $4 to $5 per day. With this wage he was not able to make as much money as the LSPs / 2WT owners. All of the time he used to think about how he could become a 2WT owner, but by early 2014 he was jobless. His luck changed, however, when he participated in a CSISA-BD training event on line-sown pulses using CA machinery. Since he showed great interest and skill when practicing with the bed planter machine, CSISA-BD staff selected him as for LSP training.

In October 2014, CSISA-MI conducted training on CA machinery attachments for 2WTs in which Yunus attended – based in large part on his earlier display of skill and enthusiasm with respect to machine operation. It was there where he learned more about the large scope and ample opportunities for LSP businesses, which only increased his desire to purchase a 2WT. He finishes this success story in his own words:

"During Rabi 2014, I purchased one 2WT at 25% subsidized price from the agricultural machinery project launched by DAE. Now, I can earn $13 to $19 per day in comparison to the $4-5 per day that I used to get before. CSISA-BD helped me a lot to improve my knowledge and because of this I am now able to earn more money that has changed my livelihood. I am very grateful to CSISA-BD for the knowledge and guidance provided in working with CA machineries and for helping me to become a better LSP."

3.1.4 Improved agricultural technologies available to farmers (Sub IR 1.4)

In this section the results of on-farm trials conducted with farmers to validate and verify that new technology will work when used by farmers are presented.

Rice

The results presented below are mainly for aman season variety and crop management trials where the emphasis has been on finding varieties and technologies that will increase the production of aman rice within the context of rice based cropping systems. During his six month reporting period data was collected on rice and mustard production grown within rice based cropping system trials. Lentil, sunflower, sesame and mungbean were all sown during this period as part of whole system trials which will not be complete until the boro rice in these systems is harvested. The results from these trials will therefore be reported in the end of project report.

Short duration aman rice varieties: On higher elevation land less prone to flooding than lower elevation land growing aman season varieties that mature earlier than traditional aman varieties allows dry season rabi crops to be planted on their optimal planting date of mid November. The project has been promoting through trial and demonstrations the cultivation of the short duration aman variety BINA dhan7. New varieties have been recently released that are also early maturing but have superior grain quality to BINA dhan7. Trials were conducted to verify if these new varieties would yield as well as BINA dhan7 and to also confirm that there would be little reduction in grain yield for the farmer from switching from long duration varieties to short duration varieties.

Table 19: Rice varieties with duration

Varieties	Days to maturity	Grain yield (t/ha)			
		Jessore	Faridpur	Faridpur	Mymensingh
Short duration varieties					
BINA dhan7	110	5.3	4.8		4.7
BRRI dhan 56	105	4.2			4.3
BRRI dhan 57	110	3.9			4.2
BRRI dhan39	120		4.4	3.8	
BRRI dhan 33	120	4.7			
BRRI dhan 62	100	4.5			
Medium to long duration varieties					
BRRI dhan 49	135	5.2		4.0	
Gutiswarna	150	5.1			
BRRI dhan44	145			4.2	
BRRI dhan52	150			4.4	

The data presented in table 19 indicates that early maturity will not result in lower grain yield compared with long duration varieties. BINA dhan7 still provide farmers with the best grain yield but newer varieties (BRRI dhan56, 57 and 62) have a finer grain quality than BINA dhan7 giving higher prices and income.

Tolerance to Submergence and Salinity: On lower elevation land rice can be submerged for many days during the monsoon. BRRI and BINA have bred varieties that will withstand submergence for up to 15 days with minimal impact on grain yield. Flooding and submergence is not a problem every year and therefore varieties with submergence tolerance should yield as well as standard varieties when flooding is not a problem.

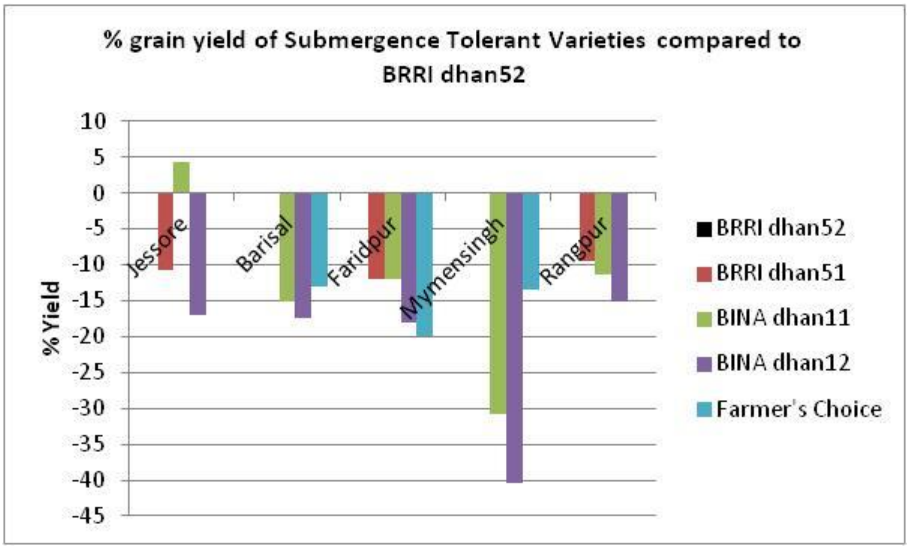


Figure 16: Percent of grain yield of submergence tolerant varieties compare to BRRI dhan52

This series of variety trials compared the standard submergence tolerant variety BRRI dhan52 with newly released submergence tolerant varieties bred by BINA.

The results shown in figure 16 as a percentage of the yield of BRRI dhan52 from locations in north and south west Bangladesh consistently show that BRRI dhan52 out performs the BINA and farmers' choice varieties

In coastal Bangladesh aman rice is often grown on land that is saline during the dry season or is grown on ghers used to grow shrimps in brackish water ghers during the dry season. Even after leaching by monsoon rains, this land can still retain a high level of salinity. Aman rice varieties with some tolerance to salinity are therefore required if this land if to be made productive for rice production. New BRRI varieties BRRI dhan53 and 54 consistently yield 20% more than the best farmers varieties across saline sites in Khulna and Barisal regions and mature 10 to 20 days earlier and have finer grain quality than similarly yielding old BRRI aman salt tolerant variety BRRI dhan41 and non saline tolerant photosensitive variety BR23.

Aromatic rice varieties: Aromatic varieties of rice consumed on ceremonial occasions are growing in demand in Bangladesh. The price paid for these varieties is two to three times more than non aromatic varieties. Most high yielding varieties are though not aromatic and the best aromatic varieties are tall local varieties. BRRI bred an aromatic variety, BRRI dhan34 that has all

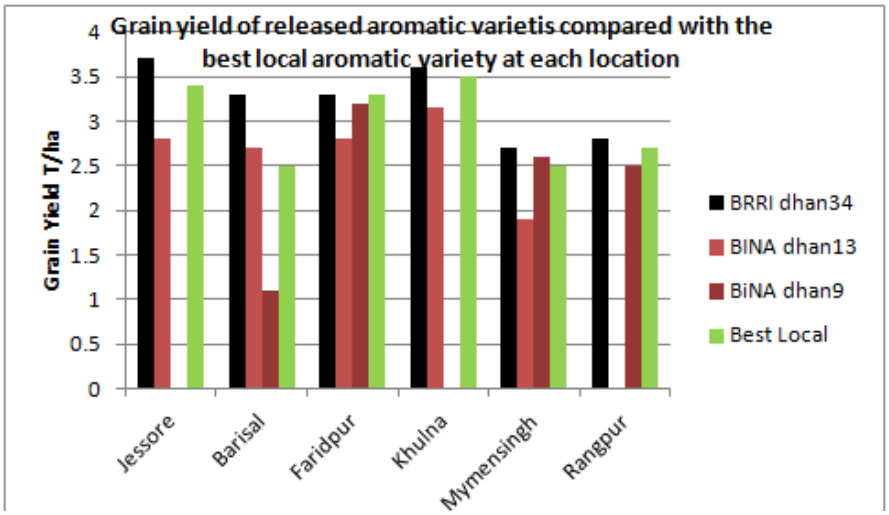


Figure 17: Grain yield of released aromatic variety compared with best local aromatic variety

the characteristics of a traditional Bangladeshi aromatic variety but with a higher yield potential than locally grown aromatic rice varieties. New aromatic varieties have recently been released by BINA and so the objective of this trial is to compare the grain yield and aroma of these new varieties with BRRI dhan34 and some locally grown aromatic varieties.

