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International Maize and Wheat
Improvement Center (CIMMYT) Bangladesh

Study into the

COMMERCIALIZATION OF SELECTED AGRICULTURAL MACHINES in Bangladesh

Report prepared by
International Development Enterprises (iDE)



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Report prepared by
International Development Enterprises (iDE)

Submitted to
International Maize and Wheat Improvement Center (CIMMYT) Bangladesh
House 9, Road 2/2, Banani, Dhaka 1213 , Bangladesh

Submitted by
International Development Enterprises (iDE)
Khurshid Garden House # 21, Road # 123
Gulshan 1, Dhaka 1212, Bangladesh

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Operating in Bangladesh, India, Nepal, and Pakistan, CSISA involves more than 300 public, civil society, and private sector partners in the development and dissemination of improved cropping systems, resource-conserving management technologies, new cereal varieties and hybrids, livestock feeding strategies and feed value chains, aquaculture systems, and policies and markets. In essence, CSISA is an innovation system platform that links a wide range of public, private, and civil society sector programs within and across South Asia.

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Acronyms

Acronym	Elaboration
2WT	2 Wheeled Tractor
4WT	4 Wheeled Tractor
CT	Conventional Tillage
BARC	Bangladesh Agricultural Research Council
BRRI	Bangladesh Rice Research Institute
BARI	Bangladesh Agricultural Research Institution
CIMMYT	International Maize and Wheat Improvement Center
CSISA-BD	Cereal Systems Initiative in South Asia- Bangladesh
DAE	Department of Agriculture Extension
iDE	International Development Enterprises
LLP	Low Lift Pump
NARS	National Agricultural Research System
PTOS	Power Tiller Operated Seeder
SA	Seeder Attachment
SFA	Seeder and Fertilizer Attachment
STW	Shallow Tube Well
SPST	Single Pass Shallow full Tillage
ST	Strip Tillage
ZT	Zero Tillage
VMP	Versatile Multi-crop Planter
WRC	Wheat Research Center

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EXECUTIVE SUMMARY

General Introduction

1. In recent years the pace of mechanization has accelerated in Bangladesh. This is largely due to reforms which were undertaken throughout the 1980s. Even after acceleration of mechanization in some specific areas such as tillage, irrigation, and threshing there are many areas which still require further mechanization. This can serve to achieve greater efficiencies such as resource conservation and unit cost reduction in crop production. Contrary to the farmer-ownership model which characterizes many developed country contexts, the high number and small size of farms in Bangladesh has led to the emergence of a service provision model whereby various small scale farm machines can be more easily accessed by small-holders. This model has seen high profile successes in the large number of service providers providing access to two and more recently four wheel tractors (2WTs; 4WTs), diesel engines for irrigation and various threshers which can be found in Bangladesh. The study contends that the most effective way to achieve an even higher level of farm mechanization is to align the incentives of the various market actors which operate in the market system. This can be achieved by development organizations understanding how to strengthen and build upon this service provision model. It is anticipated that this will lead to greater scale and sustainability.
2. This report was prepared by International Development Enterprises (iDE) for the Cereal System Initiative in South Asia-Bangladesh (CSISA-BD)¹ and International Maize and Wheat Improvement Center (CIMMYT). The study seeks to strengthen the CSISA initiative through providing context and direction for enhancing farm mechanization through commercialization in Bangladesh. There are two core objectives for the study:
 - To provide an in-depth overview on the history, current status, and potential scope for enhancing farm mechanization through commercialization in Bangladesh; and,
 - To devise a series of actionable recommendations that collectively will comprise a strategic roadmap for CSISA-BD and its strategic partners to accelerate scale-appropriate mechanization through market development approaches.
3. To achieve these objectives the study employs a **methodology** which is based upon a ‘sub-sector analysis’ approach. This seeks to understand the various actors, products and services in the different value chains which make up a subsector. The study uses qualitative tools and instruments and acknowledges that a sample based quantitative study is insufficient to understand the nuances of market behaviors which characterize the subsector. This work involved exploring the backward and forward linkages of key market relationships and transactions in order to triangulate and verify information received from market actors. This “following the lead” approach led to engagement beyond the hub areas² to adjacent regional and even national and international levels.

1. For details <https://sites.google.com/site/csisaportal/csisa-project-documents/bangladesh>

2. Hubs are the CISSA projects regional offices for doing on-farm research and the delivery of technologies

4. In terms of **structure**, first the study presents a general picture of the context for mechanization in Bangladesh with a specific focus upon mechanization in the CSISA hubs areas³. The report then outlines the key findings of investigation into the state of mechanization for notable machines which have spread either throughout the country, such as the 2WT and Threshers, or have experienced localized scale up, such as the two-wheel tractor mounted seed drill known as PTOS. Sections are designated specifically to 4WT, 2WT, Seeders, and Reapers, where both constraints and success factors are considered. Finally potential business models and interventions for scaling up agricultural mechanization are considered and recommendations provided for each of these key machines.

General Picture of Agricultural Mechanization

5. Since the early 1990s huge strides have been made in mechanizing agriculture mainly through irrigation and over one million shallow tube wells with diesel pump sets and five hundred thousand 2WTs providing tillage services to over 80% of Bangladeshi farmers. Retail sales prices suggest that there is an estimated USD66 million equivalent amount of 2WTs and over USD25 million equivalent amount of diesel engines (most bound for the irrigation pump sets, rural transport, and other agricultural machinery) supplied into the Bangladeshi market annually. Broadly while efforts have been made to introduce different machineries to stimulate more precision in Bangladeshi agriculture using machines such as reapers, seeders and conservation agriculture techniques such as zero till and bed planting, the **widespread adoption of these technologies by small-holder farmers is still to be achieved**. However, in recent years there have been three important shifts which are changing the landscape of agricultural mechanization of Bangladesh. These are: 1) an acceleration of 4WT sales and tillage service through network marketing; 2) accelerated adoption of rice threshers; and 3) localized scale-up of high speed rototiller in Rajbari district. For machines outside this group, it was found that while much activity has been undertaken in terms of different experiments and trials this has not been translated into the commercial availability of the products in the market.
6. The growth of a **service market for agricultural machines** is one of the most important developments in Bangladeshi agricultural mechanization. One of the key features of mechanization in the Bangladesh context is that in many cases machine owners offers business services to neighboring farmers and also to districts quite distant from the place of ownership. Competition is well developed and many of the exploitative negative externalities of mechanization such as ‘water lordism’ in case of irrigation service markets or ‘tillage lordism’ that were feared in earlier studies have not developed⁴. The report finds that service providers often come from poorer socio-economic groups where individual or group ownership of a particular machine serves to provide crucial services for all farmers. Also a significant number of small and medium enterprises (SMEs) have been growing to support the mechanization in terms of providing support services such as the provision of spare parts, repair and maintenance, and individual brokering businesses.

³. Dinajpur, Jessore, Barisal, Khulna and Faridpur Hub.

⁴. For a more theoretical analysis of the irrigation service market of Bangladesh the following can be consulted- Palmer-Jones, Richard. 2011. *Irrigation Service Markets in Bangladesh: Private Provision of Local Public Goods and Community Regulation?* Paper presented at an workshop at the University of Lund, Sweden.

<http://www.uea.ac.uk/~d280/other/bangladesh/Irrigation%20Service%20Markets.pdf>

7. One of the recent success stories of agricultural technology commercialization is the continued presence of threshers (especially rice threshers but also wheat/pulse threshers and maize shellers) in the local market. This success can be attributed to a number of pull and push factors. Some pull factors include: labor shortages, increased mobility, relatively high affordability, efficiency, and favorable rates of return. Some push factors include the ease of replication, local availability of raw materials for production, presence of local manufacturers and the targeted nation-wide promotion by companies. The success of the thresher highlights important lessons which can be applied to the other farm machineries which are a focus of the study.
8. Field investigations point to similar types of interventions that need to be carried out to commercialize farm machinery at a greater pace. Experience of the thresher technology also points us to a similar direction. Some of the generic interventions include, nationwide promotion, establishing a distribution and supply network early on, training of service providers by companies, branding the machines preferably with a locally recognizable name and establishing local level servicing.

Two-Wheel Tractors (2WTs)

9. Even though the introduction of 2WT started in the 1960s it was not until the 1990s when it started to scale up throughout the country. There were a number of key factors which inhibited growth during this time. These included: 1) the machine remained comparatively too expensive (Japanese and Korean models) even after subsidies; 2) there was very weak repair, maintenance service market; 3) spare parts were scarce; 4) private sectors participation in promoting the 2WT was negligible; and, 5) tariff and non-tariff barriers continued till late 80s. Along with diesel engines, 2WT market barriers were also removed during late 80s and by 1995 it was made duty free. As diesel engines used for irrigation and 2WT were alike or same, so 2WT adoption got a boost as there was already engine spare parts in the market as well as a repair and maintenance service market. Also the price of the 2WT came down to a very attractive level for the local entrepreneurs with the switch from Japanese to Chinese models.
10. The current status of the 2WT market shows heavy dependence upon one principal importer that occupies around 80% of the market share due to brand popularity. In the last 3 years on average 60,000 units per year have been imported and around 21,000 units have been sold at subsidized prices. While subsidy programs by the GoB appear to have contributed to an acceleration of national level sales, questions remain regarding the sustainability of subsidy-driven models in developing ancillary service markets and encouraging non-market behaviors. This acceleration of sales can also be attributed to defragmentation of land and the unsuitability of 4WTs in deep water and clay muddy soils, which has kept the RoI very attractive till date. One of the other factors that continues affecting the market of 2WT tillage service in areas where 4WTs have been introduced is the farmers' preference for deep tillage. This report contends that in the context of reducing per capita annual area coverage, 2WTs will remain an attractive investment because of its still valued tillage services and its multi-purpose utilities such as haulage and milling.

Seeder Attachments

11. The development of markets for seeders presents both a promising business opportunity and high potential for improved agronomic practices in Bangladesh. There are currently two principal types of seeder available in the market: 1) the PTOS (both Chinese and locally modified Bangladesh Agriculture Research Institute (BARI models) and the locally manufactured bedplanters including Versatile Machine Planter (VMP) and the BARI bedplanter. At present although more than 1,500 PTOSs are now in operation in Bangladesh, most of those are concentrated only at Rajbari district and almost all of the machines are being used only for tilling purpose via custom hiring to other farmers. Some VMP service providers have been found to rent out the VMP service to 656 farmers covering a total 81 ha of crop land. Overall the market volume of the yearly imported PTOSs is around US\$0.85 million for entire unit (2WT and seeder) and US\$0.25 million for the attachment only. At present only 2 importers are importing PTOS and 2 dealers are selling PTOS. Two local manufacturers have also been involved in producing PTOS, but in relation to development projects. Although bedplanters (VMPs and BARIs) have been produced by local manufacturers these are marketed to farmers through projects and currently no dealer network exists. Numbers of 2WT purchased with conventional rotovators has significantly decreased in the PTOS intensive areas (Rajbari) in the recent years.
12. At present only a few service providers in some villages of Rajbari are custom selling **seeding services** along with popular tilling services with their PTOSs to a few neighboring farmers, especially for seeding jute and wheat seeds. There exist several reasons why seeding metering operations has not yet been commercialized. The major reason was that although Rajbari was a major intervention area under CIMMYT-BARI's seeder project, seeding was never the priority there for the service providers and farmers there. The first batch of PTOS customers actually bought it for its high speed rotary application and its ability to fine till land for their major horticultural crops, that is, onion and garlic. Required information and skill based service on seeding operation remain largely unavailable and dealers and importers also do not act as catalyzing actors in promoting seeding operations. Similarly, the **PTOS** has not been scaled up in the surrounding districts or other areas of the country as what has happened in Rajbari. One of the major reasons has been that onion or garlic has not been the major crops in the neighboring districts. Major machinery importer(s) have not been involved in importing PTOS and no big dealer network or required support services exist in the market countrywide. No financial package or formal credit purchase facility exist for PTOS. Some spare parts of seeder attachment are not regularly available and is only sold in a few machinery shops in Rajbari.
13. The seed meter on the PTOS can only seed smaller grains and legumes whereas **VMP** is more versatile as it has a multi-crop seed meter which can accommodate a larger range of seed types. This makes it more attractive to the service providers in the field as it helps them offer a greater range of services to farmers. VMP has been tested with a service provision model however it has yet to become a commercially viable product in the market. While the product's versatility is an attractive feature, technical and market issues remain which will need to be addressed in order to achieve commercialization of the product. These issues include design features such as speed, weight, maneuverability; affordability, such as the absence of financial products in the market; and, promotional issues, such as company advertising. Despite these issues, the potential for this product

remains high, with increasing interest internationally from such diverse agronomic areas as Vietnam and Mexico. In Bangladesh, a new ACIAR supported iDE project has recently begun that seeks to deal with these issues.

14. There are nearly 4 million farmers in the CSISA hub districts, thus, there is the potential (at 100% market capacity) for some 97,000 2WTs to provide the seeding services. If seeders are worth approximately Tk. 51,000 and engines Tk. 36,000, then the total value of potential market demand for these machines is USD105 million (approx.). Therefore the value for seeding services (calculated using the average 25% premium charged for tilling services locally) can be seen to be over USD20 million per annum, yielding a potential additional income for farmers of some USD300 million per annum⁵.
15. The development of seeders by development organizations has been largely technocratic, with a disproportionate focus on the machine itself rather than the markets which are required to function effectively to bring about large-scale adoption of the seeder technology. In this context development organizations must **look beyond attempts to promote any one particular technology towards implementing interventions designed to support the development of a market system** for seeder attachments. This report therefore suggests a number of recommendations for CSISA and CIMMYT to support the commercialization of seeder attachments. These include:
 - Facilitating collaboration with the importers to achieve a large scale promotion of seeder services;
 - Creating/developing a supply chain of product and services. Since some of the manufacturers have the skills to produce seeder attachments as well as spare parts it is crucial that potential buyers can buy the machine from local dealers/retailers and access effective repair and maintenance services;
 - Facilitating companies to provide improved training to service providers. Development organizations can provide the necessary technical knowledge in order to create local trainers; and,
 - Branding the seeder with a Bengali name can also help the manufacturers and importers in demand creation.

Reapers

16. Reapers were introduced as far back as 1995 by CIMMYT. Since then local manufacturers have been involved in the research and development process. Research and development (both 2WT mounted and self propelled) reached its peak level during the Research and Extension in Farm Power Issues (REFPI) project that started in 2002 when reapers were imported from abroad to be replicated in Bangladesh. However, these locally replicated machines were largely unsuccessful due a number of reasons. These include: 1) that the local manufacturers lacked the technical and human resources required to achieve high levels of precision; 2) no plastic molding machines were available among the manufacturers and therefore they could not produce plastic based spare parts; 3) the higher cost of maintenance meant it was not economically efficient; 4) manufacturers were not sufficiently connected with the end-users to ensure a strong feedback loop which could drive innovation in

⁵. Total projection over the entire population (500,000) of potential additional income from 2WT would be around 1.5 billion USD

design and manufacture; and, 5) often manufacturers were dependent upon development projects for technical support, many of which were not responsive enough in providing this support.

17. Despite this the study finds that farmers (and government agencies and development projects) continue to show interest in the machine. The major reason for this is high labor scarcity and associated increased wage burdens during the short harvesting period. Therefore, the introduction of reapers has the potential to reduce the cost of harvesting as well as reduce the risk of crop damage and further reduce the turnaround times so that that following crops get planted on time. The report finds that **many engineers, scientists and private workshops believe that the time is right for the re-introduction of the reaper on a commercial basis**. Therefore it is suggested that any future program for promoting reapers does so on the basis of the following recommendations:
 - Seek collaboration with importers for large scale promotion of self propelled reapers and 2WT reaper attachments;
 - Create/develop an effective distribution/ supply network for reapers. For this, the 2WT supply chain can be used as a vehicle;
 - Facilitate a dealer level promotional commission. Commission based promotion by service providers can also be introduced; and,
 - Companies should also provide training to service providers to show the business potentiality and provide them with necessary technical knowledge in order to create local trainers.
18. Potential business scenarios for reaper market have been estimated in the report. It is estimated that there is over USD 18 million in additional income value to farmers in the hub areas through the reaper services. More compelling is that value for importers and SPs is around USD 80 million per annum. This indicates that there is strong potential for a **scenario to be developed where all stakeholders benefit** through supporting the commercialization of reaper units through the local domestic private sector.

4 Wheel Tractors (4WTs)

19. Historically, the adoption of 4WT has remained low and was concentrated in the eastern (Comilla and adjacent northern district) and western (Jessore, Dinajpur and some other adjacent northern districts) belts of the country. Recently, a business environment shaped by importers, owners, drivers and commission agents as well as a subsidy program by the GoB has contributed to 4WT adoption at an accelerated pace. Currently there are nine importers which have been importing annually some 6,000 4WTs of different models (mainly from India) and around 2,000-3,000 rotovators (mainly from India and Italy). Retail sales prices suggest that there is an estimated USD 69 million equivalent amount of 4WT and rotovators supplied into the Bangladeshi market annually. Importers generally offer a credit purchase scheme offering terms of a down payment of 30% of the machine price as and 70% to be paid back at a 20% flat interest rate for 2 years (24 equal monthly installments). A trend of loosening these terms has been seen with companies increasingly offering more favorable credit options in areas such as down payments and payback periods which is likely the result of increased competition.

20. The report highlights two key features in the 4WT market. Firstly, the growth of a **backward linkage industry** within the last decade that serves to support the market, for example the growth of a second hand rotovator market, refurbishing old rotovators; and workshops which specialize in the repair and maintenance 4WTs. Secondly, the emergence of **brokerage service providers** who often act as *de facto* marketing agents as well as **identifying new tillage areas** for the 4WT owners. The innovative commission system from both the importers (brokerage commission for finding new customers for the importers outlets) as well as from the owners (commission for aggregating tillage service areas). As brokers ensure an annual aggregate tillage service area for the owners so the service buyers feel more confident about timely tillage for the land.
21. The report finds that in the last three years the average tillage area for every 4WT is decreasing at a rate of around 17% whilst 4WT growth is around 21%. Forward projections suggest that this trend is set to continue. Annual tillage area per 4WT is likely to decrease at a rate of 10% till 2015 whereas the growth of the 4WT is likely to be around 11%. It is evident from field work undertaken by this study in the CSISA hub areas that the return on investment is decreasing significantly and already companies are experiencing high 'overdue' risk in the market. This market contraction can be understood as presenting a **financial 'time-bomb'** for service providers operating in the market. With such decreasing return on investment (RoI) and increasing payback periods along with reduced prospects of establishing strong network marketing for tillage service areas for new owners in other parts of the country, the signs are that the market is likely to enter difficulties.
22. However, there some potential business models that may address the core problems. Analysis suggests that the service provider adding a seeding service might significantly increase the chance to remain profitable in the years to come. It is found the **addition of a seeder attachment significantly improves the payback period by some seven years**. Interventions by development organizations which should be pursued include:
 - Establishment/ development of 4WT services in the haor, mid and southern areas of the country;
 - Introduction of 4WT seeder services in the most potential cropping systems;
 - Relaxation of financial packages for the new buyers; and,
 - National level information dissemination on the potential profitable business models for different areas and cropping systems.

