The Cereal Systems Initiative for South Asia – Mechanization and Irrigation (CSISA-MI)

Annual Report (October 2015 to September 2016)

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Submitted by

International Maize and Wheat Improvement Center (CIMMYT)
with
International Development Enterprises (iDE)

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AFP	Axial flow pump
AID	Action in Development
AMDO	Agriculture Machinery Development officer
BADC	Bangladesh Agriculture Development Corporation
BARI	Bangladesh Agricultural Research Institute
BDS	Bangladesh Development Society
BDT	Bangladeshi taka
BINA	Bangladesh Institute of Nuclear Agriculture
BMD	Bangladesh Meteorological Department
BRAC	Bangladesh Rural Advancement Committee
BRRI	Bangladesh Rice Research Institute
BTV	Bangladesh Television
BUET	Bangladesh University of Engineering and Technology
CA	Conservation agriculture
CIMMYT	International Maize and Wheat Improvement Center
CLA	Collaborative Local Agreements
CSISA-BD	Cereal Systems Initiative for South Asia in Bangladesh
CSISA-III	Cereal Systems Initiative for South Asia – Phase 3
CSISA-MI	Cereal Systems Initiative for South Asia Mechanization and Irrigation
DAE	Department of Agricultural Extension
DEMs	Digital Elevation Models
DQA	Data quality assessment
DSR	Direct-seeded rice
EC_a	apparent electrical conductivity
FFD	Farmers' Field Day
FtF	Feed the Future
GIS	Geographic information system
GJUS	Grameen Jano Unnayan Songstha
iDE	International Development Enterprises
IFDC	International Fertilizer Development Centre
IR	Intermediate results
JCF	Jagoroni Chakra Foundation
JVA	Joint Venture Agreement
LoA	Letters of Agreement
LSP	Local Service Provider
M&E	Monitoring and evaluation
MRM	Monitoring and Results Management
NGO	Nongovernment organization
PMP	Project Monitoring Plan
PMUK	Padakhep Manabik Unnayan Kendra
PNGO	Partner nongovernment organization
PTOS	Power Tiller Operated Seeder
SAAO	Sub-Assistant Agriculture Officer
SDC	Society Development Committee
TMSS	Thengamara Mohila Sabuj Songhai
USAID	United States Agency for International Development
USG	United States government
WEP	Women's Empowerment Program

Glossary for Bangla language terms

Aman	Rice grown during the monsoon
Aus	Rice grown during the pre-monsoon
Boro	Rice grown during the winter rabi season
Gher	Enclosed area where aquaculture is practiced on a single field
Kharif	Monsoon season and summertime
Rabi	Winter season

EXECUTIVE SUMMARY

The Cereal Systems Initiative for South Asia – Mechanization and Irrigation (CSISA-MI) project is a five-year (July 2013 – September 2018) program funded by USAID under its Feed the Future (FtF) initiative. CSISA-MI aims to unlock the potential agriculture productivity in Southern Bangladesh through increased adoption of agriculture mechanization technologies and services, delivered by an augmented local service provider network for machinery services. The International Maize and Wheat Improvement Centre (CIMMYT) leads this project in partnership with the International Development Enterprise (iDE). The project is implemented in the Feed the Future zone in Southern Bangladesh. CSISA-MI is also strategically aligned with the broader CSISA Phase III program in South Asia led by CIMMYT.

CSISA-MI was developed in response to calls by the Government of Bangladesh (GoB) for strategic agricultural development investments that address pressing development needs in southern Bangladesh, as articulated in Bangladesh's Master Plan for Agricultural Development in the Southern Region. Much of the area in this policy framework overlaps with the Feed the Future (FtF) zone[1]. Emphasis has been placed on technologies and efforts that can increase cropping intensity in the south, while also addressing the need for agricultural machinery and efficient crop production practices to respond to increasing labor costs and scarcity as Bangladesh moves towards becoming a middle-income country with significant non-agricultural employment opportunities. At the same time, the GoB has also called for interventions that support increased use of surface water irrigation and associated energy efficient pumping technologies in the coastal zone.

The project addresses these issues while applying an innovative public-private sector partnership and value chain approach. The project ultimately aims to scaling–out agricultural mechanization technologies suited for smallholder farmers in the FtF zone. CSISA-MI therefore focuses on engaging public research and extension institutions to innovate and improve small-scale agricultural machineries, to extend farmers' awareness and demand for these technologies. This work also generates public sector endorsement for development activities. At the same time, CSISA-MI strategically engages a suite of Bangladeshi machinery importers, manufacturers, distributors, dealers, and mechanics, to assure that a viable and profitable value chain for scale-appropriate and resource conserving agricultural machinery is established domestically. In order to reach farmers at scale, CSISA-MI also prioritizes the promotion of rural entrepreneurship through service provision business models utilized by irrigation pump, seeder, and reaper owners to serve farmers as clients on an affordable fee-per-service basis.

The third year of CSISA-MI strongly indicates that the project is on-track towards meeting its strategic aims, while also contributing strongly to scaling efforts within Bangladesh. **Sales of fuel-efficient axial flow pumps (AFPs), power tiller operated direct seeders (PTOSs), and multi-crop reapers by CSISA-MI's private sector partners have all increased more than 100% in the project's third year.** As a result of CSISA-MI's activities, over **62,000 farmers** have utilized machinery services on **28,000 hectares** (roughly 2/3rds of which of which were achieved in the last year). Hands-on training in the use of agricultural machineries has been delivered to **10,000 farmers in the current reporting period** through collaborative project, public, and private sector efforts. More importantly, the project's company partners have invested over **USD 1.6 million of their own private sector funds** to import, manufacture, distribute, advertise, and sell **1,320 scale-appropriate machines to service providers** the FtF zone during the project's first three years. Land coverage by CSISA-MI supported technologies has also grown in the last year. Against a target of 18,647 ha of land coverage to be brought under improved technologies or management practices, CSISA-MI not only achieved the target but also exceeded it by +3% bringing it to a total of 19,287 ha. This is despite the unexpected wheat blast disease affecting 15,000 hectares alone in the FtF zone which meant that fewer farmers hired mechanized harvesting services.

CSISA-MI currently focuses on commercializing three technologies – fuel efficient axial flow pumps (AFPs), multi-crop reapers for rapid and easy harvesting of rice and wheat, and power tiller operated seeders (PTOS). In the last year, the technology most used was the PTOS for mechanized land preparation and line sowing utilized by 27,912 farmers. Also in the last year, 7,329 farmers utilized AFPs, and 4,734 farmers utilized reapers. The technologies most used according to hub areas were water conveyance (AFP) in Barisal, mechanized land preparation (PTOS) in Faridpur, and mechanized harvesting (reaper) in Jessore.

[1] See: MOA and FAO, 2013. Master Plan for Agricultural Development in the Southern Region of Bangladesh. Ministry of Agriculture (MoA, Government of Bangladesh) and United Nations Food and Agriculture Organization (FAO), Dhaka, Bangladesh, p. 104.

This past year, CSISA-MI partnered with five lead firms: ACI Motors, Alim Industries, Janata Engineering, Metal (Pvt.) Ltd., and RFL. Between these five firms, there are at least two companies competing for sales of each target technology. This competition – over the long run – will support lower prices, better quality and more diverse options in design and embedded services (e.g., training, help lines and post purchases support services, machinery warranties, etc.). Combined with the crowding-in of additional companies entering the appropriate machinery market, there are strong signs that CSISA-MI is well on its way towards meeting the sustainability and scaling goals. CSISA-MI successful partnership with these five lead companies (achieving the target) is through Joint Venture Agreements outlining specific roles and responsibilities of the project and each private sector partner to expand innovative agricultural machinery sales. **Against a target of 455 local service providers (LSPs), the project successfully reached many more LSPs – 707 micro-level enterprises, to be exact**. The project's private sector partners are also now independently and pro-actively engaging public sector research institutes for technical advice in their efforts to develop domestically produced AFPs in Bangladesh. Janata Engineering, an agricultural machinery workshop based in the Chuadanga District has and continues to make machines for GoB agricultural projects and has been supported by CSISA-MI to work on imports, marketing and after sales services.

In addition to Janata Engineering, other **market actors continue to crowd-in to the agricultural machinery market in the FTF Zone**. For example, R.K. Metal, a local workshop in Faridpur has fabricated two prototypes of Axial Flow Pump with technical support from CSISA-MI and BARI engineers and technology designers, but otherwise of their own initiative. These pumps have been field-tested with the help of the project at BARI, and now **RK Metal has plans to manufacture around 50 pieces of Bangladesh's first commercial model of axial flow pump for upcoming dry season**. In year 4, Metal will focus on product quality (developing a testing house at its factory) and increase production capacity (purchased rolling machine and dices) to meet farmers' demand in the market. Another crowding-in example is RealPower, who usually imports construction machinery. Last year RealPower purchased one reaper attachment from Janata Engineering for their assessment of the product. Based on farmers' response in demonstrations, they have imported 20 pieces of the same reaper attachment and one reaper binder to further test the market. CSISA-MI's private sector partners therefore clearly recognize the increasing potential for sales in rice and wheat. **Against a total private sector investment target of USD 433,138 of all technologies in the third year, USD 581,470 has been achieved which (+)26% more indicating an overall positive trend in private sector investment in agricultural machineries**. These spontaneous activities support CSISA-MI's theory of change that over time crowding-in of market actors will cause the evolution of the agricultural machinery market.

At the same time, increased calls by the project's GoB partners for similar efforts to expand policy for resource-conserving machinery use in Bangladesh have been made. This is evident in the number of high-level policy dialogues and Governmental partner engagements held over the last reporting period. CSISA-MI's theory of change focuses on activities that develop an enabling policy and funding environment in which scale-appropriate machinery value chains, rural service provision, and farmer demand can be aligned and leveraged. Crucial to this approach is theoretical guidance from sociological literature that indicates a 'tipping point' of approximately 15-20% technology adoption is usually needed before spontaneous technology adoption may occur among farmers. **CSISA-MI utilizes sophisticated methods and cloud-based databases to track both monitoring and evaluation data pertinent to the FtF indicators. The project also utilizes an advanced monitoring and results measurement system (also cloud-based) to track and guide project activities related to machinery adoption and private sector engagement.** This system indicates that in select districts in which CSISA-MI is working, the project's activities may soon cross the adoption tipping point. Further tracking of farmer and service provider adoption in Years 4 and 5 will determine if CSISA-MI can prove its hypothesis of scalability and machinery technology adoption based on tipping point monitoring. This is therefore a truly exciting period for the project in its pursuit of self-propelled scaling models and transformative agricultural change.

Activities conducted during FY 2015-16 were however not without their challenges. South Asia's first ever outbreak of wheat blast disease on over 15,000 hectares (with average 25% yield reductions) in the FtF zone slowed farmers' enthusiasm for use of crop reapers in select areas. Plans are now underway to address the disease and its implication for cereal production and appropriate machinery use in the coming crop season, through CSISA-MI and its alignment with CSISA Phase III. Nonetheless, though the reaper has technical limitations to harvesting on wet-land, **a total of 900 ha of paddy fields were harvested using the Reaper** promoted by CSISA-MI. Additional threats – including increased risks of terrorism in Bangladesh – also reduced staff movement and activity implementation in some areas, though the generalized success of CSISA-MI's development model

meant that the project's private sector partners and service providers continued to have an impact in farmers' fields throughout the year.

New engagements with development partners in Bangladesh also provided additional opportunities for engaging women as service providers, for example through jointly planned awareness raising and training activities conducted with the USAID supported Women's Empowerment Activity in Bangladesh. Further efforts are needed to fully engage women service providers, but initial evidence demonstrates how expansion may be made possible. **Ongoing engagement with the Bangladesh Agricultural Research Institute (BARI) to conduct applied research to engineer and fine-tune appropriate agricultural machineries has also been successful**, with ongoing work focusing on tillage equipment and improved axial flow pumps. In the latter case, partnerships between CSISA-MI and the private sector resulted in collaborative testing of new pump designs with BARI, which has resulted in the first ever manufacture and commercialization of axial flow pumps within Bangladesh's borders. Leveraging this achievement, increased AFP investment by the private sector is expected to boost adoption in the 2016-17 reporting period. CSISA-MI has also matured significantly over the last year, with Department of Agricultural Extension field agents regularly engaging with the project to encourage farmer machinery adoption, on both a formal and informal basis. Research plans have also been solidified to fully evaluate the effectiveness of local machinery service provision models and the benefits and constraints encountered my MSMEs working with machinery in the FtF zone in the coming year. These studies will further guide project interventions.

Finally, CSISA-MI has worked to improve project management and partnerships between CIMMYT and iDE to assure the project's success. An adaptive project management framework was adopted, and new leadership at both the Dhaka and Hub levels has helped to strategically guide the project for both CIMMYT and iDE. CSISA-MI is also now strategically aligned and receives additional technical support and guidance from the broader CSISA Phase III project led by CIMMYT. CSISA Phase III is operational in Bangladesh, India, and Nepal, and thus provides a wealth of experience, knowledge, and partnerships on which further activities can be built. Both projects now conduct joint planning and field work to assure that interventions are both efficient and as impactful as possible. Synergies and co-coordination between these efforts also provides new opportunities to leverage investments and activities to create self-sustaining and transformative change in farmers' livelihoods throughout the FtF zone. Building on these successes, we anticipate that CSISA-MI's fourth year (FY 2016-17) will be equally, if not more successful, in scaling-up farmers' use of appropriate agricultural machinery in the FtF zone.

1 INTRODUCTION

1.1 Background

The International Maize and Wheat Improvement Centre (CIMMYT) currently leads the implementation of the Cereal Systems Initiative for South Asia – Mechanization and Irrigation (CSISA-MI) projecting partnership with the International Development Enterprise (iDE). CSISA-MI is a five- year project (July 2013 – September 2018) funded by the USAID Mission in Bangladesh under its Feed the Future initiative. CSISA-MI's main focus is to unlock the potential productivity of agriculture across Southern Bangladesh through increased adoption of agricultural mechanization technologies and services, delivered by an expanded local service-provider network with backing from both public and private sector partners. (*Section 1.4 shows the current project coverage*).

Box 1: CSISA-MI Core Activities

1. Promotion of resource-conserving agricultural machinery that is appropriate to the agronomic and socioeconomic conditions of smallholder farmers
2. Develop and strengthen rural entrepreneurship and machinery service provider networks to reach farmers at scale.
3. Leverage private sector investments to commercialize and scale-out resource-conserving agricultural technologies.
4. Facilitate virtuous cycles of applied research and capacity development with public sector partners to support an enabling environment in which appropriate machinery may be scaled-out.

CSISA-MI started its activities as an addition to the CSISA Expansion Project in Bangladesh (CSISA-BD) which began in 2011.Both CSISA-MI and CSISA-BD also fall under the umbrella of the CSISA Phase II and Phase III program that works on similar issues in Bangladesh, India, and Nepal, and is funded by the Bureau of Food Security at USAID, and the Bill and Melinda Gates Foundation.

CSISA-MI activities took forward CSISA-Phase II's and CSISA-BD's focus on adaptive technology testing, deploying new crop varieties, and training farmers. The project also focuses on facilitating output markets to expand upstream mechanization market interventions so that technologies needed for agricultural intensification are available in local markets. After CSISA-BD ended on September 2015, CSISA-MI continues many of CSISA-BD's interventions both independently and in synergy under the umbrella of CSISA Phase III (Dec '15-Nov '20), also led by CIMMYT.

CSISA-MI focuses on both commercial pathways and technical issues to achieve sustainable and scalable results. CSISA MI has affected change by working with private sector actors and in collaboration with the key agencies of Government of Bangladesh, primarily the Bangladesh Agricultural Research Institute (BARI) and the Department of Agricultural Extension (DAE). CSISA-MI utilizes collaborative learning and adaptive management in order to maintain flexibility and effective action within the evolving market for agricultural machinery and rural services provision. Over the last year, the project has made adaptive management changes which have resulted in significant achievements. This can be seen in Table 1 which shows the sales of agricultural machineries in project area over the three years.

The notable changes during this reporting year include the following:

1) Project coverage was streamlined from 105 to 60 Upazilas and from four to three hubs. These reflect adaptive management decisions to focus on key areas where the market potential for machinery services is greatest. Only areas with immediate and significant potential for mechanization (Jessore, Faridpur and Barisal) now remain.
2) Communications and coordination system between CIMMYT and iDE, and with the third phase, the umbrella of the CSISA-MI project both in Dhaka and field has ensured improved synergies in project implementation enabling better and quicker decisions to reach impact in the target areas.
3) Changes in staffing were made to align with the overall changes in project approaches.

Table 1: Sales of scale-appropriate agricultural machineries by project year

Technology	Year 1	Year 2	Year 3
AFP	134	168	434
PTOS	72	101	249
Reaper	28	27	107

CSISA-MI has advantageously and beneficially applied the experiences of the first two years and adjusted development approaches accordingly. CSISA-MI has boosted demand creation in the agricultural machinery sector through engagement of all relevant market actors, and by incentivizing and building their capacity to expand their businesses. Farmers observing and participating in CSISA-MI project activities (demonstrations, farmer field days, telemarketing, video shows and other awareness raising activities) also increasingly recognize the benefits of using CSISA-MI technologies.

The increase in sales of agricultural equipment and the willingness of CSISA-MI's Joint Venture Agreement (JVA) partners and others to increase imports and local manufacture of machinery appropriate for Bangladesh's smallholders are major indications of achievements of this project. CSISA-MI experience shows that the vast majority of market actors within in the agricultural machinery sector see the potential for profit from a range of technologies offered by these agriculture machines.

Over the last year, the project has recorded increasing sales of agricultural machineries from its company partners to farmers and there are expanding opportunities to meet increasing demand for highly popular of CSISA-MI supported technologies. These include the Axial Flow Pump (AFP), power tiller operated seeder (PTOS) and Multi-crop reapers. The increase in sales of the three machineries – AFP, PTOS and Reapers – An almost 2 to 3-fold increase – underscores the success that the project has had.

1.2 Project Objectives

CSISA-MI aims to unlock potential agricultural productivity in Southern Bangladesh through increased adoption of improved irrigation and agricultural mechanization technologies and practices, delivered by an augmented local service provider network for machinery services. This is being realized through three broad objectives:

Strategic Objective 1: To sustainably intensify and diversify agricultural production in Southern Bangladesh through surface water irrigation to increase household income.

CSISA-MI promotes Axial Flow Pumps (AFPs), as well as other efficient surface water irrigation and conveyance machineries, and works to integrate them into local markets by building public private partnerships that address key components of the supply chain. The AFP is an inexpensive surface water irrigation technology that has comparatively lower fuel consumption - and thus irrigation costs - by up to 50% at low lifts. The AFP can be driven by a two-wheeled tractor (2WT) and thus also 2WT owners increased business opportunities during the dry season. CSISA-MI also works to support farmers transitioning from rain-fed to irrigated agriculture in the FtF zone through training and research-derived technical advice.

Strategic Objective 2: To sustainably transform agriculture in Southern Bangladesh through broad-based access to agricultural mechanization services.

Following the same comprehensive supply chain approach as in Strategic Objective 1, CSISA-MI strategically partners with the private sector to introduce efficient technologies that enable farmers to a range of cereal and horticultural crops. CSISA-MI further supports the supply chain for agricultural mechanization products by facilitating the development of targeted financial services, and by working with local dealers and manufacturers to make sure that farmers who would benefit most from the technologies know where and how to purchase them. The project additional focuses on technical training in machinery operation and the rudiments of business development services for machinery entrepreneurs.

Strategic Objective 3: To develop new models for public and private institutions to support irrigation and agricultural mechanization in Southern Bangladesh.

To ensure the durability of strategic objectives 1 and 2, CSISA-MI works with public and private sector partners to promote their familiarity with machinery engineering, manufacturing, sales, distribution, and use in the field. CSISA-MI works with key government stakeholders such as the Bangladesh Agricultural Research Council (BARC), the Bangladesh Agricultural Development Corporation (BADC) and the Department of Agricultural Extension (DAE), in addition to a wide range of private sector partners. Through these partnerships, an environment in which machinery services provision can flourish is created. Mechanics and their workshops are also outfitted to handle maintenance and repairs, while also benefitting from enhanced technical training.

1.3 Project Management and Approach

1.3.1 Project Management

The CSISA-MI project falls under the umbrella of the broader CSISA program (which includes the USAID-BFS Washington and Bill and Melinda Gates Foundation funded Phase I, I, and III projects[2], and the previous CSISA Expansion in Bangladesh (CSISA-BD) project), and hence receives technical and strategic guidance from the overall CSISA Bangladesh Country Coordinator, while allowing the CSISA-MI Project Leader to contribute to the wider CSISA platform. This arrangement benefits CSISA-MI through strategic and technical alignment, and guidance with and from the broader CSISA umbrella program, while also harnessing synergies between efforts in achieving USAID's goals on poverty reduction and food security through sustainable intensification. Both the CSISA Bangladesh Country Coordinator and CSISA-MI Project Leader maintain a presence on each project coordination committees and jointly interact with public and private sector partners. The CSISA-MI Project Leader is also a member of the broader CSISA Phase III multi-country project coordination committee and regularly interacts with the CSISA Bangladesh Country Coordinator to assure support and alignment with CSISA, CIMMYT, and USAID's overall goals in Bangladesh and the South Asian region.

Through increased use of adaptive management, CSISA-MI has also been able to effectively and efficiently implement project activities. This is based on USAID's adaptive management approach[3] which is reflected as continuous and iterative in the organizational environment and monitoring and results management (MRM) system. Using this approach, CSISA-MI has stepped up coordination and communication between technical and field teams among CIMMYT and iDE, and with the broader CSISA program. As a result, the scope of sharing observations and feedback from the field team to technical team is done on a regular basis, at the same time enabling CSISA-MI to promptly generate consensus and speed the decision-making process. The internal feedback together with the MRM system (section 3.5) feeds updated and tangible information to the CSISA-MI team, allowing decisions to be made in an adaptive and informed manner.

1.3.2 Basis of CSISA-MI's project approach

CSISA-MI's theory of change is partly built on Roger Everett's diffusion of innovation theory, which is based on the premise that innovation is communicated to market actors through the process of diffusion over time and that the adoption of a given technology is influenced by the innovation itself, communication channels, time and the social system.

Figure 1 shows a segmented normal distribution and accompanying cumulative adoption curve where the different categories of adopters are shown. Following an initial effort to build an enabling environment for technology adoption, as more people adopt the innovation the total number of adopters increases at an exponential rate, producing an "*s-curve*" of adoption. According to much of the diffusion of innovations theory literature, there is typically a "*tipping point*" between the 15 and 20 percent adoption rate, after which, diffusion of innovations is expected to spread independently or less effort.

CSISA-MI project interventions strive to reach this tipping point. However, CSISA-MI at the same time recognizes that the tipping point requires qualitative changes to ensure the quantitative achievements, and that the tipping point may change with evolving market circumstances. Indications of qualitative changes include copying project activities by non-associated companies and service providers, crowding-in of these actors, and spontaneous adaptation and expansion of the business models that underlie the project's theory of change. When these indications are evident, this shows that the project is successfully contributing to an environment that is scale-friendly. This combination of quantitative and qualitative indicators defines the "foundation for scale" for CSISA-MI. CSISA-MI is in the process of reviewing MRM evidence, though initial indications are that the tipping point

[2]CSISA was established in 2009 to promote durable change at scale in South Asia's cereal-based cropping systems. Operating in rural 'innovation hubs' in Bangladesh, India and Nepal, CSISA is led by a partnership between CIMMYT, IRRI, and IFPRI, and works to increase the adoption of various resource-conserving and climate-resilient technologies, and improve farmers' access to market information and enterprise development. CSISA supports women farmers by improving their access and exposure to modern and improved technological innovations, knowledge and entrepreneurial skills. By continuing to work in synergy with regional and national efforts, collaborating with myriad public, civil society and private-sector partners, CSISA aims to benefit more than 8 million farmers by the end of 2020. More information on the CSISA program can be found here: http://csisa.org/.

[3]USAID KDMD Project. 2013. "Learning about Learning: Lessons on Implementing a KM and Learning Project from the USAID KDMD Project: Adaptive Management," p. 2. USAID Learning Lab. http://usaidlearninglab.org/library/resources-learning-about-learning-lessons-implementing-km-and-learning-project-usaid-kdmd.

may soon be surpassed in select districts, particularly for PTOS and AFP adoption, in which the project works. Further details will be provided in the next semi-annual and annual reports.

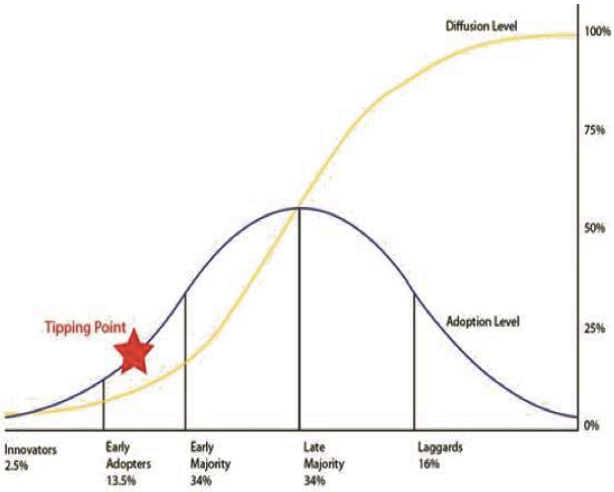

Figure 1: Technology adoption patterns and the 'tipping point' at which adoption accelerates once an enabling environment is developed.

1.4 Area of Operations

CSISA-MI's main areas of operation cover the entirety of Bangladesh's FtF zone of influence and are given in the map below where the Barisal, Jessore and Faridpur hubs are highlighted.

1.5 Visitors and notable events

During the reporting period, key visits were made by high level representatives from the government, private and donor organizations, and by CIMMYT's international staff. Through these visits, the benefits of using CSISA-MI technology was demonstrated by showing there has been reduced cost and increased productivity of different high value crops (wheat, maize, mung bean etc.). The participation of senior agriculture government officers has been important also in obtaining government sanction and support for CSISA-MI interventions.

The workshops served as forum of discussion for a diverse array of stakeholders where the pros and cons of CSISA-MI interventions and other agriculturally related concerns. These visits and other events include the following:

- Field visit to Barabari, Jhenaidah Sadar, Jhenaidah on 27 January 2016 – visited by USAID -Mr Muhammed Nuruzzaman, Mr Anar Khalilov, Mr. Matt Curtis and Mr. Mark Tegenfeldt; Former Deputy Director of USAID's Bureau of Food Security also accompanied the team.
- Learning and Experience Sharing Meeting at Char Latif in Borhanuddin Upazila under Bhola district on February 09, 2016 – attended by - Md. Hamidur Rahman, DG-DAE; Md. Shamsher Ali, DG-Bangladesh Institute of Nuclear Agriculture (BINA); Mr. Prosanto Kumar Saha, DD- DAE, Bhola; Agriculturist Dr. G.M. Faruk, Addl. Deputy Director- DAE and Ms. Marium, Upazila Agriculture Officer, Borhanuddin, Bhola
- Field visit to Laharhat and Tumchar wheat field under Barisal Sadar Upazila on March 09, 2016 – visited by Reid Hamel and Kimberly Flowers of USAID, Washington and Tim Russel, CoP RVC project, IRRI-Bangladesh. The purpose was to see Wheat Blast infections in farmers' fields
- Field visit to Wheat and Maize demonstration fields in Premchara village under Bandabilla Union, Bagherpara Upazila of Jessore district on March 09, 2016 – visited by Dr. Martin Kropff, Director General of CIMMYT.
- Field visit to see Maize field sat Boro Manika, Borhanudin Upazila and Soybean fields at Shippur, Bhola Sadar Upazila under Bhola district on April 04, 2016 and Mung bean field at Sattarkanda, Jalakathi Sadar Upazila under Jalakathi district on April04- 05, 2016 –visited by Md. Muhammad Nuruzzaman, Project Management Coordinator, USAID and Farzana Yasmeen (Monitoring Advisor).
- Visit to observe Farmers' Field Day Kalankathi, Jalakathi Sadar Upazila under Jalakathi district where more than 70 male and female farmers participated on April 07 2016 – visited by Md. Abdul Aziz Farazi, Additional Director, Barisal Zone, DAE, Md. Sheikh Abubakker Siddik, DD, DAE, Jalakathi, Dr. Md. Saleh Uddin, PSO, BARI, Barisal, Dr. Idris Hossain, PSO, BARI, Barisal.

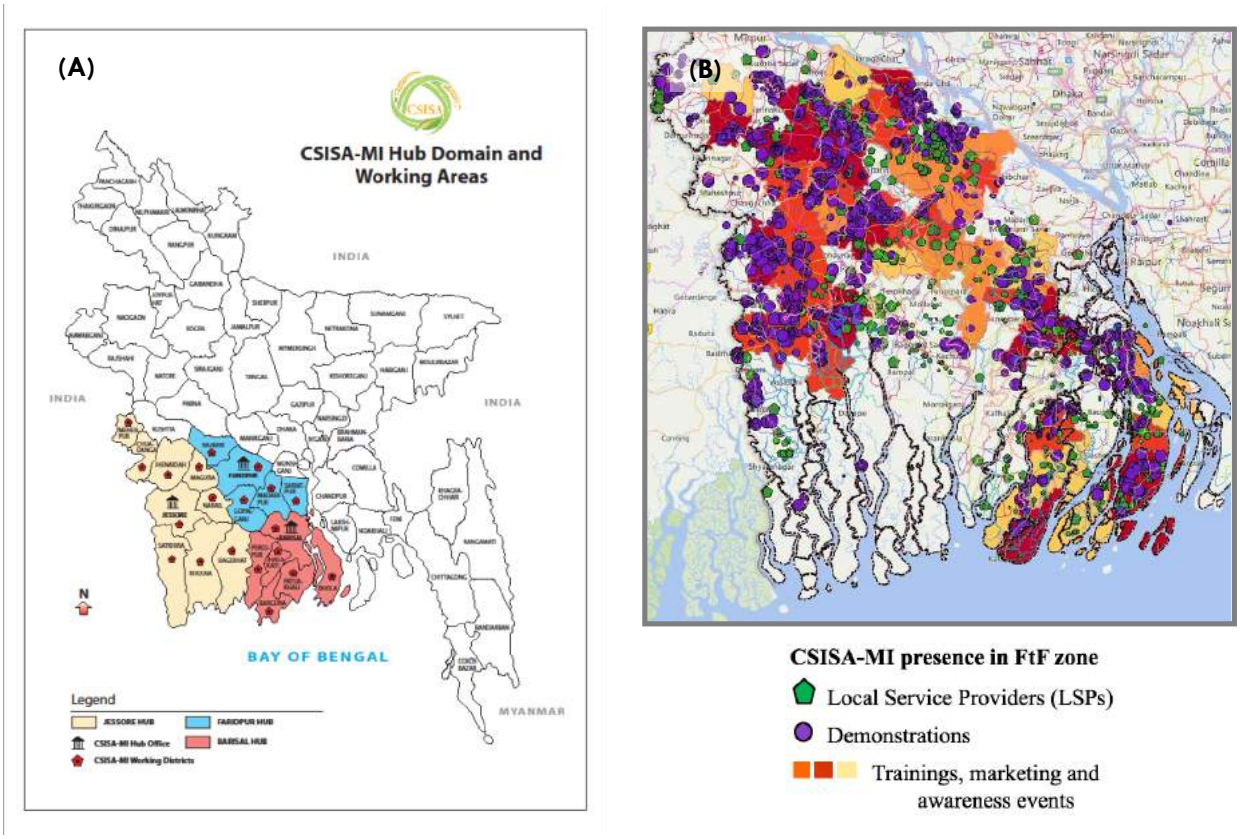

Figure 2A: CSISA-MI's Areas of Operation in Bangladesh, Figure 2B: Detail of the project's geographic spread and achievements detailed for the FtF zone

- Stakeholder Workshop in Bhola on July 26, 2016 attended by Prosanto Kumar Saha, DD, DAE, Bhola as well as Bhola District Fisheries Officer (DFO). Other participants included other Upazila level officers of DAE & DOF, LSP, Mechanics, Dealers, lead farmers and Private sector representatives.
- Stakeholder workshop at SDA Hall Room in Patuakhali on September 05, 2016 attended by Md. Nazrul Islam Matubar, DD, DAE, Patuakhali as well as DD, DAE from Barguna. Other special guests were District Fisheries Officer (DFO), PSOs-BARI, PSO-SRDI, DD-BADC. All Upazila level officers of Patuakhali and Barguna of DAE & DOF, LSP, Mechanics, Dealers, lead farmers, Private sectors representatives also participated in the workshop.
- Farmers' Field day at Nikhoria, Modhukhali, Faridpur on 19 July 2016 attended by Chandra Das, Additional Director, DAE, Faridpur Region and also see performance of line sown jute by zero tillage and PTOS.