At all locations BRRI dhan34 gave a higher or similar grain yield to the BINA varieties and the best local variety

The perception is that modern semi-dwarf varieties will yield much more than locally grown tall varieties. The trial presented in figure 18 indicates that the difference, at least on the moderately saline Khulna and Bagarhat soils may be less that often assumed. BRRI dhan54 has some tolerance to salinity and BRRI dhan 23 is a photosensitive short straws variety popular with farmers in Khulna division.

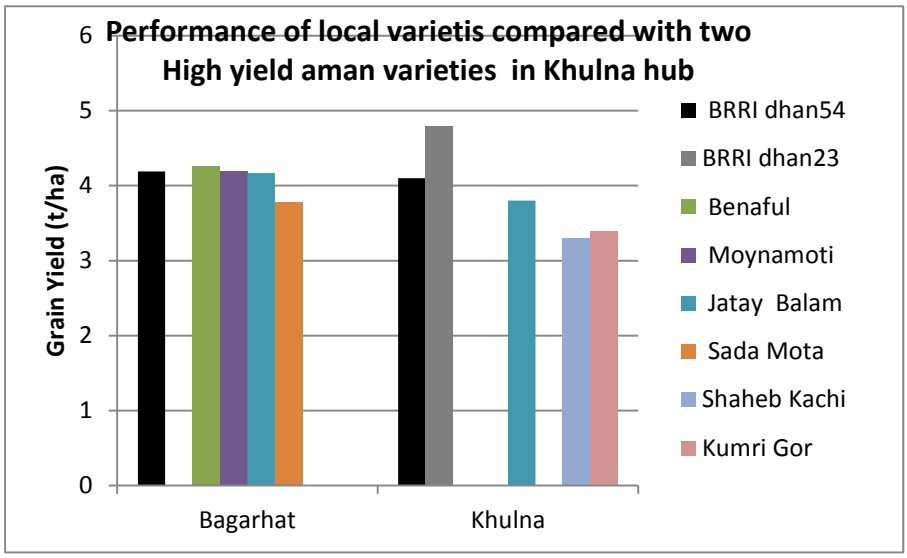


Figure 18: Performance of local varieties compared with two high yield varieties

As locally grown varieties often have a higher grain price, produce more straw and require fewer inputs than high yielding modern varieties the income from these varieties can be greater than modern varieties.

Aman rice yield gap trial: This 8 treatment trial conducted in five hubs sought to identify which of six changes in technology would have the biggest impact of aman rice grain yield. The six technologies were:

1. Change of variety
2. Use of raised beds for raising seedling and transplanting at the optimal seedling density
3. Use of the Rice Crop Manager fertilizer rate
4. Weed control using herbicides
5. Supplementary irrigation
6. Use of all these in combination with mechanical transplanting and unpuddled land preparation

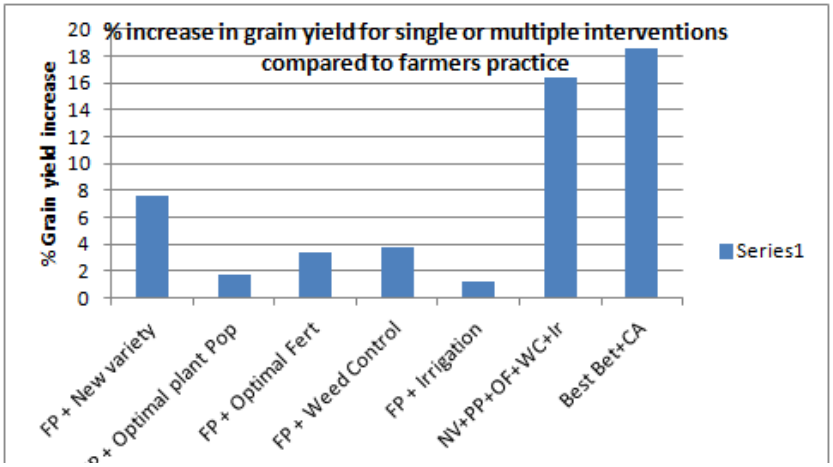


Figure 19: Percent of grain yield for single or multiple interventions compared to farmers practice

The statistical analysis of the data has not been completed but initial results indicate that of the single technology changes tried, changing variety had the biggest impact. The greatest impact

was obtained, though, when all 6 changes were implemented. Adding conservation agriculture practices and mechanical transplanting did not bring substantial benefits.

Rice mechanization: Two trials were conducted in Jessore hub on mechanization of rice planting. One compared direct seeded rice with conventional transplanting and another compared the use of a mechanical rice transplanter to transplant rice with a manual transplanting.

Table 20: Comparative grain yield in different rice mechanization

Transplanter trial - Treatments	Grain yield (t/ha)	Dry seeding - treatments	Grain yield (t/ha)
Mechanical Transplanting	5.1	Dry seeding after tilling	4.2
Line transplanting by hand	4.6	Dry seeding without tillage	4.0
Transplanting hand, not in rows	4.53	Transplanting hand, not in rows	4.7

Farmers preferred the transplanting with a rice transplanter. The principle problem with the dry seeding was that the planter did not deliver the seed in a uniform manner resulting in gaps and missing rows.

Figure 20: Transplanter in action in Jessore hub

Maize and Wheat

Evaluation of new wheat genotypes under different tillage methods: Proper crop residue management combined with different minimum tillage systems (e.g. raised beds or strip tillage) are the key components of new farming practices that can increase the profitability of smallholder farmers in Bangladesh. This is the essence of Conservation Agriculture (CA), a sustainable crop management practice being tested and promoted by CSISA-BD.

In Year 5 a multi-location trial was established to evaluate new wheat varieties under different tillage systems in order to assess biophysical and socio-economic variability resulting from such interaction of technologies. Six wheat genotypes (Bari Gom 26, Bari Gom 27, Bari Gom 28, Bari Gom 29, Bari Gom 30, and BAW 1170) were examined under three tillage methods

(Conventional = CT, Bed planting = BP, Strip tillage = ST), in four locations (Rangpur, WRC Dinajpur, Jamalpur, and Faridpur), replicated three times in each location (one farm served as one replication). Both qualitative (farmers' perceptions) and quantitative data were collected. Harvesting of trial plots has been completed, but data compilation is in progress in all locations except in Jamalpur, where the grain yield varied significantly due to tillage systems, varieties and their interaction (see Table 21).

Table 21: Grain yield (t/ha) of wheat genotypes under different tillage systems, Jamalpur (2014-15)

Genotypes	Tillage Methods			Mean
	CT	BP	ST	
BARI Gom 26	4.522 e	4.719 c	4.890 b,c	**4.711 c**
BARI Gom 27	4.387 f	4.529 e,f	4.585 e	**4.500 d**
BARI Gom 28	4.658 d	5.040 b	5.166 a	**4.955 b**
BARI Gom 29	4.805 c,d	5.231 a	5.237 a	**5.091 a**
BARI Gom 30	4.675 d,e	5.162 a	5.089 a	**4.975 b**
BAW 1170	3.674 h	3.432 i	3.971 g	**3.692 e**
Mean	**4.453 c**	**4.686 b**	**4.823 a**	**4.654**

Note: grain yield followed by the same letter is similar statistically.