CHAPTER

1

INTRODUCTION

1.1 Introduction

Bangladesh has taken a diverse path toward agricultural mechanization. Even though the effort of introducing different mechanical technology started in the 1960s⁶, it is not until the 1990s when the pace of mechanization accelerated rapidly. A number of factors contributed in the acceleration process where local service market growth in terms of technology service provisioning worked along with reduction of tariff and non-tariff barriers during the late 80s. In a number of instances, the status of agricultural mechanization of Bangladesh has been lauded; Bangladesh is one of the most mechanized countries in Asia (Justice & Biggs 2010; Biggs *et al.* 2011). Bangladesh has an interesting system of agricultural mechanization where many machinery owners also operate as service provider's enabling mechanized service to reach out to share croppers and small holders, and contributes significantly in backstopping the rural non-farm sector (Mandal 2002). This vibrant service market growth with a simple yet diversified service provisioning⁷ along with multiple innovations at domestic level through the local manufacturing sector, coupled with a growing import, dealer and retail network are important features of the current system of agricultural mechanization in Bangladesh.

1.2 Background of the study

This study originates from the basis of the objectives of **Cereal Systems Initiative for South Asia – Bangladesh (CSISA-BD)** project, which aims to disseminate mechanical technologies that complement conservation agriculture⁸. The approach outlined in the CSISA expansion document clearly emphasizes a market driven effort and facilitation as a core underlying principle in ensuring the sustainability. It is widely understood that market systems offer the most effective means of replicating, disseminating and ensuring the uptake of new technologies (Polak, 2008). Therefore this comprehensive study seeks to strengthen the CSISA initiative by providing context and direction for enhancing farm mechanization through commercialization in Bangladesh.

1.3 Objectives

There are two core objectives of this study:

- Conduct an agricultural mechanization sub-sector analysis that will provide an in-depth overview on the history, current status, and potential scope for enhancing farm mechanization through commercialisation in Bangladesh; and,

6. The then Water Development Board installed 380 deep tube-wells in the northeast part of Bangladesh during 1963-66 to explore the ground water for irrigation (BADC 2010). Also during the 60s through Bangladesh Academy of Rural Development introduced 4 wheel tractors (4WT) in Comilla area (Lewis 1996).

7. A detail discussion can be found in individual chapters for each machine where different modalities of service contract are explained. Generally speaking, each machine be it a shallow tube well, 2 wheel or 4 wheel tractor, even threshers is usually not used only by the owners but the service of the machine is sold to neighboring farmers or even to distant district i.e. in case of 4 WT.

8. For detail please CSISA expansion document for Bangladesh can be gone through <https://sites.google.com/site/csisaportal/csisa-project-documents/bangladesh>

- Delineate a series of tangible recommendations that will collectively comprise a strategic roadmap for CSISA-BD and its strategic partners to accelerate scale-appropriate mechanization through market development approaches.

Table 1a: Hubs and Districts

Public sector	Private sector
Dinajpur	Dinajpur, Rangpur, Nilphamari
Khulna	Khulna, Satkhira, and Bagerhat
Jessore	Jessore, Magura, Jhenaida, Chuadanga, Kushtia, and Meherpur
Faridpur	Faridpur, Gopalganj, Madaripur, Narail, and Shariatpur
Barisal	Barisal, Patuakhali, Borguna, Jhalokati, Pirojpur, and Bhola

1.4 Study Methodology

Agricultural mechanization studies with a subsector development approach are rare in Bangladesh⁹. Most studies into mechanization have focused on specific machine and crop specific experimentations. This is the first ever study that has covered such a large geographical area (covering both the northern and southern CSISA hub areas) with a sub-sector study approach. Given the scope of work in the MoA, iDE designed the study methodology.

The methodology is rooted in iDE's PRISM toolkit¹⁰ though this study was not limited to the boundaries of PRISM. Such a comprehensive study requires engagement with a diversity of stakeholders including: market actors, such as importers, dealers, retailers, and manufacturers; local service providers (LSP) and service buyers; public extension agencies and research institutions; and, universities and scientists. Given the dynamic nature of markets, the study team sought to "follow the lead" in order to understand the role of different market actors and discover the various aspects of the market system. This involved triangulating information received by one source with related stakeholders in the market system in order to verify the accuracy of reports received during fieldwork.

What is a Subsector?

A subsector is a network of firms that supply raw materials, transform them and distribute finished goods to a particular consumer market. Normally, a subsector is delineated by a particular final product and includes all firms engaged in raw material supply, production, and distribution of that product. In some cases, however, the defining characteristic is a key raw material, with the subsector describing the alternative transformations and distribution systems emanating from it.

(Haggblade & Gamser, 1991: 2.)

Text box 1: What is a subsector?

⁹. During 2006 one such study was done during 2005 by SEDF titled "Identification of Agribusiness SMEs and Supply and Value Chain Analysis in Agri-machinery Sub-sector". This study focused on Power tiller (PT), Shallow tube well (STW) pump, Sprayer, Rice Thresher, Corn Sheller and Rice mill. Moreover, another study was conducted by iDE for REFPI program during 2003 titled "Agricultural Machinery, Tool and Equipment Subsector". This is downloadable and please check the following [url](http://www.value-chains.org/dyn/bds/docs/detail/262/1)<http://www.value-chains.org/dyn/bds/docs/detail/262/1>

¹⁰. For details please check the following link http://www.ideorg.org/OurStory/PRISM_toolkit.pdf; and http://www.ideorg.org/OurStory/PRISM_guidelines.pdf

Why a Subsector Study?

A common practice of defining a subsector is through the final product it deals with (see text box 1) but in this study it is defined as a current and potential network of entities that are involved in production, distribution actors, experts, extension and consumers of agricultural machines. *Subsector research revolves around four principal concepts: verticality, coordination within channels, competition between channels, and leverage* (Boomgard et al., 1992). In this particular case the agricultural machinery subsector can be seen to include the companies that import the machines, local manufacturers/workshops involved in fabrication process or spare part production, the GoB and NGOs involved in extension, scientists, local dealers and retailers, financial institutions, and service providers.

The underlying goal of this study is to design interventions and associated activities to accelerate scale-appropriate mechanization at the CSISA hubs. Therefore the study delineates intervention plans based on the practical constraints in the field where multiple actors and entities are involved both vertically and horizontally.

1.4.1 RESEARCH TOOLS

Initial Consultations

Initial consultations were held with relevant experts, extension managers, scientists and CIMMYT officials to detail out the study plan and implementation. During this phase detailed protocols of different study tools were offered for review and comments.

Literature Review

A thorough literature review was undertaken for this study. Although sub sector studies on agriculture mechanization in Bangladesh are scarce but not completely unavailable, the study team reviewed the experience of various GoB and NGO projects as well as technical papers on various demonstration results. It should be noted that there is no systemic procedure from any agency in Bangladesh to collect and monitor mechanization statistics. Hence, quantitative information on various numbers of machines came from secondary sources while updating the old secondary data was done by triangulating information from importers, dealers and manufacturers.

Interviews

A key feature of designing the interview technique was ‘snowballing’ different leads from different actors. It was initially understood that agricultural mechanization has spatial variation because of different levels of penetration from market actors, and interventions from NGOs and public extension programs. While it was understood that there are key manufacturers located beyond hub areas¹¹, interviews were not limited to any administrative geographical boundaries like Districts or Upazilas¹². For example, while talking with 4WT owners and service providers in the Jessore hub it was found that there is another broker intermediary who usually helps find businesses for the service providers in distant districts. The study team therefore had to reach out to those brokers to understand the total supply chain of services even though they were outside the geographical remit of the CSISA hubs.

¹¹. Study team visited Sylhet and Rajshahi based manufacturers which are beyond the CSISA hub areas

¹². The districts of Bangladesh are divided into subdistricts called Upazila. Upazilas are similar to the county subdivisions found in some Western countries.

An ‘easy to do’ checklist was designed to carry out the interviews with the various actors¹³ that covers all the components of the subsector. Interviewers were trained on different qualitative tools i.e. one-to-one interviews, Key Informant Interviews (KII), focused group discussions along with the overall objective and nature of the study. After each day’s work the study team sat together to check the data recording sheets for group discussions for unintentional gaps and to share the overall experience of the day.

Focused group discussions (FGDs)

Focused group discussions (FGD) were carried out to understand different business models and diversities within the business models due to spatial variations from both service provider and service users perspectives. A total of 4 FGDs were conducted per hub. Detailed FGD checklist and guidelines were produced and piloted prior to embarking on actual fieldwork. The idea behind segregating the FGD respondents came from the following issues;

FGD 1 : Mechnized service peoviders of an advanced area within hub
FGD 2 : Mechnized service user of an advanced area within hub
FGD 3 : Mechnized service peoviders of non-advanced area within hub
FGD 4 : Mechnized service peoviders of non-advanced area within hub

Figure 1: FGD respondent type

1. In general, there is a spatial variation of agricultural mechanization in various regions of the country;
2. Intra-hub variations on the status of mechanizations were also found; and,
3. It was also found that some technologies have successfully been promoted in areas which are beyond the hub areas. In such cases study team did not limit its effort by limiting the study in terms of number of FGD conducted within hubs rather these success areas were also covered.

Process Case Studies

While designing the study four key issues were selected to have process case studies and these issues are as follows: a) service provisioning system (SPS); b) repair and maintenance (R&M) services; c) subsidy; and, d) access to mechanized services from service buyers’ perspective. In each hub these process case studies were documented by interviewing relevant respondents.

1.4.2 SELECTION ISSUES FOR VARIOUS METHODS

Selection of Study Area

During the selection of FGD area the study team consulted local and/ or regional DAE offices to understand different level of advancement within hub areas. It should be noted that, if 4WT and Seeders are excluded from the agricultural machinery sub-sector than the picture is almost same throughout the country. While consulting with the local agricultural offices the study team also located different manufacturers within the hub areas and interviewed them.

¹³. Company, importers, dealers, manufacturers, brokers, financial institutions, public extension agency, scientists, NGO officials and other relevant key informants.

Selection of Interview Respondents

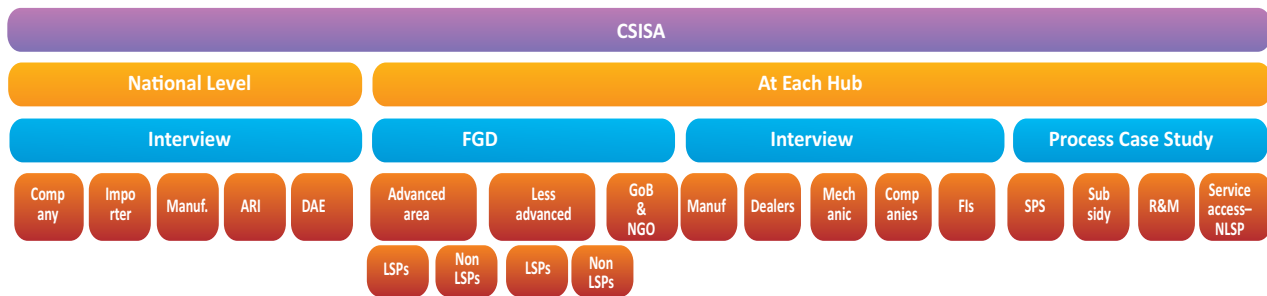


Figure 2: Overall tools distribution at national and hub level

Interview has been taken from a range of respondents. While some interviews have been done at central or Dhaka level e.g. DAE, BARI, others were done within or beyond hub areas. These were mostly manufacturers, scientists and extension agency officials, companies, dealers etc. Rather than number of interviews completed, the quality of information has remained a key consideration. For each category a short checklist was produced and enumerators were trained on each checklist.

Selection of FGD Participants

While it was very easy to find a group of mechanized service users but it was not the case when the study team tried to arrange a group of the service providers. Attention was given to have a mixed level of participants i.e. service providers of different machines so that a comprehensive picture comes out of the discussion.

Table 1b: Study participants and methods

#	Method	Participants	Dinajpur	Jessore	Khulna	Faridpur	Barisal	Total
1.	Interview (National level)	Company, ARI, DAE, Scientists	-	-	-	-	-	20
2.	Interview (Local level)	DAE, manufacturer (3), dealer (3), Mechanic (2), Companies, FIs	13	20	10	17	10	70
3.	FGD	Advanced –LSP	1	1	1	1	1	20
		Less Adv– LSP	1	1	1	1	1	
		Advance –NLSP	1	1	1	1	1	
		Less Adv– NLSP	1	1	1	1	1	
4.	Process Case Study	SPS, Subsidy, M&E, service access -NLSP	4	4	4	4	4	20
5.	Non-participant Observation report	-	2	2	2	2	2	10
Total Activity								140

1.4.3 STUDY LIMITATIONS

The study was designed in such a way to develop a broad qualitative understanding on the overall agricultural mechanization status of Bangladesh. The tools used were rapid in nature and therefore have limitations because of the reliance on respondents' recollections, limited geographical coverage, and small sample size. No statistically representative sample survey has been completed in this study that can represent national status in terms of generating different numbers of the machines. Therefore, numbers generated here may not have a 'scientific' statistical validity and quantitative data used in this study comes from various sources which used different definitions. However, the study team engaged in triangulating information throughout the study period in order to verify the accuracy of the reports received.

CHAPTER

2

AGRICULTURAL MECHANIZATION IN BANGLADESH

2.1 General Features of the Agricultural Sector in Bangladesh

Agriculture remains one of the most important sectors of the Bangladeshi economy, contributing 19.94 per cent to the national GDP¹⁴ (BBS 2011; & Raihan and Ahmed 2008). Approximately 82 per cent of the country's population lives in rural areas, virtually most of them making their living exclusively or substantially from agriculture. The agriculture production rate has been relatively steadier compared to the rapid growth in population of Bangladesh. About 8.2 million ha of the total cultivable area has already been brought under cultivation. Triple cropped area of the country is only 1.0 million ha which is 12.50% of the total cultivated area. Double-cropped area is 4.0 million ha and rest is single cropped. Total cropped area of the country is 14.00 million ha (with a cropping intensity of 180%) (Hossain, 2009).

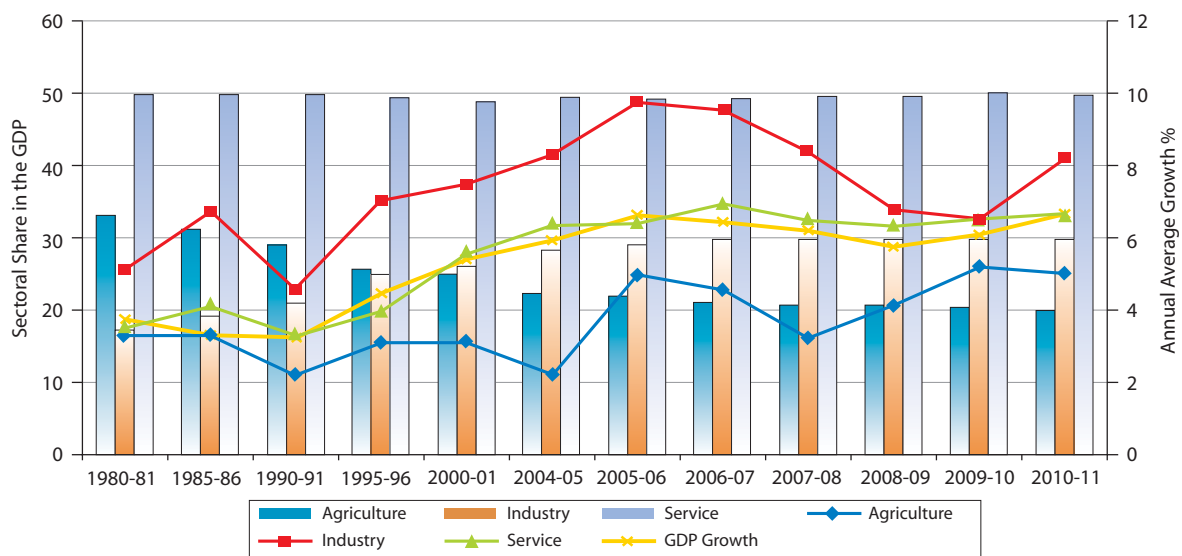


Figure 3: Inter-sectoral dynamics in the macro-economy of Bangladesh

Although the country's food production has increased from 11.0 million tons in 1971 to about 30 million tons in 2007 (Ibid 2009), Bangladesh is still importing an average of 2.0 million tons of food grains each year to meet minimum subsistence needs of the population. Bangladesh must feed a population of over 150 million people from only 8.2 million hectares of cultivable land (Ibid, 2009). Every year almost 200,000 people are being added to the total population whilst the estimated annual shrinkage of agricultural land

14. Data used for the FY 2010-11 are provisional.

is about 0.08 million hectares (BRRI, 2009). Therefore, to meet the food requirements of the Bangladeshi population in 2015, an additional 5 million tons of food grain will be required from continuously decreasing agricultural lands. To achieve this target, production per unit of land must increase as well as cropping intensity; therefore crop yield are required to increase with losses minimized.

At present some 62% of the labor force is engaged in agriculture, a very high figure compared to similar developing and most developed countries. Although 62% is engaged, there exists significant seasonal laborer scarcity and increasing labor wages which lead to increasing production costs. Total cost of production of dry season paddy in Bangladesh is US \$ 418.87/ha compared to US \$ 336.28/ha in West Bengal, \$ 253.17/ha in Punjab, 223.65/ha in Thailand and \$ 274.45/ha in Vietnam. The highest cost in Bangladesh is due to the high costs of irrigation, fertilizer and human labor (Kabir et al. 2008). Increased use of farm machinery will free many farm laborers for non-farm activities, which is essential to increase income for rural laborers. Also increasing the irrigation efficiency and use of more farm machinery can reduce the cost of production to a great extent. Therefore farm mechanization can lead to increases in production, cropping intensity and crop yield.

2.2 Historical Context – Agricultural Mechanization

Bangladesh has successfully increased its aggregate production in last the three decades. The key factors which have contributed in increase in production are:

- the availability of improved varieties of seed;
- development of shallow tubewells and spread of small horsepower diesel pump sets;
- mechanized tillage, threshing and milling;
- inter-crop time gap reduction resulting in increasing cropping intensity;
- increasing and consistent demand of cereal crops;
- a vibrant private sector in both input and output aspects of production.

During different time periods different machines have been introduced to the market both by public sector and the private sector. While the individual machines which are the subject of this study have their own historical context in Bangladesh (described in individual chapters below) a generalized historical pattern of mechanization can be built.

2.2.1 THE 1960S - A TIME OF MACHINERY INTRODUCTION

During this decade the 4WT and certain key irrigation equipment (DTW and LLP) were introduced into Bangladesh. Comilla BARD worked out a cooperative based model to promote the service of 4WT in the Comilla area (Lewis 1996) whereas BADC also installed DTW in the northern part of the country where farmers used to get the water free of charge (despite the employment of subsidies the program resulted in limited success (Hossain 2009)). A key focus during 60s was on large scale gravity flow irrigation and flood control projects but most of these projects later *suffered from large cost overruns and long implementation delays*. Lewis (1996) mentions that introduction of the 4WTs were part of a package of HYVs being promoted by the government and donors. By the end of 60s the cooperative based 4WT service stations were closed because of both technical and management inefficiencies. At the same time BADC

started its rental system operation of LLP through which farmers paid rental fees and fuel at 75% subsidy. LLPs were fielded in the low lying *haor* basins of greater Mymensingh and Sylhet areas. It should be noted that the overall practice of irrigation was manual and improved IRRI varieties were yet to be popularized in the country. But throughout the 60s LLP started to picking up its popularity with the rise of adoption of boro rice in the low lying plains.