A notable upcoming event that was supposed to take place this year is the mechanization workshop (see section 3.1.3) supported by CSISA-MI, CSISA Phase III, and DAE, due to take place on 24 October 2016. This workshop will bring together key government departments and private sector companies in order to discuss what is working and more importantly, not working in the agriculture mechanization sector.

2 RESULTS AND ACHIEVEMENTS

The third year of CSISA-MI, (October-2015- September 2016), has been significant in making progress and realigning a number of project interventions to achieve the project's goals. Contributing factors to third year achievements include the approval of the CSISA-MI Monitoring Plan with a revised set of indicators based on new theory of change. This is demonstrated in the flow diagram below (Figure 3) and shows the logical sequence of the three strategic objectives and the associated intermediate results (IRs) based on USAID's FtF indicators. The project's strategic objectives are described under section 1.2.

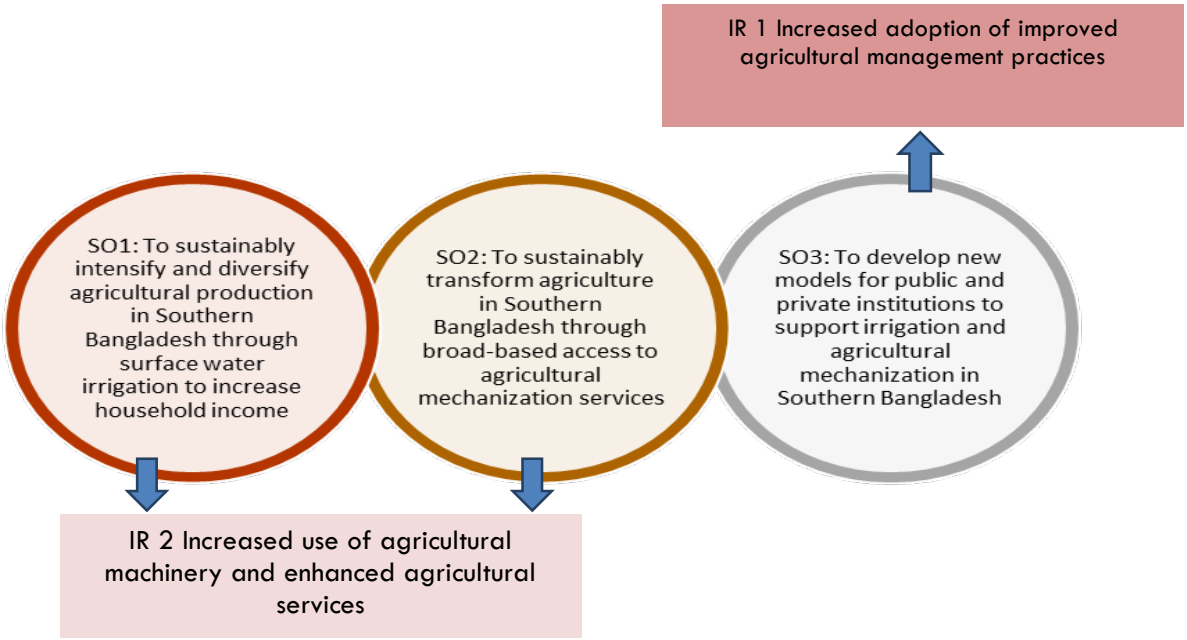

Figure 3: CSISA-MI's strategic objectives and associated FtF Intermediate Results that align with USAID and the broader CSISA program

The progress of the project is given according to project indicators based on the Feed the Future (FtF) indicators. Overall results are also based on the CSISA-MI project monitoring plan that was approved by USAID in December 2015. The two main areas of CSISA-MI's results framework include (i) adoption of improved agricultural practices and (ii) increased use of agricultural machineries.

To achieve the two intermediate results towards increased on-farm productivity, CSISA-MI has identified five major sub-intermediate results as stated above. To achieve the results, based on the five Sub-IRs, CSISA-MI has identified 4 FtF Indicators from USAID's indicator's handbook which are:

- **4.5.2 (2)** Number of hectares under improved technologies or management practices as a result of USG assistance (Sub-IR1.3)
- **4.5.2 (5)** Number of farmers and others who have applied new technologies or management practices as a result of USG assistance (Sub-IR1.2)
- **4.5.2 (7)** Number of individuals who have received USG supported short-term agricultural sector productivity or food security training (Sub-IR1.1)
- **4.5.2 (37)** Number of MSMEs, including farmers, receiving business development services from USG assisted sources (Sub-IR 2.1)

In addition to these four indicators, CSISA-MI also reports against one 'Custom' indicator:

- **Custom:** Value of private sector investment in agricultural machinery and equipment resulting from project intervention (Sub-IR 2.1)

The CSISA custom indicator deals with MSME and related interventions. The value of private sector investment is calculated as the sum of the total investment incurred by LSPs, machinery dealers, manufacturers, and Importers with within a given reporting period. The strategic objectives and the associated indicators are given in Figure 4.

The results of CSISA-MI's fourth year detailed implementation plan highlight the way in which private sector engagement has been dramatically boosted, and indicates the potential of scaling-up to cater to the increasing demand for innovative agricultural machinery services in the FtF zone.

The Accelerating Capacity of Monitoring and Evaluation (ACME) of USAID conducted the first Data Quality Assurance project visit to CSISA-MI field locations in April 2016 was an important moment in the project's progress. The DQA mission suggested CSISA-MI to include farmers from Custom Indicator 2 given in the last semi-annual report (service recipients of LSPs for mechanized agricultural support in water conveyance, mechanized land preparation, and mechanized harvesting) under the standard indicator i.e. 4.5.2 (5) which earlier was planned to track only the demonstration plot farmers (direct recipients of assistance from CSISA-MI).

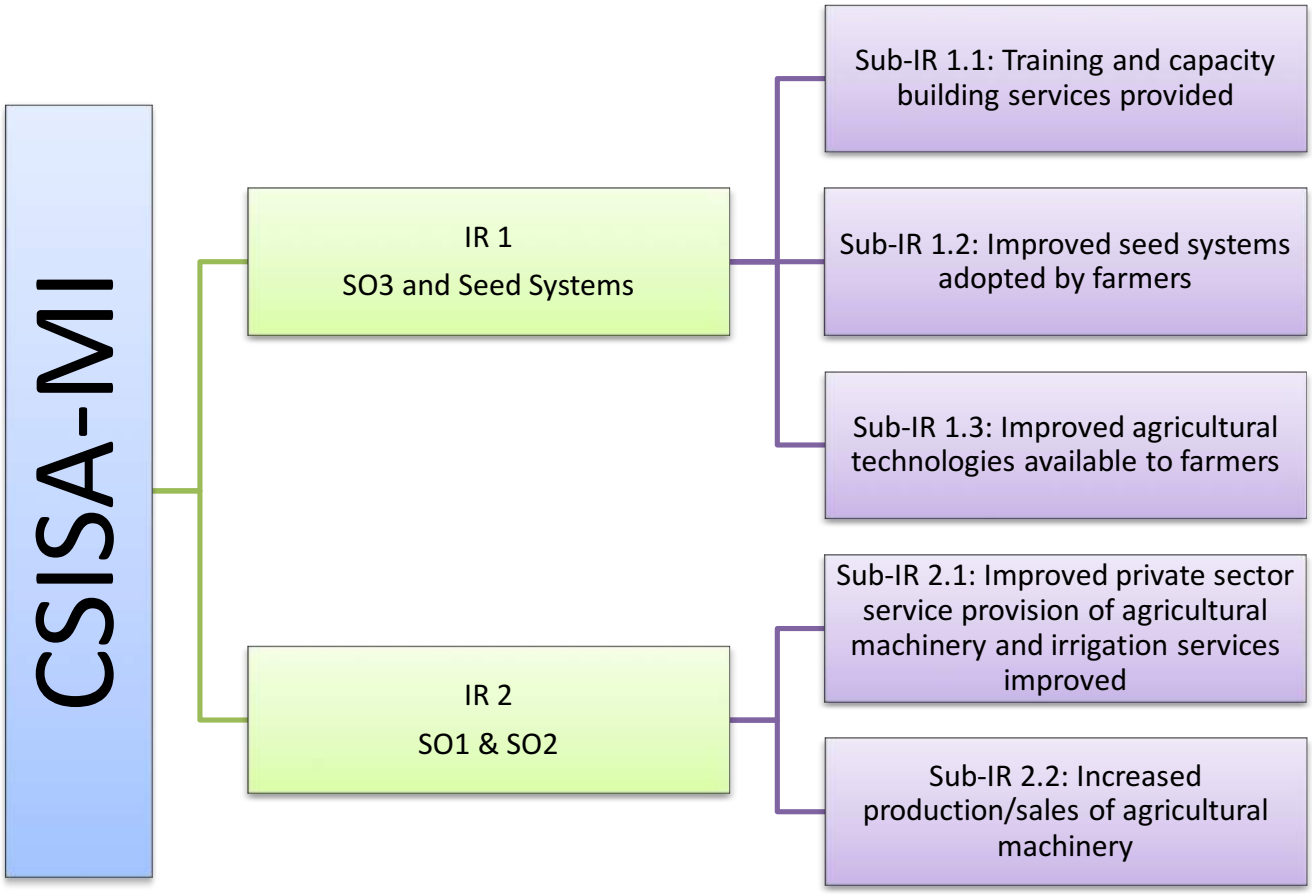

Figure 4: FtF's Intermediate Results and Sub IRs addressed by the CSISA-MI project

Through co-investment and shared CIMMYT staff-time in scale appropriate agricultural mechanization activities during FY 2015-16 by the broader CSISA Phase III project, a portion of mechanization activity achievements in Bangladesh have also been reported alongside the non-mechanization interventions pursued jointly in Bangladesh and Nepal through the CSISA Phase III project. More details can be found in the associated quantitative indicator report and narrative reporting documents for CSISA Phase III. Co-investments in mechanization activities between the sub-projects under the wider CSISA program umbrella offers opportunities to leverage synergies among public and private sector partners and to achieve enhanced on-the-ground impact in the FtF zone.

Overall, CSISA-MI's progress towards its targets is mostly on track if one looks at the high achievement numbers for most of the indicators shown in the table below.

Table 2: Summary of CSISA-MI's results by FtF Indicator

Ref. SO Ref. IR	Ref. FtF #	Core Indicator	Description	Year-1	Year-2	Target Year 3	Year-3	Deviation from target
SO 1& SO 2 Sub-IR 1.3	**4.5.2 (2)**	Number of hectares under improved technologies or management practices as a result of USG assistance	Hectare Coverage	3,584	5,726	18,647	19,287	(+)3%
SO 1& SO 2 Sub-IR 1.2	**4.5.2 (5)***	Number of Farmers and others Who have applied new technologies or Management practices as a result of USG assistance	Water Conveyance	9,073	12,939	53,668	39,975*	(-)26%
			Land Preparation and Planting					
			Harvesting and Post Harvesting					
SO 1& SO 2 Sub-IR 2.1	**4.5.2(37)**	Number of MSMEs, including farmers, receiving business development services from USG-assisted sources	Micro Enterprises (LSPs)	229	256	455	707	(+)55%
			Small Enterprises (Dealer)	45	43	40	32	(-)20%
			Medium Enterprises (Importer/Manufacturer)	2	3	5	5	0
SO 1& SO 2 Sub-IR 2.1	**Custom**	Custom: Value of private sector investment in agricultural machinery and equipment resulting from project interventions (USD)	Water Conveyance	327,975	80,861	172,168	83,375	(-)52%
			Land Preparation and Planting	252,902	95,830	130,485	124,530	(-) 5%
			Harvesting and Post Harvesting	229,191	42,815	130,485	373,565	(+)186%
SO 3 Sub-IR 1.1	**4.5.2 (7)**	Number of individuals who have received USG supported short-term agricultural sector productivity or food security training	Producer (Farmer*)	4,765	693	8,400	10,053	(+)20%
			Government Staff	16	128	200	275	(+) 38%
			Private sector	889	1,285	843	1,689	(+)100%
			Civil society[4]	139	87	0	351	N/A

**This includes farmers of Custom Indicator number 2 given in the last semi-annual report (service recipients of the LSP on mechanized agricultural support in water conveyance, mechanized land preparation, and mechanized harvesting, as advised by USAID's ACME project during their DQA of CSISA-MI.*

[4] The civil society category is given according to FtF indicators. These are actually people from the local community

2.1 Progress by Indicator

2.1.1 Indicator 4.5.2(2)

Number of hectares under improved technologies or management practices as a result of USG assistance – *(which contributes to IR 1.3 and SO 1&2)*

CSISA-MI has researched and developed suitable agricultural machineries which have been introduced and marketed in the southern part of Bangladesh (FtF Zone in general). These include the fuel-efficient axial flow pump suitable for surface water for irrigation, Power Tiller Operated Seeders (PTOS) suitable for in mechanized land preparation, sowing and basal fertilizing, and Multi-Crop Reaper (and newly introduced Power Tiller Mounted Reaper) for mechanized harvesting.

Against a target of 18,647 ha of land coverage to be brought under improved technologies or management practices, CSISA-MI not only achieved the target but also exceeded it by +3%. This is despite the unexpected wheat blast disease affecting 15,000 hectares alone in the FtF zone which meant that fewer farmers hired mechanized harvesting services. Figure5 shows trends in achievements over the last three years. The reported figures are calculated based on the land of the farmers who received mechanization support from Local Service Providers (LSP). The project's demonstration plots were taken into consideration bring the total land coverage to 19,287 ha. Note how the increasing trend in adoption of mechanized agricultural services generally follows the S-curve discussed above, indicative of the project moving towards change as articulated in its underling theory of change.

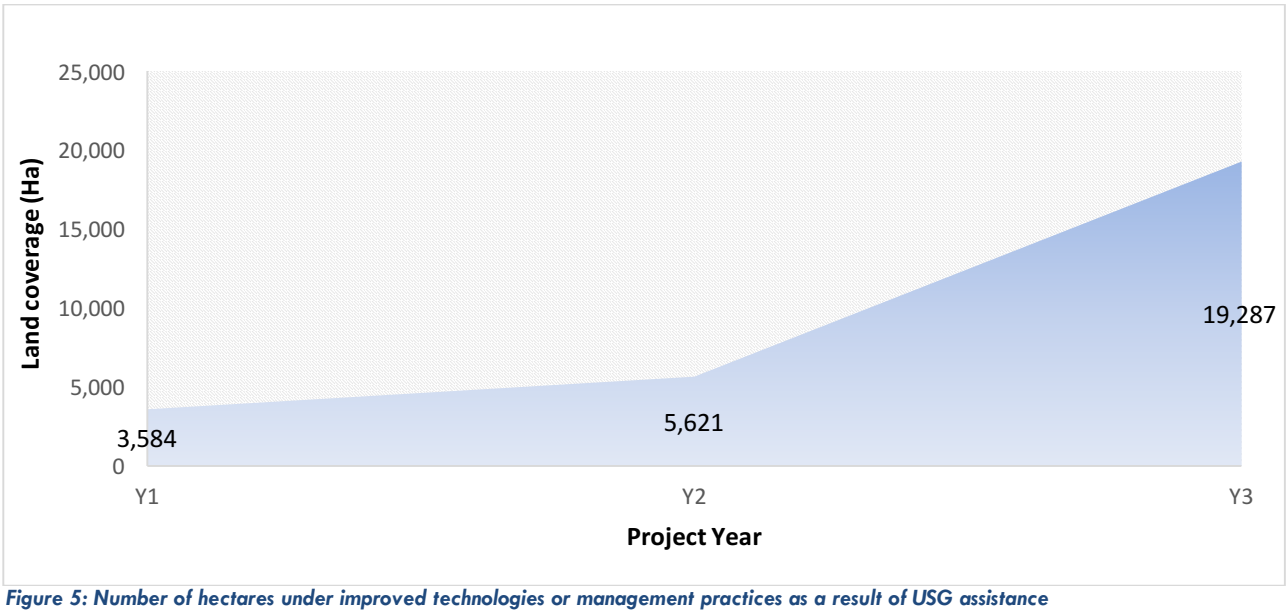

Figure 5: Number of hectares under improved technologies or management practices as a result of USG assistance

Examining the land coverage by improved technology in more detail however shows that use of all technologies have not uniformly increased (Figure 6)

In case of water conveyance, axial flow pumps land coverage was lower than expected due to wide adoption of the pumps in *gher* aquaculture of limited size, in comparison to crop irrigation on typically much larger areas. This indicates a change in the clientele for AFPs, though CSISA-M's private sector partners continue to focus on machinery sales to crop farmers. Technologies for harvesting and post-harvesting have also increased only to a limited extent, likely due to the incidence of wheat blast this year that forced tens of thousands of wheat farmers to abandon their crops. Expansion has been manly in mechanized land preparation and seeding services to alternative horticultural crops and for jute.

Looking further in-depth into use of the different technologies, by hubs and crops, additional variation and information can be discerned. Axial flow pumps were mostly used in Barisal hub area and primarily for *boro*

rice (Table 3). AFPs were also used widely in Jessore but mostly for aquaculture services in *ghers* that have limited land area, as noted above.

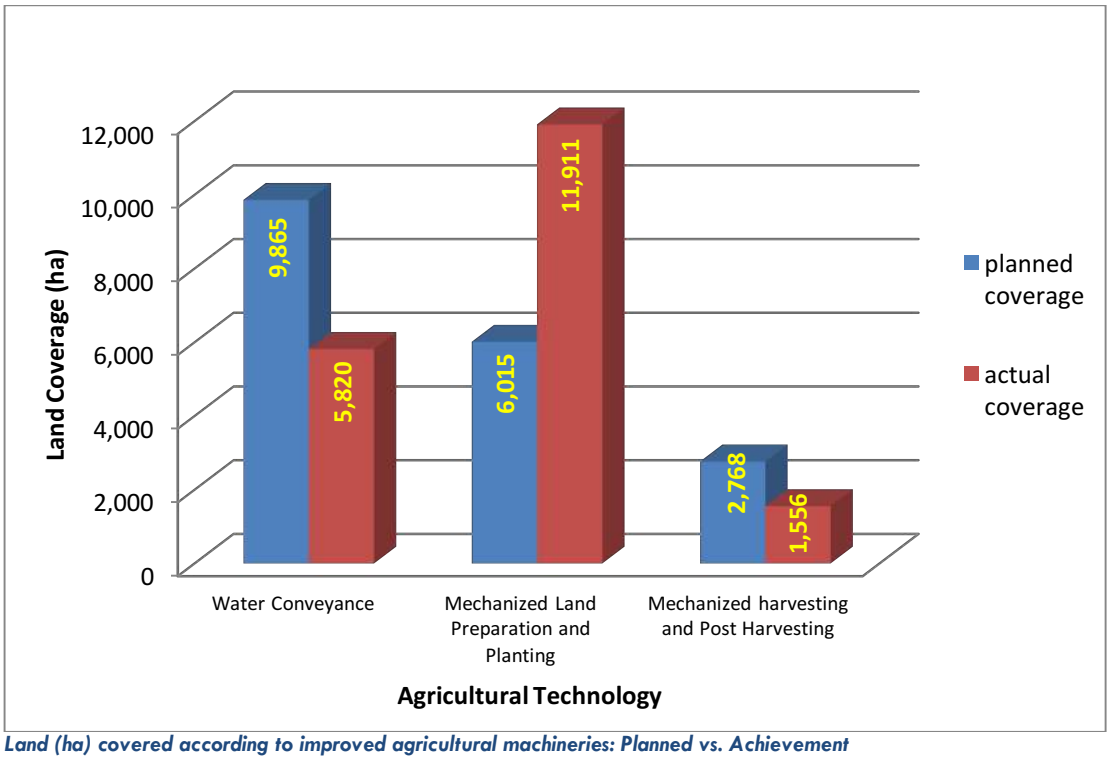

Figure 6: Land (ha) covered according to improved agricultural machineries: Planned vs. Achievement

In case of Mechanized land preparation services (Table 4), most use was in Jessore hub (for onion and wheat) and in Faridpur hub, mainly for onion fields. Overall in all hubs, PTOS was used in land preparation for various vegetables i.e. Brinjal, Cucumber, Chili, Garlic, Okra, sesame, sunflower, tomato and even for sugarcane and jute, in addition to for cereals.

Table 3: Land coverage by AFP for different crops in the three hubs

CROP	BARISAL Land coverage (ha)	FARIDPUR Land coverage (ha)	JESSORE Land coverage (ha)
Aquaculture	**250.73**	–	**2126.73**
Betel Plant	1.52	–	–
Brinjal	0.45	–	–
Chilies	2.75	0.40	–
Cucumber	36.71	–	–
Dewatering (Drainage)	–	–	235.66
Garlic	6.23	–	–
Ground Nut	1.58	–	–
Jute		–	0.41
Kakrol	8.38	–	–
Maize	1.13	–	0.32
Mungbean	18.87	–	–
Mustard	0.24	–	1.03
Okra	0.62	–	–
Rice	**1949.82**	253.35	259.28
Sesame	0.10	–	–
Sugarcane	0.54	–	–
Sun Flower	52.33	–	–

CROP	BARISAL Land coverage (ha)	FARIDPUR Land coverage (ha)	JESSORE Land coverage (ha)
Tomato	0.16	–	–
Water Melon	544.63	–	–
Wheat	101.06	5.40	–

Table 4: Land coverage by Mechanized land preparation services for different crops in the three hubs

Crop	BARISAL Land coverage (ha)	FARIDPUR Land coverage (ha)	JESSORE Land coverage (ha)
Banana	–	–	5.66
Brinjal	0.20	–	2.86
Chili	–	–	5.30
Coriander	–	0.41	1.34
Cucumber	–	–	0.40
Garlic	–	355.37	396.03
Green Pea	–	0.42	2.33
Jute	0.84	289.36	547.67
Kakrol	–	–	0.71
Lentil	6.24	65.85	528.69
Maize	13.36	23.18	53.13
Mung bean	185.50	13.99	23.37
Mustard	–	0.40	11.88
Onion	–	**2087.92**	**3037.77**
Potato	5.69	–	–
Rice	31.82	1.98	44.55
Sesame	0.89	11.68	33.58
Soya bean	12.33	–	–
Sun Flower	9.17	3.54	–
Tomato	–	–	0.20
Water Melon	0.89	–	
Wheat	156.58	**3631.34**	**306.79**

Despite the wheat blast disease, the use of reapers(Figure7) in harvesting wheat was considerable (mostly in Jessore hub). Other than wheat, another major crop harvested using the reaper was rice. Although the reaper has technical limitations in harvesting on wet-land, a total of 900 ha of paddy fields were harvested using the Reaper promoted by CSISA-MI.

Achievement of the target of land coverage was possible because of the effective training provided to LSPs and adequate awareness raising initiatives among potential farmer-adopters of each type of machinery. Both CIMMYT and iDE conducted various events i.e. video showings, farmers' field days, promotional demonstrations, and trainings, etc. to motivate and encourage farmers. At the same time, the project facilitated the availability of large numbers of machines through the LSPs in the field so that farmers could easily avail of these services.

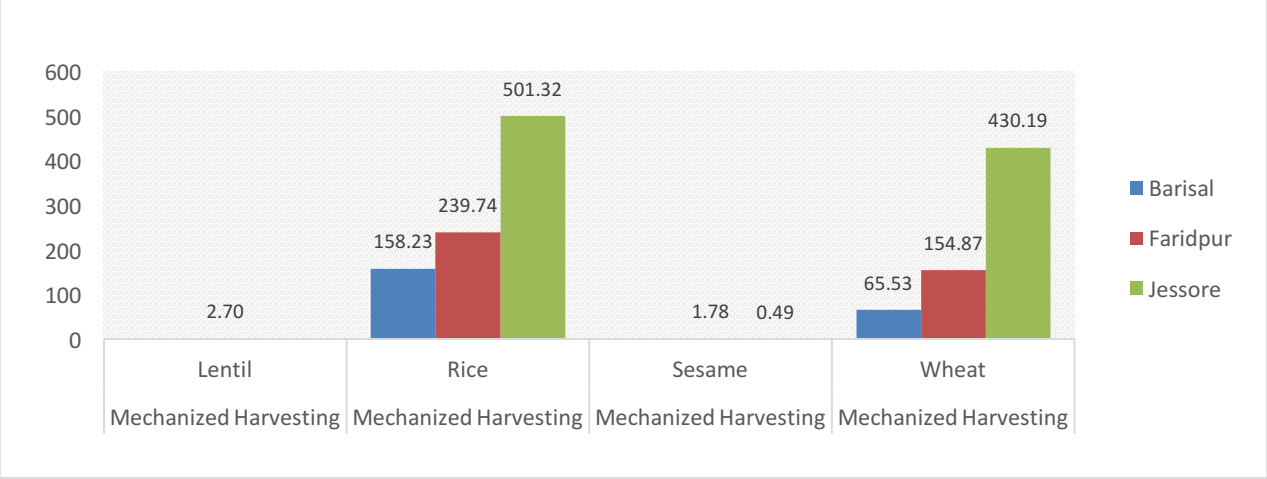

Figure 7: Usage of Mechanized harvesting (ha) according to hub area and crop. Note that some columns may be too small to see.

2.1.2 Indicator 4.5.2(5)

- **Number of Farmers and others who have applied new technologies or management practices as a result of USG assistance**

Taking into account DQA's recommendation to combine the custom indicator 2 given in the previous semi-annual report with FtF indicator 4.5.2 (5), CSISA-MI's target was revised and increased to 53,668 farmers utilizing/applying new agricultural technologies, from 1,275 farmers. While the achievement of the current target falls short by 26%, it is still more than the first two years of the project, indicative of positive success. The breakdown of achievement has been described further below. Low achievement of the target was because of – wheat blast disease affecting 15,000 ha meaning, and utilization of AFPs expanded to aquaculture more so than for *boro* irrigation. Ghers are contained land areas, rarely >1 hectare. Irrigated crop fields however may be tens of hectares in size. Still the overall sales of agricultural machineries were still considerable this year, and the expansion of pumps to *gher* aquaculture signifies an important and unexpected success of the project, while expanding the scope for sales and sustainable delivery of AFP products by CSISA-MI's private sector partners.

Figure8gives further breakdown of number of farmers utilising mechanised services according to technology and hub area. The technology most utilised was the PTOS for mechanised land preparation and sowing. 27,900 farmers took utilized this service in the last one year. This is 70% of the total farmers who used any of the three CSISA-MI supported machines, either in irrigation, land preparation or harvesting. 18% and 12% of the farmers received services for water conveyance/irrigation and harvesting, respectively. The technologies most used according to hub areas were water conveyance (AFP) in Barisal, mechanized land preparation (PTOS) in Faridpur, and mechanized harvesting (reaper) in Jessore.

The use of mechanized harvesting machinery was overall lowest among the three types of technologies. Along with the occurrence of wheat blast, another reason for this observation is likely to have been the cost of self-propelled reapers (up to USD 2000). CSISA-MI therefore introduced Power Tiller Mounted Reaper Machines that are comparatively less expensive, around USD500, which are expected to expand in Years 4 and 5. Janata Engineering Ltd. has finished selling all attachment reapers initially brought in first tranche this year (February 2016). It is expected that the cheaper version of the reaper will mitigate the demand-supply gap over time, and increase use of mechanized harvesting dramatically.

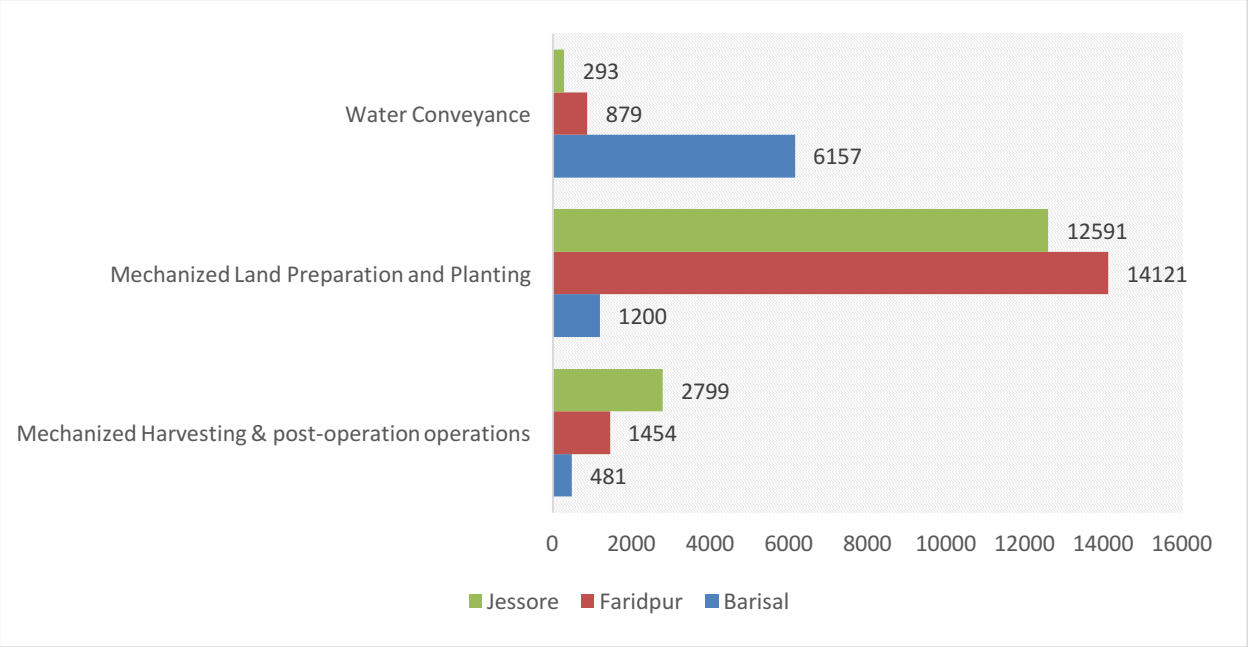

Figure 8: Mechanized service recipients (Number of farmers) by Hub by technology

2.1.3 Indicator 4.5.2(37)

- **Number of MSMEs, including farmers, receiving business development services from USG-assisted sources**

In the third year of CSISA-MI, the project conducted a number of local level market events (see Local-level Market Facilitation Under section 3.1), e.g. *Krishi Machine Porichiti* (KMP) to increase awareness about agricultural machineries, later followed by *Shombhabbo Kreta Somabesh* (SKS) to further persuade potential buyers. In addition to these events CSISA-MI has conducted a range of other activities in order to popularize agricultural machineries and create demand.

Table 5: CSISA-MI Market development activities to popularize the technologies among farmers and service providers, Year 3

Target participants	Type of market development activity	Number of events
Farmers, LSPs, MFIs, Public and Private Sector	KMP	274
	iDE Demonstration Method	76
	Learning visit	40
	Business Expansion Meeting	101
	LSP Experience Sharing workshop	11
	MFI Representative Meeting	36
Farmers, LSPs, MFIs, Public and Private Sector, MFIs, Mechanics	Gher Owners Meeting	9
	SKS	61
	UP Chairman Orientation	48
Mechanics and Private Sector	PSP Representative Meeting	18
MFI staff, Farmers and Private Sector	MFI Staff orientation	12
LSPs	Business Planning Training	12
	Market information sharing meeting	1
Farmers	Farmer Field Day	4
Mechanics	Mechanic Motivational Event	2
Mechanics and Private Sector	PSP Service Person Training	1
Senior Government Officials	Orientation meeting for government staff	1

CSISA-MI has also successfully partnered with five lead companies (achieving the target) with Joint Venture Agreements outlining specific roles and responsibilities of the project and each private sector partner to expand innovative agricultural machinery sales (see section 3.1.1).