The highest yield for tillage type was recorded in strip till plots (4.82 t/ha) and the highest yielding variety was BARI Gom 29 (5.09 t/ha), followed by BARI Gom 30 (4.96 t/ha) which was statistically similar to the yield of BARI Gom 28 (4.98 t/ha) A combination of strip till or bed planting BARI gom29 gave the best results.

Farmers preferred BARI gom30 for high yield and BAW 1170 for its earlier maturation (approx. 7 days earlier than the other varieties. Farmers preferred both bed planted and strip tilled wheat irrespective of varieties compared with conventional Tillage methods.

Aquaculture

Developing strategies to mitigate the effects of high temperature on breeding efficiency of Tilapia GIFT strains: This experiment have been conducted with a private hatchery Nova Hatchery and Fishery, Gohalkandi, Tarakanda, Mymensingh to find out which would be the best management options for improving tilapia reproductive performance during hot weather. The experiment had 5 treatments: T1: under shade; T2: Deep water; T3: showering with water during hot weather; T4: shade, deep water and showering and T5: control.

Figure 21: Trial on breeding efficiency of Tilapia GIFT

The results to date show that growing Talapia under shade (treatment 1) or in a combination of deep water spraying with water and under shade (treatment 4) produced the most eggs.

Effect of sludge removal in intensive aquaculture system: The uneaten feedstuffs and faces of the fish has long been cited as a major contributor to sludge generation in commercial

Pungasius-tilapia-carp farms. Accumulation of sludge results in water pollution and less production. To address the problems an adaptive research trial on 'Effect of sludge removal in intensive aquaculture system' was initiated with the objectives of observing the effect of sludge removal on the fish mortality and fish productivity, examining the effect of sludge removal on water quality and evaluating farm economics. The study has two treatments: pond cleaned with pond sludge removal pump (PSRP) and pond with not cleaned. The trial was repeated on five farms. Water temperature was recorded fortnightly and other water quality parameters (pH, dissolved oxygen (DO) and unionized ammonia) were recorded before and after sludge removal. In addition to those more detail information on sustainable intensified aquaculture system will be collected through FGDs and questionnaire survey.

Development of year round vegetables farming technologies on brackish water gher dikes: Brackish water Gher farming has been evolved as the most common source of aquaculture agriculture production in southwest coastal region of Bangladesh. As a result of saline water intrusion and water logging farmers have converted approximately 149,000 ha of low-lying rice fields into brackish water shrimp farms and 64,000 ha into freshwater prawn farms. To increase farm income vegetables cultivation on freshwater gher banks is now common. By contrast, due to high soil and water salinity it is not possible to grow vegetables on the banks of shrimp ghers.

Figure 22: Vegetable grown in summer rainy season on the saline water gher dike

Considering this challenge Khulna hub conducted vegetable farming trials on shrimp gher banks. It was found that during the monsoon season bitter gourd, yard long bean, bottle gourd and okra grew well while in the winter (Rabi) season sweet gourd and tomato grew well. Applying sludge from fresh water freshwater ponds significantly improved production.

***Development of low-cost feed for prawn and tilapia using sunflower cake as an alternative source of plant based protein and fish meal for freshwater gher farming*:** Feed represents the largest expenditure item in aquaculture systems and protein is the most expensive macro-nutrient in fish/shrimp feeds. As a result many farmers fail to provide sufficient feed to achieve maximum production. Often as an alternative to providing proper feed they feed prawn and tilapia on low quality feed such as boiled rice, rice bran, broken wheat, poultry droppings and mustard oil cake. The objective of this trial was to identify alternative sources of protein to fish meal, mustard oil cake and soybean cake using plant based feed ingredients such as locally available sunflower cake and maize. Laboratory analysis of these alternative feeds show that sunflower oilcake and maize contain sufficient protein to provide fish with an adequate diet and are cheaper than other fish feed ingredients. Considering the potential of sunflower cake and maize as ingredients in feeds

Figure 23: Development of low cost feed using sunflower cake

for tilapia (around 26% crude protein) and prawn (around 30% crude protein) formulations were prepared in consultation with Bangladesh Fisheries Research Institute (BFRI) and Bangladesh Agricultural University (BAU). The experimental diets have four treatments including one control with three replicates. Inclusion of 30%, 40% and 50% sunflower oil cake instead of fish meal, mustard oil cake and inclusion of maize to reduce rice bran.

The data so far suggests that the prawn feed formulation with with 50% sunflower oil cake and the tilapia feed formulation with 40% sunflower oil cake are the best.

Mechanization (CSISA-MI)

To drive the adoption of more precise and resource conserving agriculture, CSISA-MI currently promotes four keystone technologies – the fuel saving high volume Axial Flow Pump (AFP) for surface water irrigation, Bed Planters and Seeder-Fertilizer Drills that can be used for line-sowing and conservation agriculture, and the Reaper to address labor bottlenecks at harvest and speed up the time between harvest and the planting of the next crop. These machines help increase yields by maximizing the productive use of soil moisture, fertilizer and seed, while saving farmers' time, labor and money. Through public-private partnerships with machinery manufacturers and importers such as Advanced Chemical Industries (ACI), Metal Industries, Chittagong Builders and the Rangpur Foundry Limited (RFL) Group, CSISA-MI is working to commercialize and catalyze the wide-availability of these machines for LSPs in the FtF zone.

In addition during the reporting period, CSISA-MI piloted the use and demonstrated a rice transplanter creating awareness for Khulna farmers.

SUCCESS STORY

Improved Technology beats all odds to bring prosperity and profits

Salinity intrusion had left Manik and many others in his community in despair. Trying to cope with shrimp cultivation led to more losses until CSISA-BD taught Manik improved methods and the importance of PCR tested PL.

Photo: MD MONIRUJJAMAN, WORLDFISH/ CSISA-BD

"I am really grateful and proud to be a part of CSISA –BD activities because before we followed the traditional shrimp culture practice but now they have opened my eyes to improved shrimp farming by stocking PCR tested post larvae."

- Rabi Sanker Manik, CSISA-BD fish farmer, Khulna

The lives and livelihoods of the people of Bangda village under Satkhira district of Satkhira Sadar Upazila are under from climate change, natural calamities & salinity intrusion. Even 10 to12 years ago; the main crop in this area was boro rice and prawn. However after 2-3 years, some local elites enabled saline intrusion from the Morirchar River in the Bazrakhali beel for shrimp farming.

Rabi Sanker Manik along with six family members amongst the many who suffered greatly as a result with production from his 300 decimal land, homestead and gher being gravely affected. Manik was a traditional fish farmer by trade who also purchased shrimp from other ghers and sold in the depots. This saline intrusion left him and many others in despair and asking the government and other high officials for help was to no avail. Manik coped by engaging with shrimp farming but again suffered from virus attacks not knowing the importance of applying lime, using feed and having a nursery in the gher. Manik's predicament was resolved when the CSISA-BD, WorldFish personnel came along and provided him with one day training in March 2014 along with 23 other shrimp farmers and he was even selected as a demonstration farmer. Following all the technical advice from WorldFish and with a further training from IRRI, Manik regained his confidence in gher farming.

After the training, Manik stocked a total of 13500 PCR tested shrimp Post Larvae in the gher nursery for a 25 days after which he released the surviving 10800 juveniles into his 90 decimal grow out gher. He also included some carp fingerlings after the rain when salinity receded. He gave feed based on the fish weight, applied lime and exactly followed the learning of the training received from CSISA-BD WorldFish team. In the year 2014, he made total income BDT 244,809 in which shrimp alone contributed BDT 180,569 by spending only BDT 94,529.

Manik happily said *"I am really grateful and proud to be a part of CSISA –BD activities because before we followed the traditional shrimp culture practice but now they have opened my eyes to improved shrimp farming by stocking PCR tested post larvae*." He also commented that more technical support, availability of virus free shrimp PL and linkage with the various market actors is very essential for continuing profitably. His future plan is to continue following the techniques he learnt and raise awareness amongst others.