Table 2: Reforms during the 1960s

Year	Public sector	Private sector
1961	Agriculture Development Corporation (BADC) rents LLPs to farmers on an annual basis	Farmers pay the rental fee and fuel at 75 percent subsidy
1962-66	Water Development Board (BWDB) installs and operates 380 DTWs with four-cusec pumps in the north-western region	Farmers pay the rental fee and fuel at 75 percent subsidy

Source: Hossain, M 2009:2& Gisselquist. al. 2002

2.2.2 THE 1970S- THE RISE OF PUBLIC SECTOR DRIVEN IRRIGATION

One of the key features of irrigation technology development during the 1970s is the rise and fall of large investments in public sector driven initiatives. During the 1970s heavy public investment was made in installing DTWs and by 1978 the number had increased to around 9000. IDA (Credit 341 BD) financed projects also contributed in such large scale investments (WB 1978) in DTWs throughout the country¹⁵. BADC initially continued to own, operate and manage a large number of DTWs and LLPs during the 70s. It was reported that by the mid 70s the total number of LLPs was 35,000 and covered three quarters of the total irrigation area at the time. However, managing such a large number of machines was very difficult and BADC started to introduce irrigation management groups to manage these LLPs. Yet by the end of the decade there was a paradigm shift in the focus in exploiting ground water

In 1979, the government decided to change its policy of direct involvement in the input market and to privatize the marketing of irrigation equipment (along with chemical fertilizers). This policy change involved the selling off of existing and new LLPs and DTWs, initially to farmers' cooperatives and later to individual farmers. The equipment was sold through a number of private dealers with credit from commercial banks and Bangladesh Krishi Bank (BKB)—a specialized financial institution set up for the distribution of agricultural credit. The BKB started its own program of providing credit to facilitate the purchase of STWs through its appointed private farms (Hossain 2009:4). Donor supported programs continued to invest in STWs which was only 7,000 by 1978¹⁶.

In 1980 government reduced the tax to 15% and BADC stopped renting out the LLPs rather started selling the new and old reconditioned LLPs to the farmers.

15. Biggs (1978) summarized a number of reasons for such large scale investments from government and donors.

16. It was reported that by 1978 a number of proposals were already been approved to install around 35,000 STWs. 2,500 under the IDA-financed Rural Development Project (Credit 631-BD), 5,500 under an ADB-financed Agricultural Credit Project, 17,000 under bilateral assistance from Japan, Germany and India, and 10,000 under the IDA-financed STW Project (Credit 724-BD) (WB 1978).

Table 3: Reforms during the 1970s

Year	Public sector	Private sector
1972	BADC starts renting STWs to farmers' organizations	Farmers manage operation of the tubewells
1974-75	BADC starts selling STWs to individual farmers with subsidies; Bangladesh Agriculture Development Bank provides credit for the acquisition	
1977-78	BADC abandoned tillage machinery extension in 1977-78	
1979	Private sector allowed to import and distribute STWs, with credit facilities from commercial banks	Private sector starts workshops for repair of irrigation equipment
1980	Import duty on STW sets is reduced to 15 percent	Private sector starts manufacturing of pumps
1980	BADC stops renting LLPs and starts selling new and used LLPs to farmers' cooperatives	

Source: Hossain, M 2009:2& Gisselquist et. al. 2002

2.2.3 THE 1980S – DECADE OF DEREGULATION

The 1980s was probably the most important decade for agricultural mechanization in Bangladesh. While initially the deregulation that started in the late 70s did not gain momentum¹⁷, efforts continued to increase the private sector's involvement in minor irrigation. However, all these efforts faced a shock in 1984-85 as the government put different restrictions in the sales of STW pumps in 22 northern districts, a ban on import of STW pumps. All these restrictions came out as a result of the 1983 drought where it was claimed that the STWs in the northern part of the country were becoming 'dry'.

¹⁷. Hossain highlighted 2 main causes for slow impact of deregulation 1) reluctance of the civil servants to release control and power, 2) a limited private market for repair and maintenance (Hossain 2009).

Table 4: Reforms in the 1980s and 1990s

Year	Public sector	Private sector
1981-82	BADC starts offering rental DTWs for sale at subsidized prices with credit from commercial banks	Workshops and repair facilities for irrigation equipment grow
1984-87	Sale of STWs in the north-western region and formulation of Groundwater Management Ordinance; the private sector's import of small diesel engines is banned in response to drawdown of aquifer during the 1983 drought	Private sector trade limited to a few standardized engine brands; sales of STWs drop due to restricted installation within specified zones and spacing regulations
1985-87	In 1985-87, the government established a workable foreign exchange market and ended many nontariff barriers (nontariff barriers continued for diesel engines for irrigation and power tillers).	
1988	In 1988, the government eliminated import taxes on standardized (approved for agriculture) diesel engines and power tillers.	Private sector import accelerated.
1989	In 1989, the government ended standardization, allowing import without taxes for all 3-20-hp diesel engines and all power tillers.	
1987-89	Private sector bans on small engine imports are removed, import duties are eliminated, standardization requirements for equipment are abolished, and tubewells boring restrictions are withdrawn	Private traders start importing cheaper STWs from China; multiple engine brands and sizes enter the market
1990	BADC starts clearing out its stock of irrigation equipment and stops monitoring boring of equipment	Market for engines, pumps, and spare parts spreads; repair works mushroom all over the country
1995	In 1995 import of power tiller/2WT was made duty-free, along with credit support for purchase of these machineries	

Source: Hossain, M 2009:2& Gisselquist. al. 2002

While Hossain (2009) has emphasized that the internal resistance from the bureaucracy resisted the reforms, it is also the bureaucracy that led further deregulation in 1988. When the leadership changed in the Ministry of Agriculture in 1988, the new secretary took a direct interest in implementing the liberalization program. The Ministry ensured that the constraints of the private sectors are adequately addressed in the policy. Justice and Biggs (2010:9) mentioned the reasons behind in another way:

After a cyclone hit Bangladesh in 1988 within two-and-half years of a previous one, taking not only a major toll on human life, but also on the oxen population, President Ershad asked what machinery would be most appropriate for their quick replacement. He was told that the Chinese 2WTs could do this, but due to the standards committee they could not be imported. To

overcome this problem, Ershad simply disbanded the committee. This action, combined with market liberalization and the lowering of tariffs, resulted in what could be termed as a flood of small engines and associated tillage, pumping and other equipment.”

Overall, during this decade STW and 2WT experienced a major boost, the number of STWs increased from 93,000 in 1982 to 260,000 in 1990 with a 200% growth (Figure 4). These reforms probably contributed the most in accelerating the mechanization in Bangladesh and continued in the latter decades. It should be noted that, during the 1980s the fertilizer and pesticide market were also brought under reform making entry into the market for the private sector became far easier.

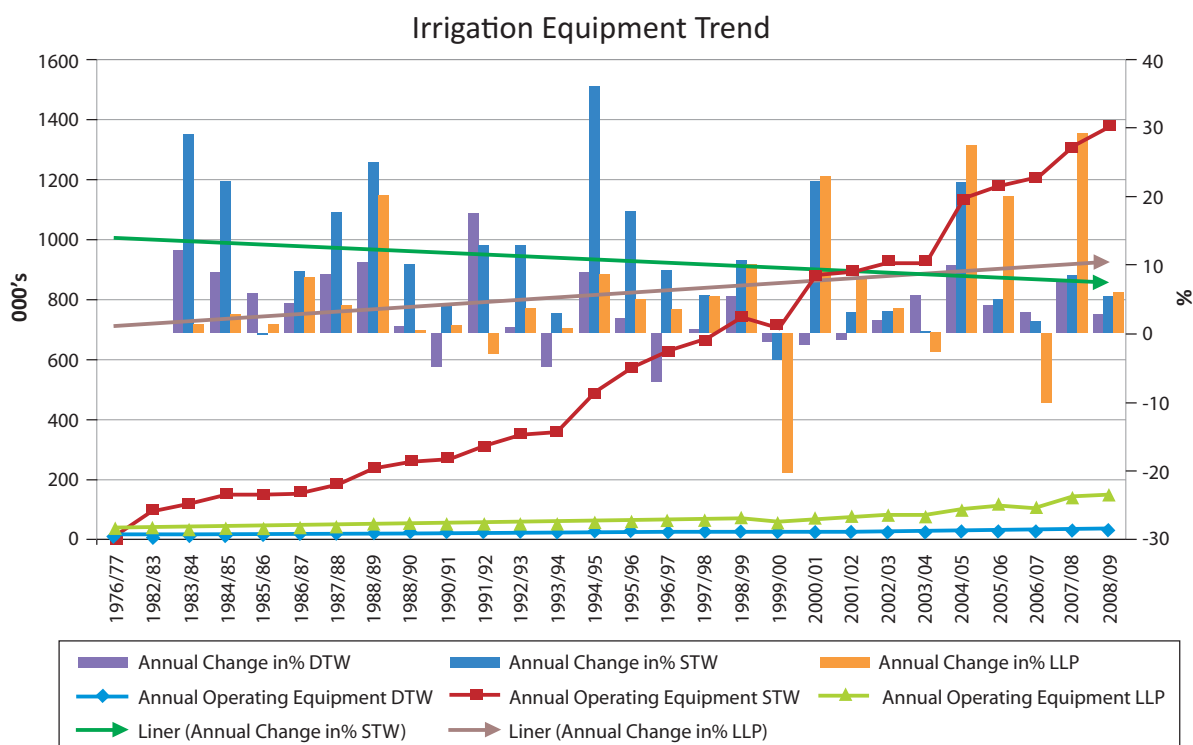


Figure 4: Irrigation equipment trend

2.2.4 THE 1990S TO DATE – GROWTH OF PRIVATE SECTOR DRIVEN MARKET

While the 1980s can be understood as the period that created a more conducive business environment, in later decades the participation of the private sector in the market continued due to an ongoing demand for various machineries for tillage and threshing. Cropping intensity increased from 153.74% in 1980 to 180.88% in 2010. While no comprehensive source of data is available in Bangladesh, the study team has reviewed various secondary documents to access historical data and the information from hubs in addition to information sourced from importers, dealers, and manufacturers.

Table 5: Number of machines used for agriculture purposes

Machine	1977	1984	1989	1996	2006	2008	2009	2010	2011
4 Wheel Tractors ^A	300	400	1,000	2,000	12,500	14,890	17,905	21,638	26,369
2 Wheel Tractors ^B	200	500	5,000	100,000	300,000	343,000	366,700	400,030	420,027
DTWC	4,461	15,519	22,448	24,506	28,289	31,302	32,174	32,912	-
STWD	3,045	67,103	223,588	325,360	1,182,525	1,304,973	1,374,548	1,425,136	-
LLPE	28,361	43,651	57,200	41,816	119,135	138,630	146,792	150,613	-
Threshers (Open drum) ^F	-	500	3,000	10,000	130,000				190,000
Threshers (Close drum) ^G	-	100	1,000	5,000	45,000				65,000
Maize sheller ^H				100	850				5,000
Combine Harvester ^I						±30			100
Winnower ^J						±500			±200
Sprayer ^K						1,250,000			1,250,000
Reaper ^L						±40			±50
Dryer ^M						±500			
PTOS ^N					451	481	620	870	1190
VMP ^O									45

VMP= Versatile Multi-crop Planter

PTOS= Power tiller operated seeder

A, B= Data till 2006 has been taken from Roy and Singh (2008), other data came from estimations and triangulations made during this study. It should be noted that annual import for 2WT and 4WT is around 50,000 and 10,000 respectively. In case of 4WT, only 50% of the imported machines are exclusively sold for haulage purpose and the rest does both tillage and haulage. Estimating that 2006 data represents the actual number of 4WT operating exclusively for tillage at that time, we have estimated the 4WT data in the following years considering the annual drop out from agricultural uses and also the yearly import. In case of 2WT, even though 60,000 are imported, it is estimated that nearly 60% are not being used for agriculture each year, thus potentially around 20,000 units are being added to the agriculture tillage system

C, D, E= Data came from Minor Irrigation Survey of BADC.

F, G, H= Data till 2006 has been taken from Roy and Singh (2008), other data came estimation.

I, J, K, L M= Data taken from Rashid (2009) and Wohab (2011)

N, O= Estimated through this study.

A view of a generic supply chain of agricultural machinery (Figure 5) clearly shows that actors from both public and private sectors are actively engaged. While public sector research organizations have been innovating and modifying existing machines, private sector actors are

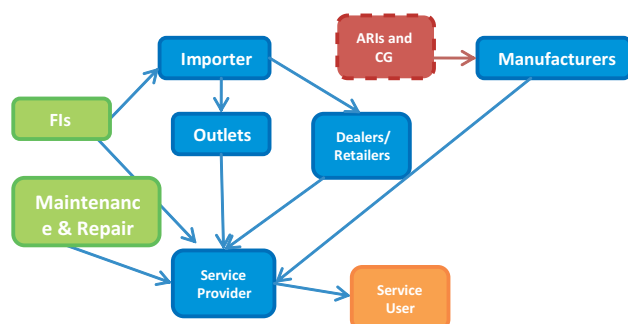


Figure 5: Generic Agricultural Machinery Supply Chain

involved in modifying the machines imported mainly from China and India. While there as many as fifteen manufacturers producing and replicating a number of locally designed machines, there are numerous workshops which support the current status of mechanization. Documents suggest that around 40,000 small and medium sized metal workshops around the country have been supporting the sector by producing different non-precision machines (weeder, threshers etc.), supplying spare parts as well as providing much needed repair and maintenance services (Ziauddin and Ahmed 2010). Importers of machines have been selling the products either through their designated outlets (4WT) or through widely distributed dealers and retailer network (2WT and Diesel engines mainly). It should be noted that local level spare parts manufacturers have been growing to produce specific spare parts of 2 WT, 4 WT and for pumps. Commercial and SME banks have also been providing financing for service providers as well as manufacturers and importers.

Sector Information

- *Each district has local manufacturers or workshops producing threshers.*
- *Only one industrial level manufacturers and supplies around 10,000-15,000 units each year through its own marketing channel (Alim Industries Pvt. Ltd., Sylhet)*
- *Several thresher manufacturing zones have been developed i.e. Sylhet & Kishoreganj zone, Dinajpur zone, Jessore-Jhenaidaha zone & Comilla Zone.*
- *Most of the local level manufacturers predominantly manufacture threshing machines and maize shellers of different types and designs.*
- *Threshing machine (Power Thresher) has been the highest selling agro machine for almost all of the local agricultural machine manufacturers/ workshops in the recent years.*
- *District level manufacturers usually produces 10 to 300 units per year but most of them produces only a few pieces (as ordered by customer).*
- *Design varies significantly and power for the threshers can be up to 20HP.*
- *Local innovation reported as their threshers can do multiple crops.*
 - o Rice, wheat, mung bean, sesame, mustard, lentil, etc. were reported to be threshed*
- *Tradition of cash payment (buyers) has been established for the threshers.*

Text box 2: Thresher-Sector Information

One of the most notable features of agricultural mechanization in Bangladesh is perhaps the service selling system through which machine owners act as local service providers. This service provision system is consistent with the landholding disaggregation as well as being pro-poor. Poor farmers can access the service all around the country. Another important aspect of agricultural mechanization is the growth of the non-farm (NF) sector which has acted as a 'growth engine' in the rural economy (Mandal 2002; Hossain 2002). It has been highlighted that most of the rural non-farm sector developed because of agricultural mechanization i.e. *rapid spread of irrigation technologies for rice production, increased mechanization of tillage, growth of equipment manufacturing, support services for farm equipment (1.7 million owners/managers, 0.76 million operators of manual irrigation device, 0.16 million rural mechanics, created 11,000 full man-years of employment), increased trade in agricultural inputs (4,000 fertilizer dealers, numerous retail traders, etc.), increased cereal production and subsequent grain storing, trading, rice parboiling and milling etc (Hossain 2002).*

This study explored the general mechanization scenario at each of the CSISA hubs. However, in-depth study has been undertaken focusing on specific machines i.e. 4WT, 2WT, threshers, Seeders and reapers. While analyzing the specific situation of certain machinery success stories of a specific machine can contribute in understanding the constraints for other machineries. In this the Thresher was selected as a ‘case’ to be explored first so that the learning can contribute in analyzing the constraints and opportunities for other focused machines.

2.3 A Success Story: The Thresher

The Thresher has been one of the most successful agricultural machines in Bangladesh. Threshers have a long history in Bangladesh and most important aspect of this long history is that Bangladesh since the early days in 60s, it never relied on import of threshers rather till date local manufacturers have continued to supply in the market. In 1960, the first prototype pedal thresher was brought from Japan and was reproduced in the Comilla Cooperative Karkhana. Bose (1986) reported that the production 218 unit in 1975-76 increased to 2,350 in 1983-84. Campbell (1986 op cit Bose 1982) pointed out that in 1979,



Figure 6: Power Threshers have become increasingly popular in Bangladesh

researchers at Comilla attempted to modify the British NIAE rasp-bar thresher (powered by a 2.2 hp engine) by making it a manually powered machine for wheat. Up to 1980, there were 1,000 power threshers in Bangladesh (Farrington 1986 *cit.* Huq 1985). The Karkhana threshers were made from engineering drawings produced in Pakistan by the International Rice Research Institute — Pakistan (IRRI-PAK), under IRRI Agricultural Engineering Extension. The basic IRRI design of the power rice thresher was modified to thresh wheat, sorghum, and maize.

At present, all the districts have local manufacturers of threshers and because of high competition among the manufacturers price remained very much affordable. Threshers can come in various sizes, shapes and capacities. The outlook of the thresher also varies because of the raw material and signature touch used by each manufacturer. Thresher is used mostly for paddy, wheat, maize and pulse crops. Regional variation of preference can also be seen. In general on the southern part open drum threshers are more popular whereas in the northern part close drum threshers have gained much popularity. It is common practice that farmers generally prefer open drum threshers for aman paddy threshing as they usually keep the straw as fodder.

Threshers in Jessore and Khulna Hub

In the Jessore and Khulna hubs, there are around 100 manufacturers of threshers - 10% of those are large producing up to 1000-2000 units each annually 30% medium scale producing around 450 units, and the rest 60% small scale with 5 to 50 units of annual production. The close drum power thresher is not popular in this region. In the south most of the large scale manufacturers are situated in Jhinaidah sadar and Kaligonj of Jhenaidah District and they have a good retailer network across Khulna, Jessore and Barisal hubs and beyond like Shirajgonj, Pabna and Ishwardi.

Regarding scale up, manufacturers stated that although the service receivers to service provider ratio shows that the thresher service provision market is quite saturated at this moment, but the demand for this machine is still quite high and have been increasing. The major reason behind this that the manufacturers identified is that during the peak season, farmers usually do not want to wait for threshing their crops as there exists risk of rain or storm. One said, "In the boro season there are chances of sudden and prolonged rain which might damage the crop. Therefore, farmers always try to store threshed crop as early as possible. As a result, since the machine saves time, is quite cheap, reduces labor cost, and has high longevity, even a 1 bigha land holder wants to be owner of a thresher."