Against a target of 455 LSPs, the project successfully reached many more LSPs – 707 micro-level enterprises, to be exact. The project appears to be reaching the 'tipping point', which is the level of adoption of machinery and private sector backing and investment in sales efforts in select Districts. This, according to the project's theory of change, this will result in self-sustaining machinery commercialization and uptake over time.

Box 2: Women successfully enter into the service provision business

Rahima Bibi (48) is the wife of a marginal farmer in Laxmipur village, Bhola Sadar. As a mother of five, she finds it hard to make ends meet with produce from 1.01ha land that her husband owned. In 2015 with an interest free loan from GJUS (a local partner NGO), Rahima bought a seed and fertilizer machine for BDT37,500 (USD 478[5]). Her husband and eldest son received training from CSISA-MI on use of power tiller operated seeders and started working within their own locality. Rahima reported income of BDT. 132,500 in sowing wheat, rice, mung bean and preparing cropland for other farmers during the 2016 Rabi season. Fuel and maintenance cost was BDT19, 700 (USD 251) and so net income in only 2 months was BDT 112,800.00 (USD1438). Rahima was exuberant and more than content with her decision to invest in agricultural machinery service provision. She and her family now dreams of establishing a machinery shop, using the income to invest further in her children's education.

[5] Based on the conversion rate of USD 1.00= BDT78.44 from xe.com dated 23rd October 2016

In case of reaching at least 40 small-scale MSMEs (dealers), CSISA-MI had a slight shortfall of 20%, still reaching 32 small MSMEs. However, this shortfall is made up by the unprecedented and increased uptake of mechanized agricultural services at the micro MSME level, and expansion of machinery use into new markets and crop sectors.

Figure9 shows the number of LSPs who bought CSISA-MI supported agricultural machineries. The highest number of machineries sold was in Barisal hub and then Jessore hub. As already mentioned the target has been more than achieved. However, the numbers of women LSPs nonetheless remain few, despite encouraging evidence in some cases (see above box), since it is difficult to engage women in this non-traditional role that usually requires work far from home. CSISA-MI nonetheless is still working to break this conception and engage women as LSPs (see section 7.4 on WEP). So far AFPs seem to be the main choice of machinery by women.

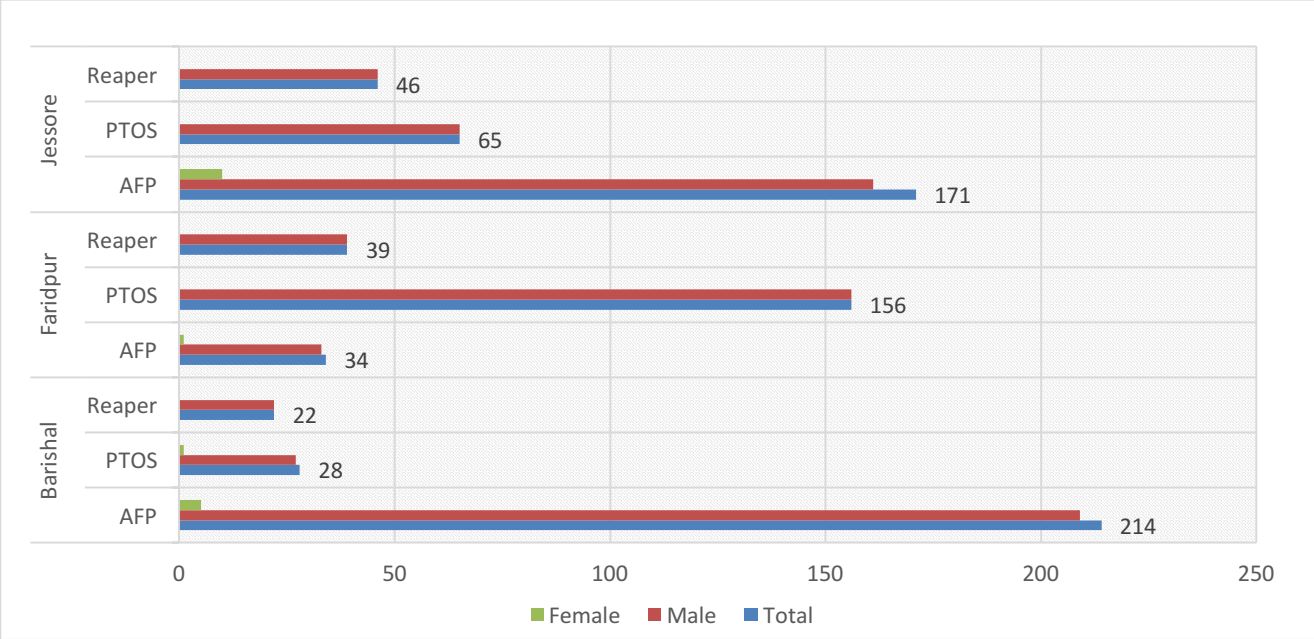

Figure 9: Number of LSPs who have bought Agriculture Machineries by Hub, Technology and Gender

Box 3: Popularizing reaper use and reducing reaper costs under CSISA-MI.

Akkas Fakir (43) is a LSP in Betbaria Village, Kaijuri Union, in Faridpur Sadar Upazila under Faridpur District. He has a power tiller, low-lift surface water pump engine, rice husking machine and sugarcane thresher which he uses for his own farmland of 1 hectare and serve neighboring farmers to cultivate onion, jute, rice, wheat, pulses and sesame crops.

Akkas used traditional farming methods which increased cost of crop production and harvest. In peak season the labor cost and crisis is high. Akkas got acquainted with the CSISA-MI project and attend Krishi Machine Parichiti (KMP) meeting, Learning Visit, and Shombhabbo Kreta Somabesh (SKS) which motivated him to by a reaper with a loan of BDT 100,000 (USD 1275) from TMSS. CSISA-MI also helped Akkas to access government subsidy of BDT51,000 (USD 650). After procurement of the reaper, CSISA-MI provided him with training in operation of the reaper, trouble shooting, and business planning. He is now known as a skilled LSP, and is making money how it matters – for his family. During the early months of 2016, Akkas reaped 6.68 ha wheat, 4.01 ha Boro rice, 2.01 ha coriander and 1.42 ha sesame and earned a total of BDT 60,000 (USD765). Of this BDT 13,000 (USD 166) was additional income from coriander and sesame. Reapers are most commonly used for wheat and rice but CSISA-MI has observed farmers spontaneously innovating by also reaping coriander and sesame. With his reaper income Akkas has been able to pay BDT 25,000 (USD 319)installment of his loan, repair his rick-husking mill which will provide him another avenue of income and plans to buy a PTOS in the coming Rabi season.

With Akkas's services in the area, reaping costs for farmers have reduced. Akkas reports: "Farmers used to pay BDT. 900 (USD 11) per 33 decimals for manual reaping and an extra BDT 400 (USD 4) to cut any standing straw. Now they pay only BDT 500 (USD6) per 33 decimals using the reaper and also cut the standing straw at the same time at no extra cost."

2.1.4 Indicator 4.5.2(7)

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

Progress against the targets of this indicator has been good. Activities under this indicator contributed to increasing awareness and building the business and technical skills needed by different actors in the agriculture machinery value chain. Increasing number of farmers living adjacent to the project technology demonstrations have pro-actively joined mechanized sowing, irrigation, and harvesting training events this year. Against a target of 8,400, the project trained 10,053 farmers. Along with farmers' increased interest in using mechanized methods of land preparation, irrigation and harvesting, this has also resulted in increased need to train private sector partners to appropriately respond. The project has therefore intensively extended trainings to 1,689 mechanics and other crucial market actors against target of 843. In selected locations in Faridpur District, CSISA-MI may be nearing the tipping point after which the private sector is expected to lead mechanization commercialization with technical backstopping and reduced financial support from the project. This however is not the case in all locations, requiring further doubling-down of efforts in Year 4 in less responsive market areas.

CSISA-MI has also strengthened linkage and collaborative activities with DAE and has successfully trained 75 additional government staff, exceeding the target of 200. These are mostly Sub-Assistant Agriculture Officers (SAAOs) trained on agricultural machines and service provision concepts.

Since most of CSISA-MI trainings are field based and take place in the open, it is not uncommon for people to join training events held in villages. In an effort to accommodate these people's pro-active interest, they were included in training programs resulting in positive deviation for this indicator, which had previously not been targeted (ref to numbers given for civil society under this indicator).

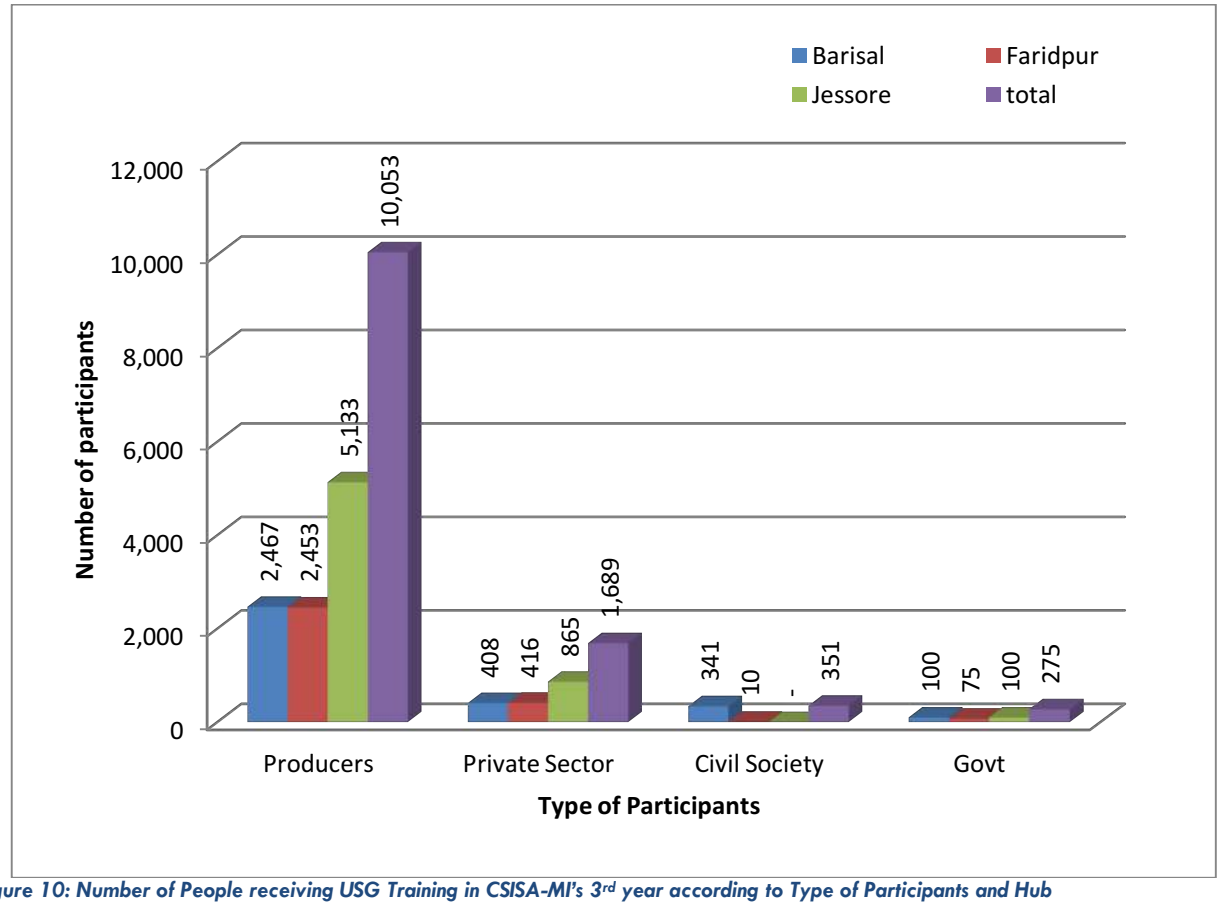

Figure 10: Number of People receiving USG Training in CSISA-MI's 3rd year according to Type of Participants and Hub

Since farmers constitute the main source of demand stimulating the uptake and utilization of agricultural machineries, the project trained 10,053 farmers in year 3. These efforts help to increase and aggregate demand for machinery services, and position LSPs to capture additional business. The next category of people most trained totaled 1,689 from the private sector, including LSPs and mechanics. Front line government staff from the DAE, i.e. 275 SAAOs who are the important actors in convincing the farmers to adopt mechanization technologies, were also trained. It is important to clarify here that participants of the FFDs conducted by CIMMYT and iDE have been taken into account as CIMMYT follows standard plan and modules to conduct FFDs, which therefore can be counted as trainings. 63% of the training participants participated in Farmer's Field Day.

The details of the different participants trained this year by hub are given in table 6

Table 6: CSISA-MI training conducted by type for different project participants during 3rd year

Target participants	Training topic	# of participants
Government front line staff (SAAOs)	Farmers Field Day	69
	LSP Training	12
	Mechanics Training	64
	PNGO Staff Training	2
	SAAOs Training on CA and Agriculture Machineries	260
LSPs	Business Plan Training	276
	LSP Training	601
	Training facilitation	441
Mechanics	Mechanics Training	295
	Refresher Mechanics Training	21
	Training of Engineering Workshop Owners	39
Producers	CA and Agriculture Machineries	1,441
	Farmers Field Day	5,878

2.1.5 Custom Indicator

- **Value of private sector investment in agricultural machinery and equipment resulting from project interventions**

Private sector investment is key to the assessing the impact and potential post-project sustainability of the CSISA-MI project. Despite variability in market demand for agricultural machineries, private investment continues as a result of CSISA-MI's transformative efforts. Overall progress towards this indicator shows that that the project has been able to motivate and engage private sector partners through financial investment, resulting in the expanded use of CSISA-MI supported scale-appropriate machineries.

The continued trend of private sector investment also indicates that the technologies in question are beneficial such in that the private sector is willing to take on their own financial risk in promoting their expansion. Figure 11 shows investment over the last three years according machine type. Where project interventions are successful and the private sector incurs continual positive financial return, the supply of these technologies is more likely to be sustainable in the long-term.

Based on year three targets for each of the technologies, investment for AFP deviated from the annual target by (-) 52%. This resulted because the project's private sector partners decided to focus on completing sales of existing machinery stocks. This effort has been successful as evidenced by the uptake of AFPs by MSMEs, and by the emergence of a new market for AFPs in the form of *gher* aquaculture. CSISA-MI's target was also based on an assumption that AFPs would be imported from abroad, which requires a higher degree of investment on behalf of CSISA-MI's private sector partners. Instead, another positive development emerged this year, namely the domestic manufacture of AFPs within Bangladesh. This signifies a positive impact of CSISA-MI and indicates that AFP production and sales may be sustained in the long-run in Bangladesh. Large firms and companies now prioritizing this as it is a more cost effective means of expanding pump sales, although because domestic

production costs are significantly lower than the investment required for imports. In the long run, we also expect domestic manufacture and sales to result in less expensive purchase costs for Bangladeshi AFP LSPs.

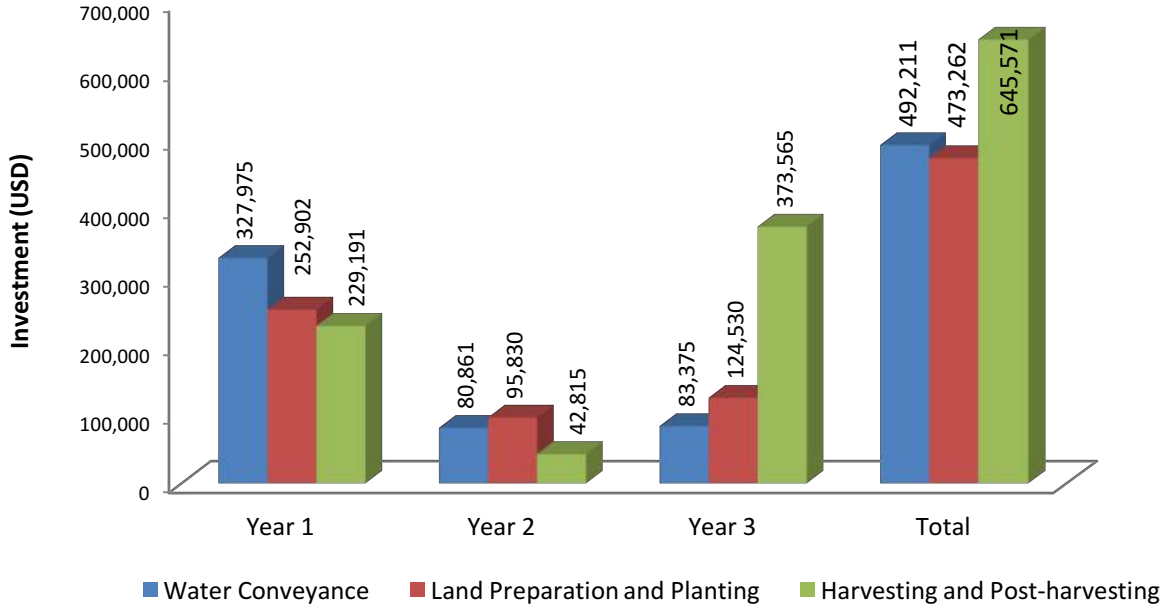

Figure 11: Public sector investment (USD) according to Technology and by Year

Box 4: CSISA-MI Trained Mechanic Becomes a Dealer for two major companies with CSISA-MI's support

Dinesh Chandra Majumdar (35) has been a mechanic for 20 years in Tambolkhana bazaar in Koijuri union, Faridpur Sadar Upazila under Faridpur District. He had a shop selling small spare parts for two-wheeled tractors and he was already well-known for his skills in servicing and repairing these machines in his locality. Dinesh attended CSISA-MI's trainings on common problems and repair of PTOS (Power Tiller Operated Seeders), reapers, and axial flow pumps (AFPs) for local mechanics in January 2015. Prior to this he had also attended a demonstration session run by CSISA-MI. These events opened Dinesh's eyes to the opportunities these innovative machineries could bring to Faridpur. Hey also eyed the profit he could make by selling these machines.

He therefore approached CSISA-MI's representatives in Faridpur and enquired how he could become a machinery dealer. CSISA-MI's Manager-Business Development introduced him to the RFL Divisional Sales Manager and after completing formalities, Dinesh became a dealer of the PTOS machine, incorporated with RFL. This was his first step from mechanic to mechanic-and-dealer. Later in 2016, seeing that Dinesh had a very good network among other mechanics and local service providers in his area, ACI Motors Ltd. Hasalso asked him to start stocking their multi-crop reapers for sales to LSPs. Now, he is a dealer of both RFL and ACI – two of the biggest companies in the country. The local mechanics are also helping promote Dinesh's dealership business. In return, Dinesh gives them a percentage of the profits he gets from the sale of each PTOS. Since he became a machinery dealer, his income increased has about 60%. He has so far sold 12 AFPs, 16 reapers and 19 PTOSs, profiting by approximately BDT 300,000 (USD 3825).

Deviation for PTOS is less than 10%, so efforts to meet this target custom indicator are on track. Further investment is expected in the coming year with the import of approximately 500 power tiller operated direct seeders to Bangladesh, to be sold with assistance from CSISA-MI.

CSISA-MI's private sector partners recognize the increasing potential for sales in rice and wheat harvesting equipment, and have therefore pro-actively invested a larger amount than expected in the import, distribution, and sales of reapers in the FtF zone, surpassing the project's investment target by (+) 186%.

3 PRIVATE AND PUBLIC SECTOR ENGAGEMENT

3.1 Market Systems Development

The market systems development approach used by CSISA-MI considers incentive structures within a systems context:

- For the private sector companies and their dealers, profit and brand value should increase as a result of target machinery sales;
- For the local services providers (LSPs), profit and social capital should increase as a result of buying the target machinery and using it to provide services to farmers as a rural business;
- For the farmers, the purchase of mechanization services from LSPs should decrease the cost of farming, increase productivity, and/or provide other agronomic benefits;
- And for governmental partners, public value – such as rural economies – should grow as the market system for agricultural machinery develops.

CSISA-MI strives to properly align incentives, thereby creating a virtuous, positive spiral effect between supply and demand. With these incentives in mind, and an eye on the constraints and opportunities within the market, CSISA-MI facilitates development within the private sector, public sector, and support services that are connected to the agricultural machinery market. To understand how the market is evolving, CSISA-MI utilizes a Monitoring and Results Measurement (MRM) system in addition to the projects FtF M&E indicator reporting system to analyze what is happening and why. The following sub-sections describe CSISA-MI's private sector engagement, public sector engagement, supporting services work, and MRM system over the past year.

3.1.1 Private Sector Engagement

CSISA-MI engages the private sector through a combination of efforts with 1) formal private sector partners (PSPs) or "lead firms "and 2) local-level market facilitation. These are described below. Additionally, as CSISA-MI's understanding of the business models associated with target technologies evolves, the project refines its business models for sharing both with private and financial sector partners. These upgraded business models are also discussed below.

Lead Firms

This past year, CSISA-MI partnered with five lead firms: ACI Motors, Alim Industries, Janata Engineering, Metal (Pvt.) Ltd., and RFL. Between these five firms, there are at least two companies competing for sales of each target technology. This competition – over the long run – will support lower prices, better quality and more diverse options in design and embedded services (e.g., training, help lines and post purchases support services, machinery warranties, etc.).

By investing in-cash cost-shares and other in-kind support (such as technical assistance), CSISA-MI leverages investments from these companies into the CSISAI-MI target technologies. The following table summarizes Year 3 PSP investment and potential Year 4 investments (based on current negotiations with the companies.

Table 7: Lead Firm Investments in Years 3 and potential year 4 under the CSISA-MI project (in USD)

Company	Year 3			Year 4		
	Cash	In-Kind	Total	Cash	In-Kind	Total
ACI Motors	146,160	6,668	152,829	88,169	10,088	98,257
Alim Industries	13,769	5,372	19,141	69,035	26,447	95,482
Janata Engineering	12,635	11,062	23,697	186,720	11,028	197,749

Company	Year 3 Cash	Year 3 In-Kind	Year 3 Total	Year 4 Cash	Year 4 In-Kind	Year 4 Total
The Metal (Pvt.) Ltd.	129,167	15,609	144,776	88,994	9,405	98,399
RFL - PTOS	95,483	47,183	142,666	150,488	1,778	152,266
RFL- AFP	73,269	43,754	250,084	20,019	2,349	50,670
TOTAL	**470,483**	**129,648**	**733,193**	**603,245**	**61,095**	**692,283**

These figures are taken from CSISA-MI's joint venture agreements with private sector partners. Although the cash contributions are verified at the end of the year by the project's M&E system; in-kind contributions are not verified

Year 3 Highlights: Increasing cash and in-kind contributions from public sector partners (PSPs) are an encouraging indicator of the private sectors investment in CSISA-MI target technologies. These investments are having an important impact in the market. Illustrative examples include the following:

- **ACI Motors** organized a first-time, daylong jamboree in Faridpur to generate greater multi-crop-reaper awareness in this part of the Feed the Future (FtF) Zone of Influence. This was an ACI-driven initiative that represents investment beyond the commitments it made through the joint venture agreement (JVA) with the CSISA-MI project. ACI successfully gathered a large and diverse crowd, as well as representatives from key stakeholder organizations, helping to build the enabling environment for broader machinery expansion.
- Through CSISA-MI, **The Metal (Pvt.) Ltd** has become increasingly interested in scaling-up its commercialization of the reaper. Metal won a USAID-funded innovation grant that helped it co-invest in two new ideas to grow its business and service offerings: Firm Machinery Hubs (FMH) and a Mobile Sales and Service Center (MSSC). So far Metal has established four FMHs and introduced its branded Metal Mobile Sales Service Bus. With the FMH and MSSC, Metal is expanding its ability to providing training, marketing, and after sales service within the FtF Zone.
- From the beginning of the project, **PRAN-RFL** has worked to commercialize PTOS and AFP under their Rangpur Foundry unit. But through its experience with CSISA-MI, RFL has seen great potential for the agricultural machinery market across Bangladesh. Therefore, RFL has initiated a new agri–machinery wing of its business which solely focuses on the commercialization of agricultural machinery products.

Figure 12: Metal's Mobile Sales and Service Center

Figure 13: ACI Motors Reaper Jamboree

Of particular note is the evolution of Janata Engineering, an agricultural machinery workshop based in the Chuadanga District. The previous semi-annual report described Janata a mid-level market actor that CSISA-MI supported since its beginnings. However, since then, Janata has very proactively grown its business, including hiring additional staff to focus on business development, marketing, and after-sales service. Based on the success of the reaper attachment in Year 3, Mohammad Ole Ullah, the proprietor of Janata Engineering, along with a Senior Technology Advisor from iDE Bangladesh, visited China in late June, 2016. There they inspected and assessed the local manufacturer and placed an order for 192 customized reaper attachments for the upcoming year. In addition, Janata has imported 82 rotovators and 110 PTOS for sale in the FTF Zone.

In addition to Janata Engineering, other market actors continue to crowd-in to the agricultural machinery market in the FTF Zone. For example, R.K. Metal, a local workshop in Faridpur has fabricated two prototypes of Axial Flow Pump with technical support from CSISA-MI's engineers, but otherwise of their own initiative. These pumps have been field tested with the help of the project at BARI, and now RK Metal has plans to manufacture around 50 pieces for upcoming irrigation season. Another crowding-in example is Real Power, who usually imports construction machinery. Last year RealPower purchased one reaper attachment from Janata Engineering for their assessment of the product. Based on farmers' response in demonstrations, they have imported 20 pieces of the same reaper attachment and one reaper binder to further test the market. These spontaneous activities support CSISA-MI's theory of change that over time crowding-in of market actors will cause the evolution of the agricultural machinery market.

Negotiations for Year 4. During the final quarter of Year 3, CSISA-MI began negotiations with its PSPs to co-create JVAs for Year 4 of the project. Illustrative examples from these JVAs include the following:

- **ACI Motors** will start selling PTOS for the first time this year (previously, the only CSISA-MI technology ACI sold was reaper) and plans to launch a new, branded service van. This van will provide after-sales service all existing reaper owners, and wherever it travels, it will show videos and create awareness about the reaper and PTOS.
- **Alim Industries** is going to import a new, improved model of PTOS and reaper attachments (previously it only sold self-propelled reapers). Alim will organize local market events and advertisement through local television and wall paintings.
- In Year 3, **Metal** domestically manufactured AFP for the first time and faced problems with quality and speed of production. In year 4, Metal will focus on product quality (developing a testing house at its factory) and increase production capacity (purchased rolling machine and dices) to meet farmers' demand in the market.
- Working with CSISA Phase III, several of CSISA-MI's private sector partners will begin PTOS and reaper sales in Dinajpur in northern Bangladesh, in an effort to expand commercial markets and tap farmer demand in this region.

Local-level Market Facilitation

Figure 14: Left KMP facilitated in Faridpur; Right –SKS facilitated in Patuakhali

CSISA-MI is engaged in various local-level market systems facilitation activities. The major categories of facilitation included awareness raising events, potential customer persuasion events, method demonstrations, learning visits, and UP Chairmen Orientations. Below are brief descriptions of each activity, followed by Table 8 quantifying the number of events and participation by project hub:

- ***Krishi Machine Porichiti* (KMP)** are awareness events that promote agricultural mechanization generally with extra focus on the CSISA-MI target technologies.
- ***Shombhabbo Kreta Shomabesh* (SKS)** meetings are persuasion events where potential customers meet with company and finance representatives as well as enthusiastic LSPs known as "Champions." The goal is to facilitate a space in which PSPs can work to convert *potential* customers into *actual* customers.

- **Method demonstrations** – These complement CSISA-MI's machinery and crop demonstrations in the field, and are brief, one-day events where potential customers, lead farmers, and SAAOs of a specific area can observe the performance of machine and ask questions about the technology.
- **Learning visits** are another form of "persuasion event" where potential customers visit a Champion LSP to see the target technology in action and learn firsthand about the financial and agronomic benefits of its use.
- **Union Parishad (UP) Orientations** are awareness raising events for members of the Union Parishad (UP), SAAOs, lead farmers and local elite. The goal of these events it to create champions in the marketplace who advocate for the target technologies amongst his or her constituencies.

Table 8: Market Facilitation Events and Participant

Type of Event	# of Events	Participants	Farmers	Existing LSPs	Mechanics	SAAOs	FSPs	PSPs
KMP	286	14,541	13,219	352	333	288	107	102
SKS	61	940	663	70	35	42	47	81
Method Demonstration	76	3544	2962	203	111	174	15	30
Learning Visits	40	452	293	83	21	30	7	18
UP Chairmen Orientations	54	1301	337	12	4	656	22	13
Total	**517**	**20,778**	**17,474**	**720**	**504**	**1,190**	**198**	**244**

Business Model Refinement

At the beginning of the project, CSISA-MI estimated business models for each technology based on technical and agronomic information about the machines, associated crops and cropping seasons, common farmer practices, and so on. Over time, practical experience of local service providers (LSPs) and farmers has enabled the project to refine the business models for each technology.

For the reaper business model, it is important to note that based on a series of variables – entrepreneurial acumen of the LSP, local demand for services, loans, and subsidies – the model can change significantly. Therefore, CSISA-MI performed further analysis to understand the various possible scenarios. Assuming that reapers can be used for *aman* rice, wheat in the *rabi* season, and rice in the *boro* season - and assuming that the LSP does not take a loan and is successful in securing sufficient demand for his services - the repayment period for a reaper is 1.8 years at the price of USD 2,159. If the current price for reapers drops by 30 percent (the current level of the GOB subsidy introduced in late 2015), the repayment period drops to 1.2 years; again, assuming high demand for services.

Based on a series of research deep dives this past year, CSISA-MI discovered that the breakeven point increases considerably when LSPs take high interest loans to buy the machine and when they are unable to find sufficient demand, or when a disease such as wheat blast harms a significant portion of a key crop. For this reason, the project is working with its private sector partners to explore a much cheaper power tiller operated reaper attachment, which retails at about a third of the price of the self-propelled reaper. Based on pilots with this technology last year, the team calculates that even when demand is low, an LSP who uses the reaper attachment can break even at 1.6 years.

3.1.2 Public Sector Engagement

CSISA-MI works with different government agencies to 1) endorse, promote and technically advice appropriate technologies in agricultural machineries to the farmers and 2) conduct research to evaluate and develop machineries suitable to the project area.

The approach to work with the government is effected at three main levels:

1. **At the field level**, CSISA-MI conducts training for Sub-Assistant Agricultural Officers (SAAOs) of the Department of Agricultural Extension (DAE). The SAAOs are the front line of advice for the farmers on agricultural machineries, and since project inception a total of 420 SAAOs have received project training. SAAOs also visit farmer's field in the project areas and provide suggestions as required on crop production cultivated by the project's promoted technologies that represent conservation agriculture.

2. **At the hub level**, i.e. Upazila and district level, CSISA-MI engages key DAE officials (Deputy Directors, District Training Officers and Upazila Agriculture Officers) to participate in various activities such as project stakeholder workshops, Farmer Field Days (FFD), farmers/LSPs training, demonstrations, as well as awareness and demand creation events and linkage meetings with MSMEs. This has helped the project gain a better understanding and endorsement from the government officials. CSISA-MI in turn has actively participated in agriculture fairs at Upazila and district levels organized by DAE and have received awards based on the performance demonstrated by CSISA-MI technologies. CSISA-MI is also closely working with the Farm Mechanization project of DAE to enhance the promotion of agricultural machinery in the project areas.

3. **At a higher coordination and policy level**, CSISA-MI advocates its project approach and objectives with key government departments and ministries e.g. Bangladesh Agriculture Research Institute (BARI), Department of Agriculture Extension (DAE), Ministry of Agriculture (MoA), Bangladesh Agriculture Research Council (BARC), Bangladesh Agricultural Development Corporation (BADC), among others. These interactions are built on CIMMYT's 30-year history working in Bangladesh and strong government relations.

3.1.3 Public Private Partnerships

CSISA-MI facilitates public-private partnerships in order to improve the extension services for farmers. Such partnerships have become in-built in most of the project activities in the field level.