This year, about 12-15 farmers were motivated by Manik and followed his example. With the profits, Manik recovered 22 decimal of his own land from mortgage by paying BDT 30000.00 and plans to purchase a cow.

3.1.5 Enhanced research and development capacity (Sub IR 1.5)

Capacity building of stakeholders such as researchers, extension workers, farmers and service sectors from government agencies, NGOs, and private agencies assists with the scaling out of technology developed and promoted by the project.

Rice

The CSISA south Asia program provided Bangladesh with an $110,000 grant to provide research groups in Bangladesh with funds to allow them to investigate a topic that would be of national interest and support the goals of the CSISA-BD program. At a meeting of the CGIAR Advisory Committee (CAC) chaired by the Bangladesh Agricultural Research Council (BARC) chairman in May 2014 it was decided that the fund would be managed by CSISA-BD. Dispersement of the funds to award winners is the responsibility of CIMMYT. Out of a total of 19 proposals 7 were selected for funding.

Figure 24: CSISA / BRRI Rice Mechanisation research grant - Farmers Field Day, Rangpur.

Table 22: List of proposals awarded from partnership funds in 2014 together with a brief report

Title	Budget ($US)*	Institution / Admin-istered	Description
Participatory Technology development and dissemination (PTDD) of stress- tolerant wheat under unfavorable ecosystem	19,500	BAR I/ CIMMYT	**Location**: Char land area of Bhuapur, Tangail, Salinity area of Patuakhali and drought prone area of Godagari, Rajshahi. Trials to test newly released wheat varieties under a range of stress prone growing environments.
Identification of suitable white-grained hybrid maize technologies for water limited environment	13,380	BARI / CIMMYT	**Location**: Gazipur, Barisal and Rajshahi Barind region. Eight hybrids (some of them from Zimbabwe) are under test.
Rice based cropping intensification by incorporating short duration crops for high productivity and profitability of farmers in southern Bangladesh	11,163	BAU/IRRI	**Location**: Bagarhat District. Farmer participatory evaluation of saline tolerant rice varieties in rice / fish ghers
Farm level evaluation of mechanical rice transplanter, BRRI weeder and BRRI prilled urea applicator to boost up agricultural mechanization	18,732	BRRI/IRRI	**Locations:** Rangpur and Jhenaida. On-farm evaluation of mechanical rice transplanters, prilled urea applicators and machine powered weeder.
Community Participatory Cropping Pattern Development and Refinement for Khulna Hub	16,068	BRRI/IRRI	**Location: Satkhira District** Trials to identify cropping systems and production technology that will allow farmers

Saline Soils			to cultivate on saline soils.
Development of sludge remover and sludge management system for better performance of intensive aquaculture	14,935	BARI/WF	**Location**: Monirampur, Jessore; BARI, Gazipur Development of a machine for removing fish waste, waste feed and silt from the bottom of ponds without draining the ponds
Development of economical feed for crab fattening to reduce dependence on trash fish in coastal region of Bangladesh	13,845	BAU/WF	**Location**: Rampal of Bagerhat – Khulna. Trials conducted to develop the best feeds and technology for fattening crabs in brackish water ponds in coastal Bangladesh.

Aquaculture

Two research fellowships are underway:

1. Mr. Subrata Mondal, Assistant Professor, Department of Fisheries and Marine Bioscience, Jessore University of Science and Technology is conducting research on "Biology and Production of Nutrient-Rich Small Fish Mola (Amblypharyngodon mola) & Darkina (Esomus danricus) in Rice-field and Pond Condition." He submitted a first draft of his thesis in June 2015.

2. Mr. Azhar Ali, Scientific Officer, BFRI, Brackishwater station, Paikgacha, Khulna through BARC is conducting research on "Development of Saline Tolerant Improved Strain of Tilapia in Bangladesh". Design and preparations for this study have been completed. Mr Azhar completed the first experiment on saline tolerance on tilapia strain in BAU lab and other experiments are proceeding at the BAU lab.

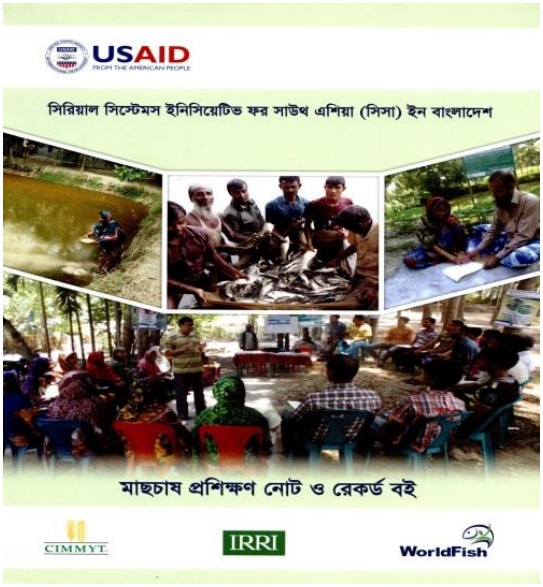


Figure 25: Aquaculture Training note and record book

Development of Training materials: WorldFish has developed training notebook in such a way that it can be used as a record keeping book for aquaculture activities. During field based training those training note books cum record book have been distributing among all farmers participated in the training courses. We hope such initiatives will encourage farmers to keep input – output and income – expenditure data so they are able to monitor the economic output from their aquaculture businesses.

Mechanization (CSISA-MI)

Science-based interventions are part of CSISA-MI's work. Within the project, CIMMYT scientists are conducting research to develop appropriate irrigation and nitrogen fertilizer regimes for maize and other cereal crops. Research is ongoing in using remote sensing and GIS to identify the appropriate environments and soils on which bed planters and PTOS can be used, and where AFPs can be employed to bring dry season fallow and poorly productive land into intensive cultivation. These efforts are combined with applied econometric analyses to identify the factors that influence LSP's investment in agricultural machinery, and to uncover the predominant structure of irrigation water pricing in southern Bangladesh. This will allow the project to develop improved business models the provision of affordable surface water

irrigation. Additional research considers the trade-offs between crop residue use for livestock vs. conservation agriculture, and in partnership with Wageningen University, CSISA-MI is supporting one PhD and one MS student using advanced crop and farming systems design models to propose solutions to these pressing issues. In addition, the project is continuing research to improve the performance of Bed Planter and domestic production of AFP.

SUCCESS STORY

Mrinmoyi's success: A milestone

Homestead based aquaculture technology can play a central role in providing nutrition (animal & Plant protein, vitamin and micronutrient) for the whole family.

Photo: MD. BADRUL ALAM WORLDFISH/ CSISA-BD

Mrinmoyi Biswas: homestead based aquaculture farmer, Jessore.

Homestead based aquaculture technology enabled Mrinmoyi Biswas to contribute to her family income which in turn made her believe in herself. Furthermore, her husband and mother-in-law acknowledged her contributions and now realize that through homestead based aquaculture with horticulture Mrinmoyi can also provide nutritious meals for her whole family.

A large number of homestead ponds are available in Tilkhori village of Shalikha upazilla under Magura district. These ponds weren't being used to their maximum potential due to lack of realization on better productivity methods, social barriers, nutritional & technical Knowledge and SIS fry availability. The suitability of homestead ponds for women's involvement was not properly explored in this village.

WorldFish and partner Jagorani Chakra Foundation, under the CSISA-BD project, identified this village through focus group discussions in 2014. Mrinmoyi Biswas was part of the 25 trainees that CSISA-BD engaged with.

She is a determined woman who is pursuing her master's degree despite of her mother-in law not encouraging her. Her family owns an 11 decimal pond. Normally her husband took care of it and average annual production was 55kg. She received intensive training on homestead based pond aquaculture and vegetables on pond dike & homestead area in 2014. After completion of training she quickly realized that she needs to prepare the pond, apply lime and fertilizer, pay attention to the size and number of fingerling being stocked and feed properly after stocking. She understood the training quickly and was eager to put her knowledge into use but her illiterate mother-in-law kept causing problems. However after a year of struggling, her mother-in-law has finally acknowledged Mrinmoyi's efforts.