Text box 3: Thresher in Jessore and Khulna Hubs

2.3.1 REASONS FOR SPREAD

Pull Factors

1. **Labor Shortage:** During the harvesting period almost all the paddy ripens and is harvested within a very short time period. At this time labor crisis had become a serious challenge throughout the country. Therefore, threshing machine has been hugely accepted by the farmers as an effective and cheap replacement.
2. **Mobility:** Service providers can move their threshers (open drum threshers can be carried and heavier have wheels attached) easily and can cover a large service area.
3. **Affordability:** It is comparatively cheaper than other machineries. While open drum manual (peddle) thresher costs around 2000 to 4000 taka, open drum power thresher costs around 20000 to 25000 taka. Price of closed drum power thresher ranges from 30000 taka to 45000 taka. This price and model range caters to many levels of farmers / SPs- their needs and budgets

4. **Efficiency:** With closed drum power thresher (rice and wheat), threshing capacity ranges from¹⁸ 800 to 2,500 kg per hour depending on horsepower, size and model. For maize thresher the capacity is 1000 to 4,000 kg/hour.
5. **Return from investment is High:** A SP can get his/her investment back within 1 to 2 seasons.

Push Factors

1. **'Simple' machine to be replicated:** Production technology of threshing machine is comparatively less complex to produce in small workshops as compared to other agro machineries. Local workshops that are mostly equipped with some jigs, saws, welding machine and often with a lathe machine, can easily produce body of threshers easily and then can attach it to the engine.
2. **Research and Development Efforts:** Under different GoB and donor projects, special effort was given on the development of threshers. Prototypes of good quality threshers were procured. Research and development activities were done by both ARIs and local manufacturers.
3. **Countrywide and District Level Promotion:** Alim Industries Ltd, the largest thresher manufacturer, conducted countrywide promotion and free demonstration of their power threshers during harvesting season. Several other manufacturers also promoted their threshers in neighboring areas through demonstrations.
4. **Raw Material Availability:** Raw material is locally available and quite cheap. Therefore, local manufacturers can buy necessary raw material easily.
5. **Local workshops can do the servicing:** As the machine is locally produced so farmers can avail the maintenance and repair service at local level. Moreover, because of numerous mechanics available for STW and 2WT engines, engine problems can also be solved at the local level.

18. According to Alim's website the capacity range for paddy and wheat thresher is 1500-2500 kg/hr; for maize thresher it is 3000 to 4000 kg/hr. However, in the field we found out that this capacity was quite lower (800 to 1200 kg/hr) for some SPs and farmers. Therefore, we used this long range.

CHAPTER

3

TWO-WHEEL TRACTOR

3.1 Sector Overview

3.1.1. HISTORICAL CONTEXT

2WT has a long history in Bangladesh and as much as 60-70% of the net cultivable land is ploughed by this machine. It was reported that from the early 1960s to 1983, 6,362 2WTs were imported, with two-thirds sold to the private sector on highly subsidized credit (Farrington 1986, Jabbar et. al. 1983). The 2WT remained an expensive item until early 1988 as imported machinery mainly originated from Japan and cheaper machines were restricted because of standards and quality issues. Even after heavy subsidies until the late 1980s the price of machines was very high¹⁹ and sales remained low. Attempts have also been made to manufacture locally²⁰ (Farrington 1986 Gill 1981). A number of new policies along with deregulation in the 90s contributed in quick adoption of 2WTs. These are:

- In 1988, the government eliminated import taxes on standardized (approved for agriculture) diesel engines and power tillers;
- In 1989, the government ended standardization, allowing import without taxes for all 3–20-hp diesel engines and all power tillers; and,
- In 1995 import of power tiller/2WT was made duty-free, along with credit support for purchase of these machineries.

Sector Information- 2 Wheel Tractor

- *There are around 7 to 8 importers that are importing 2WT. Among them, Chittagong Builders, Mollah Machineries, Green Machineries and Amanat Machineries are notable.*
- *Chittagong Builders occupies more than 80% of the market share.*
- *Only one Bangladeshi manufacturer, Alim Industries Ltd, produces around 4,000 units per year with imported engines from China.*
- *All the imported 2WT are coming from China.*
- *During last 4 years 246,000 unit were sold and on an average following an increasing trend 60,000 units are likely to be imported in the upcoming year*
- *Spare parts and mechanic available all around the country*
- *3 years ago the number of importers were 12 but now only 8 remained functional because of:*
 - *Monopoly market structure*
 - *Indication and substantiation by smaller importers that there has been some affect by the subsidy on the number of importers*

Text box 4: Sector Information of 2 WT

¹⁹. Farrington (1986) pointed out that during 1980, with a heavy subsidy the price of the machine was 1,800 USD whereas the true value of the machine in international market was 4,100 USD.

²⁰. During 1980-82, a total of 200 units of IRRI PT3 were manufactured locally using imported components and materials. But because of lack of reliability these machines were not readily adopted.

Historical context also suggests that the deregulation on diesel engines, mostly for irrigation pump sets, had a huge implication on scaling up 2WTs as the different Chinese diesel engines are similar and many parts are interchangeable even across different engine capacity. As the mechanics and repair services and spare parts availability (and even their production) increased, the sales started to increase in the rural areas. Also, fragmentation of the land has always been more suitable for 2WT as these machines can access any land plot as compared to 4WTs. Hence, the scaling up of 2WT is not merely a result of trade and policy reforms on 2WT rather reforms targeting other machines that have also had positive impact on 2WTs.

3.1.2 CURRENT MARKET STATUS

There are two types or models of 2WTs imported from China- Dongfeng and Sifang. The outward appearances seem to be similar and are differentiated only by their transmission systems. The Dongfeng and Sifang models are copied by tens if not hundreds of Chinese companies. At present eight importers have been supplying 2WTs in the market and on an average 60,000 are imported each year. The market is heavily dominated by one importer, Chittagong Builders, that controls more than 80% of market share. Other importers market share remains very small and they have been competing with each other to have a better share in the market. Clearly, the demand is very high for a particular brand²¹ and is being imported by Chittagong Builders. Unlike the 4WT market, 2WT importers generally supply 2WTs through a network of dealers and retailers with only a very small portion (3-5%) being directly sold to the customers by the importers. This large national dealer network allows buyers to easily buy at the local level (Upazila or District). Current sales trends also suggest that the number of machines will continue to increase in the coming years with the number of machines likely to reach a 0.5 million mark by 2015.



Figure 7: 2WT operating in the Field

Table 6: Historical trend of 2 WT with projection²²

Machine	1977	1984	1989	1996	2006	2008	2009	2010	2011	2012	2013	2014	2015
2 Wheel Tractors ^A	200	500	5,000	100,000	300,000	343,000	366,700	400,030	420,027	440,000	460,000	480,000	500,000

^A= Data from 2012 to 2015 are projections.

21. Sifang brand is produced by Yongkang Tractor Factory of China, and imported by Chittagong Builders Ltd. of Bangladesh. This importer alone has 321 dealers across the country covering all the districts and major Upazilas.
22. Though around 60,000 units are being sold every year, it is estimated that nearly 15-20% of those units are replaced every year because they become old and tractor drivers have difficulties in plowing using such old tractors. These are then used for haulage, so we have estimated that around 20,000 units are being added for tillage purposes every year.

3.1.3 KEY ACTORS

Importers

A total of 8 importers are actively engaged in the business. The overall retail market value of the imported 2WTs is around US\$72 million per annum. It was reported that several importers have made attempts to secure distributorship from Sifang's Yongkang Factory but could not do so. There are other good quality brands of 2WTs available. If they could similarly market their brands better there could be more competition and further benefits for buyers²³. If not the market is likely to continue have 1 large importer. Due to the Government's recent subsidy program²⁴ "approved" small importers have been benefiting as through increased sales.



Figure 8: Most of the old 2WT are later used in haulage purpose

Dealers

It has been estimated that there are around 500 dealers of 2WT in the country. Usually, 2WT dealers are also involved in the business of Chinese diesel engines, spare part of engines and pumps. Chittagong Builders Ltd. (CBL) is the only importer with its own dealer network. The rest of the importers rely on the existing dealers in the market. Dealers get a fixed amount of money for selling each machine unit. It was found that this fixed amount can be higher for the lower priced, moderate quality and low quality machines as compared to the higher quality 2WTs.

Across the hub areas around 200 dealers are selling 2WT as well as diesel engines of different Chinese brands and models including Dongfeng, Sifeng, etc. by various Bangladeshi companies including – CBL, ACI, RFL, SOWAN, PARTEX, GAZI. Besides 2WT and engines they also sell spare parts. Additionally 2WT dealers sell winnowers, peddle and powered open drum threshers. Regarding 2WTs, most of the dealers procure various machines directly from different importers (most are based in Nowabpur).

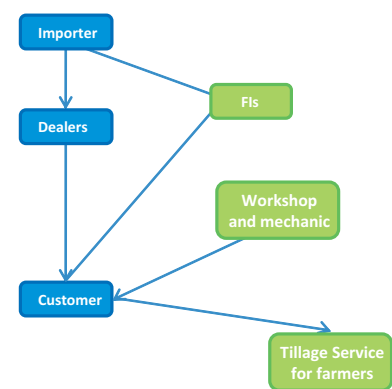


Figure 9: Actors in 2WT market

²³. Even if an oligopoly exists a review of retail markets in other Asia countries shows that Bangladesh has one of the cheapest retail prices of Chinese made 2WTs in Asia.

²⁴. GoB's Enhancement of Crop Production through Farm Mechanization Project program has a special intervention designed where only couple of enlisted companies can sell their products through subsidy to the government selected beneficiaries.

Regarding CBL, dealers have to deposit Tk. 20,00,000 to be entitled as a dealer. In addition to the deposit, dealers can access a credit facility up to 50% of the deposited amount. As a CBL dealer they are not entitled to sell other branded 2WT. If so, the dealership will be cancelled. The company sends the machines by truck with a minimum order of 15 units. Transport costs are always paid by the dealers.

Most of the CBL dealers have storage facility to keep 75 to 100 machines. The CBL dealers provide after-sales-support for one year. The CBL dealers do not provide any guarantee to the customer. Many of the other companies' suppliers also provide after sales service or warranty²⁵.

3.2 Findings & Analysis

- Credit purchase options are widely available
- Sales trends show steady growth
- Growth in 4WT sales reduces 2WT markets, though 2WTs maintain certain advantages
- Mechanic services and spare parts are widely available though standards remain varied
- Return on investment for 2WTs remains attractive
- Service provision remains informal with fuel price a major factor

Informal credit purchase options are widely available

Previously it was the lead farmers who were the major buyers of agro-machineries such as 2WTs. For the last decade small farmers, small businessmen and even landless people have also been buying different machines. Increasing awareness about the business potential of different agro-machines, availability of micro-credit services, and GoB and NGO supported activities have brought about this transformation. Purchase on credit and increased credit facilities for both dealers and suppliers has become a key issue in agricultural mechanization and its rapid spread.

Most of the 2WT dealers get credit support to procure machines. The payments are generally made on informal installments. The amount of down-payment and installment and other modalities often depends on the relationship between the dealers and importers, or the dealers and the farmers. Most of the dues are paid at the year end. At that time importers can offer considerable discounts from the total due amount. However, some dues are often added with the following year's accounts.

Sales trends show steady growth

Increasingly good quality power tillers and diesel engines are available at the rural level. Chittagong Builders (2WTs and diesel engines) and Mollah Machinery (diesel engines and some 2WT) are the largest agro machinery importers in Bangladesh and are importing good quality machineries with distributors and dealers in almost all districts and upazilas. Interviews with various dealers revealed that the **cost of 2WTs can be as much as ten times lower than 4WTs** and can be paid off within one and half years. Abilities to pay off also depend on crop price and natural disaster.

²⁵. There is a common "sales" narrative that importers and agents will provide guarantee but the farmer will have to pay 1500-2000 taka extra for it. So 99.9% of farmers decide to buy without guarantee.

There is a wide range of quality in available 2WTs. Many importers and farmers are aware of this variation which are referred to as “first, second, third, fourth, and fifth” grades of 2WTs machine with one being of the highest quality. This gradation or scoring is an informal recognition system of quality of the machines by the importers and farmer/buyers alike. The same scoring scheme is applied to spare parts as well. The problem for the buyer is that it is very difficult to tell the quality of the machinery or spare parts as they look similar. The trend of the two highest selling brands brand’s average price is given below:

Table 7: Recent sale and price trend

	Average Price (of no. 1 brand)				Average Sales volume			
	2008	2009	2010	2011	2008	2009	2010	2011
Sifang	82,000	87,000	95,000	108,000	35,000	40,000	50,000	40,000
Dongfeng	66,500	66,500	77,700	88,800	15,000	18,000	23,000	22,000

According to the importers, since all good, moderate and lower quality machines and spare parts are available in the market, the quality of the machines and spare parts that farmers are purchasing mostly depend on what the local level dealers want to push.

This issue is illustrated by the Sifeng look-alike brands and models²⁶. In the market a number of derivatives of the Sifeng brand can be found, including Sifeng, Sifang Gold, AB Sifeng and MCO Sifeng which are imported by a range of importers. Their prices are 5,000 to 10,000 taka less than that of the original Sifang (CBL) brand. However, since the quality of Sifeng is understood to be much higher than the other brands, Sifeng is still the highest selling power tiller in the country.

Growth in 4WT sales reduces 2WT markets, though 2WTs maintain certain advantages

In the areas where 4WTs were or have been introduced, markets of 2WT have shrunk. The study team identified a clear tension between 4WT and 2WT markets and in many instances it was found that influential 2WT service providers also do not allow 4WTs to enter their service area. However, it was found that 2WTs still have a comparative advantage even in areas where 4WT are widely used, and that are realizing business in these areas. The reasons for this include:

- In the rainy season lands are flooded and therefore muddy and sticky and 4WTs cannot till or puddle those lands properly. Since 2WT can run on muddy tracks, it has potential business in that season;
- 4WT rotovators have still not been adopted fully in most of the areas and only the cultivator is still being used. Therefore, farmers also take 2WT service after tilling their land with 4WT cultivator to fine till their lands; and,
- Increasing land or plot disaggregation increases the number of small farms. Often 4WTs are unable to till those small plots because of cost-effectiveness and many lands are hard or impossible to get to with 4WTs.

²⁶. Initially in China Dongfeng and Sifeng were not just two copyrighted brands from two different factories but also models or designs, with the main difference that the transmissions are very different and therefore the attachments to a Dongfeng's power take off (PTO), 0 like the rotovator cannot be fitted to a Sifeng. Today in the copyright be damned atmosphere of China there are perhaps hundreds of factories or assembly plants making both Dongfeng and Sifeng designs/brands.

As agricultural land has been decreasing²⁷ due to conversion of arable land to non-agricultural uses, further disaggregation in landholding may also reduce the amount of arable land as many of the smaller holders' lands are surrounded by trees and bushes.

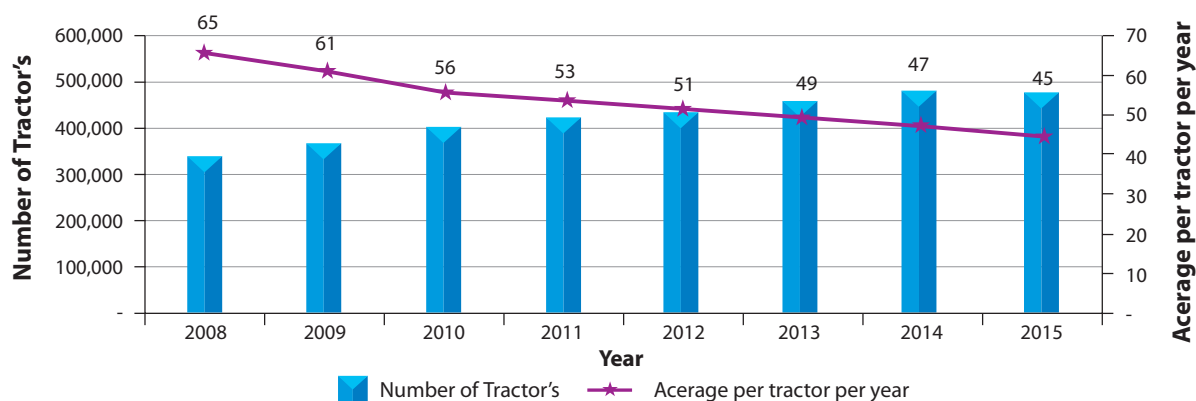


Figure 10: Decreasing acreage of 2WT

In this context 4WTs do not want to till small plots due to reduced cost-effectiveness. Therefore, 2WTs are used in those land plots which are either small or not easily accessible by 4WTs. On the other hand in the rainy season lands are muddy and sticky and 4WTs cannot till those lands properly because of an absence of cage wheels. Since 2WTs do have cage-wheels, they get the majority of the business in this season.

Table 8: Trend of landholding disintegration

Farm holdings	1960-61*	1967-68*	1983/84**	1996**	2005***	2008**
No. of marginal farms (less than 0.5 acre) million	0.80	0.82	2.42	3.35	5.83	4.10
No. of small farms (0.5-2.5 acres) million	2.33	3.09	4.65	6.07	7.52	8.43
No. of medium farms (2.5-7.5 acres) million	2.33	2.40	2.48	2.08	1.56	2.11
No. of large farms (greater than 7.5 acres) million	0.68	0.55	0.50	0.30	0.18	0.23
No. of absolute landless holdings million	-	-	1.20	1.81	3.95	3.68
Average farm size	-	-	-	1.50	1.20	1.26

Source:

* 1960-61 and 1967-68 data was taken from World Bank Staff Working Paper, Small Farmers and the Landless in South Asia, paper no 320; 1979.

** Information taken from the Agricultural Census, carried out by BBS.

*** Information taken from Agricultural Sample Survey 2005, carried out by BBS.

27. The land conversion to non-agricultural use is around 1% per annum in Bangladesh (Planning Commission 2009). Even though, the overall arable land estimated during 2005 was almost same as 1996. It has been suggested that due to conversion of forest and low lying fishing land as well as newly accreted char land to crop cultivations may be helping the country in retaining the aggregate amount of arable land. However, recent study by Quasem (2011) showed that the actual conversion ranges from 0.25 to 0.74 based on the proximity of the village from urban centers.

Mechanic services and spare parts are widely available though standards remain varied

According to many of the workshops engaged with during field investigation, when irrigation engines spread to different areas of the country a lot of mechanics also began operating in the market. As there are very similar technical features and even spare parts between irrigation diesel engine and 2WT engines, availability of mechanics was less of a problem for 2WT.

It was noted that across the study area there was no 2WT service provider found who hire drivers for tillage. Rather the service provider or other household members of the family usually drive the machine themselves. Besides driving, all service providers are able to do the minimum servicing and minimal repairs as the technology is simpler and now commonly known. But in some cases of servicing they go to the technicians who are near to the village. Triangulation of responses from farmers, mechanics and service providers suggests that on average there is at least one two-wheel tractor mechanic within 5 to 10 kilometer radius.

Based on feedback from Nawabpur importers and local spare parts shops and service providers, it is clear that 2WT spare parts are widely available in the market. From village retailer to importer there is a strong supply chain established. According to the 2WT dealers, besides themselves (who also supply spare parts), there are 5 times smaller retailers who sell spare parts. Therefore, if there are 500 2WT dealers in the market it is estimated that there are approximately 3,000 retailers of spare parts.

It was related by one importer that the spare parts import business is lucrative (with the analogy given that it is reminiscent of the computer printer industry where profit is maximized through sales of inputs such as ink cartridges rather than the capital cost of the printer).