Mechanization Workshop

As described in the previous semi-annual report, a major public-private partnership activity was originally planned to be held in July 2016. This was rescheduled however, due first to security concerns and later due to scheduling conflicts on the GOB side. This workshop is now scheduled to take place on 24 October, 2016 at BARC. This workshop will bring together key government departments and private sector companies in order to discuss what is working and more importantly, not working in the agriculture mechanization sector. From the public sector, notably the Director General of DAE will chair the workshop, the Additional Secretary (Extension Wing) from Ministry of Agriculture and the Executive Chairman of BARC will attend. Representing the private sector will be executives from ACI Motors, Janata Engineering, Alim Industries and The Metal (see *Annex 4*for draft agenda and schedule). The event will help strengthen public-private partnerships and provide an opportunity among key stakeholders to interact and build a network for the benefit for the farm and agricultural community.

GOB Voucher Sales

With support from CSISA-MI, RFL arranged a 75 percent discount voucher for the AFPs which were imported in the first year of the project. This was distributed to poorer farmers who participate in GOB agricultural projects or other FtF projects. The main objective of this voucher program was to quickly increase machine acquisition and usage in CSISA-MI project area. In line with social marketing strategies, this intervention would reduce barriers to adoption and "seed the market" for AFP. By the end of Year 3, RFL had sold 293 AFP through this method, generating not only sales but also increased awareness and advocacy within GOB stakeholders.

GOB Subsidies

As described in the semi-annual report, in 2015 the government's new Farm Mechanization Project extended subsidies to two of the three machines targeted by CSISA-MI; i.e. the PTOS and the self-propelled reaper. These subsidies had both positive and negative effects. On the positive side, the subsidy encouraged companies to import and market more aggressively and stimulated famer interest through a combination of word-of-mouth, DAE promotion, and lower prices (30 percent discount). On the negative side, customers did not act as quickly to buy machines as they waited for the subsidy process to unfold and become available (e.g., some reaper

customers who did not get their subsidies fast enough skipped wheat season and did not buy the machine until *Boro* rice season). Looking forward, a subsidy of 30% will be given through the GoB on PTOS and reapers in the upcoming year.

3.2 Supporting Services

To support the market system, CSISA-MI has facilitated interventions in support services, e.g., third party marketing (information), spare parts and repair supply chain (infrastructure), and access to finance (related services). These three interventions are described below.

Third Party Marketing

CSISA-MI invested in additional third party marketing (TPM) to promote the three target technologies regardless of brand/company affiliation. Given the sales season for each target technology, all third-party marketing work occurred during the period covered by the previous semi-annual report. However, since that report, each of the three marketing firms have submitted final reports on their activities. Therefore, relevant updates have been included below.

Telemarketing Campaign

CSISA-MI worked with Brand Results (BR) to execute a telemarketing campaign within the FtF zone area. The telemarketing campaign ran from 7 October to 30 October in 2015. At the time of the Semiannual Report, BR had estimated that its telemarketing agents had made upwards of 5,000 phone calls. However, BR's final report[6] more accurately described 3,092 phone calls to high potential farmer customers to inform them about the project-targeted machines and assess their interest level to buy these technologies. As stated in the semi-annual report, the project has concluded that telemarketing was a cost-effective way to spread marketing messages to farmers, but it was not successful at motivating them to buy. This kind of motivation is better done in person.

Figure 15: DVD covers of the videos used for the AFP and Reaper video shows

Video Show Campaigns and Awards

CSISA-MI worked with a second marketing firm, Spotlight Events Management Ltd.("Spotlight"),to conduct a video show campaign in the project area, including 150 events for promoting AFP and reaper using videos produced by the project (due to PTOS popularity, it was determined that no video show was needed for this technology). The campaign ran from 19 December 2015 to 6 April 2016. Spotlight's final report[7] confirms that these figures: 1)74 AFP video shows attracted 6,205 people, which generated 482 potential buyers and 2) 76 reaper video shows attracted 8,888 people, which generated 283 potential buyers.

CSISA-MI also played a key role in CIMMYT, BARI and Agricultural Advisory Society's (AAS's) recent international video award. This collaborative video project aimed at raising farmers' awareness of small-scale agricultural machinery, water, time, and labor saving crop management practices in South Asia has won the bronze prize in the Event and Visual Communication Association (EVCOM) 2016 Award for Communication Effectiveness at an event in London on April 28[8].The EVCOM Screen Awards are among the most prestigious competitions in corporate film and visual communications. The award was jointly accepted by BARI and AAS, and by the International Maize and Wheat Improvement Center (CIMMYT) through its CSISA programs.

[6] Reports will be made available on request
[7] Report will be made available on request
[8] http://www.evcom.org.uk/

Paul Van Mele, director of Agro-Insight, the organization which has helped produce many of CSISA's videos in Bangladesh, praised the partnership between agricultural research organizations BARI and CIMMYT, video production company Agro-Insight and video distribution partner AAS." The EVCOM Award for Communication Effectiveness celebrates a unique partnership model whereby quality training videos far exceeded the impact that agricultural development projects usually have," he said."In population-dense South Asia, the sheer number of farmers makes it difficult to expand reach to raise awareness in rural areas," said CIMMYT systems agronomist Tim Krupnik. "Video is a great medium for extension if you want to make awareness spread like wildfire."

Based on the film "Save more, grow more, earn more[9]," produced in 2012 through the Bill and Melinda Gates Foundation– and the U.S. Agency for International Development-funded Cereal Systems Initiative for South Asia (CSISA), and subsequently shown in CSISA-MI through village and television screening, which also featured some field sites shown from ACIAR and U.S. Department of Agriculture–Cornell University funded partner projects, a suite of videos was translated into eight languages for farmers in Bangladesh, China, India, Iran and Nepal. Harun-Ar Rashid, the Executive Director of AAS commented that "*our achievement was enormous*." Between 2012 and 2014, AAS and CIMMYT jointly organized 482 screenings for over 110,000 farmers in 482 villages in Bangladesh.

Israil Hossain, a leading agricultural engineer at BARI, commented that "*now farmers are inspired, seeing the advantages for crop production, and use of machinery is increasing*." Internationally, 1,500 DVD copies were distributed to farmer leaders and others such as two-wheel tractor operators, agricultural equipment and input dealers, community-based organizations, government services centers, NGOs and even tea stalls with televisions. Fifty eight million television viewers were reported in Bangladesh and over 100 million in India.

"*The videos increased farmers' awareness of the products of BARI's research, which is a huge success*," explained Md. Rafiqul Islam Mondal, director general of BARI.

Billboard Campaign

iDE also worked with Spotlight to place 50 billboards in the project area for six months' duration. Spotlight's final report[10]estimates nearly 73,000rural people viewed the billboards during their assignment.

Shift in Year 4 Strategy

Third Party Marketing was necessary in the first three years of the project to help kick-start the market for the technologies targeted by CSISA-MI. However, it is not sustainable unless private sector companies invest in them directly. Therefore, moving forward, the project will no longer independently invest in Third Party Marketing, but will rather channel this support through the PSPs.

3.3 After-Sales Service

Machines, regardless of quality, will inevitably break down. Without a functioning supply chain for spare parts and the availability of repair services, it is highly likely that customers will become frustrated with machine breakages and as a result, counterproductive negative word-of-mouth marketing will spread. This is particularly bad for LSPs for whom reliability is a key feature of their business.To address these challenges, CSISA-MI has developed a two-pronged strategy: (1) working with lead firms and (2) working with other market actors such as spare parts shops and local mechanics.

The after-sales service strategy for Year 3 – along with linkages made in the market – was describedin the previous semi-annual report.[11]Illustrative anecdotal expamples of improvements in after-sales service incude the following:

- **ACI Motors** provided repair and maintenance service to customers who brought ACI reaper machine last year and this year. Before the reaping season started, ACI deployed their trained mechanics to offer

[9] Details: http://csisa.org/tag/evcom-award/

[10] Report will be made available on request

[11] To date, CSISA-MI has worked on spare parts linkages with 36 local spare parts shops, 18 local spare parts fabrication shops, and two Dhaka-level spare parts importers/retailers. Additionally, CIMMYT and iDE have worked with RK Metal in Faridpur to increase its capacity to fabricate spare parts for AFP, PTOS, and reaper and with Janata Engineering in Chuadanga to fabricate parts for PTOS and reaper. CIMMYT and iDE have jointly trained just over 400 local mechanics during the first three years of the project, including 50 BADC mechanics. Lastly, this year the project has trained 32 company technicians who work for either ACI, Metal, or RFL.

services and increase customer satisfaction. ACI also provided a set of spare parts (worth USD 6.35) to reaper buyers as free of cost when giving repair and maintenance services.

- **Janata Engineering** organized a day-long training where twelve Mechanics from Janata dealers were trained on the power-tiller reaper attachment. The mechanics disassembled and reassembled all the parts of the reaper successfully. These mechanics will provide installation and maintenance services to the reaper attachment buyers.
- **Metal** provided free after-sales and maintenance service to Metal BG-AFP buyers during and after the irrigation season. The purpose of this was to satisfy customers and generate positive word of mouth marketing.

Figure 16: Janata Engineering trains local mechanics on reaper attachment

3.4 Access to Finance

As described in the semi-annual report, an estimated 49% of early adopter LSPs required a loan to purchase target technologies. The project team predicts that as the customer profile progresses from early adopter (mostly middle income farmers) to early majority (larger numbers of lower income farmers), it is likely that more LSPs will need access to finance. To this end, CSISA-MI negotiated JVAs with six Microfinance Institutes[12] (MFIs) to ensure that potential LSPs had at least one option, but sometimes two or more, for procuring a loan to help purchase one of the target technologies. Table9 summarizes the quantity of loan by MFI and by technology.

As part of the project's Monitoring and Results Measurement System (MRM – see below for more details) – the CSISA-MI team conducted an access to finance (A2F) study to understand what has been working well and what needs improvement. The preliminary results of that study can be found in "Access to Finance Study" below and these insights are helping to shape the A2F strategy for Year 4. In addition to this study, the project team reflected on the productivity of A2F partnerships in Year 3. As a result, the project will reduce its A2F MFI partners from six to four and will look for other innovative A2F opportunities such as collaborations with banks who are experimenting with agent banking in rural areas.

Table 9: Summary of Loans by MFI and Technology

Technology	Loan Disbursement						
	TMSS	SDC	GJUS	AID	JCF	PMUK	TOTAL
Reaper	35	12	6	4	23	1	81
PTOS	24	8	2	0	0	0	34
AFP	28	0	4	0	0	5	37
TOTAL	87	20	12	4	23	6	152

Table 10: Value of loans provided by MFI and Technology

Technology	Total Value of Loans Disbursed (USD)						
	TMSS	SDC	GJUS	AID	JCF	PMUK	TOTAL
Reaper	44,103	14,487	6,923	4,615	28,590	385	99,103
PTOS	9,231	3,077	897	0	0	0	13,205
AFP	3,333	0	1,026	0	0	321	4,680
TOTAL	56,667	17,564	8,846	4,615	28,590	706	116,988

[12]Action in Development (AID), Grameen Jano Unnayan Songstha (GJUS), Jagorani Chakra Foundation (JCF), Padakhep Manabik Unnayan Kendra (PMUK), TMSS, and Society Development Committee (SDC).

3.5 Monitoring and Results Measurement

To support evidence-based decision-making, the project uses a monitoring and results measurement system (MRM), which was summarized in the semi-annual report. The following sub-sections describe CSISA-MI-facilitated studies and data analytics that contribute to the project's understanding of what is happening in the market and why – making it possible to iterate and improve project strategy over time through the application of adaptive management (see semi-annual report for more on adaptive management within CSISA-MI).

Market Study

Commissioned by CSISA-MI, Agromech Development Initiatives (ADI), a research firm, conducted a market study[13] in Year 3 along with supplementary report materials such as the Creative Briefs, Survey Findings, and Market Size Estimates (*Annexes 6-10*). The study retrospectively surveyed the missing baseline from the start of the project in 2012 and provided insights that influenced Year 4 strategies. Some key findings are:

- Impressively 91%of LSPs interviewed expressed that they have benefitted in one form or another from CSISA-MI promoted machinery.
- Surveyed LSPs purchase machinery to reduce time required to provide agricultural services and to economically profit from service provision.
- In 2015, nearly one-third (27%) of LSP's total household income was derived from providing machinery services increasing from 22% in 2012
- Mechanics have been found to play a crucial role in potential LSPs decision-making process of purchasing machinery. The study found that, in the project area, local mechanics are not well informed/trained on machineries and hence there is a need to identify, orient and train local level mechanics on project machineries to support facilitation of sales.

Figure 17: A reaper deep dive interview

An early adopter analysis was attempted through the study, which found that early adopters of all three machines have similar characteristics regarding their education level, land holding and income. When compared to the general populace statistics, these characteristics have been found to be higher for the agricultural machinery early adopters considered by the study.

ADI's market study helped the project generate market size calculations, which is market intelligence needed by the private sector for future planning and by the project to determine working locations in Year 4. See Annexes 9 and 10for details on how these calculations were made and a detailed breakdown of the calculation by district and machine respectively. The study showed that Barisal had significantly higher potential for private sector investment relative to other districts when it came to AFP, confirming the project's technology targeting work conducted prior to the advent of the project and during its first two years. On the PTOS front, Faridpur, Magura and Rajbari are the three districts with the highest potential for private investment. The calculations further showed that Bhola could attract huge investment from private sector partners for SPR.

Reaper Deep Dive

Ahuman-centered design (HCD) reaper deep dive[14] was conducted by the project in nine districts of the Feed the Future Zone in southwest Bangladesh. The primary objectives of the deep dive were to provide insights into the market system of the self-propelled reaper (SPR) and the power tiller operated reaper attachment (RA) and generate recommendations for future CSISA-MI interventions.

The deep dive aimed to shift the focus from the reaper as a product to its market system and the actors who populate it. The deep dive collected and analyzed information on the market system through the HCD deep dive. The study was conducted in three phases, to reflect the peak harvesting times of *aman*rice season in November

[13] Study Report will be made available on request

[14] Report will be made available on request

(Phase I), *wheat* season in March (Phase II) and *boro*season in April (Phase III). Phase I of this work was conducted in Barisal, Madaripur and Bhola Districts, Phase II in Faridpur, Jhenaidah and Jessore districts and Phase III in Jhenaidah, Chuadanga, Jessore, Magura and Narail districts. To gain an in-depth understanding of the LSP and farmer journey maps, in specific geographical contexts, various supply chain and demand side market actors were interviewed in all locations. Data collection was conducted in the form of focus group discussions and individual interviews.

The following are preliminary insights from this study:

- Personally handling the machine during demonstrations induces strong *motivation* to purchase amongst the potential LSPs since they are inspired by the success of the champion LSPs.
- Providing reaping services are usually not the SPR LSP's primary source of income. They hire trusted operators to provide reaping services to farmers at a rate of BDT 300 – 500 per day.
- LSPs are showcasing reapers at their alternative business storefront. They are also communicating in person with local farmers, which include handing out business cards and showing videos of machines in action on their phones.

Access to Finance Study

A retrospective study[15] was conducted in March 2016 to understand the impact of CSISA-MI interventions in the access to finance sphere. Three categories of stakeholders were interviewed - LSPs, MFI-NGOs and PSPs. Examples of preliminary findings and recommendations from this study include the following:

- For MFIs, it is difficult to launch existing loan products to new borrower demographics for new purposes (e.g., to LSPs for buying new agricultural machinery). Having a full-time staff assigned for agricultural technology loan products to a new borrower demographic or product – as was facilitated by the JVAs between MFIs and iDE – is a productive way of popularizing the product as well as expediting the associated paperwork and processes. However, this is not sustainable and the work done by specifically assigned and skilled staff must be embedded into the rest of the MFIs' infrastructure.
- Most private sector dealers prefer not to make loans directly to customers. Instead, dealers prefer to be linked to a financial service provider who has the expertise – and will bear the burden – of vetting potential borrowers and collecting payments. Until now, these linkages have been informal. The project should explore ways of formalizing the linkages.
- If company sales representatives are to link potential borrowers to sources of loans, they must be familiar with the lending criteria so that they can pre-screen customers based on the likelihood that they will be approved for a loan.
- Policy level advocacy to support more tailored agricultural machinery loan products. For example, if PKSF were to launch a standard loan product for agricultural machinery that was "farmer friendly," it is highly likely that MFIs across the country would pick up that product and start promoting it more enthusiastically.

MRM - "Digital CSISA-MI"

In Year 3, the project increasingly focused on finding digital solutions to upgrade its MRM systems. The team referred to this effort as "Digital CSISA-MI" – a play on the GOB's campaign, Digital Bangladesh. Here are examples of digital upgrades in Year 3:

- **Smartsheet**s, a web-based project management platform (https://www.smartsheet.com/), was used by both Dhaka and Field teams to plan and report on activities. Web-based forms allowed field staff to send key information quickly to the management team in Dhaka, creating a near real-time feedback loop for implementation analysis and decision-making.
- Smartsheets information was fed into an improved, Excel-based **Dashboard**, which made analytics for both machine sales and project activities much easier and faster.

[15] Report will be made available on request

- The team also used Smartsheets data to perform **Data Analytics** such as plotting sales of a machine against demand creation activities and after-sales service initiatives over time. See Figure.18 for an example.

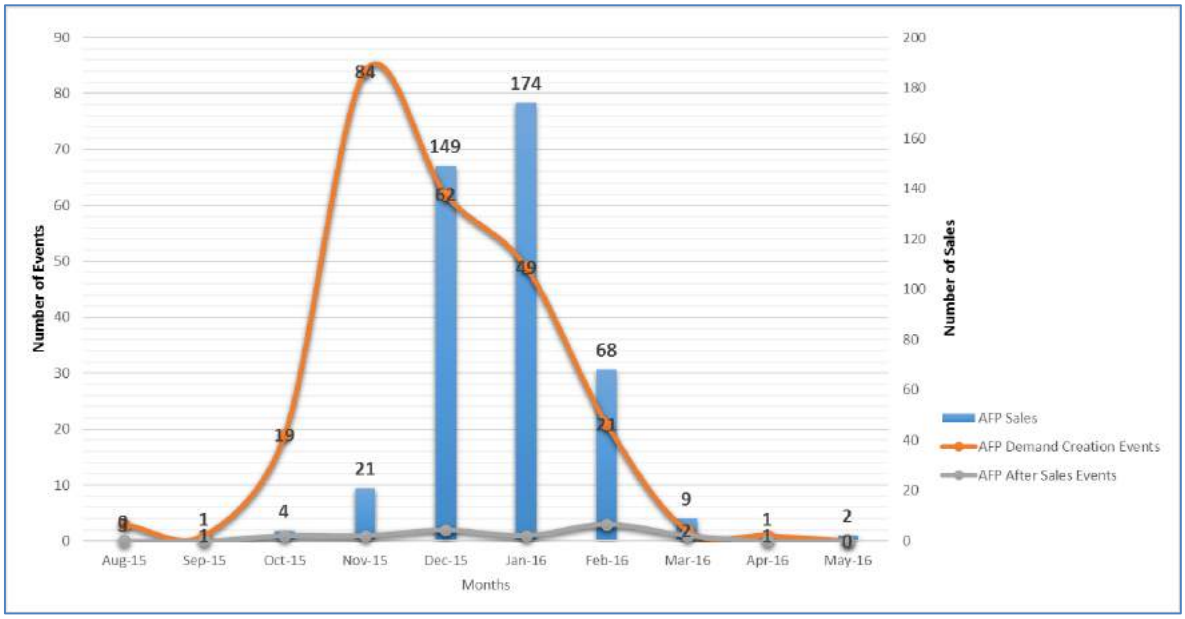

Figure 18: Data Analytics for AFP Sales, Demand Creation Events, and After-Sales Service Events

- Data visualization played a crucial role in understanding intervention results and performing strategic planning. A series of **PowerMap** (https://support.office.com/en-us/article/Get-started-with-Power-Map-88a28df6-8258-40aa-b5cc-577873fb0f4a)scan be found in *Annex 11*and a sample Powermap is given in figure 19, with more details in the annexes.
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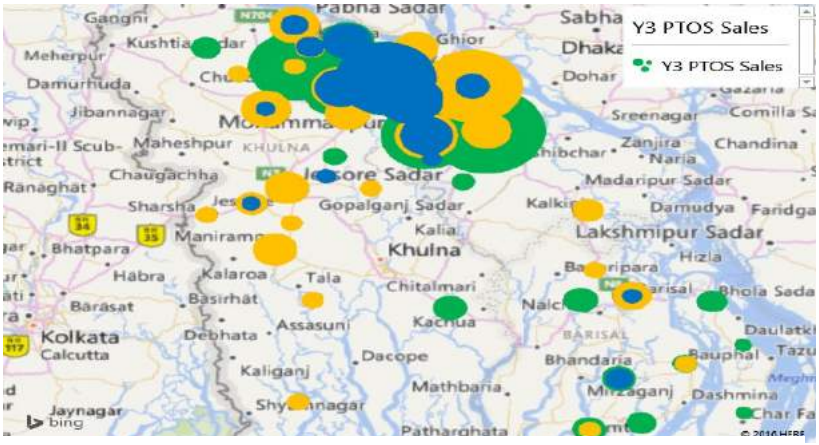


Figure 19:PowerMap Example of PTOS sales in CSISA-MI's third year

- A DCED-style Results Chain[16]developed through a participatory approach between the Field and Dhaka teams captures the project's theory of change. The results chain describes interventions, market triggers,

[16]The Donor Committee for Enterprise Development(DCED) standard is a tool consisting of eight components that is used in market systems projects to effectively measure results. The first step in the process is to explain the results chain by visually portraying what the project is working on and why they are doing it, and how they plan to achieve their goals and objectives. See more athttp://www.enterprise-development.org/measuring-results-the-dced-standard/implementing-the-dced-standard/

market uptake, enterprise performance and poverty reduction. It does this with sub-divisions by technology and by area of work (e.g., private sector engagement, field work, public sector engagement, and access to finance. By returning to this tool on a quarterly basis, the project team can understand if the market is evolving as projected and reconsider causal links between activities and market changes. This exercise is an important part of adaptive management and can leads to important, strategic pivots.

4 PROJECT MANAGEMENT

CSISA-MI project management continued to utilize an adaptive management approach by making changes to staffing, stepping-up communication among CIMMYT and iDE, reviewing and stream-lining geographical coverage and drafting future project implementation plans. These are described below.

4.1 Staffing

Over the last year, there were changes in staffing with recruitment in several vacant and new positions in Dhaka and field level. With these recruitments, project management feels that the project now has the required strength and capacity to implement the program effectively. The Dhaka team was assembled to ensure that core competencies under management, finance and technical positions and thus be effective in providing proper guidance to the field and monitor the project activities. During the current reporting period, three new positions were created at Dhaka level to strengthen capacity of team. These include a Training Specialist, an IRS Value Chain Agriculture Economist, and a Technical Specialist. Another significant change has been the departure of William J Collis end of August 2016 as Project Leader. He has been replaced by CSISA-MI's original project leader and project designer, Dr. Timothy J Krupnik from August of 2016. Dr. Krupnik also serves as the CSISA Phase Country Coordinator for Bangladesh that provides an umbrella for and guides CSISA-MI's activities in concert with efforts in Nepal and India. This position is however likely to be interim, as the Bangladesh Country Coordination role exists to strategically guide and coordinate all CSISA activities within Bangladesh, including CSISA-MI. For this reason, it is likely that a new Project Leader will be assigned to assist in CSIS-MI's 4th and 5th years in consultation and coordination with Dr. Krupnik. After these changes, the CSISA-MI CIMMYT Dhaka Office team will be complete, guided by the CSISA Bangladesh Country coordinator and led by the Project Leader, with contributions from the Project Manager, Training Specialist, M&E Specialist, Communication Expert, Machineries Expert and Project Finance Officer. The iDE Head Office team is also complete with a Deputy Project Manager leading three Intervention Managers who manage Relationships, Joint Venture Agreements, and Private Sector Implementation activities - a Manager of Public Sector Engagement, an MRM Specialist, and a Technical Specialist.

Several CIMMYT Hub Coordinators were replaced in 2015 and 2016, with individuals having broader field level management experience. In the current reporting period, Hub Coordinator position of Faridpur, Agriculture Machineries Development Officer (AMDO) and M&E Officer were recruited. iDE Business Development Manager was promoted to Field Coordinator of Faridpur. The CIMMYT and iDE teams work together to provide overall management and implementation guidance to the field. In addition to the project team, technical experts of CIMMYT and iDE and scientists provide support on research, technical strategies, and development initiatives of the project.

4.2 Coordination among CIMMYT and iDE

CSISA-MI project activities are jointly implemented by CIMMYT and partner iDE in all the working areas. Over the last year, the coordination and cooperation between project partners in the hubs has been stepped up. This has been effected through:

- **Regular integration and coordination with CSISA Phase III.** CSISA Phase III, which is led by CIMMYT, acts as the umbrella program under which CSISA-MI's activities are undertaken, and is guided by Dr. Timothy J. Krupnik as the Bangladesh Country Coordinator. All Phase III and CSISA-MI activities are therefore planned and coordinated in unison to assure synergy and harmony across CSISA activities.
- **Monthly coordination meetings** at the Hub level. All Hub level staff of both CIMMYT and iDE and senior staff from Dhaka office participate in the monthly meeting where discussion include field activities implementation, planning, budgets and problems/constraints are discussed in the meeting and agreements made for joint initiatives and efforts.

- **Bi-monthly project coordination meetings** with all field and senior level staff from CIMMYT and iDE. Discussions are held on hub-wise activity implementation progress, major successes, lessons learnt, problem/constraints, next plan, review of strategies and priorities of the project. Major decisions are taken for better implementation and coordination.
- **Regular coordination** between iDE and CIMMYT: There is day-to-day communication in addition to the monthly and bi-monthly meetings between the partners at both Dhaka and Hub level. Different issue or event based meetings are organized with relevant staff of CIMMYT and iDE at Dhaka and Hubs. Other strategic and planning meetings have also been organized jointly. Regular informal communication is also maintained among the partners and staffs to discussed and solve issues of the project.

4.3 Geography and coverage

In the first two years, the project covered 105 *Upazilas* to implement program activities. In Year 3, however project refocused on areas where activities would most effectively support machinery commercialization. In 2015 CIMMYT and iDE began discussions on overall project coverage and to identify the areas were CSISA-MI work brought most impact. It was then agreed CIMMYT and iDE would work in the same areas for better impact and synergic effect of the works. The project gathered sales data from MRM and M&E system and conducted sales mapping exercise. Based on the exercise, working areas were reduced from four to three Hubs (Jessore, Faridpur and Barisal). The Khulna Hub office was closed but some sales and demonstration activities were continued. Overall the number of *Upazillas* was reduced from 105 to 60 in 20 districts.

Figure 20: Map showing 2nd and 3rd year activity and sales of agricultural machineries

In third year 2015-16, the project implemented activities in 60 Upazillas under 20 districts of the FtF zone in a more coordinated way. The project has conducted a mapping exercise based on market studies for selection of most potential working areas for 2016-17 i.e. the fourth year. The mapping exercise looked at existing working areas, considering market size of specific machines, sales data of last 3 years, existence of dealer points, availability of mechanic services in the area and the overall experiences/observations of the staff. Considering all of these, the project further streamlined activities to 17 districts and 57 *Upazilas* for implementation of project activities in the 4th year.

4.4 MIS system of CSISA-MI

CSISA-MI uses CIMMYT's recently developed Database System for the Management Information System (MIS) to assure quality and timely M&E data reporting into the FtF mainframe. The MIS is simple, interactive and has user-friendly interfaces in order to manage and maintain the collected data from the field level. The MIS complements CSISA-MI's MRM system, but has its strongest focus on tracking the expansion of the project's FtF indicators in the context of a comprehensive analytical and visual representation database that is cloud based.

It has customized features to help monitoring the progress made by partner organizations against the set targets and to generate reports in tabular and graphical forms. The database has two deployment environments: The Web Application (Cloud App Model) and the client-server (desktop) solution. Users of the web app can view, edit, and delete M&E data directly in their web browser with appropriate access rights. The client-server solution is on the other hand used by Monitoring Officers and common users to check the quality of the data and generate

detail and donor reports. The database is interfaced with Quantum Geographic Information System (QGIS) for thematic mapping, PowerBI for interactive and better visualization, and GoogleEarth to plotting stakeholder such as LSP and Dealer locations. Data Security and access to data is ensured by using user name and password.

M&E staff of CSISA-MI have been trained to use the new system effectively and are collecting and storing the information on a regular basis using the web application. All the previous M&E data (Years 1, 2 and 3) have been transferred to the new system and results presented in this report are based on this system. This system has been helpful in saving time on record keeping and report generation.

Figure 21. Snapshot of the conceptual structure of the Web App.

4.5 Detailed Implementation Plan for 2016-17

Series of exercises and workshops were conducted to develop the Detailed Implementation Plan (DIP)for the next year i.e.4th year (2016-17) of the project. The CSISA-MI DIPs have also been constructed to create activity synergies with the wider CSISA Phase III umbrella program in Bangladesh, and therefore have been collaboratively developed in unison among the two projects. The full process was participatory involving field and Dhaka office staff from both CIMMYT and IDE. As part of DIP drafting process, analyses of CSISA-MI project objectives & results, the intervention strategies, theory of change and findings of the market study, risks and challenges, progress against the overall targets and M&E reports was completed.

CIMMYT and iDE teams in the three Hubs prepared draft DIPs for 2016-17 together with the participation of Hub staff. The project organized a DIP workshop from 8 to 9 August 2016 in Dhaka which was attended by all senior and technical staff as well as Hub staff of CIMMYT and iDE. Here all the hub-based DIPs were drafted and shared for feedback and then finalized and submitted to project management. A compiled DIP was developed based on the three Hub DIPs, and in concert with similar efforts for CSISA Phase III activities.

The main focus of the4th Year Detailed Implementation Plan is on how to achieve sales target, promote availability of commercial service provision for the farmers, ensure availability of machines in the working areas through timely import, manufacture and establishing distribution channel across the project areas, build capacity of Local Service Providers (LSPs) and market actors and create demand of mechanization services at the farmers' level. Additional emphasis is placed on synergistic co-coordination of activities to fall in-line with broader CSISA Phase III objectives in Bangladesh.

Major CSISA-MI targets for 2016-17

- Expand coverage of a further 29,813 ha of land under different improved technologies.

- More than 1,400 farmers will adopt new technologies
- Training of 9,725 farmers and service providers
- Investment of USD 758,650 by private sectors in agriculture machineries
- Develop 705 MSMEs and business development services
- More than 84,566 farmers will use improved agriculture machinery services for irrigation, land preparation, planting, harvesting and post-harvest operation.

The major CSISA-MI activities to achieve the target for 2016-17:

- Organize demonstrations of the mechanization technologies at the farmers' level.
- Organize Farmers Field Day (FFD) for result sharing of demonstration.
- Develop linkages between potential LSPs, dealers, MFIs and mechanics.
- Capacity building of MSMEs and service providers to deliver commercially viable service provision.
- Train farmers on improved technologies of conservation agriculture and mechanization.
- Increased use of LSPs' in establishing demonstrations for promotion of market based services rather use of project facilities/machines.
- Machinery research and modification for effectiveness and multi-crop use of machineries.
- Promotion of resource conserving technologies and suitable cropping systems for mechanization.
- Increased collaboration and coordination with government departments, research institutes, NGOs, USAID projects and private sector organizations for sustainability and cost effectiveness of the interventions.
- Capacity building of staff from government agencies, NGOs and partners' staff on agriculture mechanization technologies.
- The DIP will be implemented in 57 Upazillas of 17 districts.
- Conduct M&E, socio economic studies of project interventions, key survey and quarterly tracking of activity progress; prepare data base.
- Strategic alignment and synergy with CSISA Phase III activities.

4.6 CSISA III's role in CSISA-MI

The Cereal Systems Initiative for South Asia (CSISA) is an eco-regional initiative to support science- led agricultural development in South Asia since 2009 (http://csisa.org/). CSISA aims to enhance the productivity of cereal- based cropping systems while also increasing farm incomes and reducing the environmental footprint of production through sustainable intensification technologies and management practices. CSISA-III program (Dec 2015-Nov 2020) which started last year, works in India, Nepal and Bangladesh, and is supported by the Bill and Melinda Gates Foundation and USAID (Washington). CSISA entails diverse set of partners in the public and private sectors. This broad CSISA program provides the umbrella and strategic framework under which CSISA-MI's activities are planned and take place. Details of the strategic alignment and coordination of Phase III and CSISA-MI can be found in the report sections on project management.