As per training, Mrinmoyi stocked 517 carp fingerlings and 1.4 Kg of Mola. In addition she also planted vegetables (Bean, orange sweet potato, celery, arum) on some parts of her homestead land, pond dike area and unutilized land beside the pond dike. Parts of the input (eg: Mola brood, OSP vine and vegetable seeds) were supported by the project but most of the expenditures were supported by her husband. Her husband assisted her to purchase lime, fertilizer and feed as well as in netting during sampling and harvesting for selling the fish. She can operate the cast net by herself whenever she needs to catch mola by using rice bran as bait.

After a 6 month period, Mrinmoyi's total production was 214 Kg carp, 8 Kg mola and 86 Kg vegetable. Fish production cost was BDT 8,632 and return value was BDT 20,795 with net income of 1,512 BDT from vegetable covering a 1 decimal area.

She now helps the neighbors, when they face any problem. Neighboring women are influenced by Mrinmoyi better productivity through technical knowledge. As a result, Mrinmoyi status in family as well as society has increased. Mrinmoyi happily confirms 'Increased production helped our family's income and nutrition.'

3.1.6 Increased use of enhanced agricultural services (Sub IR 1.6)

Mechanization (CSISA-MI)

During the reporting period agricultural machinery and irrigation services promoted by CSISA-MI were applied on 2,995 ha. Out of this number, 1,237 hectares were irrigated by LSPs using fuel-efficient Axial Flow Pumps (AFPs). Crucially, RFL and individual LSPs invested $45,000 of their own funds to spread AFP services to farmers.

Since October 1,096 hectares were cultivated by using Seed-Fertilizer Drills (SFD) and bed planters, in a suite of crops including rice, maize, wheat, jute, vegetable crops (onion and garlic), Lentils among others. In order to make this happen, CSISA-MI's private sector partners invested $30,400 of their own funds to expand use of the equipment. This included the advertising shown in figure 26. An additional 662 hectares of wheat and rice were harvested using multi-crop reapers through local service provision and the action of our private sector partners ACI and Metal who demonstrated and advertised to farmers and potential LSP clients. Sales of reapers to LSPs are currently on-going.

Figure 26: Billboards have been displayed in prominent locations in the FtF zone (Barisal).

A total of 6,682 farmers in the FtF benefited from the project's activities through interventions implemented by the project and private sector partners.. During the same time period, 936 farmers, of which 824 were male and 112 were female farmers, received short term hands on training on different agricultural technologies under CSISA-MI, and a total of 160 entrepreneurs received business development training from the project.

An interactive campaign that included baul songs, games, quizzes and promotional videos was conducted in 12 upazilas of 3 districts to motivate the potential buyers of the machines. Promotional gifts were shared and referral coupons were distributed to potential equipment buyers. Through these activities, nearly 15,000 people were reached and exposed to the SFD; and among them 143 would-be customers were identified. .

Unfortunately, due to political unrest especially series of strikes and blockades during the reporting period, many of CSISA-MI's planned field activities were hampered. But despite these problems, reasonable progress was made.

SUCCESS STORY

Reaping success of a 'costly' deal

Apparently a high-priced investment in an agricultural machine turns out to be most economical.

Photo: SHIRIN/CSISA-MI

- Rafiqul, a 53-year old veteran Agricultural Service Provider in Kalukhali, Rajbari, with his wife Shirin on his right and childhood friend Jahangir on his left

"The demand of reaper service will increase in the dry season; and if weather conditions remain favorable, crops of 20.23 hectares of land can be harvested by the machine."
- Mohammad Jahangir Jowarder, 55, reaper machine operator of Local Service Provider Rafiqul Islam

This story is made possible through support provided by the United States Agency for International Development (USAID). The contents and opinions expressed herein are those of the project and do not necessarily reflect the views of the USAID or the United States Government.

As an experienced agricultural Service Provider, Mohammad Rafiqul Islam, 53, of Kalukhali Upazila, Rajbari was keen to minimize labor expense in order to accelerate his cropping business. Months back, he saw a cropping device in a neighboring village which led him to purchase a similar type of machine on 3rd May, 2014. Imported and marketed by ACI, this reaper machine allows rapid harvest and subsequent replanting of the next crop within the recommended planting window. The machine is suitable for reaping wheat and Amon and Aush paddy. Funded by USAID, the Cereal Systems Initiative in South Asia – Mechanization and Irrigation (CSISA-MI) Project – part of President Obama's Feed the Future (FtF) Initiative – is facilitating the market promotion of the machine in collaboration with ACI.

In Kalukhali, farmers mostly cultivate paddy, which requires engaging bulk labor force in order to harvest the crop. Earlier Rafiqul had to hire 10 laborers for two weeks to harvest his 4.04 hectares of land. It cost him around BDT 105,000 (USD 1,354.89). "In the beginning, my family members were against the investment of BDT 185,000 (USD 2322.68) for purchasing this machine" said Rafiqul. And in reality the Reaper allowed him to harvest 6.47 hectares of land in three weeks. He added, "the cost for hiring a machine operator and purchasing fuel was BDT 462 (USD 5.95) per day that allowed me to save around BDT 99,000 (USD 1275.66) from cropping expense only. In addition to this, cropping 2.43 more hectares of land brought me BDT 3,600 (USD 46.39) from the service charge of BDT 1,200 (USD 15.48) per 0.40 hectares of land to harvest with the Reaper."

"Earlier, during the harvest season I could not sleep more than three hours a night as I had to prepare at least four meals for ten laborers as well as dry, thresh, pack and store around 80kgs of paddy every day. But this time I was able rest in the evenings which happened for the first time in last 30 years," shared Rafiqul's wife Shirin Sultana, 42, who opposed the decision to invest in the machine at the beginning. Adding to these advantages, Rafiqul's childhood friend Md. Jahangir Jowarder, 55, who operates the Reaper, shared that four laborers can harvest 0.40 hectares of land in a day costing BDT 2800 (USD 36.13). In comparison, the Reaper takes 1.5 hours to harvest the same parcel of land costing BDT 1,200 (USD 15.48) only. Supplementing Jahangir's calculation, Rafiqul shared his plan to expand his business in neighboring districts. "One of my relatives offered me to harvest wheat in the wide *char* lands of neighboring districts. If things happen as per plan, I can recover and thus will start to make profit soon."

3.1.7 Private sector service provision of agricultural machinery (Sub IR 1.7)

Mechanization (CSISA-MI)

A key measure of CSISA-MI's success is the willing investment of ACI, Metal and RFL in the machinery technologies supported by the project. All are receiving technical support from CSISA-MI to import and market agricultural machines. In addition LSPs also invested $105,000. RFL imported 246 Chinese SFD units for sale to LSPs. In addition they are importing 200 more SFD for sale outside the FtF zone.

Figure 27: Mechanization demonstration

Metal Private Ltd., signed a joint venture agreement with CSISA-MI to contribute in the sales of agricultural machines

These private sector companies are generating demand for the machinery technologies through promotional activities like video road shows, billboards, local newspapers and cable advertisements and other marketing materials. A number of practical demonstrations in local markets (haat-bazar), , dissemination of other communications items to enhance the awareness and to motivate potential clients have been done.

SUCCESS STORY

Farmers Rooting for Mechanizations

Days of manual cultivation gradually coming to an end in Bangladesh

Photo: SHIRIN/CSISA-MI

Najrul with his wife and son

"For the irrigation service by AFP, I charge BDT 450 (USD 5.82) per 0.03 hectors of land and thus, I earned around BDT 145,650 (USD 1,883.08) in last dry season."