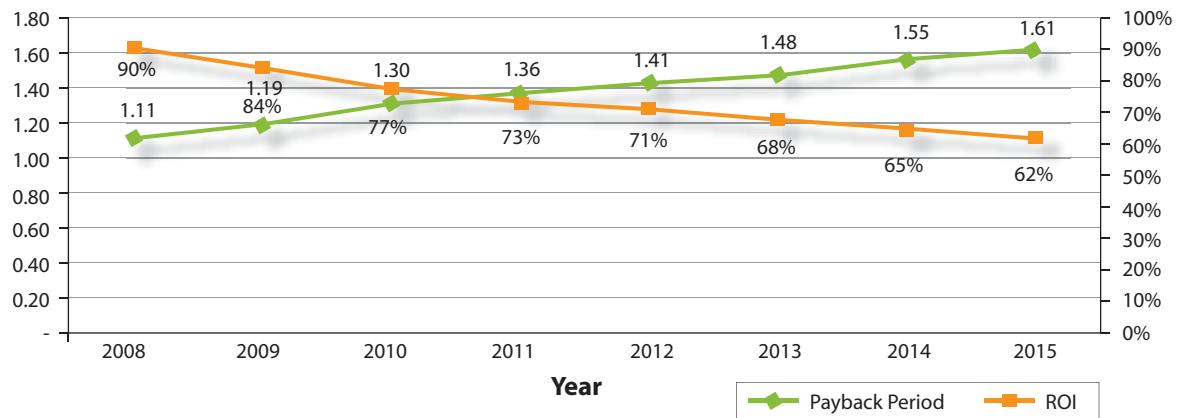


Figure 11: Rol and Payback period of 2WT

Return on investment for 2WTs remains attractive

Across the study area, no service provider was found operating at a loss. Based upon the national average acreage for 2WT (65 acres per year), if a service provider buys a 2WT against 112,000tk and provides service within this average area with a service charge of 800tk per acre per pass, then the owner is able to earn the capital cost within 1 year and 4 months. Even though the number of 4WTs is increasing and the average area covered by both 4WT and 2WT appears to be decreasing, the return from investment in a 2WT remains very attractive. This is evidenced in Graph 8, which shows that even if the area of 2WT tillage decreases (Figure 10), the ROI is still attractive.

Service provision remains informal with fuel price a major factor

The rate of increase in the adoption of 2WTs is leading to changes in the model of service provision, including the choices available to farmers, their bargaining capacity and quality of service they receive. There remains no common terms and conditions and services remain largely informal. Most of the time service providers provide services on credit and rates are set mainly based on fuel price. LSPs generally provide services on a “first come first served” basis. Other characteristics of service provision across the hubs are:

- 1200tk/acre for 2 passes tillage, 800tk/acre for pass tillage;
- In Barisal hub another pro-poor modality found is payment in kind (1/5th of the harvest); and,
- Many farmers believe that the service providers avoid deep till realizing greater profits as deep tillage consumes more fuel. Farmers reported that the tillage operation was satisfactory when the fuel price was lower but along with the increasing fuel price the quality of the tillage is also decreasing as service providers want to expend less fuel by operating for a shallower tillage.

3.3 Constraints & Opportunities

- Demand forecasting is unsystematic and generally inaccurate
- Subsidy approaches have boosted sales though may not lead to sustainability
- Encouraging diversified operations can maximize the value of the 2WT
- 2WT can build on their competitive advantage over 4WT

Demand forecasting is unsystematic and generally inaccurate

The machinery importers forecast the demand of any upcoming season from analyzing the sales of the previous year and their experience and knowledge about the market. Most of the time, their forecasting does not deviate much from the actual sales volume. However, it was found that **often demand forecasting can be inaccurate**. In 2011, sales of power tillers and diesel engines have been much less than what many importers expected. The major reasons behind low sales were reported to be the low market price of potato, jute and some other major crops that year and against the steep price increase of 2WTs.

Subsidy approaches have boosted sales though may not lead to sustainability

From July 2009 to the present, nearly 22,000 2WTs were sold under the GoB project *Enhancement of Crop Production through Farm Mechanization Project* which employs a 25% subsidy. Of those around 21,000 units were 2WTs totally nearly a third of the total 2WT sale in that year. The presence of subsidy has increased 2WT sales though **the subsidy approach may have to be reconsidered to support the sector in the long term**. Some of the reasons for this include that:

- Sales have increased for larger, enlisted importers, and it is reported that the market share of non-listed importers has decreased. The major reason for this includes the requirements for enlistment required that a company must have distribution agents countrywide and can provide one year service warranty of their products. This was not possible for many smaller importers. Therefore, small importers that could play a potentially valuable role (though were not selected for enlisting in the subsidy program) are not supported by the initiative.

- There were reports of the effectiveness of the program being reduced due to the difficulty of accessing quality information and the presence of perverse incentives. During field investigation it was reported that people had sought to acquire subsidized machinery using fake identification documents in order to resell the units on the open market. The presence of farmer lists leaves open the potential for moral hazard in the identification of beneficiary farmers.
- While the subsidy program may be seen to have stimulated short-term growth, there is a need to consider how this growth can be sustained after the completion of the subsidy program. In this it is highly likely that after the end of subsidy project a financial product/ increased marketing from the dealers will be required to retain the current sales growth.

Encouraging diversified operations can maximize the value of the 2WT

Besides tilling and cultivation related services 2WT are used for diversified purposes like haulage, rice threshing and milling across the hub areas. Haulage provides 2WT operators with significant off-season business opportunities throughout Asia (Justice and Biggs, ND (FAO)). It is an area of potential income for service providers. 2WTs service providers who live in near bazaars or brickfield or sand areas with good road communication areas tend to enter this business. It was found that each 2WT could earn money for around 5 months per year in haulage operations. One service provider said that after subtracting the costs of fuel and two laborers he is able to earn 800tk. per day and estimated that should he work for 15 days in a month he could bring in as much as 60,000tk in 5 months.

In the boro season, power threshers are widely used throughout the country. A service provider can get approximately 15 days per season and around 30 days in 2 seasons in a year to provide the service. Each day a thresher on an average thresh around 6800 kg (170 mounds) and earn around 3400 taka per day (20 taka per mound). Daily fuel cost and labor cost are both 1000 taka. So, daily income excluding the costs is around 1400. Therefore, yearly income by a power thresher was calculated as around 42,0000 taka.

2WT can build on their competitive advantage over 4WT

It has been found that the 4WT business area is increasing. Yet 2WT business is also continuing in those 4WT business areas. For example, across the hub areas, Jessore is the most renowned area for the operation of 4WT. As the rate is comparatively high here, many of the service providers of this area migrate to different parts of the country for tilling business. They also provide services in the locality. But in the high tillage and planting seasons, many farmers state they still face the shortage of service providers. During this time the demand of 2WT is very high and none have reported that they must go outside of the village or district to find work. In one village named Bauliain, Jessore there are 62 4WTs and 10 2WTs among 300 households.

3.4 Interventions

Attachments enabling the provision other services offer significant business opportunities

The decreasing area coverage is not the ultimate constraint in the 2WT market systems as the return on investment is likely to remain profitable in the near future. Yet, additions of new attachments e.g. seeders, planters, and reapers, etc. to provide other services offer significant opportunities to 2WT service providers to earn more, as well as provide additional needed services not yet available particularly in the area of harvesting.

In the next two sections this study will consider the potential of two, of what many people consider the 'best bet' attachments: seeders and reapers.

CHAPTER

4

SEEDERS

4.1 Sector Overview

4.1.1 CONTEXT

A possible next step in the mechanization process is to bring further “precision” into Bangladeshi agriculture. This can be achieved through the use of Seed and Fertilizer Attachments—that would also bring new agronomies like placing seed and fertilizer together in the same furrow resulting in increased fertilizer efficiency (up take) by 10-15%. With proper designs or modifications the use of such SFAs as well as other seeders and planters would allow for greater uptake of Conservation Agriculture (CA). Agriculture under CA principles can bring improved soil health, reduced water use/irrigations, reduced energy use, and even higher yields through even more uniform plant stands.

The use of 2WT for land preparation and rural transportation has increased rapidly in the country due to its versatile use, lower cost for tillage, lesser time required for cultivation and resulting in higher crop yields (Miah 2000). Since the mid-1990s, research and development work on conservation agriculture (CA) based resource conservation technologies (RCTs) started with locally developed small machinery, like minimum tillage or no tillage planters, crop production on permanent bed systems, and residue retention. During this time the national capacity for producing many spare parts for Chinese two wheel tractors and diesel engines and even seeders and reapers was on the increase. In this context, BARI, BRRI, and CIMMYT have been conducting research and development on resource conserving technologies in Bangladesh since 1995 in collaboration with other NARS partners, NGOs, private sector and farmers in different parts of the country, with funding from various donors, particularly from USAID (Monayem et al. 2008).

There are a number of Seeder Attachments currently in the market. The **PTOS (power tiller operated seeder) seed drill** has come out as a potential two wheel tractor attachment for seed drilling which is can be used for tilling, sowing and laddering operations simultaneously in a single pass. PTOS has the potential to be used for various crop establishments. With the current imported versions from China most of the grain seed like wheat, paddy, maize, jute, pulses, oilseeds etc can be sown in line.

At present more than 1500 PTOS are now in operations and most of those are concentrated at Rajbari (a few in the northern part, especially in Dinajpur). The owners of PTOS are using this device for their own crop cultivation and earning cash income through custom hiring to other farmers. However, it has not been adopted very well compared to the actual potential of PTOS. Presently almost all of the machines are being used only for tilling purpose.

A toolbar based approach for zero till and bed forming was initially begun with **zero till tined seed drill** was developed which bolts to the rear of a 2WT instead of the standard rotovator. The machine was tested in farmers’ fields from 1999-2004. Although performance was reasonable, the seed drill lacked abilities for handling residue clearance and draft power limitations²⁸ (Justice et al 2004).

²⁸ The lighter weight of the Two-wheel tractors is both a benefit and curse. Being lightweight it is easy to maneuver and get into difficult places. But this limits how much the 2WT can actually pull (draft). In a personal communication with relevant experts we came to know that studies have shown that for the Chinese 2WT to be able to properly utilize its full horsepower it would need to add nearly 800 kilograms of extra weight over the drive wheels. Toolbar designs that work well for 4WTs (that were purposefully designed to be heavy to increase their draft-pulling power) don't work well for 2WTs. So that zero till drills with more than three openers have difficulty with much wheel slippage in heavier soils.

The draft limitations for zero till were also evident in the use of toolbar and shovels to make beds. Cornell University also supported designs and research around the tool bar based bed planter. Earlier demonstrations and attempts to use the rotovator of the PTOS for forming beds also looked promising (Justice, et.al. 2004). This, along with the toolbar limitations led in 2006 to BARI Engineering and Wheat Research Center programs using a modified standard 2WT rotovators to form beds and plant on them. There has been near continuous programs of refinement with this technology from BARI and has led to some success in Rajshahi (WRC) where farmers in that district are buying locally made bedplanters and 20 or more FMP BARI bedplanters being offered for the last 4 years in the BARI subsidized machinery program.

In the end, interest in toolbar designs for zero till waned in CIMMYT but were pickup by a new project in 2006, with funding from Australian Centre for International Agricultural Research (ACIAR) culminating in a toolbar design called Row-grow. The interest in that toolbar again waned after the end of the project in 2008.

While the PTOS continued to spread for mostly tillage purposes another ACIAR funded project commenced in 2008. It was felt that as none of the planters imported or developed locally for 2WTs were capable of planting in all modes of tillage a new planter was developed that could be used Single Pass Shallow full Tillage (SPST), Strip Tillage (ST), Zero Tillage (ZT), Bed Planting (BP), and for Conventional Tillage (CT) using full rotary tillage, when driven by 12-16 HP 2WTs. A key aim of the development was for a planter whose seed meter could plant a wider range of crops and on which the setting up of blades, row spacing, seed depth and the calibration of seed and fertilizer rates could be accomplished quickly by the operator in the field. Incorporating features from a range of earlier planters for 2WTs, a **Versatile Multi-crop Planter (VMP)** was designed with capability for banding seed with fertilizer in four rows.

The SPST, ST, ZT and BP by VMP saved 38, 82, 50 and 13% diesel fuel over CT. Land prepared by VMP saved 50-68% labor in land preparation, seeding and fertilizer application. The greatest savings were with SPST and ST, followed by ZT and BP (Haque et al. 2011). So far only a total of 45 units of VMP have been sold. 4 VMP service providers have been rented out the VMP to 656 farmers covered total 81 ha of crop land.

Related but separate to these initiatives are the Bangladesh Agricultural Research Institutes (BARI) programs that have led to local manufacturing of rotary bed former “bed planters”. Both BARI’s Farm Power and Postharvest Machinery (FPM Division and the Wheat Research Center) have produced two-row-bed formers in local workshops and sold it to farmers. This has been possible through their own funding and also partnerships with the Enhancement of Crop Production through Farm Mechanization Project (FPM- with nearly 20 sold) and Cornell’s Food For Progress Program (WRC-20 pieces sold).

4.1.2 CURRENT MARKET STATUS

PTOS

At present only 2 importers are importing PTOS. All the imported PTOSs originate from China. At this time the demand from service providers comes mostly from Rajbari District (only a few PTOS can be seen in Northern parts of the country).

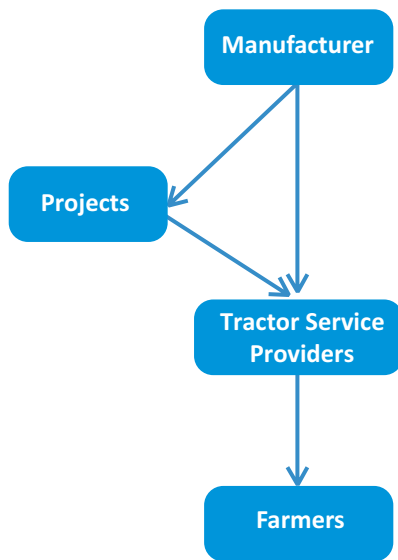


Figure 12a: Supply chain of VMP

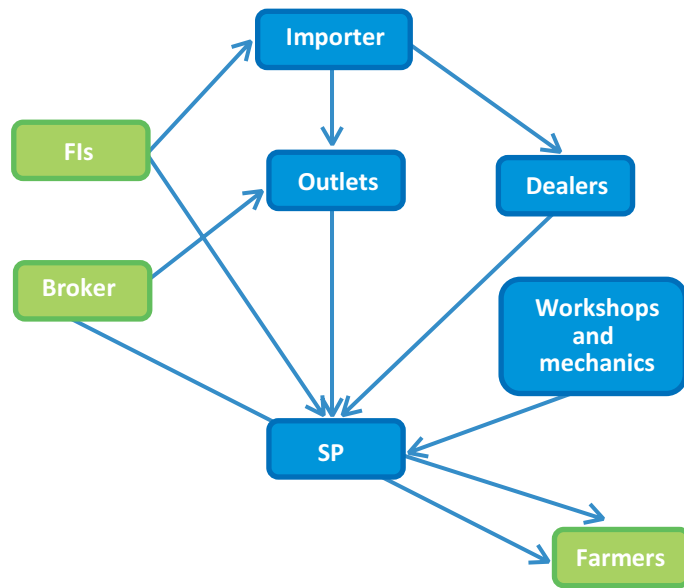


Figure 12b: Supply chain of PTOS

Currently more than 1500 PTOSs are being used by farmers of Rajbari (around 1200 PTOS in Baliakandi and Pangsha upazila and only a few in Rajbari Sadar), Faridpur (around 60 in Boalmari and Nagarkanda upazila; mostly purchased in 2010 and 2011), Magura (around 60 in Shreepur upazila; mostly purchased in 2010 and 2011) and Dinajpur (only 20).

VMP

So far all the VMPs have been produced by local manufacturers. To date a total of 45 units of locally manufactured VMP have been sold including 16 to international buyers in India, Mexico and Vietnam; and eight private buyers providing services for planting crops in Bangladesh. 4 VMP service providers have been rented out the VMP to 656 farmers covered total 81 ha of crops including wheat (32 ha in 237 farmers), maize (16 ha in 122 farmers fields), mung bean (13 ha in 101 farmers fields) and rice (11 ha in 80 farmers fields). Recently the project has just placed an order for 20 more from Alim Industries in Sylhet.



Figure 13: Versatile Multi Planter (VMP)

4.1.3 KEY ACTORS

Importers

Broadly the import network for seeder attachments is very limited. All VMP units have been produced by local manufacturers and no import network exists for this SA. There are two importers actively engaged in the PTOS business, Solar Vision and Green Machineries (mainly the seeder attachment including seeding device and high speed rotary tiller, the 2WT on which it is attached is the same machine that is used in general power tilling). All the imported PTOSs are come from China. The market is dominated by the two major players with Solar Vision occupying more than 65% of total market share. Overall market volume of the yearly imported PTOSs is around \$0.25million. At this time the demand from service providers comes mostly from Rajbari District; (only a few can be seen in Northern part). The largest 2WT importer, Chittagong Builders (that holds more than 80% of the market share), has not been involved in importing this machine.

Dealers

Consistent with the importer network only a few dealers are retailing seeder attachments. At present only two dealers are selling PTOS in Rajbari: *Krishi Sheba Beetan* and *Faruk Machineries* (both at Baliakandi upazila in Rajbari). However, *Krishi Sheba Bitan* has established two more outlets in Rajbari; one in Baliakandi upazila Sadar and the other one in Pangsha upazila. While *Krishi Sheba Beetan* sells PTOS of Solar Vision, *Faruk Machineries* sells PTOS imported by Green Machineries. It should be mentioned that both the dealers used to buy PTOS only from Green Machineries. It's from 2010 that Solar Vision entered the market and from then on supplying machines to *Krishi Sheba Beetan*. Green Machineries has also set up a dealer outlet in Baliakandi upazila recently (*Eskendar Machineries*) just beside *Krishi Sheba Beetan* to capture some market share. Presently *Krishi Sheba Beetan* holds the largest market share (more than 65%).

Krishi Sheba Beetan (the biggest PTOS seller; importer: Solar Vision) has been trying to expand their market area. *Krishi Sheba Beetan* got opportunity to collaborate with BARI's different demonstration programs through those expert service providers of Shonaikuri village, actually work as a promotional tool for *Krishi Sheba Beetan*. They have already opened 2 outlets in Rajbari (one in Baliakandi, and the other one in Pangsha) last year (2011). They have plans to open branches in neighboring districts gradually and carry on the demonstration program to those districts.

VMPs have been marketed to farmers through projects and it is likely that the recently developed ACIAR project in partnership with iDE-B and other organizations is going to develop strategic supply chain for VMP in different areas of the country²⁹.

Manufacturers

Domestic manufacturing of seeder attachments is in its infancy and most of the manufactured SFAs have gone directly to projects and to project farmers especially in the case of GoB's *Enhancement of Crop Production through Farm Mechanization Project*.

Since the start only one local manufacturer, Alam Engineering, had been producing VMPs. The workshop is situated in Dhaka and has its own plastic molding factory. They have been involved with the research and development with this machine since 2006/07. All their production goes to end users through ARIs, projects and DAE. As mentioned above, recently, Alim Industries in conjunction with the iDE/ACIAR project has just started producing 20 VMPs.