The third phase of CSISA entails these generalized objectives:

- Promote widespread adoption of resource-conserving practices, technologies and services that increase yields with lower water, labor and input costs.
- Support mainstreaming innovations in national-, state- and district-level government programs to improve long-term impacts achieved through investments in the agricultural sector.
- Generate and disseminate new knowledge on cropping system management practices that can withstand the impacts of climate change in South Asia.
- Improve the policy environment to facilitate the adoption of sustainable intensification technologies.
- Build strategic partnerships that can sustain and enhance the scale of benefits accrued through improving cereal system productivity.

In Bangladesh, all CSISA-MI activities are planned in collaboration with CSISA Phase III activities to assure synergies, strategic alignment, and to leverage public and private sector partners for development. CSISA-III will be working in the same areas as CSISA-MI and its activities will support the overall goals and objectives of CSISA-MI. in addition to CSISA-MI working areas in Southern Bangladesh, CSISA-III will work in six districts in northern Bangladesh to expand machinery sales, also in collaboration with iDE.

The main intervention areas that CSISA Phase III is focusing on in Bangladesh include the following activities, a number of which are aligned with CSISA-MI:

1. Developing the directly sown rice (DSR) service economy, strongly aligned with CSISA-MI
2. Agronomic and variety recommendations to reduce the threat of wheat blast, aligned with CSISA-MI
3. Precision nutrient management and digital soil mapping
4. Healthy rice seedling awareness raising
5. Leveraging input dealers to deploy better-bet agronomic messaging, aligned with CSISA-MI
6. Rabi fallows development, aligned with CSISA-MI
7. Premium quality rice market linkages
8. NARES capacity building – focus on on-farm research methods and advanced statistics
9. Expanding integrated weed management in rice
10. Expanding commercial machinery supply chains for machinery in Dinajpur hub, strongly aligned with CSISA-MI
11. Early wheat sowing to combat heat stress, aligned with CSISA-MI

A major area of support for CSISA-MI is CSISA-III's efforts to engage and assist change agent 'intermediaries' – i.e. public and private sector partners who in turn will support large numbers of farmers. With this approach, CSISA-III will continue to support and strengthen four primary scaling pathways to accelerate change: 1) the service economy for scale-appropriate mechanization with SME entrepreneurs, 2) input and output markets with private sector companies, 3) women-inclusive livelihoods initiatives with reach into marginalized communities, and 4) national agricultural research and extension systems (NARES) extension partners. By embracing government, NGO, and market-led solutions, CSISA's investments are scalable and will strengthen systems that will persist long after the termination of the project, thereby contributing to better sustainability.

5 TURNING RESEARCH INTO IMPACT

Applied research provides the backbone for the CSISA program and CSISA-MI's interventions, and to target and improve the machinery technologies and service provision models extended by the project. All of the technologies promoted by CSISA-MI come following collaborative research between CIMMYT and BARI. The passages below detail some of the ongoing applied research efforts conducted by the project.

5.1 Preliminary results from soil bin testing

'Tillage-and-Seeding Laboratory' establishment at BARI and preliminary test results

Soils in the FtF zone are typically heavy with high silt and clay contents. This means that the blades used to till the soil that come with the PTOS supported for sales by the project are not always optimal for the agronomic conditions faced by farmers. For this reason, CSISA-MI is working in partnership with BARI to improve tillage blade design and to improve the PTOS. Design and development of tillage and seeding machinery requires frequent testing to identify the most efficient design or design parameters. Field testing of these early prototypes is expensive, time consuming and limited by day light, weather conditions and availability of optimum fields. To overcome the above limitations and allow machinery, Research and Development use the indoor soil bin system is used as a screening bed throughout the year. As a part of continued collaboration with BARI, CIMMYT has helped BARI to establish such a Tillage-and-Seeding Laboratory at the Farm Machinery & Postharvest Process Engineering (FMPE)Division, in Joydevpur, Gazipur. This has reduced the cost and accelerates the development of appropriate tillage and seeding equipment.

The laboratory consists of a soil bin system and a tool carriage system (Figure 22). The soil bin system can be used for testing machinery at dry or wet (puddled) soil conditions. The tool carriage runs over the soil bin and holds the test tools, measurement instruments and a high speed camera. The carriage can be driven at varying forward or backward speeds. Initial experiments have focused on developing/improving tillage and seeding machinery for challenging clay soil conditions of the South and therefore clay soil has been collected from the field. The soil contains 47.2% sand, 22% silt and 30.8% clay and has a field capacity soil moisture content of 33.4% (on a dry weight basis). A protocol has been developed to prepare the soil to a consistent bulk density

and soil moisture content representative of the field condition (dry soil condition).The soil preparation process takes three days making the soil bin ready on day 4 for testing. A total of 12 test runs can be fitted into the soil bin in one batch (Figure 23); however, depends on the purpose and machine type.

Figure 22 : The 14.0 m long soil bin system ready for test. The test rig has been fitted with test tool (rotary blades) and instruments for a strip-tillage experiment

Figure 23: Furrow backfill, soil tilth and other furrow data collection in the soil bin followed by an experimental run

Preliminary test results

Utilization of fallow lands during the *Rabi* season in the south-western Bangladesh through promotion of CA machinery is challenged by unfavorable soil conditions (heavy clay soil high in soil moisture at seeding). Use of popular 2WT operated seeders – e.g. a strip-till drill – in this wet clay rich sticky soil results in throw out of soil from the furrow producing inadequate furrow backfill and a cloddy seedbed. This reduces seed germination and increases the risk of bird damage. Test of three blade designs i.e. P- (43 mm wide at the tip), M- (4 blade set at 50 mm cutting width and 50 mm cutting depth) and S- blades (4 mm wide at the tip) (Figure 24) at 480 rpm in the soil bin using wet clay soil (moisture content 28.4% which equals to 85% of the field capacity; bulk density of 1.43 g cm^{-3}) at varying depth and width settings has revealed that a good quality seedbed results largely from blade design and settings.

Figure 24:Blades tested (left to right): P-blade, M-Blade and S-blade

In sticky soil conditions, the S-blade was found most effective in cutting and retaining silt in the furrow as well as having better re-tillage resulting in higher amounts of optimum clods (1–20 mm). The S-blades were found to have the lowest energy expenditure.

Preliminary results are given in Table 11 below showing the comparative performance of the three blades. Similarly, use of higher number of blades on the rotovator and larger width and depth of cut can help improve the seedbed quality for all the blades. Therefore, the S-blade offers the best performance being able to produce a quality seedbed even at the lower width setting (4 S-blades/row) when operated at 75 mm or greater depth. The S-blade version will be used in field validation trial planned in the upcoming *Rabi* season. Where positive results are found, the project's private and public sector partners will be briefed, with efforts put into place to commercialize the best-bet blade design adapted for use in the FtF zone.

Table 11: Effect of blade design and settings on the furrow shape and seedbed quality parameters

	P-blades	M-blades	S-blades
Blade operating depth 50 mm	b[1] =1.045 kg m^{-1} (21%) o[2] = 0.810 kg m^{-1} (78%) v[3] = 3420 cm^3 m^{-1}	b = 0.369 kg m^{-1} (14%) o = 0.270 kg m^{-1} (75%) v = 1769 cm^3 m^{-1}	b = 1.546 kg m^{-1} (43%) o = 1.250 kg m^{-1} (82%) v = 2465 cm^3 m^{-1}
Blade operating depth 75 mm	b = 1.010 kg m^{-1} (16%) o = 0.810 kg m^{-1} (76%) v = 4281 cm^3 m^{-1}	b = 0.799 kg m^{-1} (19%) o = 0.52 kg m^{-1} (65%) v = 2977 cm^3 m^{-1}	b = 1.852 kg m^{-1} (41%) o = 1.31 kg m^{-1} (72%) v = 3114 cm^3 m^{-1}
Blade operating depth 100 mm	b = 1.306 kg m^{-1} (16%) o = 0.970 kg m^{-1} (74%) v = 5463 cm^3 m^{-1}	b = 1.379 kg m^{-1} (23%) o = 0.910 kg m^{-1} (67%) v = 4177 cm^3 m^{-1}	b = 3.660 kg m^{-1} (48%) o = 2.820 kg m^{-1} (77%) v = 5349 cm^3 m^{-1}
4 blades/row, cutting width 50 mm, cutting depth 50 mm			
Blade operating depth 50 mm	b = 2.247 kg m^{-1} (32%) o = 1.020 kg m^{-1} (47%) v = 4795 cm^3 m^{-1}	b = 3.066 kg m^{-1} (41%) o = 1.83 kg m^{-1} (61%) v = 5384 cm^3 m^{-1}	b = 4.154 kg m^{-1} (53%) o = 2.89 kg m^{-1} (69%) v = 5505 cm^3 m^{-1}
Blade operating depth 75 mm	b = 3.332 kg m^{-1} (32%) o = 2.240 kg m^{-1} (65%) v = 7224 cm^3 m^{-1}	b = 3.383 kg m^{-1} (41%) o = 2.320 kg m^{-1} (69%) v = 5787 cm^3 m^{-1}	b = 5.027 kg m^{-1} (47%) o = 3.180 kg m^{-1} (63%) v = 7565 cm^3 m^{-1}
Blade operating depth 100 mm	b = 50.94 kg m^{-1} (35%) o = 3.18 kg m^{-1} (64%) v = 10156 cm^3 m^{-1}	b = 5.749 kg m^{-1} (43%) o = 3.830 kg m^{-1} (64%) v = 9271 cm^3 m^{-1}	b = 8.578 kg m^{-1} (60%) o = 6.15 kg m^{-1} (72%) v = 10043 cm^3 m^{-1}

P-blades	M-blades	S-blades
6 blades/row, cutting width 100 mm, cutting depth 100 mm		

[1]b= Furrow backfill expressed both as the amounts of soil retained in the furrow after strip-tillage (also expressed as %). A high backfill is desired to adequately cover seeds to ensure seed germination and reduce the risk of bird damage.
[2]o = Optimum clods measured as the amount of 1-20 mm clods retained in the furrow soil (also expressed as %). A high amount or percentage of optimum clods is desired for optimum seed-soil contact and ensure uniform seed germination.
[3]v = Volume of soil disturbance (or furrow volume) measured by sand replacement method. Unnecessary soil disturbance should be avoided as it indicates energy wastage and increases soil erosion risk.

5.2 Updates on geospatial research

CSISA-MI's technology targeting research on surface water irrigation in Bangladesh published in high-profile international peer-reviewed journal

GoB recently adopted policy calling for investment of over USD 7 billion to support agricultural development in southern Bangladesh. Approximately 1.7 million farm households crop only during the monsoon, contributing to food insecurity. Of the funds requested by the GoB, USD 500 million is to be allocated for surface water irrigation to transition farmers from monsoon rice–fallow or rain fed systems into double cropping. CSISA-MI has made inroads in providing more efficient irrigation alternatives to farmers through the axial flow pump, which is in line with the Master Plan for Agricultural Development adopted in 2013 by the GoB. Further emphasis in this plan is placed on increasing dry *boro* season rice production to offset increasing production and energy subsidy costs in existing *boro* areas reliant on groundwater. The viability of this approach has however been questioned given the southern region's soil salinity constraints and concerns over the long-term effects of climate change. Precise geospatial assessment of where freshwater flows are most prominent or where viable fallow or low-production intensity crop land is most common remains lacking.

In response, CSISA-MI used remotely-sensed data to identify agricultural land, detect the temporal availability of freshwater in rivers and canals, and assess crop production intensity over a three-year study period in a 33,750 km^2 case study area in southwestern Bangladesh. These data were combined with geo-referenced and temporally explicitly soil and water salinity information, in addition to relative elevation classifications, in order to examine the extent of winter fallows and low productivity and rain fed cropland that could be irrigated by axial flow pumps. Applying observations of irrigated crop with sowing dates and yields from 510 wheat, 550 maize, and 553 rice farmers, crop intensification production scenarios were also modeled from within the case study area. It is conservatively estimated that at least 20,800 and 103,000 ha of fallow and rain-fed cropland, respectively, could be brought into intensified double cropping using SWI.

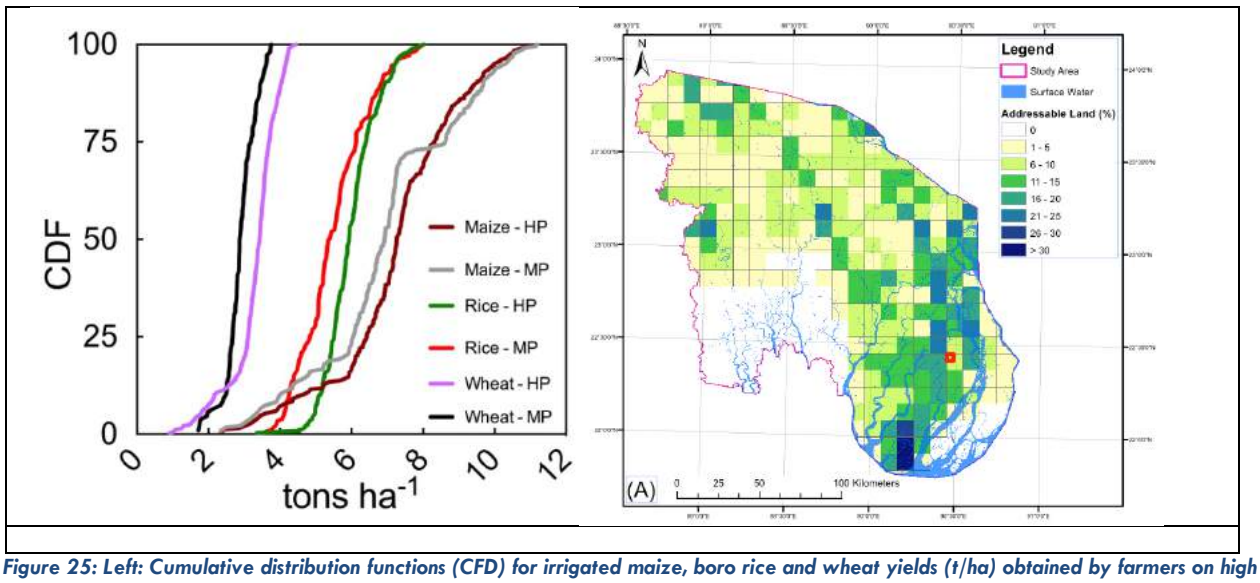


Figure 25: Left: Cumulative distribution functions (CFD) for irrigated maize, boro rice and wheat yields (t/ha) obtained by farmers on high (HP) and medium potential (MP) land considering the soil and water salinity index between 2011 and 2014. Right: Agricultural land suitable for surface water irrigation expressed as percentage of total cropland area in 100 km^2 imposed grids. Low- and marginal-potential lands were excluded.

Scenario analysis indicates that if 25% to 75% of the fallow or low-intensity land were converted to irrigate maize, national aggregate production could increase by 10 to 14% or 29 to 42%, respectively. Conversion to wheat would conversely boost national production by 9 to 10% or 26 to 31%. Irrigated rice would however not contribute > 3%. In aggregate, these actions could generate between USD 36 to 108 million of revenue annually among farmers.

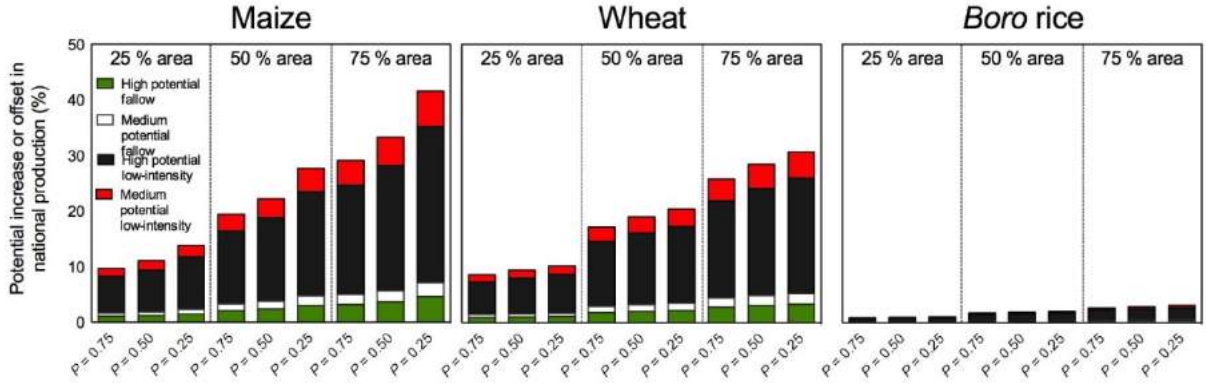


Figure 26: Modeled results describing the potential contribution of surface water irrigated boro rice, wheat, and maize to national aggregate production in Bangladesh.

Data depict three high and medium suitability land coverage scenarios with respect an integrated soil and water salinity index, including projections using one-quarter, one-half, and three-quarters of all fallow and low-intensity cropland identified within riparian buffers. Probability values indicate the probability of contribution from surface water irrigated cereals at the probability (P) of 0.25, 0.50, and 0.75 derived from the cumulative distribution functions above.

Both USAID and GoB have emphasized sustainable intensification in southern Bangladesh. Considerable investments in surface water irrigation are planned by the government to move land under monsoon season '*aman*' rice – dry season fallow crop sequences and *aman* – rain sequences into irrigated rice-rice double cropping and to shift *boro* cultivation from the country's north where production requires costly energy subsidies.

CSISA-MI's findings[17] indicate substantial scope for surface water irrigation to intensify cropping, even in the face of soil and water salinity constraints, although the potential for *boro* production appears to be more limited than anticipated. In contrast, dry season cultivation of wheat or maize cropping appears to result in significant production increases with important implications for national food security. Production of these crops also address income generation constraints while minimizing water pumping and withdrawals and hence, environmental risks. These results should however be interpreted cautiously, as studies into alternative crop and land use options and best-bet policy mechanisms to align risk reduction, finance provision and market access for farmers will be needed, alongside improved water governance measures. Further studies to model crop productivity, salinity and land availability are also needed in consideration of climate change scenarios. Emerging risks such as wheat blast disease, which appeared in 2016, must also be considered in future simulations.

Salinity tolerant crop genotypes are also important, as nearly one-quarter of the observed fallow and low-productivity addressable land fell into the medium-potential category. Additional efforts are thus required to model the most appropriate allocation of surface water irrigation to crops on different land types and salinity levels, in addition to market proximity and value. This would then advise farmers on the best-bet mixture of farm diversity to reduce risk and provide for food security while increasing incomes. In areas with soil and water salinity is >4 dS/m, conversion to aquaculture may be a more viable land use strategy.

In northern Bangladesh, dry season irrigation initially expanded through relatively unrestrained shallow tube well installation, resulting in increased pressure on groundwater in intensively cultivated areas. Proper environmental monitoring and conservation policy was adopted only after resource extraction problems became evident. Learning from these lessons, surface water irrigation and intensification efforts will require measures to manage withdrawal, especially as the ecosystem services of salinity regulation and freshwater provision are

[17]Krupnik, T.J., U. Schulthess, Ahmed, Z.U., McDonald, A.J. Sustainable crop intensification through surface water irrigation in Bangladesh? A geospatial assessment of landscape-scale production potential.*In Press: Land Use Policy*.

reliant on maintaining sufficient southward flow. The aforementioned issues aside, these results support the targeted use of surface water irrigation, in partial support of governmental land use policies, though crop diversification options should be seriously considered.

5.3 Machinery value chain research

Study on Scale appropriate mechanization for small scale farmers of Bangladesh: Commercial viability, adoption and strategic intervention for potential scaling up

CSISA-MI promotes three core technologies to drive more precise and resource-conserving agriculture practices (axial flow pump, power tiller operated seeder, and reaper) to boost income and yield by maximizing the productive use of water, soil moisture, fertilizer, and seed, while saving farmers' time, labor, and money. CSISA-MI has undertaken studies to strengthen the CSISA-MI initiatives through providing context specific information of the problems and opportunities in the agricultural machinery supply chain in order to formulate a strategic roadmap for CSISA-MI and its partners to accelerate scale-appropriate mechanization. The studies include:

5.3.1 Identifying and evaluating the existing business models in terms of economic and commercial viability

A business model is the way by which a company or an institution or an individual, structures its resources, partnerships and customer relationships in order to create and capture value – in other words, a business model is what enables an entrepreneur to make money. Business models are considered as more inclusive as they involve close working partnerships with local landholders and operators, and share value among the partners. This study will examine a range of business models that can be used to structure small appropriate agricultural machineries in Bangladesh. The intention of this study is not an overview of "best practice", but a survey of a range of possible business models which is being applied in the agricultural machinery sector in Bangladesh, give emphasis on identifying their pros and cons, opportunities and constraints, and options for scaling up. The aspect would specifically:

- Explore and identify the existing business models of agricultural farm mechanization in Bangladesh, especially for the machineries promoted by CSISA MI
- Measure the economic and financial performance of the machineries and identify options for improving financial performance.
- Conduct an economic and financial performance (BCR, NPV, IRR) of the machineries (e.g. PTOS, AFP, and REAPER)

Data and Methods: Focused Group Discussions (FGDs) were carried out to understand different business models and diversities within the business models due to spatial variations from both service provider and service user's perspectives. A total of 60 FGDs were conducted across the three hubs, with data currently under analysis. Results of this work will be reported in the subsequent semi-annual report.

5.3.2 Determining the factors affecting the adoption of the small-scale farm mechanization technologies (e.g. PTOS, AFP, and reaper) at the LSP level

There is strong advocacy for agricultural machinery appropriate for smallholder farmers as the farm holding size and socio-economic background of the farmers of Bangladesh is diverse and is mainly dominated by small and poor farmers. These 'scale-appropriate' machineries can increase returns to land and labor of the farmers through better access to the machinery services. Higher ownership of these machineries is also expected by local small scale service providers\farmers as the investment is comparatively lower compared to the large-scale agricultural machineries. MRM data collected by the project indicates that many smallholders are now utilizing agri-machineries. However, ownership is still questionable as the rate of adoption by local service providers/farmers has been somewhat uneven both geographically and temporally. There is a need to better understand the factors associated with agricultural machinery purchases and service provision in order to more effectively facilitate the development and investment in scale-appropriate machinery. This study will make an attempt to identify the factors influencing the ownership/adoption of the scale-appropriate agricultural machineries. This research is slated to begin in early 2017 and will comprise an important evaluation of the project's scope and reach to support a vibrant local service provision economy in the FtF zone.

5.4 Determining the factors affecting the utilization of the small-scale farm mechanization technologies (e.g. PTOS, AFP, and reaper) at the farm level.

Mechanization of agriculture is an important factor promoting to higher output of the agricultural farm and thereby increasing the profitability of the farming practices. However, farm mechanization requires more initial capital, improved technical know-how and quality support services. Lack of access to these services may constrain small farmers to involve in farm mechanization. The findings and lessons of CSISA-MI indicate that many of the farmers of the project villages did not adopt the mechanization technologies even after two years of the intervention. It has also been observed that some of the project farmers have only partially adopted the technologies, using the project machineries for only a small proportion of land. The findings indicate that available and appropriate technology is not the only factor and is probably determined by a set of inter-related factors such as size of farm, irrigation, access to institutional credit, government extension support services, experience of the farmers etc. This study will try to examine this issue.

The specific objectives of this research is to

- determine the utilization level of the scale appropriate machineries at the farm level in Bangladesh
- identify the constraints and opportunities for the adoption of the scale appropriate machineries at the farm level in Bangladesh
- identify the factors affecting the utilization level of the machinery for crop production

This work complements the research work stream discussed above, and will also be implemented in early 2017.

6 CHALLENGES

6.1 Wheat blast

The first outbreak of wheat blast outside the Americas was recorded in Bangladesh in February 2016, affecting a large area (15,000 hectares) in seven warmer districts: Kushtia, Meherpur, Chuadanga, Jessore, Jhenaidah, Barisal and Bhola, establishing itself swiftly, and causing significant crop losses for small-scale farmers. Average yield losses in affected fields were 25-30%, but up to 100% loss has also been seen in severely infected plots. The Ministry of Agriculture, Bangladesh officially announced the presence of this devastating fungal disease on 27 March 2016. Government formed a sub-committee under the leadership of Bangladesh Agricultural Research Council (BARC) with representatives from Department of Agricultural Extension (DAE), Bangladesh Agriculture Development Corporation (BADC), Bangladesh Agriculture Research Institute (BARI), Bangladesh Rice Research Institute (BRRI), different Universities, FAO and CIMMYT to formulate steps to mitigate the spread of the disease.

Figure 27: Symptom of Wheat Blast

Plans and partnerships to address wheat blast:

Under the umbrella of CSISA Phase III, CSISA-MI has been helping to coordinate blast mitigation activities with the help of concerned organizations. CIMMYT assisted one senior pathologist of Wheat Research Centre (WRC), BARI to attend International Blast Workshop at Brazil held in April 2016. Blast samples were collected from affected areas in collaboration with BARI and sent to Kansas State University, USA through USDA for genetic analysis of the pathogen. US and some other laboratories confirmed the pathogen as *Magnapor0the oryzae pathotype Triticum* (MoT), very close to South American isolates and most importantly did not evolve from the rice blast pathotype or variants from other local hosts. CIMMYT coordinated the organization of the Regional Consultation Workshop on "*Mitigation of the Threat of Wheat Blast in Bangladesh and beyond*" during 26-27 July, 2016 at Kathmandu, Nepal. The workshop outputs were drafting of short, medium and long-term action plans for mitigating spread and damage due to wheat blast and have recommended:

- Development of precision phenotyping platform in Bangladesh and Bolivia: Greenhouse/plastic tunnel screening and field screening (two cycles/year) under natural and artificial inoculation in Bolivia, and under natural infection in Bangladesh.
- Breeding for wheat blast resistance: Identification and characterization of diverse sources of resistance develop much targeted breeding strategy and strengthen international collaboration through germplasm exchange.
- Studies on disease surveillance, Epidemiology, alternate hosts and integrated pest management
- Conduct Molecular and other advanced studies on the pathogen
- Strategic decision on seed, management practices and wheat production issues for next season
- Capacity building (personal and infrastructural)
- Development of long-term multi-disciplinary international collaborative research for mitigating blast.

CIMMYT with the Wheat Research Centre under BARI has prepared a fact sheet on wheat blast that has been presented to all other members of the wheat blast mitigation sub-committee, corrected as per their suggestions and submitted to the Ministry of Agriculture for approval through BARC. After getting approval, CIMMYT will print and distribute the fact sheet to the farmers and concerned GO-NGO and private sector partners especially dealers by October, 2016 with the help of other GO-NGO partners. NGO partners include: Jagoroni Chakra Foundation (GCF), Society Development Committee (SDC), Grameen Jano Unnayan Sangstha (GJUS), Padakhep Manabik Unnayan Kendra (PMUK), Thengamara Mohila Sabuj Sangha (TMSS).

CIMMYT has a formal partnership with the WRC, BARI to conduct research on wheat blast in the research stations and farmers' fields as per above recommendation and conditions of LoA, and informal partnerships with BARC, DAE, BARI, BADC, Bangladesh University of Engineering and Technology (BUET), Soil Resource Development Institute (SRDI).

Combining funding streams from CSISA Phase III and CSISA-MI, CIMMYT has also pro-actively responded to the threat of wheat blast with applied research and forecast modeling to predict outbreaks in near-real time. Before 2016, wheat blast was restricted to the tropical regions of South America (north-eastern Argentina, lowlands of Bolivia, central and south-central Brazil and Paraguay). Like other South American countries where head blast is one the major diseases in wheat, wheat blast now considered a limiting factor for wheat production and restriction on increasing the area in Bangladesh. Higher temperatures and two episodes of rainfall during the crop's heading stage in February may be responsible for this disease outbreak in south and south-western part of the country. However, the precise environmental conditions needed in wheat blast infection have not yet been clearly defined, although it is known that temperature and spike wetness or wetness duration are the most important environmental factors affecting the interaction between the disease and wheat plant, and ultimately disease development. It has been observed that the severe blast coincides with wet years, where there is rain and high humidity in heading period. The endemic is also observed to be coinciding with El Nino period when the rain is a common event in all over Brazil except south-west and north-east where draught prevails.

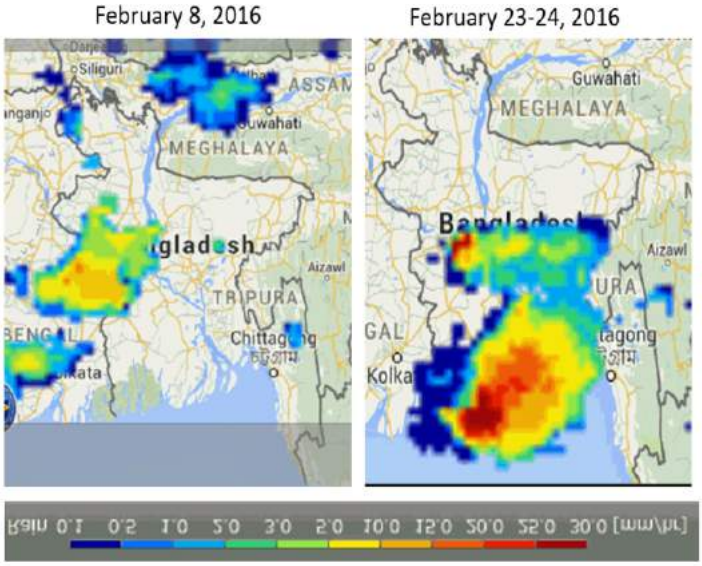
Despite intensive research being conducted since the appearance of wheat blast in South America, durable resistance in wheat genotypes has not yet been discovered. Some tolerant cultivars have however been identified in specific areas. Moreover, the complex epidemiology of the diseases that has not been properly explored, suggests that eradication of this disease will not be entirely possible. This, together with the large potential yield losses within very short period of time after the outbreak, will require innovative measures from farmers and researchers to effectively manage it. The development of a forecasting model which use climatic models considering the presence of a host, a pathogen and favorable atmospheric condition which affect disease development, is important for providing early-warning to wheat farmers to combat MoT outbreak.

In 2016, wheat blast was recorded in the wheat producing districts of south and south western in mid to late February. Two rainfall events at heading stage (February 8 and February 23-24) in south-western and southern part of the country (Figure. 28) and higher minimum temperature (Figure. 29) triggered wheat blast epidemic in this region. Symptom appeared about week after the first rainfall event (8 Feb) in south-western districts and after second rainfall event in southern districts (Feb 23-24).

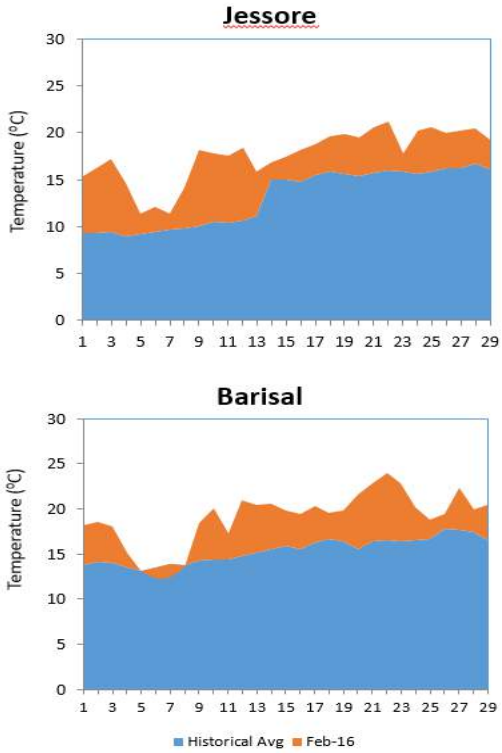
CSISA Phase III and CSISA-MI in collaboration with BUET and BMD is developing a wheat blast forecasting model using historical weather data. An initial index model was developed using the meteorological data from 33

weather stations for the month of February. We used temperature and wetting period values for blast outbreak in Latin America for calculating suitability index of blast. The preliminary grid based analysis in wheat area is underway. Initial analysis showed that from February 8 to 14, from south-western to south-eastern of part of the probability of MoT outbreak is higher than the rest of the country. Only in the south-western part the country in the FtF zone, were optimum conditions for outbreak was with the heading stage of wheat, leading to larger infection rates.