- Md. Najrul, 23, an agricultural machinery service provider of Lalmohan Upazila, Bhola

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Bangladesh's agricultural mechanization system is perhaps unique wherein many machinery owners also operate as service providers enabling mechanized services to reach out to many small-holder farmers. Md. Najrul (23) is one of such farmers in Bhola, a south-western district of the country. Being in the agricultural service provision business for four years, he currently owns two irrigation pumps, a power tiller and a thresher. In this, Najrul is highly appreciative about the Axial Flow Pump (AFP) he bought from RFL in February, 2014. Imported and marketed by RFL, the AFP is an inexpensive surface water irrigation technology that reduces fuel consumption - and thus irrigation costs - by up to 50% at low lifts. Able to be driven by a two-wheeled tractor (2WT), the pumps give 2WT owners increased business opportunities during the dry season. Funded by USAID, the Cereal Systems Initiative in South Asia – Mechanization and Irrigation (CSISA-MI) Project – part of President Obama's Feed the Future (FtF) Initiative – is facilitating the market promotion of the AFP machine.

Najrul came to know about the AFP from a demonstration event organized by CSISA-MI in his area. "I was attracted by its water discharging flow and prompted to buy within few days of the event. With a discount of BDT 4,000 (USD 51.72), it cost me only BDT 16,000 (USD 206.69)," he shared, adding that the discount was offered as part of a CSISA-MI scheme. In comparison to his other pump, which is a traditional one, Najrul said, "the AFP consumes less fuel. In two and half months, it saved me around 200 liters of fuel costing around BDT 14,000 (USD 180.86)." The pump discharges water as soon as the engine starts and instead of two, only one person is required to run and maintain it, which saves the cost of a labor, he added. It is also versatile, as it can be used in excavating and cleaning of ponds. Moreover, adding a hosepipe provides significant extension, as water can be carried in far reaching fields as well. "Thus, just in the last season, I could irrigate around 9.71 hectares of land belonging to some 150 farmers."

Najrul is also interested in investing in further technologies, such as a rice trans-planter. "Farmers can minimize production cost largely if the machine is available. There are thousands of hectares of land around here and people mostly cultivate paddy in this area… We need to engage a bulk labor force to cultivate these lands during the plantation season. But, laborers are scarce which results in delayed plantation and a lower rice production," he said. Considering this demand, CSISA-MI project is piloting rice trans-planters in one of its working areas and has already undertaken the initial market survey on related manufacturing companies.

3.2 Range of nutritious food consumed (Sub IR 2)

Aquaculture

More than 60% of the people in Bangladesh do not receive enough vitamin A, iron, and zinc from their diet to meet nutritional requirements—with young children and pregnant and lactating women being particularly vulnerable. Inadequate intake of fruits, vegetables, fish, and other animal-source foods is a direct cause of micronutrient deficiency.

Interventions initiated include polyculture of carp and/or tilapia with small nutrient-rich fish, "mola" (*Amblypharyngodon mola*), as well as encouraging the production of vegetables on pond banks. Training sessions provide nutrition education, including the benefits of eating mola and other fish, orange sweet potato (OSP) and other vegetables, the importance of a balanced diet, how to process and cook food so that the nutritional value is not lost, and the consumption requirements of pregnant and lactating women. For this training, women are targeted as they have the primary role for managing fruit and vegetable gardens, they are more vulnerable to malnutrition than men, and they play a critical role in ensuring intrahousehold distribution of food to children.

In this reporting period (October'15 – March'15), 953 new women farmers were given training on homestead food production including carp and/or tilapia polyculture with small indigenous 'mola' fish and vegetable including OSP production and training on nutrition. In addition, 963 women trained during prior years were given refresher training.

During the reporting period, vegetables seeds mini-packs were given to 1,075 women participants and by end of May all of them will receive mola brood.

Orange sweet potato (OSP): CSISA-BD distributed 257,630 OSP vines to 2,108 women in this reporting period and 215 women beneficiaries multiplied OSP vines for sale to other farmers. This year CSISA-BD beneficiaries sold 399,578 OSP vines to four projects and organizations who that they had distributed them to 3,294 women.

Figure 28: Harvests pumpkin leaves from her pond dike near Mymensingh.

Horticultural production models: Three vegetable production models have been developed by WorldFish to disseminate horticultural technologies and vegetable varieties in different contexts, including the banks of ghers, rice fields, and the banks of commercial and homestead pond systems. A crop calendar was prepared to help hub personnel determine which models are seasonally appropriate. Three models are:

1. ***Household-based pond system:*** This model considers how to use available household resources such as pond banks, underused spaces around houses, house roofs, and no fruit/timber trees. Emphasis is placed on women-friendly technologies and the selection of crops that both meet the household's year-round nutritional needs and have high value.
2. ***Gher dikes/edges:*** Crop selection is based on commercial dike production, market demand, and seasonal value of vegetables.
3. ***Production on pond dikes/edges:*** Developed for around pond dikes and edges mostly produced for maximizing income. See figure. 28.

3.3 Women participation in food security activities (Sub IR 3)

Wheat and Maize:

Integrated development of women-led maize farmers in Jessore: A small pilot initiative undertaken in Jessore Hub is designed to foster the holistic development of farm households via an integrated approach centered on women's empowerment. Beyond merely linking participants with agricultural technologies family members (especially the women) brainstorm to define an ultimate goal, and then identify the intermediate objectives required to reach this goal. To achieve the objectives, each development component is planned for individual families of a group, and blends the existing knowledge and technologies in the community with the active and leading contribution from participating farmers.

The specific steps in the process are described as follows.

1. ***Organizing women-led groups and creating plans:***
    a. Each group of 10 families is created, based on good participants as group members.
    b. Ultimate aims in life are defined, and synchronized with the initiative's objective.
    c. Each group sets intermediate objectives designed to reach the aim, this includes:
        - Identification of resources and potential within the group,
        - Planning different sub-sectors, developing plans for individual families,
        - Building up the skill to utilize the resources and potential.
2. ***Developing skills:***
    a. Skill in economic activities and nutritional practices,
    b. Maintaining a proactive mental attitude and good social behavior.
3. ***Plan implementation:***
    a. Coordinate plan activities with external technical resource people (e.g. CSISA-BD).
    b. Improve diets with appropriate types, amounts, and processing of foods.
    c. Plan for, and practice, sanitary hygiene.

Progress to date: As this is an intensive pilot program, only 10 communities are targeted across Jessore Hub. The total number of women participants is 100; they are assisted by their husbands since both the wife and the husband received training from CSISA-BD. Quantitative results have not yet been tabulated for all communities; however, Table 23 displays the current status for 43 women in 4 groups – 3 of which are located in Jhenaidah District, and the other in Magura District (Group 1). Approximately 84% of the women were trained on the organization of group activities, production technologies on best-bet technologies / management practices for maize and/or wheat, including intercropping legumes within the maize crop. Fifty-eight percent of the households conducted demonstrations on different maize crops and homestead production, 47% started producing homestead vegetable on raised beds, and 93% are growing vine (runner) vegetables. Virtually all households (95%) are now using modern cooking techniques to improve family nutrition, as well. Finally, 84% are now managing fruit trees, with 74% using a grafting-like technique to generate improved fruit varieties from older trees (referred to as "top working").

Table 23: Data on selected homestead development groups of women-led maize farmers, Jessore Hub

Group	No. of Women	Training Received	Demonstrations Conduced	Modern Cooking Process	New Vegetable Beds	Vine Vegetables	Top Working Fruit Trees

#1	15	14 on IPM, women integrated dev., USG	6 on maize	13	2 = 2 beds 11 = 3 beds 1 = 4 beds	15	13
#2	9	3 on integ. dev. 3 on maize (or wheat) & integ. dev.	5 maize-pea IC; 1 maize (in-line)	9	1 = 2 beds 2 = 1 bed	9 with multiple types	3
#3	10	9 (multiple types, including integ. dev.)	6 maize-pea IC	10	3	8 multiple crops	7
#4	9	IPM (7 husbands) 2 husb. on IPM + cereal CPT	7 maize CPT; 1 kharif maize-legume IC + 3 treat. maize	9	9 (being prepared)	8	9
Total	**43**	**36 (84%)**	**25 (58%)**	**41 (95%)**	**20 (47%)**	**40 (93%)**	**32 (74%)**

Aquaculture:

CSISA-BD aims to reduce the technology adoption gap between men and women by ensuring that both men and women farmers are involved in the technology development and dissemination process. Since the start of the project, 346 women farmers have participated in project-sponsored adaptive trials and demonstrations and 10,908 women farmers have been trained in crop and fish production. An additional 20,889 women farmer has participated in farmers' field days and cross-farm visits.