29. <http://www.idebangladesh.com/ide-cp/images/documents/SmallholdersConservation%20Agriculture%20in%20Bangladesh.doc>

Three local manufacturers have been involved in producing PTOS: Mahbub Engineering Workshop (Jamalpur), Rahman Engineering (Kushtia), and Alim Industries. Both Rahman and Mahbub workshops were involved with the early research and development and manufacturing process of PTOS seeder for several years with BARI and CIMMYT. With the help of CIMMYT and WRC Rahman in 2001-2003 manufactured several pieces including lighter weight 4 and 5 row versions. Around 2005/06 Mahbub first sold some of those seeders to some commercial farmers of Rajbari and Dinajpur under a BARI-CIMMYT project. Alim Industries made 150 PTOS with the incline plate in 2010-2011 for a sub-project of GoB's *Enhancement of Crop Production through Farm Mechanization Project*. All the locally made PTOS have been plagued by quality problems and therefore additional orders/sales have been slow to come.

The production of seed meters has been beset with problems over the years. Rahman was the first to make fluted roller meters. WRC has also started producing flute roller type seeders. Almost all of the plastic parts of Mahbub Engineering Workshop's PTOS (including seed meter) are made in the plastic molding factory of Alam Manufacturing in Dhaka. Now other mold makers have started and there are now injection molding factories in Jamalpur, Bogra and Dhaka making these parts. Many different parts go into making a PTOS. To get an idea of the complexity of manufacturing and sourcing material and parts for PTOS manufacturing, backward linkages that are undertaken by Mahbub Engineering Workshop are mentioned below:

- Nut-bolts (Nawabpur based importers; China)
- Sprockets and other metal molds [molding factories in Jamalpur, Bogra and Dhaka (Lata Engineering Workshop, Nawabpur; Machine Tools Factory)]
- Plastic parts for seed meter - both fluted roller and incline plates (Alam Manufacturing)
- Flute type seed-meter (WRC, Alam Engineering, local plastic molding factories in Rajshahi, etc)
- PTOS rotovator gear box and assembly (scrap power tillers, bought from Nawabpur, Bogra and local workshops and that are renewed)
- Cutting, bending, welding, frames, seed boxes, etc, and finishing, assembly (own workshop)

4.2 Findings & Analysis

- Seed metering of crops increases efficiency- makes possible new conservation agriculture techniques
- Demand for seeding services varies dramatically depending upon cropping strategies
- Bed planting with the WRC bedplanter has gained traction in Rajshahi
- Local manufacturers lack sustainable sources of technical assistance
- Some seeder attachments have not yet become successful commercial products
- PTOS is mostly being used for high speed rotary tilling
- Despite impressive results in tilling operations for Onion and Garlic the PTOS remains underused for seeding
- Adoption of seeder attachments offer the opportunity to raise productivity and promote CA principles among the current users
- Scale up of seeding services has been slow
- Profits for the service provider do not increase using the seeder attachment
- Either rates, or tilling area must increase

Seed metering of crops increases efficiency

It was found that in Shonaikuri village that line sowing of jute with the PTOS and its seed meter has become moderately popular with the farmers there in the last two years. Those four trained PTOS owners began testing their machines for seeding different crop grains (in trial and error method) and found good results in jute, mustard and sesame production. Jute is produced on comparatively more cultivable land (from April to August) and results from line seeding of jute seeds were more promising. Labor cost significantly decreased with increased crop yield (later shown in the cost-benefit analysis). Use of seed meters can save around 20% seed and given the increasing price of seed, the service is likely to be more attractive if effective interventions can be made.

Demand for seeding services varies dramatically depending upon cropping strategies

In 2010 those four service providers seeded around 60 acres of wheat and 100 acres of jute lands of around 50 neighboring farmers (so, on an average 15 acres of wheat and 25 acres of jute land each), in 2011 only a few farmers demanded their seeding service (in wheat and jute). They cumulatively seeded only 30 acre of jute lands and 20 acres of wheat land. The reasons are given below.

- In 2010 farmers faced loss in wheat production (price was 550 tk against a production cost of 670 tk per 40 kg) against a moderate profit in onion and garlic production. Therefore, this following year most of the farmers minimized their wheat area significantly and produced more onion and garlic.
- Farmers that used seeder in seeding their wheat last year reported that because of line sowing, birds ate more wheat grain from their fields.
- In the case of jute, water seems to be a significant factor acting behind seeder usage. Most of the farmers do not irrigate their land and rather depend on rain water. Usually after the first rainfall (end of April), they broadcast (or seed by PTOS) jute seed (to increase germination rate). Last year it rained on appropriate time and many of the neighboring farmers used PTOS in seeding jute seeds. But this year it did not rain at that time and most of the villagers broadcasted their seeds on tilled dry land.

Bed planting with the WRC bedplanter has gained traction in Rajshahi

- At the beginning when the SPs started providing service with VMP, they insisted on the farmers to take different services like SPST, ST, ZT and BP in their small demo-plots and requested them only to pay if they get better results. However, so far, of all the services that the VMP can offer, Bed Planting has become comparatively more popular in that area³⁰. The major reasons might be that the yield increase in wheat production after bed planting has increased significantly. Previously the yield was 1.78 mt/ha. After employing BP (with seeding) this rate increased to around 4.45 mt/ha. And BP without seeding the productivity increased to around 3.85 mt/ha. Cost of irrigation and weeding has also decreased. These were well reviewed by the farmers there and some of them started taking BP service.

Local manufacturers lack sustainable sources of technical assistance

In many cases it was found that the local manufacturers got interested in developing and manufacturing any new machine according to the potentiality and business plan that NARIs/IRIs had given them. Then they invested lots of capital and time on it to develop that machine. But because most of the manufacturers do not have the industrial set up, trained engineers and technicians to produce a quality product, their produced machines did not pass the required accuracy and performance level and did not

³⁰. This is due in great part that WRC, Rajshahi with the help of CIMMYT and Cornell University has been promoting bed planted wheat in this area, first with the older toolbar set up and later with the FMP, BARI rotovator bed planter and still later the modified WRC/CIMMYT/Cornell bed planters.

do well in the initial field tests. At that time they expected technical feedback from the experts of different project but could not get enough support.

Local manufacturers that were involved in producing PTOS did not have the necessary industrial set up, human and physical capital and required technical expertise to produce quality market product and make profit. This also came at a time when the CIMMYT programs had been greatly scaled down. As much of the budget was flow through to the various NARIs they were also forced to reduce their programming.

Some seeder attachments have not yet become successful commercial products

However, despite the strong performance of certain seeder attachments for additional income generation, some are yet to become commercial products. The study found that very few farmers in Rajshahi have bought the VMP for commercial use. Indeed, of the 45 VMPs which have been sold in the last three years, most of these were procured by the GoB or through donor-funded projects. This is in contrast to the performance of the PTOS which has seen a higher commercial growth rate. The major reasons for this include:

- The VMP field capacity is less. The operating speed of VMP is slower since it runs in first gear and is only half the width of a PTOS (60 versus 120 cm). Most models do not have a road wheel or seat and one has to walk it through to take it to different lands.
- Calibration skills are required to get maximum performance from the VMP and training for service providers is limited. Although VMP can perform different types of land preparation tasks (high speed rotary tilling, strip tilling, zero tilling, and bed planting), one need to adjust and calibrate different machine parts to do those accordingly. The PTOS in contrast is mostly used solely for tilling. Therefore an SP can simply detach the seed box and use the PTOS as a rotovator for preparing land-albeit a much faster rotovator. Not much extra training or technical knowledge is needed there.
- There is little promotion and marketing occurring for VMP services in the market. It was felt by trainees interviewed that this lack of promotional activities presents a major issue in creating demand for VMP services at the field level.

PTOS is mostly being used for high speed rotary tilling

Although more than 1,500 PTOSs are being used by farmers of Rajbari, Faridpur, Magura and Dinajpur, almost all of the machines are being used only for tilling purposes. Locally it's called as 'High Speed Seeder' and farmers are only buying or taking the service from a PTOS owner for the fine tilling that the machine can do with its 48 blade tiller. Farmers reported that onion yields increased from 9.09 mt/ha to 11.86 mt/ha and a 25% gain in yield in that season. These startling results captured the



Figure 14: Only the rotovator of PTOS is being used for fine tilling; the seeder attachment is removed

interest of many neighboring farmers and many wanted to buy this machine or get their onion/ jute land tilled with this machine. Those 1,500 plus PTOSs till around 90,000 acres of land a year.

It was found that only four service providers in Shonaikuri village of Baliakandi upazila were using PTOS for both seeding cum tilling operations. Besides seeding their own crops (wheat and jute), they also provide their seeding service to different neighboring farmers who want it. Demand for them has been quite high. Excepting their own lands, those service providers seeded around 60 acres of wheat and 100 acres of jute lands in 2010 (so, on an average 15 acres of wheat and 25 acres of jute land each)

Adoption of seeder attachments offer the opportunity to raise productivity and promote CA principles among the current users

The study finds that significant change has occurred in Rajbari district due to the adoption of high speed rotary tillage services by farmers using seeder attachments. In Rajbari, farmers have been experiencing a decreasing yield level since the first bumper crop of onions³¹ immediately after the introduction of an seed drill attachments (in this case the PTOS). Farmers claim that the fertility of the land has been decreasing and even after increasing the application of chemical fertilizer and that they were not experiencing 'good' harvests.

At present the yield is 9.88mt/ha and this is gradually returning to pre-PTOS yield levels. Prima face a the decline could be high speed tiller related (soil structure breakdown, etc) and could be a chance to demonstrate CA agronomies and new crops for reversing the soil related declines. Many of these 1,500 PTOS that still have their seed meters (a sizable number) are capable of line sowing full tillage and CA and could be enlisted into a program to promote reduced single pass tillage and with slight modifications (removing and straightening blades) strip tillage and zero tillage.

Scale up of seeding services has been slow

The process of scaling up/ expansion in neighboring districts has been moderately slow. Several factors have been working behind this fact. The major reasons are:

- Onion and garlic are intensively grown only in few villages of Magura and Faridpur. Shreepur upazila of Magura and Boalmari and Nagarkandi upazila of Faridpur are the most prominent onion/garlic producing areas. It has been found that around 120 PTOSs has been sold in those areas from 2007 to 2011 (mostly in 2010 and 2011) and those are mostly being used for preparing onion/ garlic lands.

Table 9: Relative profitability of services using PTOS and VMP

VMP Calculations		PTOS Calculations	
Income	195,000	Income	192,500
Rate/acre	1500	Rate/acre	2,500
Acreage	130	Acreage	110
Expenses: Fuel & Maintenance	48,680	Expenses: Fuel & Maintenance	39,496
Total Profit	146,320	Total Profit	153,004
Profit	% 75%	Profit %	79%
Expense per acre	374	Expense per acre	359

³¹. Granted onions, garlic and other root crops do not lend themselves easily for CA practices.

- The ancillary services are not established to support the PTOS use. Only 3 dealers are selling PTOS and all of them are stationed at Rajbari district and spare parts of high speed rotary tiller are only available in those shops. Therefore, if any blade, pinion or arm pipe gets broken, a PTOS owner in Faridpur or Magura has to go Rajbari to purchase those spare parts.
- Dealers and customers lack the technical knowledge on how to maintain PTOS and its seed meters. It was found that seeder attachments have two different sets of fluted rollers: one for crop seeds like wheat, lentil, jute, etc, and another one for wheat and paddy seeds. Buyers that take the seed box are only provided with the roller set that is applicable for wheat and jute seeding. Since maize is not that cultivated here and most importantly, since seeding application by PTOS is almost missing here, neither customers ask for that additional roller set or dealers push those to their customers.
- Use of meters to line sow seeds and fertilizer therefore is much more knowledge intensive, and with the lack of additional training and backstopping the demand for the technology, was found to be low amongst local farmers. The study asked farmers and agro-machinery service providers of different districts (Magura, Faridpur, Shatkhira, Jessore, Zhinaidaha, Meherpur and Rajshahi) where onions are being produced about PTOS and the success stories of Rajbari. However, few farmers and dealers were found that have heard about this high speed seeder (also known as high speed rototiller) technology. Many of them have the perception that such 48 blade tiller cannot till their soil cause their soil 'is harder' or 'stickier' than that of Rajbari.

Table 10: Profits gained by 2WT tilling operations vs when seeding

	Year				
	2011	2012	2013	2014	2015
Number of tractors	420,027	436,000	456,000	78,000	498,000
Acreage per tractor	53	51	49	47	45
2WT income	127,359	122,693	117,312	111,913	107,418
2 WT Profits	80,802	77,842	74,428	71,002	68,151
Income with seeding	73,812	71,108	67,989	64,860	62,255
Expenses	14,777	14,235	13,611	12,984	12,463
Profits from using SFAs	59,036	56,873	54,379	51,876	49,792

Profits for the service provider do not increase using the seeder attachment

Providing additional seeding services through the addition of seeder attachments does not yet look to be a profitable venture for service providers and there is also some variation between the profitability of certain seeder attachments. Focusing on the PTOS and the VMP as examples, it can be seen that service providers are realizing some **75-80% profitability** through utilizing these machine. This is based upon income generated through service provision less expenses incurred (fuel, oil etc) for this service provision (see Table 10 above). Income is here calculated through the average acreage for which the respective machine was used by interviewed service providers (110 for PTOS and 130 for VMP) multiplied by the rates charged (on average) for each pass of the machine. Whereas PTOS has different rates for crops (primarily used for jute and wheat) based on the number of passes (Tk 2,500 is for two passes), VMP has a standard rate for 1 pass (Tk 1,500). The profits when seeders are used (and PTOS figures are used to calculate the figures in Table 11) actually decrease if the same rates for tilling are used, what is being paid for 2WT

operations. The tilling/seeding area is based on the projections given in the 2WT section (53 acres in 2011). Thus, **there does not seem to be any incentive on the part of the service providers to provide seeding services. Either the rates or tilling area must increase.**

It is important for either the area for seeding to increase or the rates to change as shown in Table 12 for seeder services to be pushed by service providers.

The current rate is around Tk 2,500 for two passes for PTOS and around Tk 1,500 for VMP (1 pass). If the land area were not to be increased the service provider, assuming that they will sell the services if they get around 25% extra profits, needs to sell the service at Tk. 2,300. Otherwise, the land area for the service provider needs to be increased from the current average of around 53 acres.

Confounding this is the researchers' insistence that the PTOS represents a single pass technology. They have multiple data to show good results especially in wheat with both full tillage single pass and strip till and zero till single pass in comparison to conventional farmer practice in wheat (2+ passes). Apparently these results have not been made clear to the farmers we interviewed.

Table 11: Making Seeder Services Saleable

Point of seeders still making sense to service provider		
	2011	2015
Tractor profits	80,802	68,151
Land per 2WT	53	45
Addition profits for interest in seeders	25%	25%
Total Profits	101,002	85,188
Sales that have to be made	121,726	102,667
Land required	70	59
Rate has to increase to	2,300	2,300

4.3 Constraints and opportunities

- Hands-on training in seeding has been insufficient to develop skills
- Lack of development of support services checks private sector growth
- Interventions to promote SFAs have not paid sufficient attention to the social and commercial drivers of the technology
- Overcoming 'zero-sum game' thinking amongst service providers is a challenge
- Dealers/ Importers are not currently pushing the benefits of certain SFAs
- Lack of a Bengali language user manual reduces farmer understanding
- The market size is significant

Hands-on training in seeding has been insufficient to develop skills

PTOS owners in Rajbari area have received very little hands-on training on seeding operation with PTOS. In the last few years BARI-CIMMYT did give a few classroom trainings to farmers on seeding operation. Additionally, two of four local expert service providers conducted field demonstrations under BARI/CIMMYT projects in 5 places in Rajbari (Baliakandi and Pangsha upazila). Yet, according to the PTOS owners interviewed for this study the trainings and demonstrations were not sufficient to pass on information effectively. Seeding operation using the seeder attachment is still a technical and somewhat cumbersome thing for the PTOS owners and according to them they need hands-on training on field to be able to seed with this machine properly.

Lack of development of support services checks private sector growth

This can be largely attributed project-driven approaches which undermine certain areas of the market system. Because there is no market actor in the VMP supply chain, therefore, different support services like mechanics, repairing or maintenance workshops, credit services, etc do not exist yet. Additionally, as customers have to buy the other machines like VMP and BARI PTOS and BARI bedplanter machines through projects, little or no relationship exists between the customers and the manufacturers at present. It was noted that in the case of one seeder attachment introduction project, the project discouraged SPs from charging extra for their seeding service in order to encourage tilling services. The thinking was that in the demonstration phase an extra service charge for seeding would discourage farmers to take the service. While this was later rectified, many farmers still have the perception that since seeding can be done while tilling, there should not an extra charged or the charge should be very small.

Interventions to promote SFAs have not paid sufficient attention to the social and commercial drivers of the technology

The seeder business has been primarily driven by projects and the government. Project designs for extension have tended to favor a technocratic focus, rather than a market focus. It is time to concentrate on how make the business system viable. This will require (as this study has done) identifying the market size, where the problems lie, and working with the market actors (importers are particularly key) to market the products and embed the training of CA within the system.

Overcoming 'zero-sum game' thinking amongst service providers is a challenge

Some service providers stated that when other SPs came to them to learn about how to seed different crops using PTOS they did not train them. This was as they wanted to maintain their market demand and extra income. This kind of 'zero-sum' thinking (where the SP believes that another operator will invariably reduce his own fixed amount of business) raises questions over how farmers can be incentivized to pass on information to other aspiring SPs in the community and beyond. In the last Robi season, around 5 PTOS service providers of Baliakandi and Pangsha requested one of four lead farmers, to train them on how to seed wheat and jute with PTOS. This offer was refused and they did not want to teach others for free. The lead farmer believed that if he taught them seeding operation, then more SPs would have come to learn. The farmer did not want to jeopardize the connection that he has been getting from GoB/NGO/Donor-funded projects.

Lack of a Bengali language user manual reduces farmer understanding

A user manual is given with every seeder attachment. But that manual is written in English and farmers or SPs literally do not have any use or little use of that user manual. Clearly, a Bengali language seed drill could be very helpful for buyers to understand their machine better³². This manual would need to become available in the market to ensure that SPs can access this information and not be reliant upon a project or development intervention for access.

Dealers/ Importers are not currently pushing the benefits of certain seeder and fertilizer attachments

Not one of the dealers (two dealers with one having two outlets) was found to be aware about the advantage of seeder usage. Dealers interviewed generally did not have any further technical understanding beyond the basic function of the seeder (the seeder attachment means the 2WT 'can also be used for seeding'). However, since seeder boxes are not currently in strong demand by customers, dealers are

³². An earlier CIMMYT project developed a Bengali manual though it is not clear why dealers and their farmers have not been provided that manual.

taking an extra benefit from this. Dealers often offer customers the option to sell their purchased brand new seeder box back to them as scrap metal (a seeder box weighs around 25 to 30 kg) (Figure 15). Since most of the farmers do not understand the benefits the application of this seeder box could have, many of them sell it to the dealers just after purchasing the machine at 1,000 to 1,500 taka. The dealers then resell it to other parties in higher price³³.