In the Faridpur region where wheat area is rapidly expanding, probability of blast outbreak is also higher, but observed outbreak in 2016 was lower than in the Jessore region because heading wheat in this area tended to occur after 8-10 February. In the Ishwardi area, observed infection was low, likely because farmers were able to sow the crop on time, although the probability of outbreak was higher in mid-February. In non-traditional wheat growing areas of the southern part FtF zone, the probability of infestation was higher in late February. Due to late sowing, heading date in late February was perfectly synchronized with condition of MoT infestation which led complete crop loss in some area of Bhola and Barisal Districts. Detail forecast models based on gridded data product from Global Atmospheric Model is underway.



Left Figure 28. Rainfall in early and late February in the FtF zone, 2016



Right Figure 29: Daily minimum temperature and 30 years mean for the month of February

Figure 30: Initial weather-based wheat blast suitable index maps for the month of February, 2016

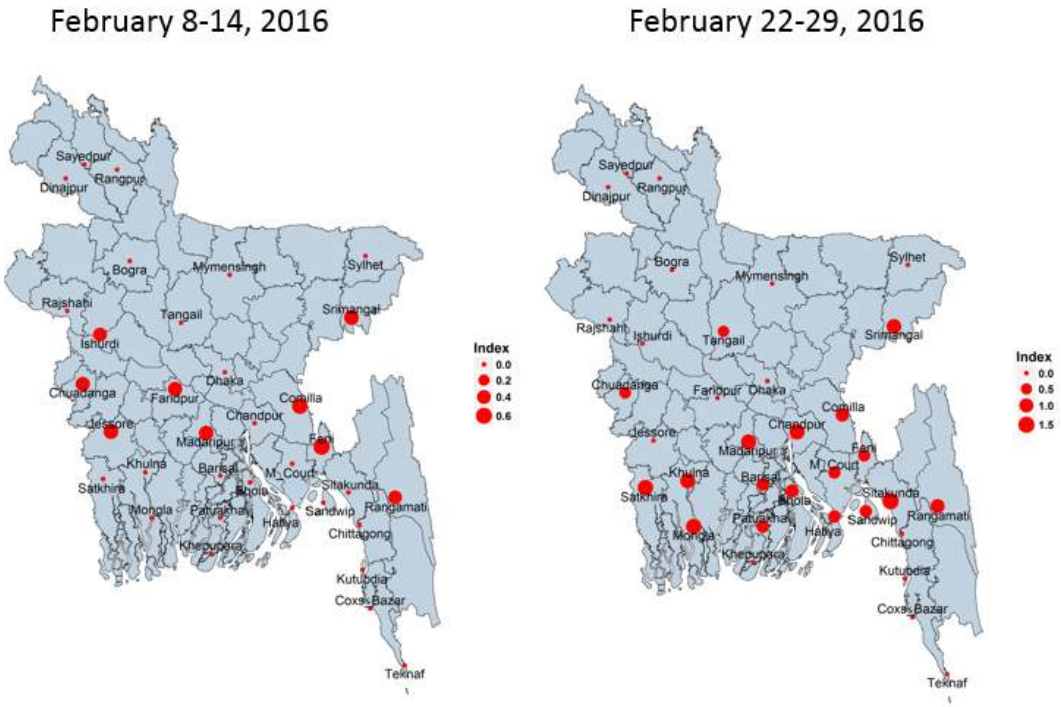


Figure 31: Preliminary wheat blast outbreak potential index developed using agro-meteorological data from available weather stations in Bangladesh.

This model is currently being refined and further developed in the CSISA Phase III project in alignment with CSISA-MI.

6.2 Problems in Engaging Women as Entrepreneurs

Since its inception CSISA-MI has found it difficult to involve women in machine-related activities as this is a non-traditional profession for women. Usually men operate and own agricultural machines in Bangladesh. Women and their families prefer women to engage in work that is near the home, a result of deep social prohibitions on engaging women in alternative activities. To become an LSP would also require travel to different farmer fields and extended stays outside the home. This represents a significant barrier, although CSSIA-MI has continued to work towards engaging women entrepreneurs as LSPs.

To date a total of 24 women have been involved in the project as LSPs (seven in Barisal hub, eleven in Jessore hub and in six in Faridpur hub). These women have arranged to purchase the agricultural machinery but the operation and have worked to develop viable and profitable business models for their machines, although operation of machines will almost always remain in the hands of male family members.

In an effort to expand the role and access of women to agricultural machineries and machinery services, CSISA-MI had reached an agreement with USAID's Women's Empowerment Program (WEP) in February 2016. WEP identified25potential women entrepreneurs who have been trained by CSISA-MI (see section 7.4).

6.3 Government of Bangladesh Subsidies

As previously reported in the semi-annual report and discussed again under section 3.1 of this reports, GoB subsidies have had both positive and negative effects on CSISA-MI's functioning. Positively Private sector companies are interested to import and market more aggressively and negatively customers waiting for subsidies to come through are not buying up machineries as quickly. It is expected that in the coming year that this will be overcome with the 30% subsidy on PTOS and reaper.

Conversely, many subsidies were initially distributed to politically favored farmers, even if they did not want to purchase a machine. Other potential LSPs delayed purchase of machines to wait for subsidies, which impacted the project's reporting targets this year. In some cases, CSISA-MI and company staff also had to lobby the Farm

Mechanization Project to get names of new customers – farmers who actually wanted to buy the machines – on the list of approved subsidies. These issues are in the process of being discussed with GoB partners to assure smoother functioning and complementarity of the subsidy plan next year.

6.4 Technical challenges faced with Axial Flow Pumps and Inclusion of attachable reaper

Figure 32: Direct shaft coupled AFP testing at BARI

Axial Flow Pumps

Due to a lower operating cost and ease of use for surface water lifting (compared to centrifugal pumps), AFPs have become popular with service providers and leading farm machinery manufacturers and importers (RFL (Rangpur Foundry Ltd), TML (The Metal Ltd), and R K Metal, Faridpur) in Bangladesh. Based on feedback from AFP owning LSPs, the project felt the need to experiment with direct coupling the outer-shaft AFPs with their engine, to assess if higher energy efficiency could be obtained. Direct coupling is commonly used by *boro* rice farmers who have to operate pumps for hours at a time, and are easier to install compared to the v-belt driven AFPs. In partnership with Alim Industries Ltd, 100 mm (4 inch) and 150 mm (6 inch) models were designed. Both the models have passed factory testing (Figure 33) and are awaiting performance tests at BARI, which will be followed by endurance tests (also at BARI) and subsequent field tests (by service providers). The project also came forward with a design solution for a batch of RFL's 170 imported AFPs that were observed to have poor performance. Performance test at BARI has found that the suggested design solution will significantly improve their performance of the pumps through additional testing and modification of impellers, which is under way in collaboration with Georgia Tech University in the US.

Reapers

CSISA-MI efforts during the first two years of the project created increasing demand for reaper harvesting services among farmers, particularly for rice and wheat. However, early in the 2014-2015 FY the project moved away its initial emphasis on self-propelled this because of their high price (unit cost USD 1,500-2,000) that meant long pay-back periods before LSPs were able to break even. In early 2015, the project however looked at a range of harvesting equipment available in on the international market- including reapers, reaper binders, and small combines. Those products, many of which were available on the Chinese market, appeared to be either too expensive or unreliable. Based on information from CSISA Phase II's mechanization activities in Nepal, CSISA-MI identified a reaper that attaches to a 2-wheel tractor and which comes at a much cheaper price (unit cost USD 350-450).

Eight reapers - 4 units of 100 cm model (4GL 100) and 4 units of 120 cm model (4GL 120) - were imported by the project and field tested for *aman* at BARI research field and in the farmers' fields involving service providers, manufacturers, importers, IRRI and other development partners. Testing went well with both the reapers in rice-harvesting, however for taller local varieties, the 4GL 120 model appeared the best. Following the successful field testing and demonstrations, Janata Engineering imported 20 units of 4GL 120 reapers for the *boro* rice and wheat season of 2016, with technical support from CSISA-MI. The 20 reaper units were sold within two weeks of their arrival to eagerly awaiting LSPs. Seeing this market demand, Janata Engineering ordered another 48 reapers for the *aman* rice season of 2016 and plans to order 200 more for the upcoming *boro* rice/wheat season of 2016/7.

Figure 33: Jute harvesting in Jhenaidah by the attachable reaper (modified)

CSISA-MI is also field-testing how these attachable reapers can be used for harvesting other crops such as sesame, jute, and pulses. Sesame was easily harvested, however, jute and lentil had problems, though after some further testing, easy to implement modifications of the attachable reaper have been developed which allowed successful harvesting of jute. These results are expected to expand the potential for business generation opportunities among reaper owning LSPs, by offering a new crop that can be machine harvested.

7 COLLABORATION WITH OTHER USAID PROJECTS AND GOB AGENCIES

Where relevant CSISA-MI actively collaborates with other USAID projects as described below:

7.1 Rice Value Chain (RVC) Project

CSISA-MI has worked closely with the Rice Value Chain (RVC) project led by IRRI by providing agricultural mechanization support for trails and demonstration activities. During the its third year, CSISA-MI and CSISA Phase III lent use of PTOS machines to 48 demonstration plots of Directly Sown Rice (DSR) during *Aus*. The project's reaper machines were also used to support harvest of *Boro* rice demonstration plots planted by the RVC project. These activities have contributed to enhancing the practical knowledge of demonstration collaborating farmers, and of the surrounding community. CSISA-MI staff also supported farmers' trainings on machinery through the RVC project and gave additional orientations. RVC farmers have also come forward to express interest in ongoing and self-elected hiring of LSPs that have developed their skills in collaboration with CSISA-MI.

7.2 Agricultural Inputs Project (AIP)

Along with RVC, CSISA-MI has agreed work directly with the AIP and Agro-Input Retailers Network (AIRN) to conduct trainings on agricultural mechanization. CSISA Phase III is also collaborating with AIRN on large-scale weed management trainings for input dealers, which are anticipated to help LSPs backed by CSISA-MI who are interested in bundling multiple agricultural services (e.g., weed control and mechanization) for sales to farmers. CSISA-MI staff conducted training for 100 AIRN dealers on agricultural machinery supported by the project in June. CIMMYT will also be providing AIP with wheat blast fact sheets to distribute to the AIRN members to create greater awareness on wheat blast disease and its control measures. Though that effort is convened by CSISA Phase III, it is expected to benefit CSISA-MI activities in the coming year by helping to assure the wheat crop.

7.3 Agriculture Extension Project (AEP)

AEP through its work with DAE-AIS has made it possible for a range of CSISA-MI and CSISA Phase III videos, agricultural and agronomy materials to be uploaded onto the DAE- AIS website. These include the following:

1. Poster- Proper use of pesticides
2. 2 pager- Strip tillage
3. Pocket book- Hybrid Maize practices
4. Pocket book- Hybrid Maize-vegetables intercrops production practices
5. 2 pager- Bed planting
6. 2 pager- Conservation agriculture
7. Pamphlet- Better yield of Wheat
8. Video- AFP
9. Video- Reaper
10. Video- PTOS
11. Video- Strip tillage
12. Video- Bed planting
13. Video- Save more, grow more, earn more

The initiative to upload these information on the website has helped create access to the materials for a wider range of professionals, organizations and farmers.

7.4 Women's Empowerment Project (WEP)

CSISA-MI has signed an agreement with the Women's Empowerment Project, led by Winrock International, through which 25 women entrepreneurs interested in agriculture machinery have been trained by CSISA-MI. These events focused on raising women's awareness of innovative agricultural machinery and access to financial services to aid in machinery purchase. These training created awareness and piqued the interest of women in agricultural mechanization and rural business services. CSISA-MI continues to maintain communication with the WEP and trained women by providing information on machines and support for becoming an entrepreneur and local service provider.

7.5 Development Food Assistance Program (DFAP)

CSISA-MI has initiated discussions with DFAP program of World Vision and Winrock International to identify areas/scope for collaboration between the two projects. Both projects are interested to implement collaborative program the future. Further discussion on this topic will appear in the next semi-annual report if collaboration is pursued.

7.6 Collaboration with Government agencies (DAE and BARI)

CSISA-MI works with different government agencies to (1) endorse, promote and technically advice appropriate technologies in agricultural machineries to the farmers (key partners include the Department of Agricultural Extension - DAE) and to (2) conduct research (Bangladesh Agriculture Research Institute -BARI) to evaluate and develop machineries suitable for smallholder farmers and the FtF zone.

CSISA-MI implements project activities in coordination with DAE district and Upazila level offices. DAE officials are well aware of CSISA-MI activities, and informally support and endorse the technologies promoted to the farmers and training programs. CSISA-MI also delivers trainings to DAE front-line staff (SAAOs) on agricultural machineries and resource conserving production practices. CSISA-MI hub offices also closely participate in DAE activities (agricultural fairs) and support the government's project such as the Farm Mechanization Project (see earlier sections on subsidy programs and public sector support).

CSISA-MI also signed a sub-grant agreement with BARI's On-Farm Research & Development (OFRD) in year three, the purpose of which is to conduct applied research, demonstration and trials on project supported agricultural machinery in Faridpur. CSISA-MI is implementing activities to establish three 'mechanization villages; through OFRD in this capacity. In addition, project staff participate in BARI events like demonstration and farmers' field days. CSISA-MI al also provides machinery support to the BARI demonstration plots to reach larger numbers of farmers.

7.7 The Blue Gold project:

CSISA-MI project has also initiated collaboration with the Blue Gold Project in Barisal. Blue Gold is a collaboration program between the Governments of the Netherlands and Bangladesh. The program is implemented by the Ministry of Water Resources, through Bangladesh Water Development Board (BWDB, lead agency) and the Department of Agricultural Extension (DAE). As a part of CSISA-MI's collaborative work with DAE, CSISA-MI is providing technical support to the Blue-Gold project. For example, CSISA-MI has provided PTOS machines support to establish two demonstration plots for mung bean within the Blue Gold's farmer field school programs. Blue Gold project organized visit for more than 100 farmers from different areas to the demonstrations. 20 of these farmers have expressed interest to buy the seeder machine and five have already decided to buy machine in the upcoming season. CSISA-MI is now working to assure that this is made possible.

Cereal Systems Initiative for South Asia – Mechanization and Irrigation Project (CSISA-MI)

ANNEXES to the Annual Report (October 15 to September 16)

October 2016

Submitted to
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Submitted by
International maize and Wheat Improvement Center (CIMMYT)
with assistance from
International Development Enterprises (iDE)

Table of Contents

1. Success Stories

USAID
FROM THE AMERICAN PEOPLE

FIRST PERSON
Aquaculture Irrigation Changing Pace

Efficient Irrigation technology is likely to overhaul traditional pumps in Keshabpur, Jessore

— Md. Delowar Hossain (Rasel), 38, in front of his AFPs stored for next season

"An intense promotional campaign will help to sell 800 AFPs in this upazila only," *says Rasel.*

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.

Since entering into fish production in Keshobpur, Jessore, in 2007 Md. Delowar Hossain's (Rasel) output of fresh and saltwater fish has been growing each year. Rasel's fish enclosures cover around 200 hectares of land where his operations have been running with 25 traditional centrifugal low-lift pumps.

Rasel visited the RFL showroom to see the company's new product, the Axial Flow Pump (AFP) after getting an invitation from field officers of the USAID funded *Cereal Systems Initiative for South Asia Mechanization and Irrigation* (CSISA-MI) project, part of President Obama's Feed the Future (FtF) Initiative. Through a public-private partnership between the Government of Bangladesh and RFL facilitated by CSISA-MI, AFPs have been introduced into Bangladesh as a new surface water irrigation technology for agriculture. Now fish enclosure owners are starting to realize the potential of AFPs for their operations.

Rasel was impressed by the design of the AFP and bought four 5- inch diameter AFPs. Through personal trials, Rasel discovered that he is able to run the four AFPs with only one 12 horsepower engine, compared to only one in the case of his centrifugal pumps (he used the other side of the pulley of each AFP to attach and run the next one). This innovation means that Rasel can save around BDT 250 (US $3) for each hour that he uses the fuel efficient AFPs instead of the centrifugal pumps. Last season Rasel did not need to hire any additional pumps other than the ones he owns. This has reduced his overhead costs as he could save money on pump hiring fees, operator's fees and fuel costs.

Rasel has seen positive changes in the conditions of his workers. Using AFPs they have now less operational problems as well than using the centrifugal pumps. "If workers have to go to the fish enclosures in middle of night to get into waist deep water to check pumps, they suffer because of the chilling winter season, but with AFPs these operational problems have decreased and they are more beneficial for workers."

Rasel leases the land for his fish enclosures from paddy famers. Part of this agreement is that land will be dewatered for planting paddy seedlings by December each year. Using centrifugal pumps to meet this deadline has caused problems for Rasel due to the pumps comparatively low volume water discharge and more frequent operational problems. This year Rasel is planning to use the AFPs in his fish enclosures to benefit both his workers and paddy farmers.

In the next season, Rasel expects to increase his enclosures by nearly 15 hectares and is excited about using AFPs to assist in this extension. Already, two other fish enclosure owners in the area have begun using AFPs, and Rasel envisions a large scale overhaul of traditional pumps in favor of the more efficient AFPs in this fish producing district.

CIMMYT
International Maize and Wheat Improvement Center

iDE

FIRST PERSON

Laharhat fallow no more

The riverine char is now producing crops throughout the year. During the 2015 dry season, 23.43 ha area of Laharhat have been brought under wheat cultivation.

Photo: FAISAL/CSISA-MI

'This year we saw the miracle. I did not even imagine that this land can produce more. And the wheat grew well here.'

-Mr. Nantu Hawlader, a farmer.

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.

Laharhat is a riverine char situated in Tungibari union of Barisal Sadar Upazila under Barisal district. The triangular shaped char is 22 km away from Barisal town. The char is aged about 50 years with sandy loam soils. It does not have any homesteads yet land owners from the surrounding have started to produce more crops there.

'We always thought one crop is enough for Laharhat. We never thought it would be possible to grow a second crop there,' Mr. Enayat Hawlader, a farmer said.

Earlier farmers used to grow only one crop on the char during the *Aman* season (November-December). In very few cases some of them used to grow lentil crops and for much of the rest of the year the vast land on the char would remain fallow. Mr. Habib Mollik, another farmer said, 'We used to grow one crop throughout the year. We used to think this char has no capacity to grow more.'

However, things changed when new technologies were introduced to the char under USAID funded *Cereal Systems Initiative for South Asia- Mechanization and Irrigation* (CSISA-MI) project. Mr. Md. Washiq Faisal, Agriculture and Machinery Development Officer of CSISA-MI project, CIMMYT, says 'this year we proved that the vast char land of Laharhat could be properly utilized to produce crops'.

Faisal explains that during 2011-12, the Bangladesh Agricultural Research Institute (BARI) started adaptive trials of wheat in Laharhat. During the *Robi* (winter) season in 2013 CSISA-MI started operating in the area. The project worked with 12 farmers initially to practice mechanization to improve yields. It introduced PTOS (power tiller operated seeder) in the demonstartion plots which achieved improved yields and demonstrated the potential of the land. The farmers who came to visit the harvesting of wheat with the multi-crop reaper further saw the potential to cultivate their fields in coming seasons.

In March 2015, during the harvesting of wheat with reaper, more enthusiastic farmers came to see the results. They were amazed to see nearly four tons per hectare yields. A farmer named Motlof Mollah said, 'next year I also will use PTOS in my land to grow wheat.'

Mr. Monirul Alam, District Training Officer, DAE (Dept. of Agricultural Extension) said, 'I am so happy to see the smiling Laharhat farmers and wish to see next year the whole Laharhat producing wheat after Aman rice. The land is appropriate for wheat as a second crop.' He added, 'Farmers which switch from traditional legumes to growing wheat are increasing their profit margins. If they continue to adopt new technologies like PTOS, Axial Flow Pump (AFP) and the Reaper, Laharhat will be fallow no more in the future.'

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SUCCESS STORY
Farmers Rooting for Mechanization

Days of manual cultivation gradually coming to an end in Bangladesh

Photo: SHRINCSISA-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

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.

Bangladesh's agricultural mechanization system is perhaps unique in that many machinery owners also operate as service providers for local small-holder farmers. Md. Najrul (23) is one such farmer 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 most excited about the *Axial Flow Pump* (AFP) he bought from RFL in February 2014. Imported and marketed by RFL as the *Jumbo Pump*, 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), AFPs give 2WT owners business opportunities during the dry season.

Najrul learned about the AFP from a demonstration event organized by CSISA-MI (*Cereal Systems Initiative in South Asia – Mechanization and Irrigation* project) in his area. He explains, "I was attracted by its high flow rate and prompted to buy within few days of the event. The AFP costs me only BDT 16,000 (US$ 206)." In comparison to his other traditional centrifugal pump, Najrul says, "the AFP consumes less fuel. In two and half months, it saved me around 200 liters of fuel which would normally cost me around BDT 14,000 (US$ 181)."

The pump discharges water as soon as the engine starts and a single person can run and maintain it, "which saves the cost of hiring another laborer", 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 10 hectares of land belonging to over 150 farmers." As a result of all these benefits, Najrul and two other service providers have already ordered three more AFPs for next season.

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." Considering this demand, this year CSISA-MI is piloting rice trans-planters in one of its working areas and has already undertaken the initial market survey on related manufacturing companies.

Funded by USAID, the CSISA-MI Project – part of President Obama's Feed the Future (FtF) Initiative – is facilitating the market promotion of fuel efficient and labor-saving agricultural machines.

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SUCCESS STORY
Reaping success of a 'costly' deal

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

- 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

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As an experienced agricultural service provider, Mohammad Rafiqul Islam, 53, of Kalukhali Upazila, Rajbari was keen to minimize labor expenses in order to accelerate his business. Months back, he saw a cropping device in a neighboring village which led him to purchase a similar type of machine. Imported and marketed by ACI, the 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.

In Kalukhali, farmers mostly cultivate paddy, which requires engaging a large labor force in order to harvest the crop. Previously Rafiqul would hire 10 laborers for around two weeks to harvest 3.57 hectares of land. It cost him around BDT 102,000 (US$ 1,303). "In the beginning, my family members were against the investment of BDT 185,000 (US$ 2363) for purchasing this machine" said Rafiqul. "They told me this will be a 'costly deal'" he added.

However, the Reaper allowed him to harvest his 3.57 hectares of land in less than two weeks. He added, "the cost for hiring a machine operator and purchasing fuel was BDT 457 (US$ 5.84) per day that allowed me to save around BDT 95,602 (US$ 1234) from cropping only. In addition to this, providing services for around two more hectares of land in one more week brought me BDT 5,928 (US$ 75.72) from the service charge of BDT 1,200 (US$ 15.33) per 0.4 hectares of land to harvest with the Reaper."

The benefits extend beyond the farm however, making home life more comfortable. "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 to rest in the evenings which is the first time in last 30 years!" laughed Rafiqul's wife Shirin Sultana, 42, who originally opposed the decision to invest in the machine.

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.

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FIRST PERSON
Farmers Picking Value over Tradition

Farmers impressed with benefits of upgrading traditional agricultural machines

Photo: MIA KEY-CHRONICLE/CSISA-MI

— Abdur Rahman, 82, with his Seeder Fertiliser Drill (SFD) machine

"With this machine (SFD), you can do four things at one go and so, you are saving your time in four ways," *says Abdur.*

Since his childhood Mr. Md. Abdur Rahman, now aged 82, has been fascinated by machines. As a farmer and fish enclosure owner in Jhikorgacha Jessore, Abdur has always looked for ways to improve the efficiency of his farming operation. An opportunity arose when field staff of the USAID funded *Cereal Systems Initiatives for South Asia – Mechanization and Irrigation* (CSISA-MI) project, part of President Obama's Feed the Future (FtF) Initiative, invited Abdur to attend a machinery demonstration event.

During February 2015, Abdur was invited to the demonstration event where he met representatives of machinery importer RFL who are introducing the Seeder Fertilizer Drill (SFD) into the Bangladeshi agriculture sector. The SFD impressed Abdur greatly as it is attachable to his two-wheel tractor and can simultaneously till, plant, and fertilize crops in lines with greater precision and energy efficiency. He paid BDT 35,700 (US $463) to RFL for the SFD. Using the machine has helped him realize clear benefits. "I can now save over BDT 5,400 (US $70) per season by tilling, seeding, fertilizing and leveling my 10.7 hectares of land with this SFD machine," says Abdur. In addition to this he is making money by selling services to farmers nearby.

Being an avid innovator of machinery, Abdur is also working to improve the machinery. He collaborated with CSISA-MI field staff to extend the performance of his SFD by adapting the metal work under the seed box to control dirt from clogging the chain and infiltrating the seed box during use.

Abdur has been so impressed by the versatility of the SFD that he decided to buy another product from the RFL product range, the Axial Flow Pump (AFP) for his fish enclosure business. After visiting other AFP owners with the CSISA-MI team, Abdur bought an AFP for BDT 10,830 (US $140). The AFP is an inexpensive surface water irrigation technology that reduces irrigation costs by pumping water at lower pressures and higher flow rates than traditional centrifugal pumps. "With the traditional centrifugal pump dewatering my 1.07 hectare enclosure takes 15 days and uses 25-30 liters of fuel which costs BDT 1,750 - 2,100 (US $22-27). The AFP dewatered the pond in 7 days and used only 20 liters of fuel, saving between BDT 350 - 700 (US $4.50-9)," notes Abdur.

Abdur says, "The traditional pump takes more time to dewater than the AFP. For early monsoon arrival I would not have time to dewater the pond before starting cultivation for the next season but as the AFP dewaters my pond quicker than this is no longer a problem."

CSISA-MI facilitates the commercialization of efficient agricultural technologies, in collaboration of private and public sector stakeholders, through service provision models in southern Bangladesh.

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2. Print and electronic media coverage of the CSISA-MI Project

List of media coverage

Sl no.	Date	Name	Remarks
01	11.11.15	Vorer Prottasha	Local
02	19.11.15	Nabachitra	Local
03	20.11.15	Agrilife24.com	Online
04	24.11.15	Ajker Poriborton	Local
05	24.11.15	Banglar Kontho	Local
06	24.11.15	Bhorer Alo	Local
07	24.11.15	Bhorer Ongikar	Local
08	09.12.15	Bahumatrik.com	Online
09	11.12.15	Rapidprnews.com	Online
10	17.12.15	Newsbangladesh.com	Online
11	23.12.15	Ajker Bhola	Local
12	23.12.15	Banglar Kontho	Local
13	23.12.15	Barisal Protidin	Local
14	23.12.15	Daily Shahanama	Local
15	24.12.15	Banglar Bone	Local
16	27.12.15	Ajker Bhola	Local
17	27.12.15	Barisal Protidin	Local
18	27.12.15	Bhorer Alo	Local
19	27.12.15	Poriborton	Local
20	08.01.16	Daily Jaijaidin	National
21	30.01.16	Shokaler Khobor	National
22	11.02.16	Prothom Alo	National
23	18.02.16	Channel I	National TV Channel
24	22.02.16	Desh TV	National TV Channel
25	07.03.16	Banglanews24.com	National
26	08.03.16	The Daily Star	National
27	08.03.16	The Daily Sun	National
28	09.03.16	ATN Bangla	National TV Channel
29	14.03.16	Shongbad	National
30	08.04.16	Daily Motobad	Local
31	08.01.16	Daily Noapara	Local
32	08.01.16	Daily Samajer Kotha	Local
33	08.01.16	Daily Jai Jai Din	National
34	13.04.16	Daily Star	National
35	14.01.16	Daily Noapara	Local
36	14.01.16	Daily Bangler khobor	Local
37	14.01.16	Daily Dristipat	Local
38	14.01.16	Daily Gramer Kagoj	Local
39	14.01.16	Daily Jessore	Local
40	20.01.16	Ekushey sangbad	Online
41	20.01.16	Gnews24	Online
42	20.01.16	Somokal24	Online
43	20.01.16	Daily Samajer kotha	Local
44	21.01.16	Dainik Onirban	Local
45	21.01.16	Dainik Probaha	Local
46	21.01.16	Kaler chitra	Local
47	21.01.16	Somajer Kagoj	Local
48	21.01.16	Uniquenews24	Online
49	24.01.16	Khedmot	Local
50	24.01.16	Spondon	Local
51	29.01.16	Daily Desh Shingjog	Local
52	30.01.16	Newssonarbangla	Online
53	30.01.16	Daily Gramer Kagoj	Local
54	30.01.16	Daily Projonmer Vabna	Local
55	30.01.16	Shokaler Khobor	National
56	10.02.16	Annesha	Online
57	10.02.16	Banglanews24	Online

58	11.02.16	Dainik Dristipat	Local
59	11.02.16	Daily Alokito Sangbad	Local
60	11.02.16	Daily Jessoe	Local
61	12.02.16	Alokito sangbad	Local
62	12.02.16	Dainik Probaho	Local
63	12.02.16	Omoyer Khobor	Local
64	12.02.16	Dainik Dristipat	Local
65	16.02.16	Daily Mathavanga	Local
66	16.02.16	Daily Notun Khobor	Local
67	17.02.16	Projonmer Vabna	Local
68	17.02.16	Woman voice	Local
69	18.02.16	Dainik Onirban	Local
70	18.02.16	Dainik Jessore	Local
71	18.02.16	Juger Barta	Local
72	18.02.16	Kaler Chitra	Local
73	18.02.16	Daily Nobochitro	Local
74	18.02.16	Daily Projonmer Vabna	Local
75	19.02.16	Dainik Nobochitra	Local
76	19.02.16	Gramer Kagoj	Local
77	19.02.16	Narikontho	Local
78	19.02.16	Projonmer Vabna	Local
79	20.02.16	Projonmer Vabna	Local
80	23.02.16	Dristipat	Local
81	26.02.16	Daily Khulnanchal	Local
82	26.02.16	Daily Noapara	Local
83	26.02.16	Daily Prabaha	Local
84	26.02.16	Daily Proborton	Local
85	26.02.16	Dainik Potrodut	Local
86	27.02.16	Daily Jonmovumi	Local
87	27.02.16	Daily Khulnanchal	Local
88	27.02.16	Daily Proborton	Local
89	27.02.16	Daily Samajer Kotha	Local
90	27.02.16	Daily Spondon	Local
91	27.02.16	Daily Noapara	Local
92	27.02.16	Projonmer Vabna	Local
93	11.03.16	Projonmer Vabna	Local
94	11.03.16	Daily Sotyopath	Local
95	12.03.16	Nobochetona	Local
96	01.04.16	Daily Ajkaler Khobor	Local
97	01.04.16	Daily Jessore	Local
98	02.04.16	Daily Samajer Kagoj	Local
99	03.04.16	Weekly BD Khobor	Local
100	24.02.16	Patrodut	Local
101	16.05.16	Projonmer Vabna	Local
102	16.05.16	Shomajer Kotha	Local
103	16.05.16	Shotyopath	Local
104	19.05.16	Daily Shotyo Sangbad	Local
105	19.05.16	Daily Kirtonkhola	Local
106	20.05.16	Doinik Jessore	Local
107	20.05.16	Doinik Noapara	Local
108	26.05.16	Daily Shotyo Sangbad	Local
109	26.05.16	Doinik Noapara	Local
110	28.05.16	Daily Bhorer Daak	Local
111	29.05.16	Doinik Kolyan	Local
112	31.05.16	Shorboshesh Shongbad	Online
113	01.06.16	Daily Kirtonkhola	Local
114	02.06.16	Dokshinanchol	Local
115	02.06.16	Doinik Matrikontho	Local
116	02.06.16	Rajbarikontho	Local
117	04.06.16	Daily Kafela	Local
118	04.06.16	Daxiner Moshal	Local

119	04.06.16	Juger Barta	Local
120	04.06.16	Kaler Chitra	Local
121	04.06.16	Potrodut	Local
122	04.06.16	Doxiner Moshal	Local
123	04.06.16	Juger Barta	Local
124	04.06.16	Kafela	Local
125	04.06.16	Kaler Chitra	Local
126	04.06.16	Doinik Potrodut	Local
127	09.06.16	Shomajer Kotha	Local
128	09.06.16	Shotyopath	Local
129	09.06.16	Spondon	Local
130	18.06.16	Daily Shomajer Kagoj	Local
131	18.06.16	Daily Alokito Shongbad	Local
132	18.06.16	Daily Jessore	Local
133	18.06.16	Shonali Khobor	Local
134	19.06.16	Bhorer Prottasha	Local
135	21.06.16	Daily Jessore	Local
136	21.06.16	Daily Kolyan	Local
137	21.06.16	Daily Noapara	Local
138	21.06.16	Channel I	TV Channel
139	24.06.16	Daily Kolyan	Local
140	24.06.16	Bhorer Prottasha	Local
141	25.06.16	Daily Jessore	Local
142	25.06.16	Daily Noapara	Local
143	27.06.16	Gramer Shongbad	Local
144	27.06.16	Bangladeshbani24.com	Online
145	28.06.16	Daily Alokito Shongbad	Local
146	28.06.16	Daily Jessore	Local
147	28.06.16	Daily Samajer Kagoj	Local
148	30.06.16	Potrodut	Local
149	30.06.16	Daily Probaho	Local
150	30.06.16	Daily Proborton	Local
151	21.07.16	MyTV	National TV Channel
152	22.07.16	Bangladesh Betar FM 105	National Radio
153	26.07.16	Ekattor News	National TV Channel
154	26.07.16	ATN Bangla	National TV Channel
155	26.07.16	Channel I	National TV Channel
156	27.07.16	Daily Banglar Khobor	Local
157	27.07.16	Daily Jessore	Local
158	27.07.16	Daily Narikontho	Local
159	27.07.16	Daily Somajer Kagoj	Local
160	27.07.16	Proborton	Local
161	27.07.16	Probaho	Local
162	27.07.16	Daily Mathavanga	Local
163	27.07.16	Daily Somoyer Somikoron	Local
164	27.07.16	Ajker Bhola	Local
165	27.07.16	Bhola Times	Local
166	27.07.16	Dokshinanchol	Local
167	27.07.16	Poriborton	Local
168	27.07.16	Bhorer Alo	Local
169	28.07.16	Daily Ajkal	Local
170	28.07.16	Bangler Kontho	Local
171	28.07.16	Daily Motobad	Local
172	28.07.16	Doinik Kustia	Local
173	30.07.16	News3Live	Local Online
174	01.08.16	Doinik Kustia	Local
175	01.08.16	Dailymujibnagarnews	Local Online
176	02.08.16	Akash Khobor	Local
177	04.08.16	News3Live	Local Online
178	16.08.16	Mati-O-Manush	BTV
179	23.08.16	Daily Matrikontho	Local

180	23.08.16	Rajbarikontho	Local
181	31.08.16	Monthly Krishibiplob	Local
182	31.08.16	71 News	National TV Channel
183	06.09.16	Daily Barisal	Local
184	06.09.16	Daily Motobad	Local
185	07.09.16	AIS	Online
186	08.09.16	Bangler Kontho	Local
187	08.09.16	Bhola Times	Local
188	08.09.16	Channel I	National TV Channel
189	21.09.16	Ajker Bhola	Local
190	21.09.16	Bhola Times	Local
191	21.09.16	Dokshinanchol	Local
192	21.09.16	Daily Prothom Alo	National News Paper
193	21.09.16	Bangladesh Betar FM 105	National Radio

3. Scale-appropriate machinery promotional materials used by CSISA-MI and its private sector partners

Billboards:

ACI Reaper Leaflet

Reaper Festoon

ACI pen

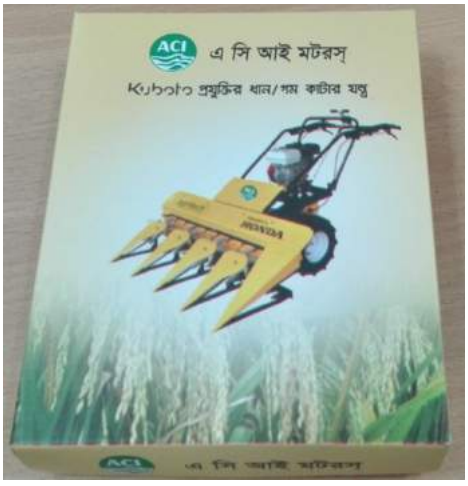
Janata Engineering T-shirt

ACI pen and key ring

Janata Cap

Janat

Aleem Industries Ltd. Keyring



Janata sticker

Backdrop

4. DAE and CSISA-MI led Appropriate Mechanization Workshop for Smallholders in Bangladesh – Agenda

Agenda Objectives:

1. Bangladesh and Ag mechanization: identify what is and is not working.
   a. Public and Private sector to share experiences, knowledge and relevant activities on commercial farm mechanization.
   b. Share ideas about best ways to advance commercial mechanization in Bangladesh.
2. Strengthen public-private partnerships.
3. Identify common areas of interest, concern and strengthen areas for potential collaboration.
4. Provide an opportunity among the key stakeholders to interact and build a network for the benefit of the farm and agriculture community.