Not only that, CSISA attempts to identify different avenues for women's involvement, considering the socio economic context. Accordingly technologies and interventions are designed that are appropriate for women and thus specifically target them. Some such technologies are the homestead based pond aquaculture with horticulture on dike and homestead area, the participatory action research on shaded ponds, the cage aquaculture technology and different post harvest technologies.

Trial of new extension approaches for targeting women: In 2014, CSISA-BD reassessed the way it delivers technologies to women. This is because evidence from a study conducted in 2013 on the impact of two women-targeted aquaculture technologies (i.e. cage aquaculture and pond aquaculture) on women in four villages from the Barisal and Khulna hubs has shown that just providing technical solutions for women may not be enough to enable sustained use and equitable benefits from technologies. This discrepancy between expected and actual outcomes arises because women, and men, exist in a multidimensional system of gender relations which influence women's ability to: adopt technologies, gain and apply knowledge and skills to adapt them, achieve anticipated production and consumption outcomes and share equitably in their benefits. Results from the study have informed a trial of a new aquaculture technology dissemination approach in two villages of CSISA-BD's Faridpur hub. The technology package has been re-designed to combine technical aquaculture training with gender consciousness raising exercises derived from HKI's *Nurturing Connections* manual. Families are involved from the beginning of the intervention and the training is modularized to interact with the different stages of the production cycle and address any social and gender issues that may arise as a result of applying new knowledge. Changes in production and in knowledge, attitudes and practices (both technical and social) are being monitored among participating women and their spouses through survey research methods and process documentation.

CSISA-BD celebration of International Women's Day on 8th March 2015

On 8th March 2015, WorldFish, along with the gender coalition in Khulna (of which CSISA-BD is a part) arranged a program to celebrate women's day at the CSS, AVA Centre in Khulna. Women farmers, entrepreneurs, professionals from both public and private sector attended the event. This included the District Women Affairs Officer, District Child Affairs Officer, and Gender Specialists of different organizations and representatives of different media (both print and electronic).

Gender Coalition in Khulna

WorldFish along with CSISA-BD and other partners have formed a Gender Coalition for the South of Bangladesh. There are about 8 member organizations with more being added. Bi-monthly meetings are held to share knowledge and experiences and to organize common events like the International Women's Day celebrations

CSISA-BD is also looking into solving further constraints women face within the homestead to allow successful adoption of aquaculture or agriculture. Accordingly, in recognition of women's preference towards homestead ponds which are shaded with trees and therefore secluded from outsiders, CSISA-BD is testing which fish varieties grow within these shaded conditions in a different Research in Development (RinD) extension approach where the women themselves are the researchers. Similarly acknowledging women's roles in post harvest activities, IRRI has introduced different post harvest technologies that make it convenient for women to perform these activities.

Another approach to the development of women's entrepreneurship has been to initiate a program to test the concept of "InfoLadies." In this program, women are provided with bank loans to buy laptops and Internet connections. They use these to sell web-based services to rural communities such as applications for passports, school exam results, and Skype connections for contacting relatives working outside Bangladesh. For CSISA-BD, the aim of this intervention is to determine whether InfoLadies can also sell agricultural information services to farmers. These might include services such as fertilizer recommendations generated from the Rice Crop Manager website, crop production technology through viewing online videos, and

links to buyers. Using funds from the IRRI GRiSP program and CSISA-BD, nine InfoLadies have been trained by two local NGOs, Pride from Jessore and Dnet from Dhaka.

4 PROJECT MANAGEMENT

4.1 Project monitoring and evaluation

Internal Data Quality Assessment (DQA): An internal DQA was conducted in three hubs out of six hubs by the central M&E team from 9 February to 2 April 2015. The DQA in each hub lasted two days, and assessed the project's data collected during the 1st quarter of Year 5. On the first day, the M&E team reviewed the hard copies for Event Register, Sign-up sheet, and Basic Household Information (BHHI) from the three CGIAR centers and compared these data with the data submitted by the hub in soft copy for the 1st quarter. On the second day, the M&E team visited 2-3 communities (1 for each CG center) to interview randomly selected farmers in order to cross check the data recorded in the respective formats for trainings and for demos/trials. Some aspects covered in this interview were: type of training received, technology name, duration of training, quality of training in terms of learning and usefulness, technology implemented, area covered, type of support received from project, satisfaction on supervision by the project staff, dissemination of the knowledge acquired. On the second day, the M&E team shared the findings from the DQA with hub level available staff (i.e. Hub Managers, and ADOs) and also shared those findings report to project management. Due to this process, the information generated in the 2nd quarter of year 4 is more useful and valid. See text box for examples of findings from a DQA

Examples of findings from a DQA

- Some of farmers are registered from the same household (son and father) with separate household ID and they cultivate crop in the same land, but in our database they have been entered as two different households
- Without entering BHHI it is not possible to entered event information.
- Without attended participants information event information will not be counted though entered only event information in the database without attended participants.
- The event titles are not exactly the same in hardcopies vs. database; in some cases we found only the technology name. So in the database, the event name should be the same as the name in the hard copies.
- GO participants will not be counted as participants in the 'Farmer Trainings' (Event Registries).
- Some sheets (or hard copies) do not have cross checked the fields 'Prepared by' and 'Approved by'.

Indirect Farmer Survey (IFS): In February 2015, a draft report was produced that summarizes data and information collected from the CSISA-BD IFS, which was conducted during July 2014. This report was provided to the CSISA II Evaluation Team tasked with assessing the performance of the project. A small amount of additional work on the report is required for its finalization, and much of it will be incorporated into the final project evaluation report to be submitted to USAID (November 2015).

Adoption and Impact Surveys: The Adoption and Impact Survey of Year 3 Farmers (AIS-Y3F) was implemented during the period September-December 2014, with 1,034 farm households sampled. The survey was stratified such that each CGIAR center randomly selected 340 households engaged by CSISA-BD during Year 3 (2012-13) from their list of Year 3 project beneficiaries, with another 200 so-called "combined" farmers randomly selected, as well. Note that a combined farmer is one who has received training from any 2, or all 3, of the CSISA-BD core partners (CIMMYT, IRRI, and WorldFish).

In mid-May 2015, CSISA-BD will launch another survey (AIS-Y4F) similar to the above survey; it will target 1,100 households engaged by the project during Year 4 (2013-14). Each center will

have 200 households randomly chosen from their lists of Year 4 project beneficiaries, and 500 combined farmers will also be randomly selected. Moreover, an "end line" survey will be implemented to sample 1,000 households that were originally surveyed as part of the CSISA-BD baseline survey. This will help project personnel make comparisons between and within project years, and between control and project villages.

The key objectives of these surveys are to:

- Assess the effectiveness of training activities, and demonstrations and/or research trials, on project-promoted technologies and management;
- Estimate/validate rates of adoption of, and extent of area covered by, key technologies and management practices promoted by CSISA-BD;
- Estimate gains in the yield and gross margin values for maize, rice, wheat, fish, and shrimp from applied improved technologies and/or management practices.

Finally, one sub-set of the overall survey team will re-interview a total of 900 farmers from Year 2 (400) and Year 3 (500) who were previously sampled during the AIS-Y2F and AIS-Y3F surveys. The purpose of this "revisit survey" is to estimate the continuity of technology adoption and economic impact over the course of multiple seasons/years.