The Market size is significant

A simple potential scenario across the hub levels has been calculated showing different requirements at each hub. Potential aggregate gain for the service providers as well as the farmers has been estimated. Aggregate business volume shows an attractive business case for the importers which may be realized through appropriate interventions. The following table showcases potential business scenarios in the seeder business.³⁴



Figure 15: Backyard of PTOS dealer shops are dumped with seeder attachments

Table 12: Market size of seeder attachments

Hub	Number of small farmers	Number of seeders	Value for importers/manufacturers		Value for Service Providers	Additional Income to farmers
			Seeder	Diesel Engine ³⁵		
Barisal	916,934	23,563	1,201,695,830	848,255,880	401,452,467	5,516,484,652
Faridpur	790,503	13,246	675,530,974	476,845,393	225,675,723	4,755,846,840
Khulna	995,100	11,069	564,521,470	398,485,744	188,590,599	5,986,749,185
Jessore	545,251	25,771	1,314,320,634	927,755,742	439,077,217	3,280,354,718
Dinajpur	746,105	23,776	1,212,575,558	855,935,688	405,087,075	4,488,738,318
Total (Taka)	3,993,893	97,424	4,968,644,466	3,507,278,446	1,659,883,080	24,028,173,713
Total (US\$)			62,109,000	43,841,000	20,749,000	300,353,000

³³. It was found from one importer that dealers are now asking him to send only the HSRT (seeder is detached) and also asked the importer to adjust the price accordingly. On the other hand, as that importer has already imported a number of PTOS units, so he is in a challenge. This is a common practice in Bangladesh that the market actors in agri-machinery (manufacturers and small equipment importers) heavily rely on the promotion of different project. This factor of dependency should always be considered while preparing any further interventions by any organization so that the participation of the market actors works in such a way that they feel confident and see the incentives of market promotion done by the market actors.

³⁴. We have taken an average of 0.5 acre for smallholders and calculated the potential business scenarios based on current actual cropped area or relevant crops and current profits made by the seeder service providers. Gains at farmer level have been estimated based on information obtained through engagement with seeder service buyers in Rajbari district.

³⁵. Since using the SFAs would need higher powered engines, the market for engines would also increase.

The table shows that amongst the nearly 4 million farmers in the hub districts, there is the potential (at 100% market capacity) for some 97,000 2WTs to provide the seeding services. If seeders are worth approximately BDT51,000 and diesel engines BDT36,000, then the total value of potential market demand for these machines is USD105 million (approx.). Therefore the value for seeding services (calculated using the average 25% premium charged for tilling services locally) can be seen to be over USD20 million per annum, yielding a potential additional income for farmers of some USD300 million per annum.

4.4 Interventions

- Promote through national companies
- Establish a distribution and supply network
- Training of service providers by companies
- Brand seeders with a locally recognizable name
- Certify service providers
- Establish local level servicing

Promote through national companies

Collaboration with the importers is essential in large scale promotion of seeder services as they have been importing the machines from China and supplying to the market through dealers. At present the dealer network for seeders is only limited in a few places but promotion in other areas may be done using the existing dealers of other districts/ upazila. Activities under this intervention could include:

- Memorandum of understanding with importers to collaborate for joint promotion.
- Joint analysis (with the importers) on potential new areas for marketing that has cropping patterns which are most suitable at present for potential seeder service providers.
- Promotion of service charges that attracts both the service providers and service renters through collaborative demonstrations. Hence a demand creation activity has to be done to attract more entrepreneurs.

Establish a distribution and supply network

While importers have their own dealer network, manufacturers generally not have this network because of scale of their business and dependence on different donor supported projects and programs by NGOs and the government. Since some of the manufacturers have the skills to produce seeder attachments as well as spare parts, so it is imperative to create/develop a supply chain of product and services up to the level where the machines are under promotion so that potential buyers can buy the machine from local dealers/retailers and avail the repair and maintenance service alike 2WT. The following activities can be pursued:

- Refresher training for the manufacturer with updated technological features of seeder attachment. This will involve the engineers or head mechanics of the manufacturers who are actually involved in the machine production lines. This could include not only the PTOS but the other moderately successful bed planters currently being manufactured and sold and even the VMP.
- Promotion by Service Providers (commission basis). It is well established in case of 4WT market systems and the lessons learned from that market can also be replicated in this case. Creation of a service

provider network in the places where seeder is going to be promoted and can influence the adoption significantly.

Training of service providers by companies

Capacity development is a key requirement in order to facilitate the take-up and continued use of the machines in the field. Therefore the following activities should be considered to underpin this:

- Participatory and hands-on training where service providers can produce, analyze and finalize their micro-business plans for the machines. As there are existing service providers of 2WT tillage service, so attracting them through a commission system is likely to help them in deciding to procure and sell seeder attachment.
- Creation of local trainer using the existing service providers. These would be especially important in the promotion of line sowing with their seed meter (prerequisite of CA) as it involves a number of technical issues³⁶. A comprehensive ToT (training for the trainers) would be necessary and this ultimately will create further scope for these service providers in providing training services for the potential buyers of the line sowing seed drill PTOS. This would also act as a way to increase the sales of the machines. It is recommended to involve the current 4 trained service providers among the first local trainers trained up. They would also act as a commission agent for the manufacturers or importers where commission price will consider both the commission of finding new customers as well as providing the training to the customer. There could also be some award given to them and their farmers by a project for being among the first farmers to adopt line sowing and even more awards for any one starting to use CA on a regular basis.

Brand seeders with a locally recognizable name

iDE has experience of promoting treadle pumps throughout the country and one of the key feature of that promotion was branding the treadle pumps. This particular lesson is also applicable for this seeder attachment can help the manufacturers and importers in demand creation through 'meaning making' of the products.

Certify Service Providers

Network marketing has proven successful in market the 4WT in the country. The same model could be used for the seeders. As has been explained above, it is the tractor service providers that need to sell the seeders for expansion. These same providers could then train the new buyers. However, these service providers need to be certified and some kind of a certification mechanism can be developed.

Establish local level servicing

It is imperative to ensure there is local level repair and maintenance capacity for the attachment. As there are mechanics to provide the repair servicing for the 2WT so targeting the existing repairing service providers is necessary. These mechanics should also be linked with the local level dealers/retailers of spare parts so that the service can be provided without any delay. There could be a onetime sizeable grant of spare parts for the seeders particularly the harder to find seed meters.

³⁶. For different types of land preparation blade number, blade direction and seed meter have to be calibrated accordingly. Besides, tilling depth and the machine speed have to be carefully controlled during operation.

CHAPTER

5

REAPER

5.1 Historical Context

Like the seed drills, reapers that cut rice and wheat and lay them for drying, bundling and collection are not new in Bangladesh. Literature review found that accounts of reaper introduction in Bangladesh are scarce though a few documents were identified. Mirpur Agricultural Workshop and Training School (MAWTS) had a program for local manufacturing and testing of 2WT mounted reapers in the early 1990s.

Another project was introduced in 1995 by CIMMYT. Originally those reapers were imported from China but by 2001 a small program was initiated by CIMMYT for local manufacture of reapers by Rahman Engineering in Kustia and by 2002, 14 such reapers were delivered to farmers for experimentation and field test (RWC 2002). Proliferation of reapers³⁷ had also been attempted by through a revolving loan disbursement system (Meisner et al 2003). It was noted in this project that whereas combine harvesters get rid of nearly 90% of all labor in harvest of rice and wheat, reapers constituted a Bangladeshi styled middle path towards mechanization of harvest as it would rid farmers of the problems of the huge labor spike and shortages in the few weeks or month of aman and boro rice and wheat harvests but that labor would continued to be need for bundling of the harvest, transporting and threshing.

Sector Information

- *CIMMYT Bangladesh imported 2 reapers back in 1995 and by 2002 14 reapers were distributed.*
- *Drive to popularize this machine started during the early 00s through REFPI project; especially the self propelled rice and wheat reapers.*
- *Some local manufacturers were involved in the development process. Prototypes were procured from China, Korea and other origins.*
- *Research and development activities were done in both ARIs and manufacturers' own workshops.*
- *Local manufacturers had produced reapers couple of years ago. But now they have stopped producing it. They sell imported reapers to different projects.*
- *Deep water rice reaper is yet to be developed in Bangladesh.*

Text Box 5: Sector information- Reaper

Research and development of reapers (both 2WT mounted and self propelled) went to its peak level during the Research and Extension in Farm Power Issues (REFPI) project that started in 2002. During that time self propelled reapers (reapers that come with their own small 5-7 horsepower two-wheel tractor) were imported from Thailand (Kobota machine), China and Japan to be replicated in Bangladesh. Five manufacturers³⁸ were selected and provide technical support for fabrication of the reapers. Other manufacturers joined in without project support.

³⁷. A set of machines were prepared where each set contained reaper, seeder and pump-set for irrigation via hand tractor engine and hosepipe.

³⁸. BhaiBhai Engineering Workshop, Janata Engineering Workshop, Uttaran Engineering Workshop, Mahbub Engineering Workshop and Ananda Engineering Workshop.

By the end of 2003, due to early positive reception by project farmers there was optimism amongst researchers in CIMMYT and REFPI and manufacturers that there would be quick uptake and spread of the machinery. Yet by 2005 even after several hundred were manufactured and sold (albeit with considerable support from the two projects) sales waned and soon projects came to an end.

Recently, researchers, engineers, and economists from NGOs and the government, noting a great increase in scarcity of labor in the last two to three years, have renewed their interest in reapers time. The GOB has responded with the NATP and other subsidy programs that are promoting imported self-propelled reapers from Korea and BARI and BRRI engineering departments have smaller programs with Vietnamese and Chinese self-propelled reapers.

5.2 Constraints & Opportunities

- Lack of manufacturing skills
- Commercial actors were not integrated well in the pilots
- Lack of locally available raw materials for spare parts
- Brand seeders with a locally recognizable name
- Establish local level servicing
- Manufacturers lacked the market capacity
- Unavailability of local repair expertise
- Growing interest to acquire reaper services
- Potential huge market exists for reapers

Literature review and engagement with farmers and other market actors identified a number of reasons why locally produced machines were less successful. Some of such constraints are provided in this section.

Lack of manufacturing skills

Roy and Singh (2006) mentioned that the locally produced machines were of lesser quality due to manufacturers lacking the level of precision production of the machinery requires. There was also a lack of plastic molding machines among the manufacturers to produce plastic based spare parts which pushed prices higher with parts being casted aluminum or machined from steel. The machines did not perform well during demonstrations, impacting upon the creation of local demand. This included the machines not being able to reap deep water paddy and having difficulty with crops that had lodged. The locally developed blades were not of sufficient quality (not made of tool steel) and only one season or so of crops could be harvested before they needed replacing, hence the cost of maintenance was prohibitively high;

It was noted that the lengthier two-wheel tractor mounted reapers (whether imported or locally manufactured) had trouble turning difficulties in small plots (Justice & Biggs 2010).

Commercial actors were not integrated well in the pilots

As most of the reasons are related to manufacturing, attempts had been made to explore the problems they have had been facing. While discussing with them it was found that the projects got themselves involved in the research and development phase of various donor supported projects, and could not always access required technical support on demand.

Manufacturers usually supplied their manufactured reapers to different projects. And farmers bought/got those reapers from those projects through DAE or NGOs. **While this model facilitated the physical machine to the farmer it causes an arbitrary dislocation between the manufacturers and farmers.** This led to a weak feedback loop as manufacturers could not/cannot get reviews (negative or positive) of their produced reapers from the field level, they could not/ cannot modify their machine designs, production process or materials and take further necessary steps. The promotional activities also failed to adopt a supply chain approach and therefore manufacturers were rarely connected with the actual users.

Lack of locally available raw materials for spare parts

Some raw materials and spare parts were either not available here or not cost-effective. In those cases manufacturers had to use spare parts of junk machines. These spare parts have very uncertain service life and often create problem or go out of order quickly. For example, Mahbub Engineering Workshop stated that reaper blades that they produced from local raw material do not perform well and quickly turn blunt or became broken. They could not get the required blade metal locally in cost-effective price, or connected to an exporter that could supply the blades cheaply.

Manufacturers lacked the market capacity

Most of the local manufacturers do not have enough marketing capacity to achieve sufficient promotion of their products in the market. And because they do not have such people, they also do not get field reviews of their products and modify their design/machine accordingly. Some of the smaller manufacturers do not have the necessary industrial setup and hi-tech machines and equipments (e.g. milling machine, shaper machine, planer machine, surfacing machine, etc) to produce high performance and properly calibrated reaper machine.

Unavailability of local repair expertise

Field investigation revealed that one agricultural machinery dealer at Rajbari district has been trying to create local demand. The dealer usually rented to the interested farmers or the four expert seeder service providers in that area. Yet these service providers reported that these machines face frequent problems as there is no expert mechanic and spare parts is very scarce and that their training was also minimal, or even simply on-the-job. At present service providers have been charging 2000tk/acre for rice and 1350tk/acre for wheat. After all these demonstration and small scale service provisions demand seems to have been created in that locality where around 25 villagers want to purchase reapers but waiting for subsidy announcement. Still, they are hesitant about a few issues like spare parts or maintenance service availability.

Growing interest to acquire reaper services

During the harvesting period almost all of the wheat and rice nearly all ripens within a very short time period and has to be harvested within that time span. At this time laborer crisis has become a serious crisis throughout the country. Therefore, reaper has huge potential among farmers as an effective and cheap replacement for laborers. It also appears that at least 30% harvesting costs may be reduced by introducing the technology³⁹.

Potential huge market exists for reapers

Potential business scenarios for reaper market have been estimated⁴⁰ through this assessment. Apart from the number of smallholders all other numbers have been estimated in the following table. The table below

³⁹. Calculation had been done based on the service charges prevailing in Faridpur area.

⁴⁰. In case estimation we have considered 2 rice season along with another crop (wheat, pulses, oil crop etc.). Moreover, reaping cost and 'willingness to pay' has been estimated from the current available information for the reaper service charge at Rajbari as well as from the conventional manual harvesting cost incurred by the farmers.

shows that there is over USD18M in additional income value to farmers in the hub areas through the reaper services. More compelling is that value for importers and SPs at around USD80M. This indicates that there is strong potential for a **win-win-win scenario** to be developed through supporting the commercialization of reaper units through the local domestic private sector.

Table 13: Market size for reapers

Hub	Number of small farmers	Number of reapers	Value for importers/ manufacturers	Value for Service Providers	Additional Income to farmers
Barisal	916,934	13,259	1,657,319,444	1,759,039,942	344308717
Faridpur	790,503	5,648	706,024,306	749,357,619	296833876.5
Khulna	995,100	6,154	769,187,500	816,397,551	373660050
Jessore	545,251	12,446	1,555,777,778	1,651,266,001	204741750.5
Dinajpur	746,105	12,518	1,564,709,722	1,660,746,157	280162427.5
Total	3,993,893	50,025	6,253,018,750	6,636,807,269	1,499,706,822
in US\$			78,163,000	82,961,000	18,747,000

5.3 Interventions

- Promotion with national companies
- Establish a distribution and supply network
- Training of service providers by companies
- Branding reapers with a locally recognizable name
- Establish local level servicing

Labor scarcity and the price of labor in the time of harvesting is currently one of the most pressing issues affecting agriculture in Bangladesh. Introduction of reapers has the potential to reduce the cost of harvesting as well as reduce the risk of crop damage. As a mechanical technology which will move through the market in a similar manner to the seeder, the interventions here could work in parallel with the seeder interventions. These interventions are:

Promotion with national companies

Importers have been importing both self-propelled reapers as well as reaper attachment for 2WT from China. Activities under this intervention can be as follows:

- Memorandum of understanding with importers to collaborate for joint promotion.
- Joint analysis on potential new areas for marketing that has cropping patterns which are most suitable at present for potential reaper service providers. For example, places where crops like onions, sugarcane and maize are dominant the chance of using the machine is also less.
- Promotion of service charges that attracts both the service providers and service renters through collaborative demonstrations. The service charge should consider the current market price of harvesting with manual labors.

Establish a distribution and supply network

Establishing a distribution/ supply network would provide the pipeline through which machines could flow from manufacture to consumer. This is critical for the sustainability of the market system for reapers in Bangladesh. Following activities can be pursued;

- Create/use the dealers of 2WT to make the machine available in the respective areas. These actors also have to be supplied the necessary spare parts.
- A dealer level promotional commission should be facilitated
- Promotion by Service Providers (commission basis). Creation of a service provider network in the places where reaper is going to be promoted can influence the adoption significantly.

Training of service providers by companies

Service providers will only be attracted to buy the machine or attachment if only they find it profitable. As there are existing service providers of 2WT tillage service, so attracting them through a business plan is likely to help them in deciding to procure reaper attachment or the self propelled reaper. Only the companies themselves can deliver training that is demand driven and reach the scale required to make a sizable impact upon agricultural practices nationwide. Companies must be incentivized to deliver the training and mechanisms must be found to benchmark the quality of this training to agreed standards.

Branding reapers with a locally recognizable name

AS mentioned earlier iDE has experience of promoting treadle pumps throughout the country and one of the key feature of that promotion was branding the treadle pumps. This particular lesson is also applicable for this reaper attachment can help the manufacturers and importers in demand creation through 'meaning making' of the products.

Establish local level servicing

As reapers are semi precision machine so it is necessary to create skilled repairing service providers. Experience shows that this machine needs frequent changes of spare parts. Existing mechanics should also be linked with the local level dealers/retailers of spare parts so that the service can be provided without any delay.

CHAPTER

6

FOUR-WHEEL TRACTOR

6.1 Sector Overview

6.1.1 HISTORICAL CONTEXT

Bangladesh has a long history of involvement with the 4WT. In the late 1950s a few 4WTs were imported for government farms (Farrington 1986:90). Lewis (1996) has noted that the introduction of 4WTs in the late 1960s and early 1970s was largely through rural development and cooperative programs. 'Tractorization' through government firms and cooperative continued until the early 1980s. Because of a number of reasons, Comilla BARD remained a pioneer organization in terms of agricultural mechanization, acquiring two 35 HP Massey Ferguson 4WTs imported from the UK in 1960. Throughout the 1960s, the number of 4WTs increased steadily as BARD continued to establish a 4WTploughing service through cooperatives (ibid 1996).

Farrington (1986:90) reported that 500 4WTs were imported in 1972 on concessional terms to make up for losses of draft animals during the war of independence during 1971. *They were distributed among government farms, cooperatives, 4WT hire pools, and individuals (ibid 1986:90).*

Private sector level imports started in 1982 by a Bangladeshi company⁴¹ and by 1985 it was able to establish a local assembly plant with joint

Sector Information- 4 Wheel Tractor

- *Sales from the 1960s were always low. Even in 2002 sales were less than 700 per annum.*
- *Since 2006 sales have grown steadily to where 5,000 units were added in 2010-2011.*
- *9 large scale importers, operates mostly through their own outlet*
- *Around 50% of the tractors are for tillage and haulage, the rest are exclusively used for haulage.*
- *Around 400 units have been sold through subsidy program in the hub areas so far.*
- *Concentration remained largely in the western and eastern belt of the country (middle portion has lesser incidence and the Southern coastal areas is almost excluded).*
- *In general, more than 50% of the new entrepreneurs usually come from the commission agents; most of those commission agents are tractor drivers.*
- *Existence of financing mechanism - pushed the sales*
 - *Usually 30% down payment (DP), to be paid the rest 70% within 2 to 3 years, 24 to 36 installments, 20% effective interest rate (flat rate)*
- *Good marketing network set up*
 - *Brokerage commission is around Tk. 10,000 has helped the industry in increasing the sales*
 - *Drivers are finding new service market by contacting/creating commission agents in newer areas*
- *Supporting 'cottage industry' has been growing up to produce blades of rotovators and engine works.*
- *Price varies significantly based on HP (35 HP to 75HP generally available).*
- *By 2015, a total of 24,000 new units are likely to have entered the market.*

Text box 6: Sector Information- 4Wheel Tractor

⁴¹. Corona group started importing from Belarus UMZ models

cooperation from the USSR. In 1987, another company, Metal Private Ltd, started importing TAFE 4WTs from India and within 20 years it had sold 6,000 units in Bangladesh. Since the early 1990s other companies/importers began to act as sole distributors of different 4WT manufacturers of India. At present there are nine large scale 4WT importers, all importing from mostly India, competing with each other by offering various special offers for the customers as well as competitive prices and financial packages.