Tentative schedule:

Date: 24October 2016 **Venue:** BARC Conference room 1, Farmgate, Dhaka

Program Schedule

Time	Activity	Resource person
09.30 – 10.00 am	Registration	
10.00 – 10.05 am	Welcome address and objective sharing	Sheikh Md. Nazim Uddin, Project Director, FM, DAE
10.05 - 10.10 am	Welcome address	Timothy J. Krupnik, Project Leader, CSISA-MI, CIMMYT-Bangladesh, Bangladesh CSISA Country Coordinator
10.10 - 10.20 am	Overview on agricultural mechanization in Bangladesh	Dr. M. A. Sattar Mandal, Former VC, BAU and former member, Planning Commission
10.20 - 10.30 am	Voices from the field	A Local Service Provider
10.30 – 10.40 am	Speech by the Special Guest	Kbd. Dr. Md. AbulKalam Azad, Executive Chairman, BARC
10.40 – 10.50 am	Speech by the Chief Guest	Md. Mosharaf Hossain, Additional Secretary, Extension wing, Ministry of Agriculture
10.50 – 11.00 am	Speech by the Chair	Kbd. Md. Hamidur Rahman, Director General, DAE
11.00 – 11.20 am	Tea-break	
11.20 – 11.25 am	Technical session's Chair	Dr. M. A. Sattar Mandal
11.25 – 11.40 am	Presentation on 'Research on agricultural machinery: Experience and challenges in the field'	Dr. Md. Israil Hossain, CSO, FMPED, BARI
11.40 am – 11.55 pm	Presentation on 'Research on agricultural machinery: Experience and challenges in the field'	Dr. Md. Abdur Rahman, CSO, FMPHTD, BRRI
11.55– 12.10 pm	Presentation on 'Machines' demonstration to the field: Challenges and way out'	Sheikh Md. Nazim Uddin, PD, FM, DAE
12.10 – 12.25 pm	Presentation on 'Scaling up agricultural mechanization: CSISA-MI experience'	Timothy J. Krupnik and Kevin Robbins, Director of Programs, iDE
12.25 – 12.40 pm	Presentation on 'Manufacturers of agricultural machinery: Constraints and opportunities'	Md. Alimul Ehsan, MD, Alim Industries Limited on behalf of AMAB
12.40 – 01.00 pm	Presentation on 'Import and distribution of agricultural machinery: Experience and strategies'	Mr. Subrata Ranjan Das, ACI Motors Limited, on behalf of importers.
01.00 – 02.00 pm	Lunch & prayer break	
02.00 – 02.30 pm	Experience & learning sharing	- Dealer - Local workshop owner/Mechanics - LSP
02.30 – 03.10 pm	Open discussion	Participants
03.10 - 03.25 pm	Remarks	Distinguished representatives from different organizations
03.25 – 03.40 pm	Tea while watching video documentary	
03.40 – 03.55	Closing remarks by the Technical session Chair	Dr. M. A. Sattar Mandal

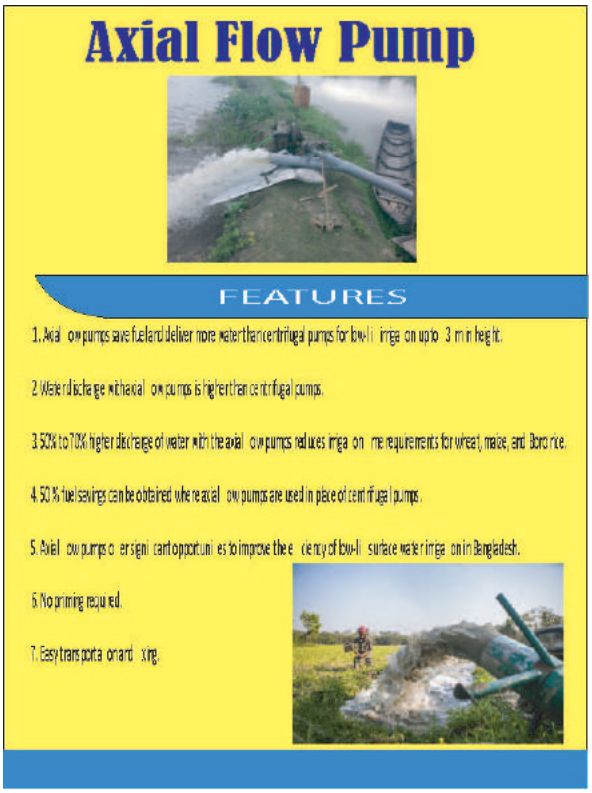
pm		

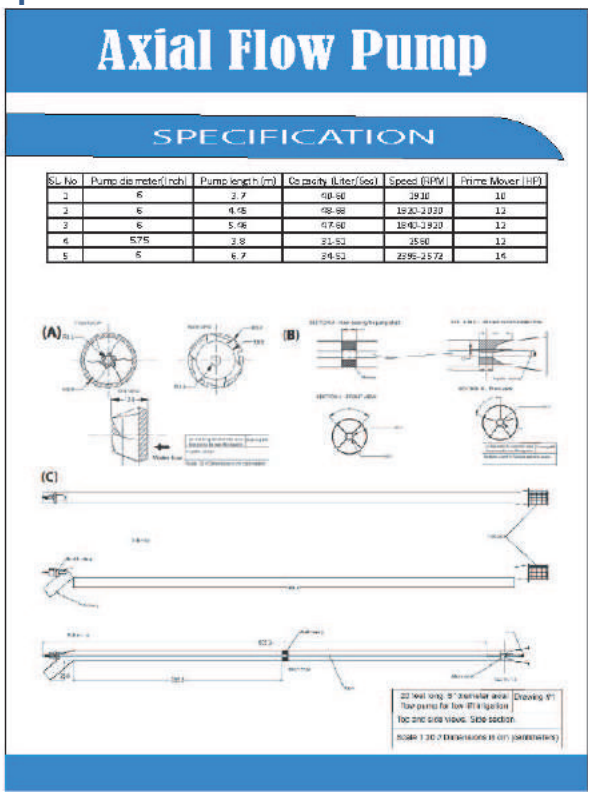
5. List of Market Studies and Market Facilitation reports carried out during CSISA-MI's third year

No	Name of Study/Report[1]	Purpose of study	Conducted by	Submitted on
1	CSISA MI Project: IVR Campaign Implementation Recommendations for Future Interactive Telemarketing Campaigns	•1: To sustainably intensify and diversify agricultural production in Southern Bangladesh through surface water irrigation to increase household income; •2: To sustainably transform agriculture in Southern Bangladesh through broad-based access to agricultural mechanization services; and •3: To develop new models for public and private institutions to support irrigation and agricultural mechanization in Southern Bangladesh.	Brand Results, Expressions Ltd, House 10A | Road 25A | Block A Banani | Dhaka 1213 | Bangladesh Telephone : (8802) 550 33840,	10 November 2015
2	Completion Report for CSISA-MI: Marketing Implementation campaign	Haat Activation – 150 video show event	SpotLight Event Management Ltd Plot 180, Block B, Bashndhara R/A, Dhaka 1229	14 June 2016
3	CSISA-MI Billboard Activation Report	Billboard display and observers viewing billboards	SpotLight Event Management Ltd Plot 180, Block B, Bashndhara R/A, Dhaka 1229	3rd August 2016
4	Market Study: Agricultural Machinery in Southern Bangladesh for the CSISA-MI Project Final Report	To (1) calculate the potential market demand for the PTOS, AFP and reaper, (2) retrospectively calculate the baseline scenario of PTOS, AFP and reaper markets and (3) assess the socio-economic characteristics of early adopters	ADI House # 817; Rd # 04; Baitul Aman Housing Adabor, Dhaka – 1207 Cell: 88-01712-918342, 01972-918342 T&T:+88-02-8190747	June 2016
5	CSISA-MI Reaper Deep Dive Insights Deck	The focus of the Deep Dive was to assess the existing market system of the reaper after three years of CSISA-MI interventions in those areas. The deep dive was conducted over three phases between November, 2015 and May 2016	iDE- Bangladesh	July 2016

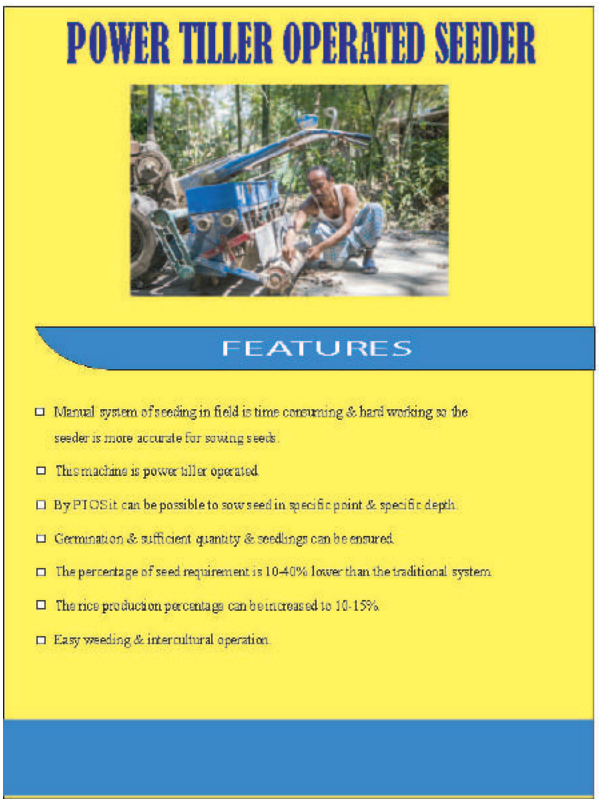
[1] Reports will be made available on request

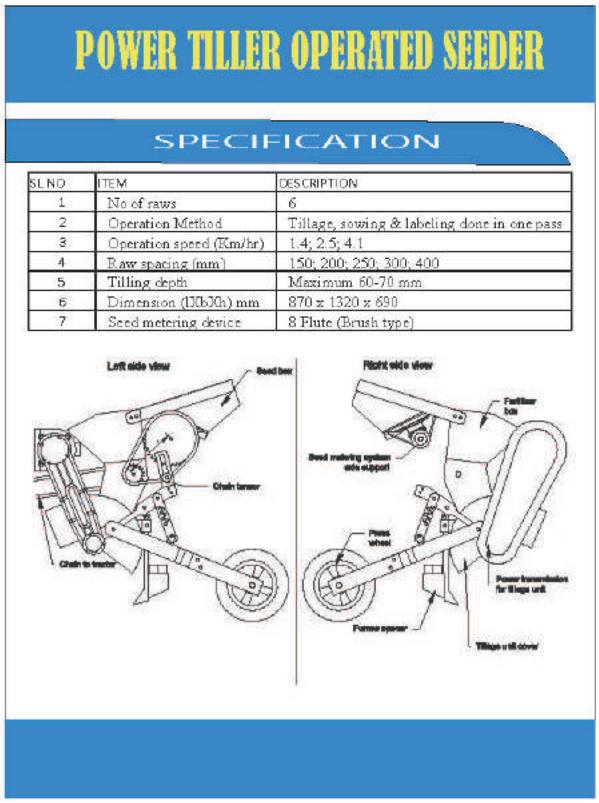
6. Creative brief on Axial Flow Pumps





7. Creative brief – PTOS





SL NO	ITEM	DESCRIPTION
1	No of raws	6
2	Operation Method	Tillage, sowing & labeling done in one pass
3	Operation speed (Km/hr)	1.4; 2.5; 4.1
4	Raw spacing (mm)	150; 200; 250; 300; 400
5	Tilling depth	Maximum 60-70 mm
6	Dimension (LXbXh) mm	870 x 1320 x 690
7	Seed metering device	8 Flute (Brush type)

8. Creative brief – Reaper

FEATURES

01. Manpower Problem will be Solved
02. Able to Cut More Crops in Less Time
03. Crop Conservation is possible in Digester by reaping crop in short time duration.
04. No Loss Occur when Cutting Crops
05. Production Cost is Minimum for using Patrol

SPECIAL FEATURES

01. Able to reap 120 cm or 6 row paddy at a time
02. Able to reap 1 acre or 100 decimal crop in 1 hr 24 min and the cost is 1.5 liter approx.
03. It's a light weight machine because of its patrol engine. So suitable for any kind of crop field.
04. Easy to operate. So, extra training is not needed.

REAPER

SPECIFICATION

SL. NO	Item		Description
1	Crop		Rice and Wheat
2	Reaping Power		80-90 Decimal/Hr
3	Cutting width		120 CM
4	Row		6 row
5	Engine	Type	4 Stroke, Air cooled
		Starting	Recoil
		Fuel	Petrol
6	Transmission	Clutch	Dog clutch
7	Weight		150-175 KG

COST COMPARE

Item	By Rice Reaper	By Traditional System
Labour	1 person	9 person
Time	1 hour 24 min	8 hrs
Cost	Tk. 335 (Labour-100 + Patrol-200 + Depriciation-35)	Tk. 1800 (Labour-200x9)

9. Market size calculation for Reaper, PTOS and AFP

As the PTOS, AFP and reaper all are relatively new technology in Bangladesh, no comprehensive study was found that accurately replicated the business models and contexts of the respective machines within the FtF zone given the lessons learned by the project in Years 1-3. The CSISA-MI team had to improvise and collect data from various sources and combine them to create a data context suitable for each machine to accurately reflect social, economic and agronomic potential. Based on this data, the market size was calculated.

A two-step process was used in calculating the market sizes for PTOS, reaper and AFP. The first step was to collect Upazila wise quantitative data on actual hectare coverage of different suitable crops for the three types of machines. Data sets were gathered from CIMMYT's Map Explorer, Bangladesh Bureau of Statistics (BBS), Bangladesh Integrated Household Survey (BIHS) and the Department of Fisheries. Data sets were organized to reflect each machine's business model (e.g. PTOS cultivating onion, wheat and jute).

The second step involved the field work to counter or validate the data sets to accurately reflect the context of the respective areas. The rationale of using a subjective reasoning was to take into consideration the unique agronomic conditions and practices of each Upazila and how the three machines were used in that context.

The refined hectare coverage of suitable crops represented the ceiling amount that a machine could service in a particular area. To convert this serviceable area into the maximum number of machines in the market, the team took an average number of hectares covered by each machine based on 3 years of hectare coverage data provided by CIMMYT:

AFP: 19 hectares per machine per year for Boro, 5 hectares per machine per year for Gher
PTOS: 22 hectares per machine per year for all crops
Reaper: 22 hectares per machine per year for all crops

The following table highlights the factors considered for each machine and their respective sources:

	Factors	Source
AFP	Surface Water	CIMMYT Map Explorer
	Canal	BBS
	Boro	CIMMYT Map Explorer and iDE Field Team
	Gher	Department of Fisheries
	Watermelon	BBS
	3 meter head	CSISA-MI Field Teams
	Water salinity	CSISA-MI Field Teams
	Soil salinity	CSISA-MI Field Teams
PTOS	Soil hardness and type	CSISA-MI Field Teams
	Rabi crops: onion, wheat, mustard, mungbean, lentil	BBS
	Kharif crops: jute	BBS
	Number of power tillers	The numbers exceeded maximum envelope. Good indicator of early adoption but not of market size.
Reaper	Wheat	BBS
	Boro	BBS
	Aman	BBS
	Water level during reaping (high vs low land)	CSISA-MI Field Teams

	Bichali practice	CSISA-MI Field Teams

10. Preliminary results of market size assessment by method and district

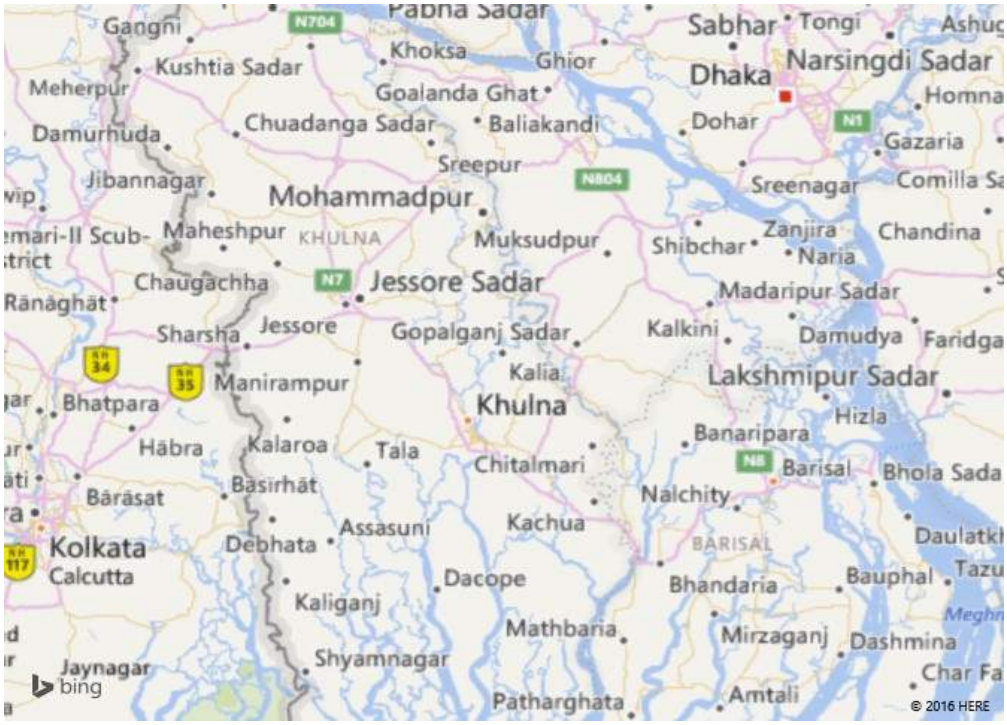
FTF Districts	AFP Market Size Estimate	AFP - Potential Private Sector Investment at MRP (USD)	PTOS Market Size Estimate	PTOS - Potential Private Sector Investment at MRP (USD)	Reaper Market Size Estimate	SPR - Potential Private Sector Investment at MRP (USD)	PTOR - Potential Private Sector Investment at MRP (USD)
Bagerhat	1391	315,731	79	55,802	715	1,557,776	504,166
Barguna	13	3,004	137	96,768	618	1,347,319	435,769
Barisal	**3298**	**748,502**	265	187,053	545	1,187,127	384,294
Bhola	**1948**	**442,082**	762	536,978	**2649**	**5,774,452**	**1,867,885**
Chuadanga	18	4,191	1029	725,618	290	631,649	204,487
Faridpur	0	0	**2433**	**1,715,862**	1339	2,918,573	944,167
Gopalganj	**1788**	**405,780**	876	617,557	1511	3,293,721	1,065,449
Jessore	820	186,120	1530	1,078,771	1585	3,453,998	1,117,628
Jhalokati	463	105,077	20	14,257	164	357,535	115,641
Jhenaidah	122	27,591	1222	861,659	1051	2,290,850	741,090
Khulna	596	135,356	131	92,388	516	1,124,277	363,846
Madaripur	828	187,932	1173	827,181	725	1,579,367	511,218
Magura	157	35,618	**2129**	**1,501,266**	522	1,138,771	368,077
Meherpur	0	0	1430	1,008,407	582	1,267,378	410,385
Narail	693	157,275	409	288,662	941	2,050,330	663,526
Patuakhali	1038	235,553	152	107,466	**2079**	**4,530,203**	**1,465,962**
Pirojpur	755	171,409	44	31,323	116	252,610	81,795
Rajbari	0	0	**1899**	**1,339,241**	513	1,118,560	361,731
Satkhira	708	160,579	497	350,638	**1598**	**3,483,150**	**1,126,795**
Shariatpur	541	122,777	1164	820,793	133	288,924	93,782
Total	**15179**	**3,444,579**	**17384**	**12,257,691**	**18191**	**39,646,572**	**12,827,692**

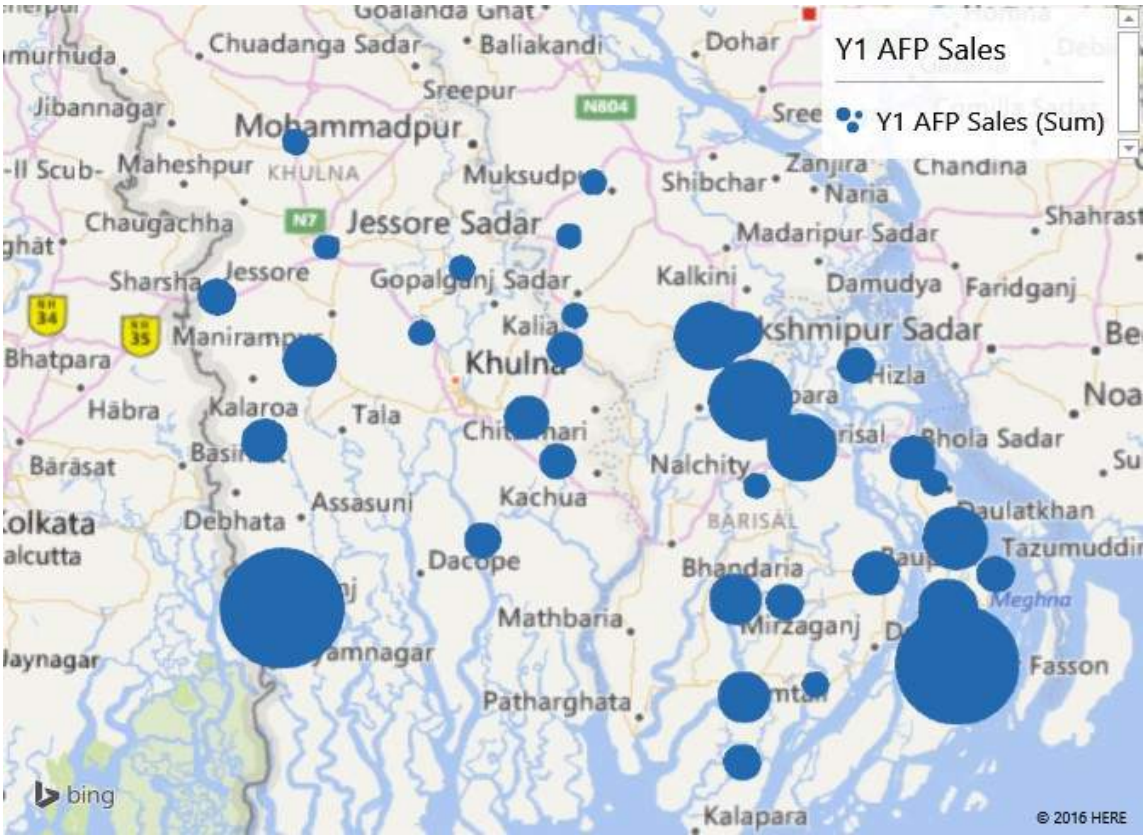
** top three as per machine and investment are highlighted : grey for AFP, blue for PTOS; green for Reaper and purple for PTOR*

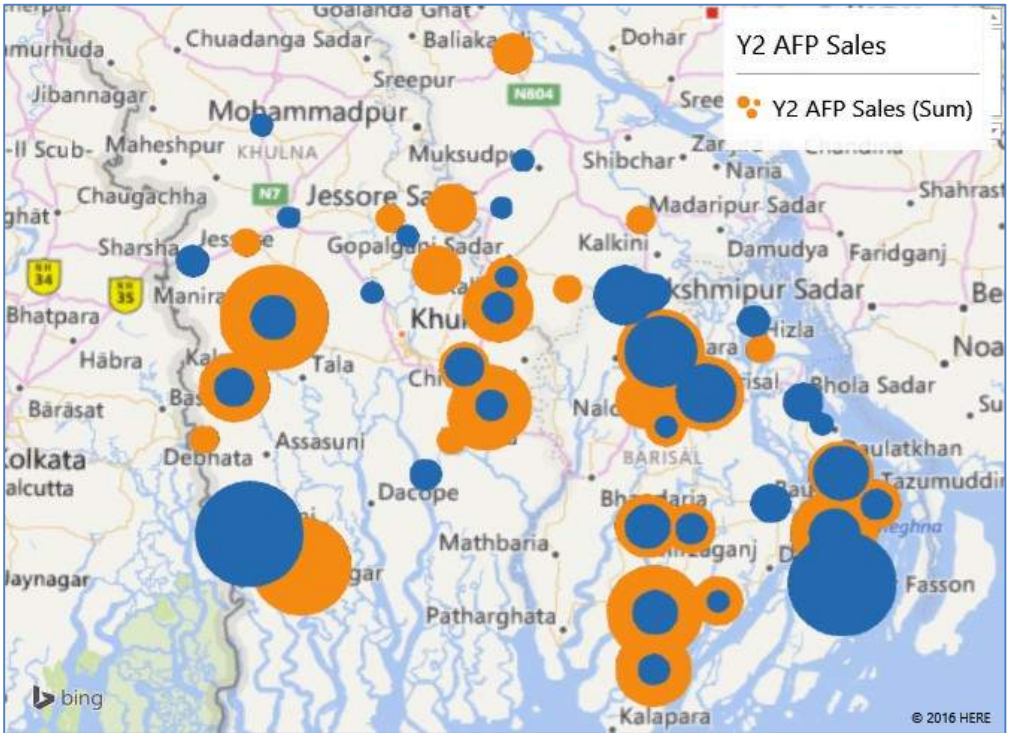
Note that these calculations are initial and can be used to help guide activities but are not to be taken as finalized calculations.