5 LESSON LEARNED AND WAY FORWARD

CSISA-BD has developed and validated a set of crop production technologies that allow farmers to intensify and diversify cropping systems and increase income. These are:

Medium to high elevation land not subject to salinity or flooding

1. Short duration aman rice – BINA dhan7 still the best grain yield performer but BRRI dhan56, 57 and 62 and BRRI hybrid4 are all potential alternatives with higher quality grain features.
2. On land that drains late the medium duration BRRI dhan49 is still the best variety despite being susceptibility to false smut.
3. October / November harvesting aman rice with a reaper
4. November strip till planting wheat, maize, mustard (BARI sarisha15) or lentil with a PTOS
5. Mechanical rice transplanter for Boro rice (BRRI dhan58 or 60) after mustard using either relay sowing of the mustard if aman rice maturity will be late or sowing mustard with a PTOS.
6. Relay cropping mustard over aman rice increases income, allows for quick crop turn over and early boro rice transplanting where either the aman crop harvest will be later than mid November or land will remain too wet for land preparation with a 2 wheel tractor by mid November.
7. Growing a "premium quality" cropping system consisting of aromatic aman variety BRRI dhan34 followed by relay cropped Tori7 and then fine grained Basmati type boro variety BRRI dhan50 is very profitable but market chains still need to be developed.
8. Fungicide control of lentil disease complexes removes risks from growing this high value crop
9. Harvesting wheat with a reaper to enable rapid, "same day" planting of mungbean
10. PTOS planted mungbean after lentil or wheat allows for very rapid early march planting and reduces the risk that the crop will be damaged by early monsoon rains.
11. PTOS dry seeded (DSR) Aus (BRRI dhan48 or 55)
12. PTOS dry seeded (DSR) Aman rice (BBRI dhan49) on higher land where June flooding will not be a problem

Low to Medium elevation land

1. Early transplanted submergence tolerant BRRI dhan52 followed by maize, sunflower or fine grained high value boro rice (BRRI dhan50).

Low elevation land

1. Where flooding will not permit aman rice cultivation mustard (BARI sarisha15) broadcast sown after flood receding followed by boro is possible and adds income to this normally one crop system.

Medium to high elevation land subject to salinity

- Salinity tolerant aman varieties BRRI dhan53 or 54 followed by November planted, dibble sown sunflower or PTOS sown wheat (BARI gom29) or sunflower.
- Farmers growing boro rice on this land should:
  1. Sow in November
  2. Use high potassium fertilizer rates in seed beds
  3. Transplant in late December
  4. Use 45 day seedlings
  5. Transplant 3 to 4 plants / hill
  6. Use BINA dhan10, Hira series hybrids or BRRI hybrid4

Low elevation land subject to salinity

Gher system

- Aman rice variety BRRI dhan34 followed by brackish water shrimp and Talapia
- Fresh water prawns and carp followed by boro BINA dhan10, Hira series hybrids or BRRI hybrid4

Issues still to be resolved

1. DSR for aman rice – Although this would reduce transplanting costs the heavy dependence on herbicides for weed control and the possibility of early rains making sowing difficult may limit application of this technology. It is therefore necessary to determine the extent to which this can be practiced in most years needs to be determined.
2. Mechanical rice transplanters offer farmers a viable alternative to manual transplanting or DSR but the raising of seedlings is expensive and complex.
3. Problems with the application of fertilizer by PTOS planters has not yet been resolved and requires the adoption by farmers of compound fertilizers
4. The use of ICT based farmer advisory services such as the Rice Crop Manager waits for wider ownership of smart phones and internet access.
5. Scaling out technology remains a challenge though the approaches developed by CSISA-MI offers the possibility that the entrepreneurial spirit of the private sector can be harnessed to resolve this issue.
6. The provision of credit to allow LSP businesses to expand will be essential if more expensive machines such as rice transplanters and mini combine harvesters are to be adopted.

Annex 1. List of Farmers Training

CIMMYT Supported technologies

Description of Training	No. of trained farmers	% of women
Agronomic impact of crop residue retention and tillage options by residue management interactions in rice-wheat rotations (strip till, BINA 7, BARI Gom 25) (New ST-BINA-7, BRRI Dhan30, BARI Gom 25)	30	20
Evaluate different tillage and management options in soil moisture stressed and soil saline environments (BINA 7, NK-40) (Old ST-BRRI Dhan41, BRRI Dhan52, NK40)	159	21
Integrate livestock into the farming systems of small households	36	97
Integrated maize/wheat farming and improved carp polyculture in pond and dyke cropping (CIMMYT-WF)	166	19
Integrated rice-wheat/maize & pond fish	518	23
Intercropping different economic crops with maize (potato, sweet potato, garden pea, bush bean, red amaranth/ spinach, olkopy, bitter guard, yard long bean, ribbed guard, onion, garlic, turnip, radish, etc.)	62	24
Maize/ Wheat in favorable eco-system-Pond Aquaculture (CIMMYT-WF)	82	16
Performance verification of wheat genotypes under saline and non-saline environments (BARI Gom 25, BARI Gom 27, Satabdi)	90	33
Promotion of best practices for cereal-based cropping patterns (SS Aman rice-maize/wheat-jute/mungbean or sesame using CA machinery)	30	30
Promotion of heat-, salt-, and rust-tolerant or resistant wheat genotypes (BARI Gom 25, 26, 27, and 28)	523	26
Promotion of maize varieties for human consumption and income generation (pop corn, sweet corn, hybrids: Elite, Miracle, CP808, NK-40, etc.)	785	30
Promotion of wheat seed production of new BARI varieties to increase yields and income from both seed and grain	148	20

Rice-maize/wheat/pulses/oil seed/spices-sesame/mungbean (for intensive cropping area) (IRRI-CIMMYT)	1024	23
Storage and preservation technologies to mitigate price risk and reduce post-harvest losses	31	16
Grand Total	**3684**	**25**

IRRI Supported technologies

Description of Training	No. of trained farmers	% of women
Aman - Boro rice GAP- Low Land System	419	23
Awareness and outreach to farm households	262	15
Best agronomic practices (younger seedlings, timely planting, optimum fertilizer management and integrated pest management)	118	25
Fallow-Mustard-Boro/Aman	93	40
Gher rice (non saline) VT	43	9
Integrated rice-wheat/maize & pond fish	86	6
New favorable eco system Boro Varieties	63	8
Premium Quality Rice Cropping System (BRRI dhan34, BRRI dhan50)	154	23
Premium Quality Rice Groups	50	38
Rice - mustard - jute	34	18
Rice in favorable eco-system-Pond Aquaculture (IRRI-WF)	60	10
Rice-fish-vegetables	554	19
Rice-maize/wheat/pulses/oil seed/spices-sesame/mungbean (for intensive cropping area) (IRRI-CIMMYT)	315	11
Rice-mustard-rice	750	14
Rice-sunflower-fallow	342	21

Single Boro Rice GAP	420	12
Grand Total	**3763**	**17**

WorldFish Supported technologies

Description of Training	No. of trained farmers	% of women
HH based aquaculture techniques	51	100
Household based pond aquaculture and horticulture on dyke	905	100
Improved carp polyculture in pond and horticulture on dyke	1615	25
Improved carp-shing polyculture in Pond and horticulture on dyke	25	0
Improved carp-tilapia/ or pangas polyculture in pond	50	0
Improved farming of fresh water prawn and carps in gher and horticulture on dyke	378	12
Improved Farming of Prawn and Shrimp polyculture in Gher	25	36
Improved farming of tilapia in pond and horticulture on dyke	73	10
Improved rice-fish farming with dyke cropping	40	0
Improved Shrimp farming by stocking PCR tested PL in Gher system	279	35
Integrated maize/wheat farming and improved carp polyculture in pond and dyke cropping (CIMMYT-WF)	101	16
Integrated rice-wheat/maize & pond fish	75	15
Rice-fish-vegetables	298	12
Grand Total	**3915**	**40**

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