11. Power map examples used to help track and guide project activities and successes

Examples cover sales areas in the the FtF zone






Y2 AFP Sales
Y2 AFP Sales (Sum)
Chuadanga Sadar
Dohar
Sreepur
Mohammadpur
Maheshpur
KHULNA
Muksudpur
Shibchar
Naria
Chaugachha
Jessore
Madaripur Sadar
Shahrast
Sharsha
Gopalganj Sadar
Kalkini
Damudya
Faridganj
Manira
Bhatpara
Habra
Tala
Bhola Sadar
Barasat
Assasuni
Debhata
BARISAL
Dacope
Mathbaria
Patharghata
Fasson
Kalapara
bing
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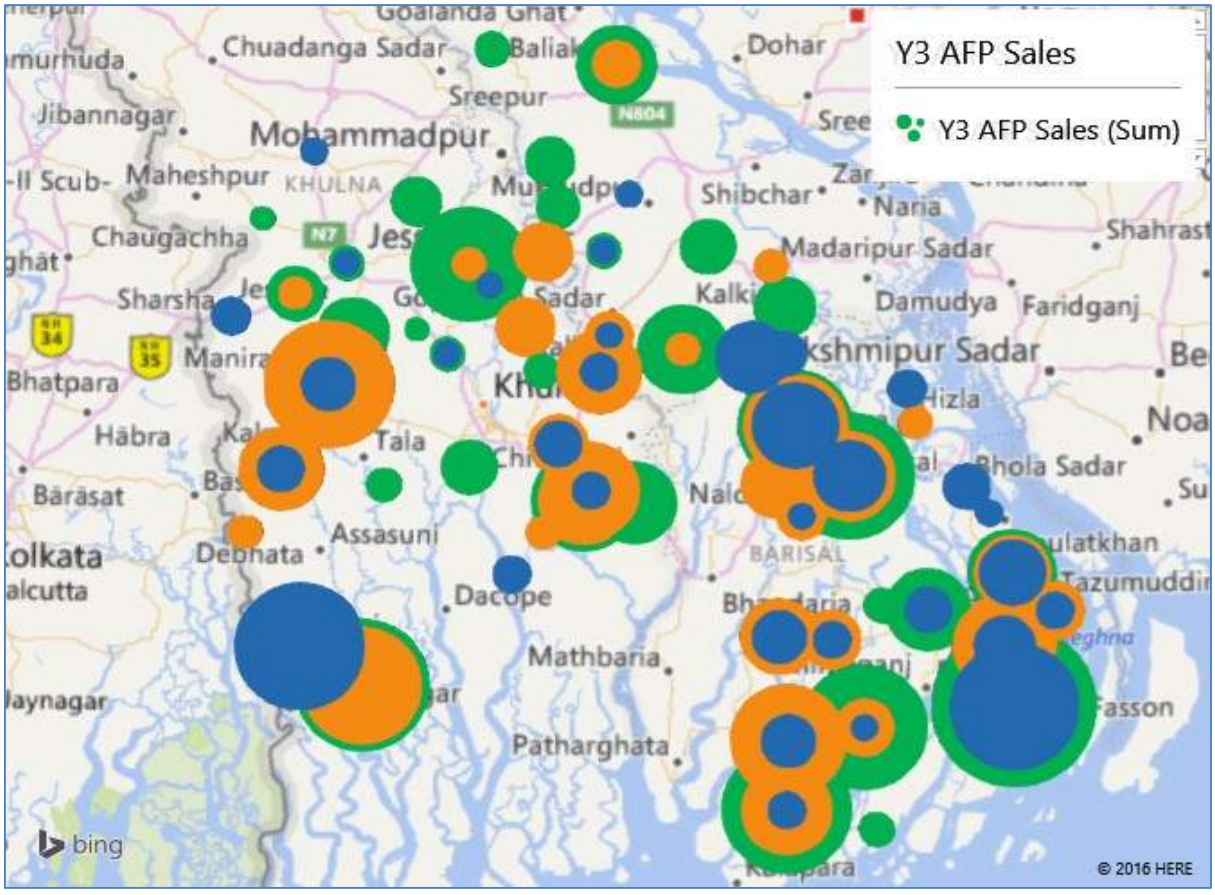
Y3 AFP Sales
Y3 AFP Sales (Sum)
Chuadanga Sadar
Dohar
Sreepur
Mohammadpur
Maheshpur
KHULNA
Shibchar
Naria
Chaugachha
Madaripur Sadar
Shahrast
Sharsha
Kalkini
Damudya
Faridganj
Manira
Bhatpara
Habra
Tala
Bhola Sadar
Barasat
Assasuni
Debhata
BARISAL
Dacope
Mathbaria
Patharghata
Fasson
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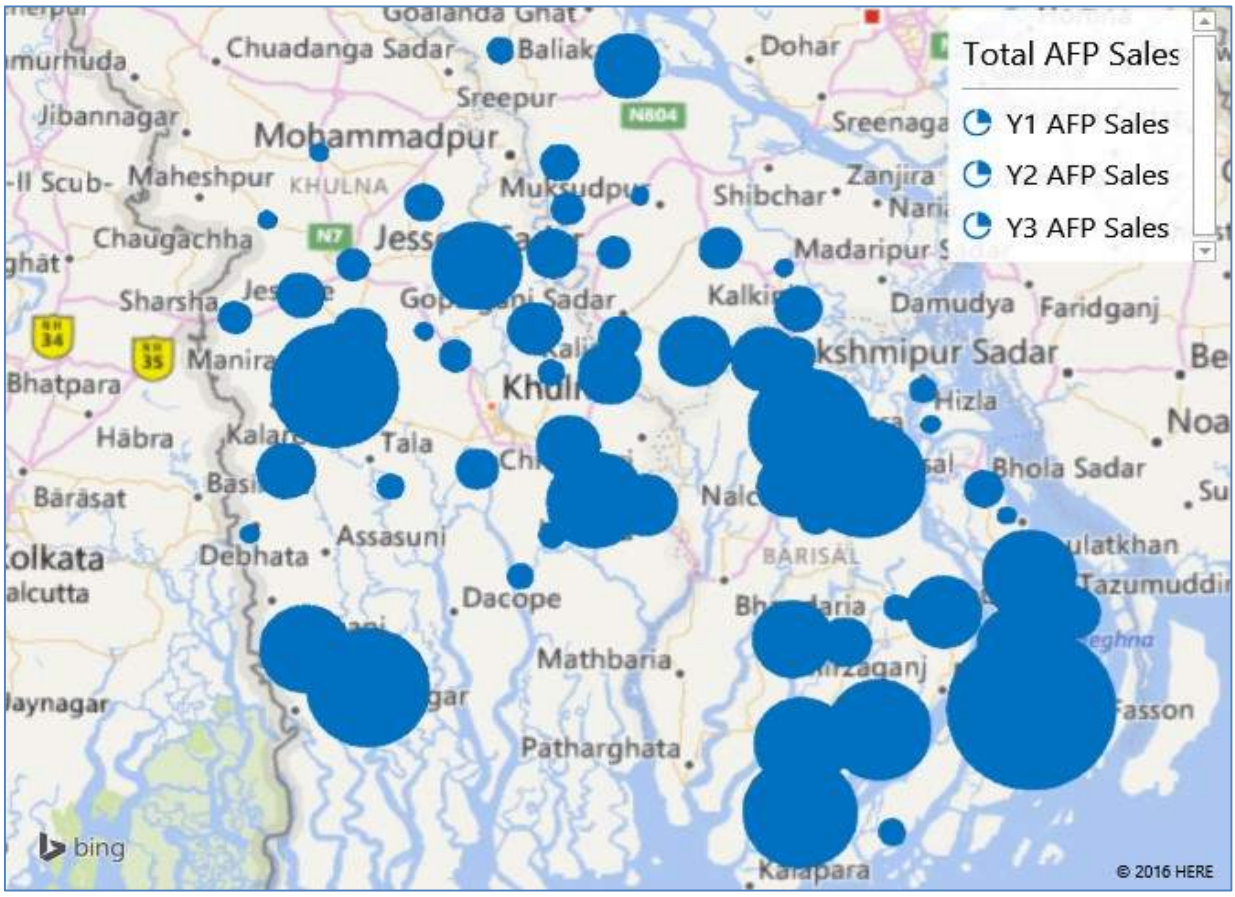
Total AFP Sales
Y1 AFP Sales
Y2 AFP Sales
Y3 AFP Sales
Chuadanga Sadar
Baliakandi
Dohar
Sreepur
Mohammadpur
Jibannagar
Maheshpur
KHULNA
Muksudpur
Shibchar
Zanjira
Chaugachha
Jessore Sadar
Madaripur Sadar
Sharsha
Gopalganj Sadar
Kalkini
Damudya
Faridganj
Manirampur
Bhatpara
Khulna
Hizla
Hābra
Kalaroa
Tala
Bhola Sadar
Bārāsat
Basirhat
Assasuni
Debhata
Kolkata
Calcutta
Dacope
BARISAL
Mathbaria
Jaynagar
Patharghata
Kalapara
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Y1 PTOS Sales
Y1 PTOS Sales
Pabna Sadar
Gangni
Kushtia Sadar
Meherpur
Ghior
Sabha
Dhaka
Damurhuda
Chuadanga
Dohar
Jibannagar
Mohammadpur
Sreenagar
Gazaria
Comilla
Maheshpur
KHULNA
Zanjira
Chandina
Shibchar
Naria
Chaugachha
Jessore Sadar
Madaripur Sadar
Rānāghāt
Sharsha
Gopalganj Sadar
Kalkini
Damudya
Faridga
Manirampur
Kalia
Lakshmipur Sadar
Bhatpara
Khulna
Hizla
Hābra
Kalaroa
Tala
Banaripara
Chitalmari
Barisal
Bhola Sada
Bārāsat
Basirhat
Nalchity
Assasuni
Kachua
Debhata
BARISAL
Kolkata
Calcutta
Dacope
Bhandaria
Bauphal
Kaliganj
Mathbaria
Mirzaganj
Dashmina
Shyamnagar
Jaynagar
Char Fa
Patharghata
Amtali
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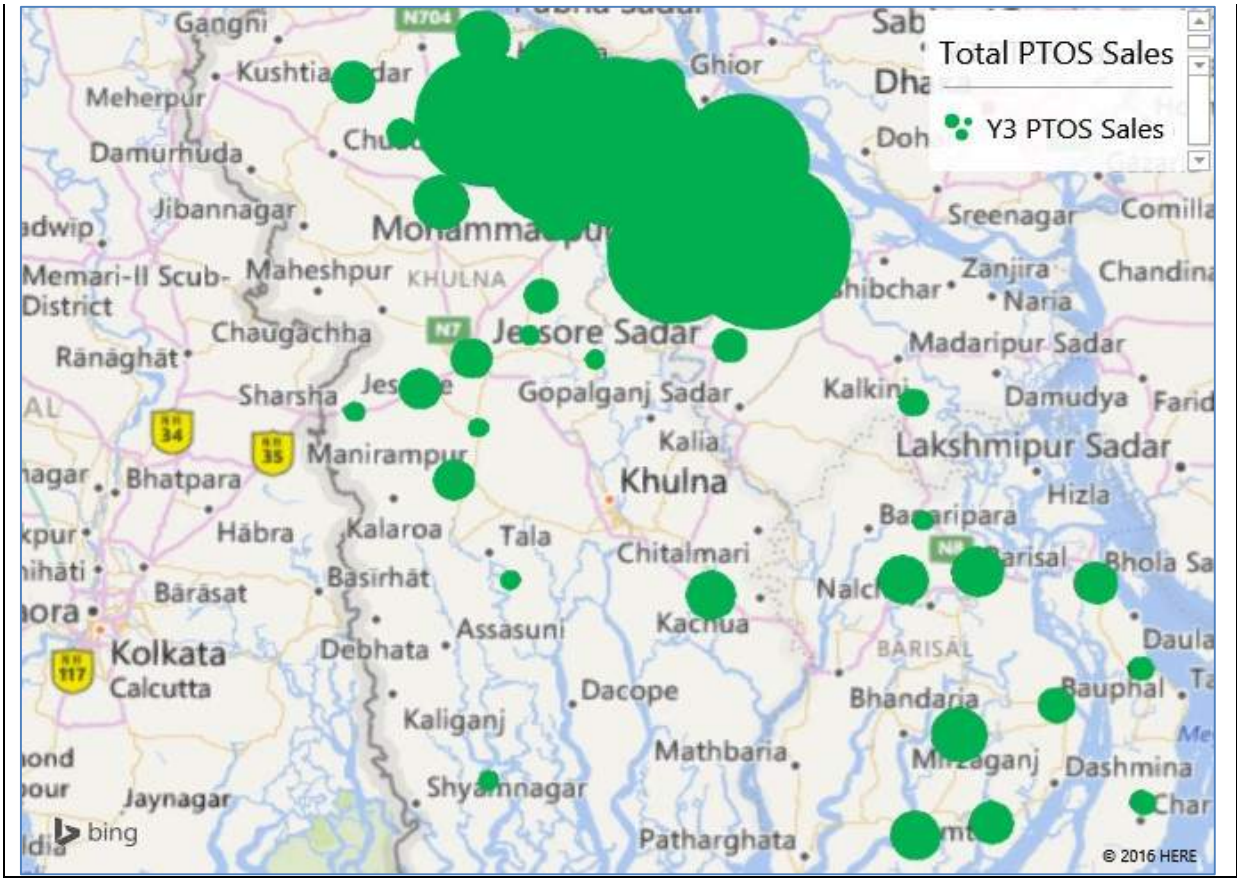
Total PTOS Sales
Y3 PTOS Sales
Gangni
Kushtia
Meherpur
Damurhuda
Jibannagar
Maheshpur
KHULNA
Memari-II Sub-District
Chaugachha
Rānāghāt
Sharsha
Jessore Sadar
Gopalganj Sadar
Manirampur
Bhatpara
Hābra
Kalaroa
Tala
Khulna
Kalia
Chitalmari
Bāsirhāt
Bārāsat
Assasuni
Kachua
Kolkata
Calcutta
Debhata
Dacope
Kaliganj
Mathbaria
Shyamnagar
Jaynagar
Patharghata
Ghior
Sreenagar
Zanjira
Naria
Madaripur Sadar
Kalkini
Damudya
Lakshmipur Sadar
Hizla
Barisal
Bhola
Nalchity
BARISAL
Bhandaria
Bauphal
Dashmina
Mirzaganj
Daula
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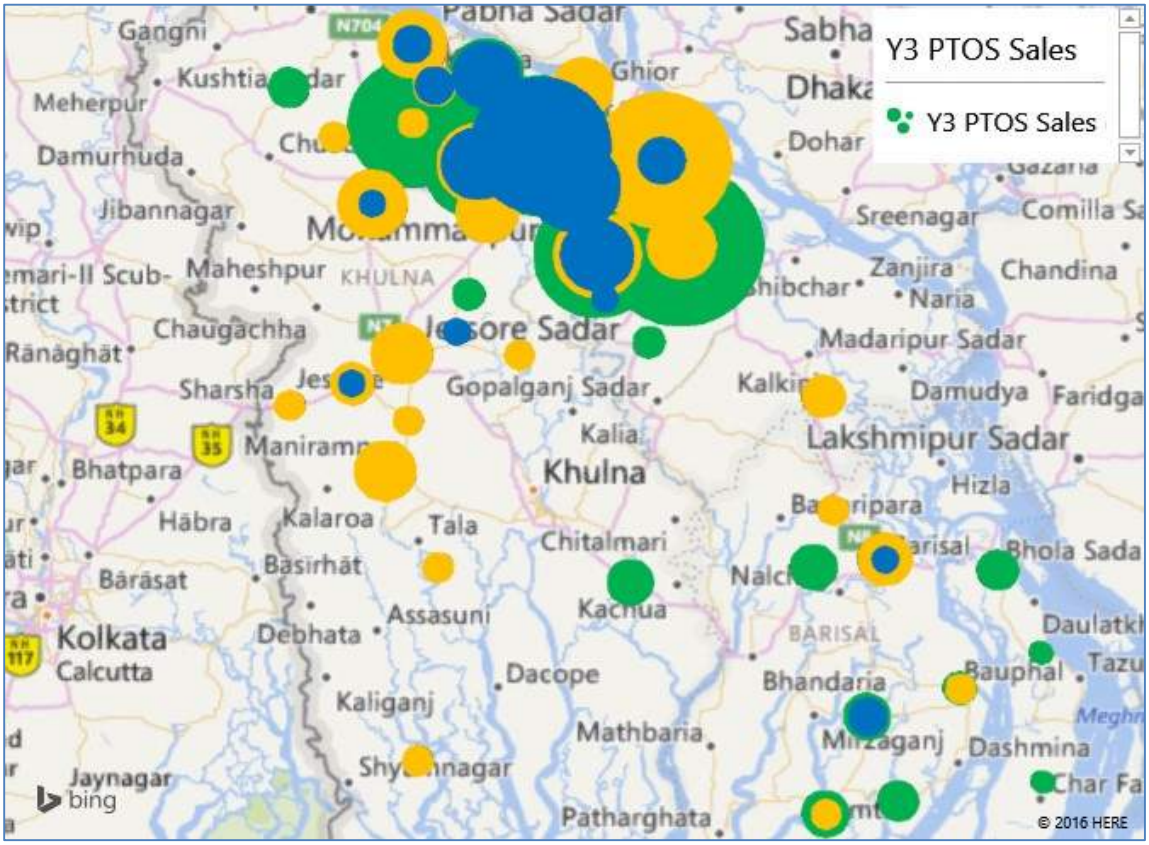
Y3 PTOS Sales
Y3 PTOS Sales
Gangni
Kushtia Sadar
Meherpur
Damurhuda
Jibannagar
Maheshpur
KHULNA
Chaugachha
Rānāghāt
Sharsha
Bhatpara
Hābra
Kalaroa
Tala
Bārāsat
Basirhāt
Assasuni
Kolkata
Calcutta
Debhata
Kaliganj
Dacope
Jaynagar
Gopalganj Sadar
Kalia
Khulna
Chitalmari
Kachua
Mathbaria
Patharghata
Ghior
Dohar
Sreenagar
Zanjira
Shibchar
Naria
Madaripur Sadar
Damudya
Lakshmipur Sadar
Hizla
Bhola Sada
Nalchity
BARISAL
Bhandaria
Bauphal
Mirzaganj
Dashmina
Char Fa
Sabha
Dhaka
Chandina
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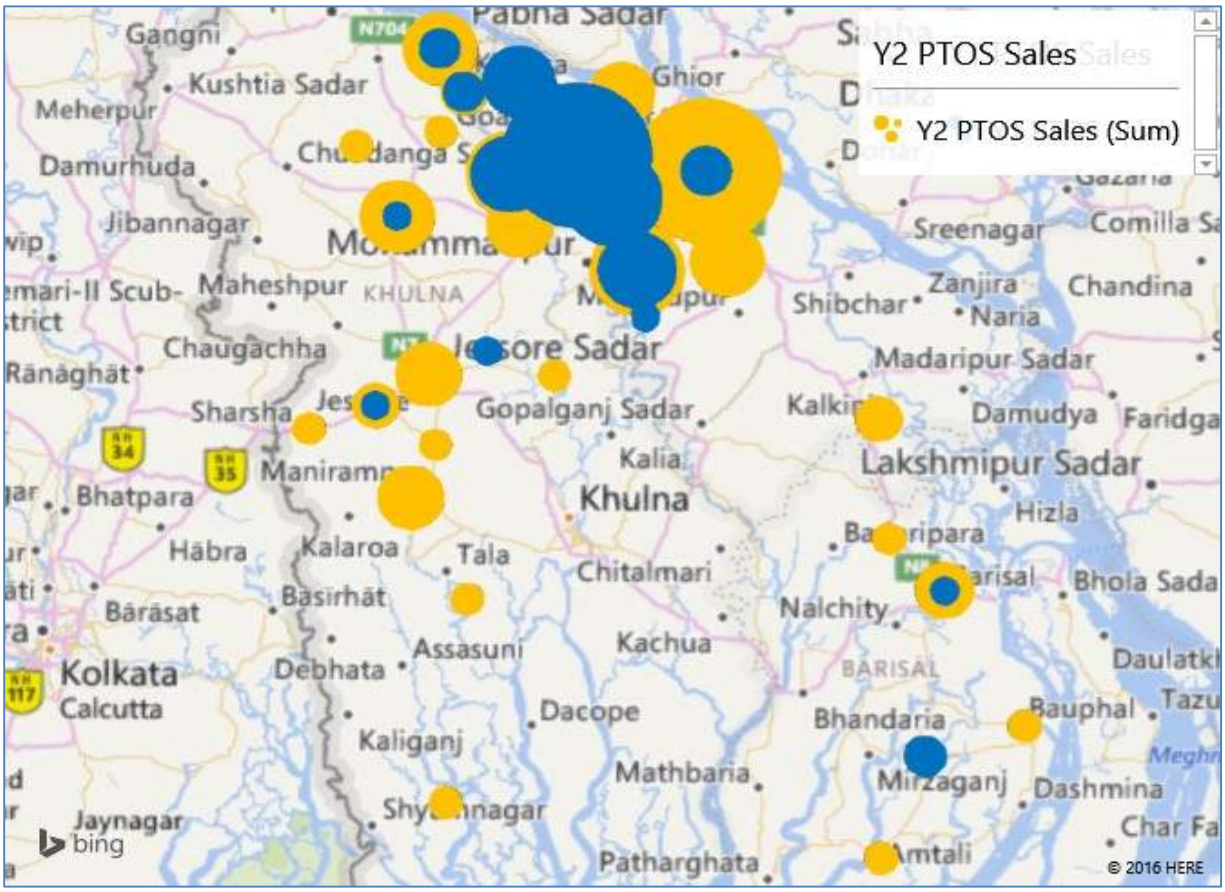
Y2 PTOS Sales
Y2 PTOS Sales (Sum)
Gangni
Kushtia Sadar
Meherpur
Damurhuda
Jibannagar
Maheshpur
KHULNA
Chaugachha
Rānāghāt
Sharsha
Bhatpara
Hābra
Kalaroa
Tala
Bārāsat
Basirhāt
Assasuni
Kolkata
Calcutta
Debhata
Kaliganj
Dacope
Jaynagar
Gopalganj Sadar
Kalia
Khulna
Chitalmari
Kachua
Mathbaria
Patharghata
Ghior
Sreenagar
Zanjira
Shibchar
Naria
Madaripur Sadar
Damudya
Lakshmipur Sadar
Hizla
Bhola Sada
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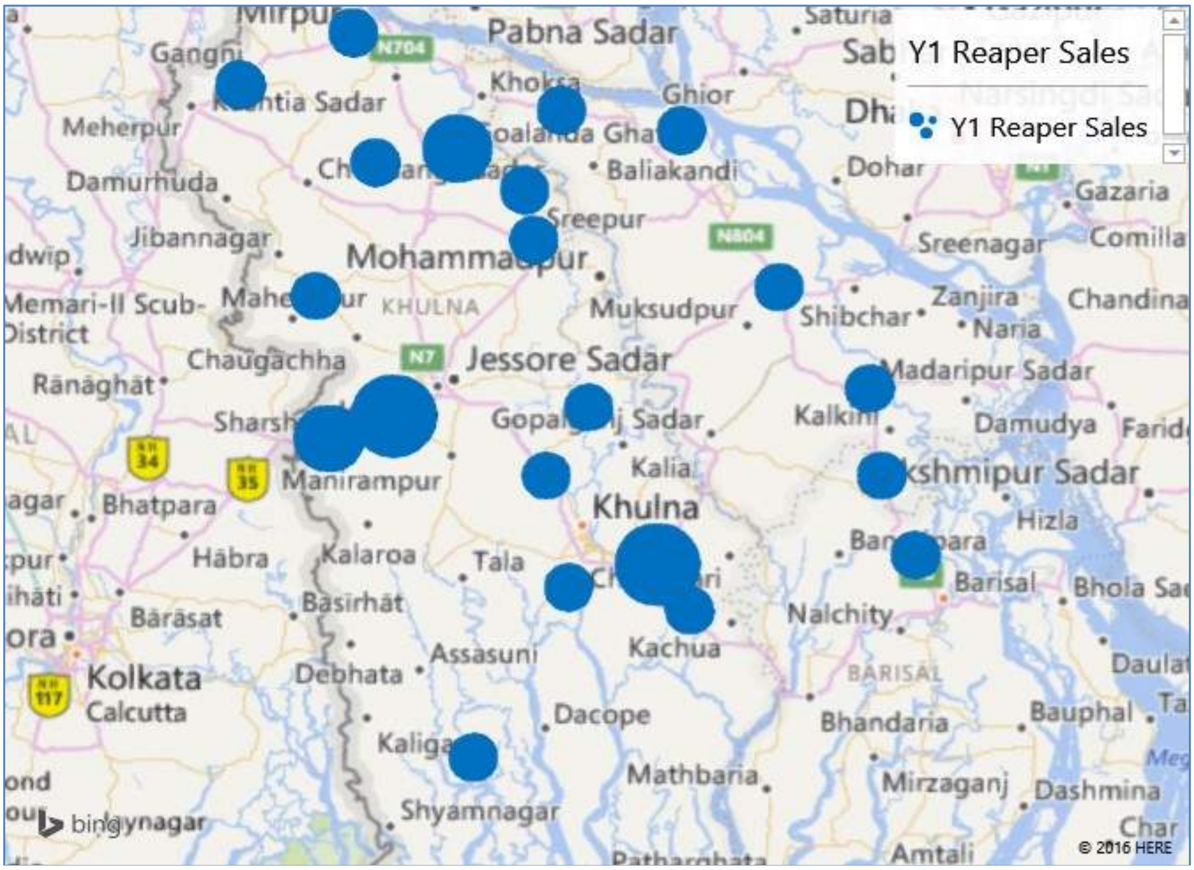
Y1 Reaper Sales
Y1 Reaper Sales
Pabna Sadar
Saturia
Gangni
Meherpur
Damurhuda
Jibannagar
Mohammadpur
Baliakandi
Sreepur
Ghior
Dohar
Gazaria
Sreenagar
Comilla
Muksudpur
Shibchar
Zanjira
Naria
Chandina
KHULNA
Chaugachha
Jessore Sadar
Madaripur Sadar
Ranaghat
Kalkini
Damudya
Manirampur
Kalia
Khulna
Hizla
Bhatpara
Habra
Kalaroa
Tala
Barisal
Bhola Sa
Basirhat
Nalchity
Barasat
Kachua
Kolkata
Calcutta
Debhata
Assasuni
BARISAL
Bhandaria
Bauphal
Dacope
Mathbaria
Mirzaganj
Dashmina
Shyamnagar
Amtali
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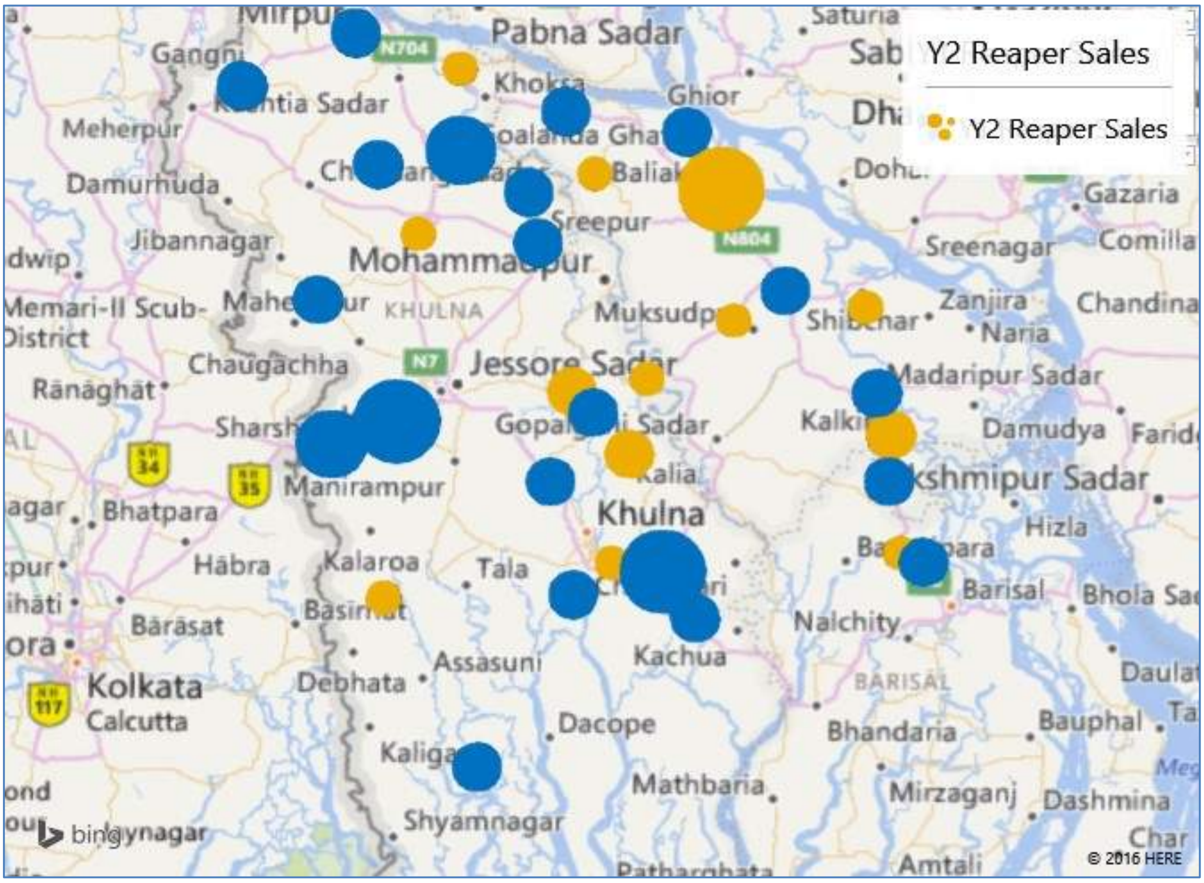
Y2 Reaper Sales
Y2 Reaper Sales
Pabna Sadar
Saturia
Gangni
Meherpur
Damurhuda
Jibannagar
Mohammadpur
Sreepur
Ghior
Gazaria
Sreenagar
Comilla
Zanjira
Naria
Chandina
KHULNA
Chaugachha
Madaripur Sadar
Ranaghat
Damudya
Manirampur
Khulna
Hizla
Bhatpara
Habra
Kalaroa
Tala
Barisal
Bhola Sa
Nalchity
Barasat
Kachua
Kolkata
Calcutta
Debhata
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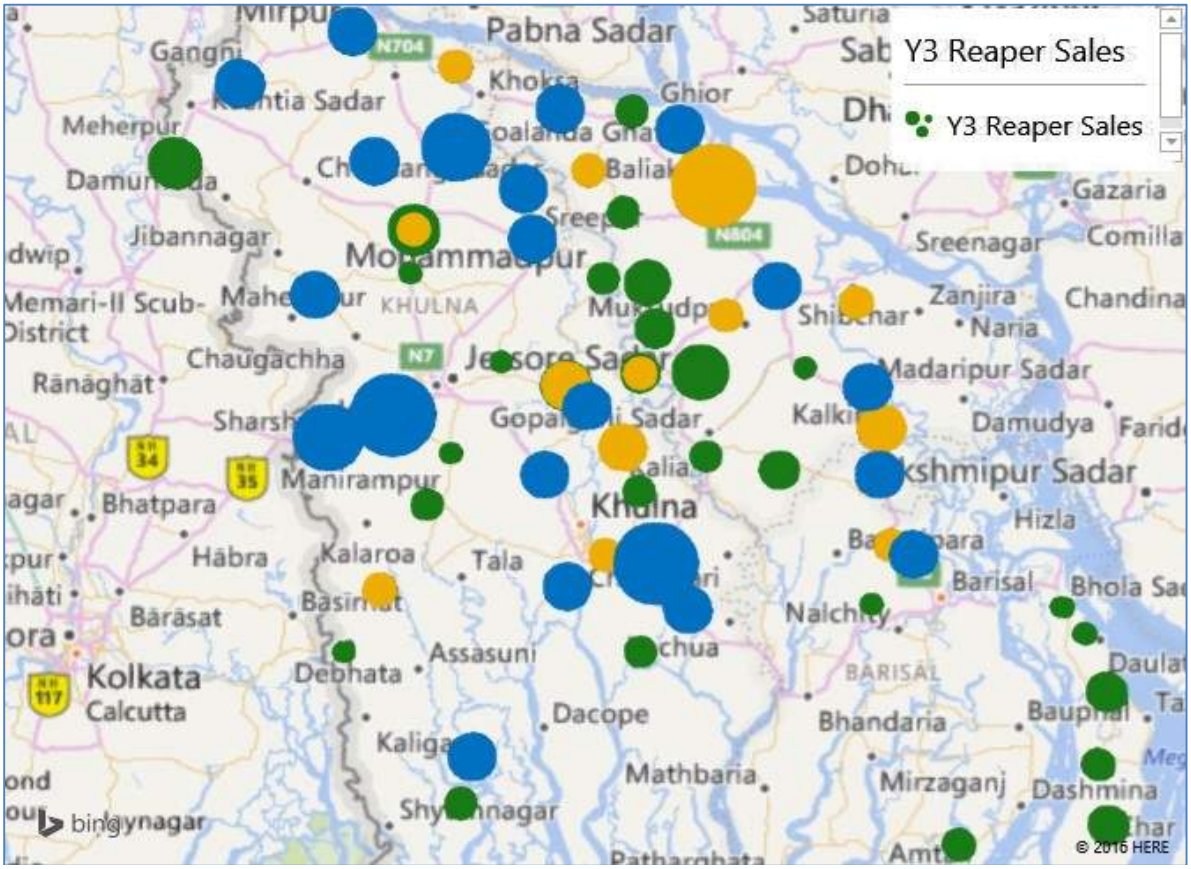
Y3 Reaper Sales
Y3 Reaper Sales
Pabna Sadar
Khoksa
Ghior
Meherpur
Jibannagar
Mohammadpur
KHULNA
Chaugachha
Rānāghāt
Jessore Sadar
Manirampur
Bhatpara
Khulna
Hābra
Kalaroa
Tala
Bārāsat
Basirhat
Assasuni
Debhata
Kolkata
Calcutta
Dacope
Kaliganj
Mathbaria
Shyamnagar
Bagerhat
Gazaria
Sreenagar
Comilla
Zanjira
Chandina
Naria
Madaripur Sadar
Damudya
Kshmipur Sadar
Hizla
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