6.1.2 CURRENT MARKETSTATUS

4WTs in Bangladesh are used for both tillage and haulage purposes.

The 4WTs' capacity depends on its HP. Usually 27 to 90 HP 4WT is found in Bangladesh. Among them 27 to 41 HP is used only for haulage where as rest are used for tillage and haulage as well. It is noted that 45 to 70 HP are two wheel driven and 75 to 90 HP are four wheel drive machines. For tilling two types of attachments are widely used: cultivator and rotovator. Nine to eleven tine cultivators are used like local ploughs which is capable to depth up to 9 inch⁴². The cost is 20-22,000 taka. The rotovator is used for fine tilling. There are different types and sizes of rotovator from 42 to 60 blades. The cost is BDT230,000-260,000.

Table 14: 4WT historical trend

Machine	1960 ^A	1968 ^A	1972 ^B	1977 ^B	1984 ^B	1989 ^B	1996 ^B	2006 ^B	2008 ^C	2009 ^C	2010 ^C	2011 ^C
4 Wheel Tractors	±10	28	500	300	400	1,000	2,000	12,500	14,890	17,905	21,638	26,369

Source: ^A= Lewis 1996, ^B= Roy and Singh 2008, ^C= Own estimation

Current growth patterns suggest that the number of 4WTs will continue to increase in years to come.

Currently 4WT services are concentrated in the eastern and western belts of the country but companies have been strategically expanding their business into new areas (such as the mid and southern portions of the country where the take up of 4WT services have been low). Increasing this number potentially has 2 major impacts: a) per capita tillage coverage will decrease hence the profitability; and, b) the payback period or full investment recovery time will increase because of decreasing acreage.

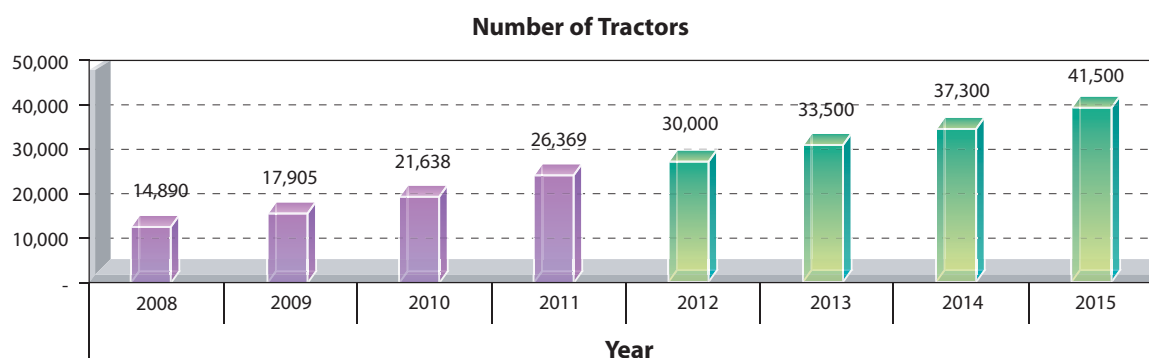


Figure 16: Recent trend of 4WT with projection

42. Fixed and spring tine cultivators are among the most common tillage implements used in South Asia. They do not invert soil like a moldboard plow does but opens the soil and pulls up clods that then slowly broken down in multiple passes.

Jessore is the main hub for 4WTs

Jessore has produced a very large percentage of the tillage 4WT drivers who work for different 4WT owners all over the country. In one village of Jessore, Baulia, at present there are around 300 4WT drivers. There are several other similar villages in Jessore (such as Chachra). This phenomenon can be explained due to a number of factors:

- Jessore has been advanced in agriculture for many years. The local BADC office had around 10 Russian 4WTs in the Pakistan period (1960s) and some Jessore locals were appointed there as drivers and helpers. Those 4WTs were used to cultivate BADC lands and some lead farmers' lands and local people have seen the effectiveness of this new machine in tilling land.
- In around 1985 many 4WT were auctioned from several sugar mills (especially Nougan) and at that time some locals, especially the ones that had been appointed in Jessore BADC office before first bought some of those 4WTs. Local villagers were appointed as helpers for those 4WTs. Those helpers also gradually learnt driving from the drivers.
- Many 4WTs were auctioned from sugar mills and Jessore locals bought those 4WTs. The comparative advantage that Jessore people had was that there were already a good supply of drivers and helpers there by that time and they understood the tillage business quite well.
- When people from other districts started to buy 4WTs (mostly the auctioned 4WTs), they also sought out and hired drivers from Jessore. The Belarus 4WTs were comparatively more difficult to drive as compared to today's Indian 4WTs and also not many 2WT drivers existed at that time.

Service charges vary significantly

Service charges were found to vary significantly in the network-based marketing model. Service charges ranged between rotovator and cultivator from BDT350 to 500 / acre (just using cultivator; 1 pass) (broker's commission is included) to BDT650 to 900 / acre (just using rotovator; 1 pass) (broker's commission is included). Broker's commissions generally were found to vary from BDT10 to 50.

Also, the number of passes that they provide also varies from place to place. For example, while in some area farmers only till their onion fields 3 times with 4WT cultivator (then 2 more with 2WT), there are areas where farmers till onion fields 6 times with cultivator first and then 2 more times with 2WT. According to the 4WT owners and drivers, this number is dependent on regional/local soil texture and water content along with farmers' traditional practice and perception.

There are a number of categories of after sales service

Many companies claim to offer a number of after sales services. However, the **quality and reliability of these services were found to vary**. Indeed, there were some examples of maintenance services being offered to encourage sales, though these were not found to be free in many cases. Due to high overhead costs, companies generally do not undertake promotional activities at the local level.

Table 15: Different after sales service offers of the companies

	Company 'A'	Company 'B'	Company 'C'
Warranty	Fully free service and spare parts change and free servicing up to 1000 hrs of usage	Fully free service and spare parts change and free servicing up to 1500 hrs of usage	Spare parts change and free servicing up to 1200 hrs of usage
Maintenance and Repairing	<ul style="list-style-type: none"> - Provides driver training - Provides introductory maintenance and safety training - Has established workshops where their machine density is high - Has trained mechanics in each districts working in different workshops (the number depends on the intensity of 4WTs in that area; for example in Barisal region they have 10 mechanics now) - Upon call from their customers, their mechanics go to the customers' places and provide repairing service 	<ul style="list-style-type: none"> - Provides driver training - Provides introductory maintenance and safety training - Has trained mechanics in each districts working in different workshops - Has service centers in most of the districts called 'Customer Tech Point' from where they provide maintenance and repairing service 	<ul style="list-style-type: none"> - Provides driver training - Provides introductory maintenance and safety training - Has 12 regional offices all over the country, each having 5 to 7 mechanics (in almost each districts) working in different workshops - Upon call from their customers, their mechanics go to the customers' places and provide repairing service

Repairs and maintenance are required frequently

During the peak tillage season, 4WTs are used in the field for tilling to a maximum of around 20 hour in a day. Moreover, when the 4WT goes to distant districts through brokerage medium, the drivers want to finish the job as soon as possible and work usually days and nights. This type of extended work periods with less stoppage for routine maintenance puts the machines in a 'more than' optimal situation. Hence, the owners and drivers reported frequent breakdowns which require repairing. Some common issues reported include:

- Full engine or different parts of an engine of a new 4WT need repairs on an average after 3 years. Repairing is required annually from this point. The cost of engine repair (whole engine and spare parts) can be as much as BDT 50,000 to 100,000.
- Tires need to be changed after each 4.5 years for tillage 4WTs, and 3 years for haulage 4WTs. The cost of tires ranges from – BDT 90,000 to 110,000.
- Different parts of rotovators or the whole attachment need to be changed after 2.5 to 3 years. The price for these parts depends upon the quality and availability of spares. Generally, a full set of pinion gears and sprockets would cost between BDT 70,000 (for Italian-made parts) and 30,000 (for Chinese/Indian produced parts). Pinion parts could cost in the range of BDT 8,000 to 25,000 for Chinese/Indian manufactured parts (Italian pinion parts are not available as a full set has to be purchased).

4WTs offer a year round business

Operators of 4WT can advantage of sequential cropping seasons to offer services (tilling and haulage) year round (see Table 17 below). Often the machines and operators will travel long distances to provide tillage services. There are clear peak seasons throughout the year with the major business seasons are: October to February – 4 month; and, April to June – 3 months. In these seven months, a 4WT usually works in field for around 120 to 150 days.

Table 16: Jessore 4WT Migration to different areas for different crops

Month	April	May & June	October	November	December	January & February
District	Jessore, Khulna	Jessore	Meherpur	Rajshahi	Mymensing, Netrokona, Kishoreganj	Char land of Padma
Crop	Boro	Boro	Jute	Potato	Boro	Ground Nut & Boro

In the **rainy season there is a reduced tillage business** for the 4WT. At that period they lose business of at least 15 to 20 days to the 2WTs because the heavy 4WTs cannot run on muddy lands and the 2WTs can. If mud is more than 3? deep, tires slip and it becomes difficult to operate 4WTs on such land⁴³. However, 4WT owners, drivers and company people suggested that lighter machines (of lower HP like 33 to 37 HP) might operate well in the muddy land.

Installment payment options are available

It has been found that the presence of an installment facility is a recent phenomenon⁴⁴. Most of the buyers of new 4WTs had a comparatively higher socio-economic profile than that of the present buyers. During that time, since all the money had to be paid in cash, buyers either had to sell their assets or take loans from banks or through informal channels. Therefore, almost all were comparatively well off. Yet, now a buyer has the option of buying a 4WT on installments subject to arranging around 300,000 taka as a down payment.

Payment plans have been promoted by the 4WT companies delivering the message that a buyer can reach the break-even point within at best 2 seasons. This has been encouraging even landless or small farmers to consider making a purchase on this basis. To achieve this they are either selling their small assets or taking loan from NGOs or relatives for arranging the down payment.

43. It should be noted that during the study we have not encountered and reported any cage wheel for 4 WT. While talking with one of the tractor importers we have found that as the tractor importers are trying to capture the Khulna and Barisal Division market so they have started to thinking about it. ACI Motors (importer of Sonalika Tractor) mentioned that, on an experimental basis they have made available a few unit of cage wheel but there is not much demand as the cage wheel costs around 200,000 to 250,000 taka. During this report preparation it was also found that Bogra and Naogaon based local level workshops have started producing a few units of cage wheel and they only produce based on demand order.

44. There were only 2-3 importers till the mid of 00s and the competition among them was not so fierce as of today. Hence, the financial product was not much.

6.1.3 KEY ACTORS

There are a number of key market actors involved in the system. These actors fulfill different roles in the chain from importer level to the provision of services in the field. The relationships between these actors are outlined in Figure 17.

Importers

Currently, nine **importers** are actively engaged in the business. All the 4WTs are mostly coming from India through Benapol land port. Rotary tillers are imported from several countries, including Italy and China. But according to the companies, the best quality rotovators are imported from Italy. Importers have their own outlets throughout the country even though these outlets are mostly located in the western and eastern belt of the country⁴⁵. Outlets usually have a couple of marketing executives. These executives maintain customer tracking services as well as searching for new customers either through **brokers** or by themselves through field visits.

Brokers

Brokers are the existing drivers of 4WTs who often serve as local level sales agents for the 4WT dealers. Brokers are mainly local poor people who were either landless or have a small amount of land. Social linkage and relationships are the major capital they require to engage in the business. Since the brokerage business is not highly esteemed in rural society, farmers or villagers that have land or social status generally do not enter this business. Most of the successful brokers have the capacity to collect their money from farmers through mutual relationships and negotiations.

There are two types of brokers: one that works for companies to increase their customers, and another that works for the 4WT owners to find new tillage areas. Brokers are key agents in the 4WT business as they often **act as commission agents** for finding new customers for the companies and also find new tillage areas for the 4WT owners.

Brokers often perform an informal demand assessment role in certain geographical areas (such as villages or Unions) and aggregate the total demand for 4WT services. Then pass this information to 4WT owners who send their 4WTs and drivers to meet this demand.

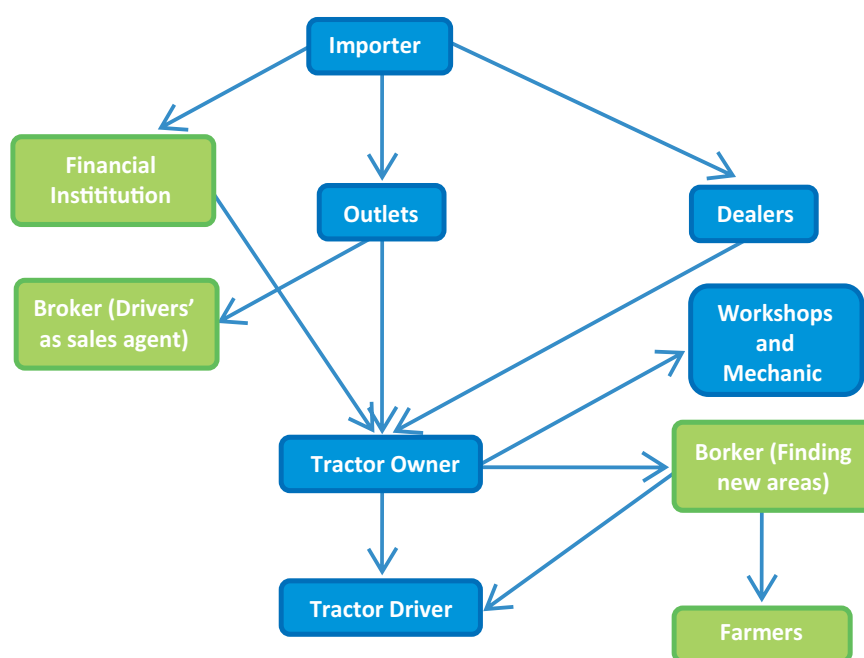


Figure 17: Actors in 4WT Business

⁴⁵. For details please see the outlet map in the annex.

Most of the brokers run their businesses on-credit. Either they collect money at the end of any cropping season or at the end of last pass⁴⁶ (for example if a farmer cultivates a piece of land four times, he/she has to pay the service charge at the end of the 4th pass). Only a few of them can run their businesses on a cash basis. As many of the brokers run their business on credit, they usually arrange 'Haalkhata'⁴⁷ ceremonies each year to collect/ withdraw their money from farmers. However, most of them cannot withdraw a significant part of their cash from farmers and those who still owe have their payments aggregated into the following year. Thus, a dependency relationship is formed over years between the brokers and farmers.

Outlets/Dealers

Outlets usually arrange local level fairs, driver training etc. and provide maintenance services during the warranty period. As the overhead of running the outlets is high the companies have been considering opening up a dealership network for 4 WT. It should be noted that two 4WT importers are also involved in 2WT business and usually they sell 2WT through dealers.

4WT Owners/Drivers

Most of the 4WT owners/drivers are farmers themselves. As mentioned earlier, the drivers have emerged from the BADC program and went on to become owners. With the increase in installment financing (explained later), lot of drivers are turning into owners. New owners who are working overseas or have returned are becoming the new owners, as they have the capacity to fulfill the down payment as required by the companies for financing the 4WTs.

Workshops and Mechanics

Workshops mainly repair different parts of the engine and rotovator. The manufacturing and repair business operates for up to nine months per year, mostly from August to May. There are some 15 to 20 Jessore based workshops that have the expertise to repair 4WT engines. 4WT owners from different parts of the country seek services from those workshops to repair engine which can cost anything between 5,000-80,000 taka. Similar workshops are also present in Dinajpur and Rangpur district.

The average turnover for such workshops is 20 to 30 lac taka each year where on average 5 to 10 mechanics, technicians and laborers work regularly. Average monthly salary of a mechanic is 15,000tk. A lot of these workshops can be categorized as 'informal'. Mechanics generally learn through on-the-job training as they usually start from an early age as apprentices. In the South two large markets were found at Lohapattiin, Jessore and at Sheikh para in, Khulna.

46. It should be noted that number of passes varies significantly. During field work we have found that it ranges from 2 to 4 depending upon soil texture. In most of the cases, the number of passes is 3 but we also have found that when broker is involved as the intermediary; especially in the clay type hard soil then the farmers ask for 4th pass and to secure the relationship with the farmer, the broker also make the tractor driver to do the 4th pass. As there is a fear that if the 4th pass is not done the farmers may not pay the complete amount of money which the broker collects through haalkhata.

47. Haalkhata is a Bangladeshi traditional event organized by the businessmen/trader all around the country. Usually, in the first day of Bengali Calendar year they observe this event. All the customers who usually owe money are invited to have sweetmeat and pay the owed money to open a new balance sheet in the ledger book of the trader. But in case of the tractor brokers, they organize haalkhata at the end of tilling season, mostly in the Bengali month of Joistho.

6.2 Findings & Analysis

- Sales have been boosted through installment payment options
- Advertised installment calculations on 4WTs have misled customers
- Network marketing has emerged as another major driver of sales
- Emergence of after sales services to safeguard investments
- Brokers are becoming new 4WT owners leading to shrinking coverage areas
- Power is shifting from 4WT owners towards the brokers
- Emergence of 4WT Owners' Associations
- 4WT migration routes continue to change
- Bank financing remains focused upon companies rather than direct customers
- Lengthening payback periods indicates that the present financing market is taking greater risks
- Emergence of second-hand rotovator market
- Tensions exist between the 4WT and the 2WT service markets
- Increasing numbers of 4WTs leading to decreasing area per 4WT

Sales have been boosted through installment payment options

Most of the 4WTs sold by different companies are in installments (generally 2-3 years). Initial minimum down payment is generally 30% for nearly all the 4WT companies. The companies advertise their products along with the payment scheme (which also illustrates what one could earn from the 4WT). At present the interest rate in paying the installments is around 15%.

Advertised installment calculations on 4WTs have misled customers

The payment scheme that the companies advertise takes only the costs of the 4WT into account. However, in practice, the customer has to buy the trailer and the rotovator along with the 4WT. Additional investments into these attachments increases the ROI for the customer (see Figure 20). The customers buy the 4WTs based on the payback scheme (advertised around 2 years at present) but then realize that it takes them longer to pay off the loan.

Network Marketing has emerged as another major driver of sales

A key feature of the Bangladeshi 4WT market system is the network marketing processes for products and services. Multiple actors are involved in these processes throughout the hubs. Service providers have developed a number of mechanisms to cater the mechanized service to the customers. Broadly, in the case of 4WT market system there are two network marketing processes working simultaneously:

1. **Marketing of 4WTs.** Company outlets keep in close contact with drivers and mechanics and offer them a commission for finding new customers. As these drivers and mechanics visit areas for work, they are able to identify new customers. In this they adopt the role of marketing agents for the company outlets. Commissions are substantial, with reports of companies providing as much as BDT 10,000-15,000 for finding a new customer.
2. **Marketing of 4WT Services.** Marketing of 4WT services generates demand for new customers. As drivers and brokers rely on the network marketing of service provision so they are generally

proficient in usually estimating potential business, understanding cost-benefits, and managing cash flow in their business. Thus they find it easier to convince a new customer. Network marketing of 4WT services has different modalities as follows:

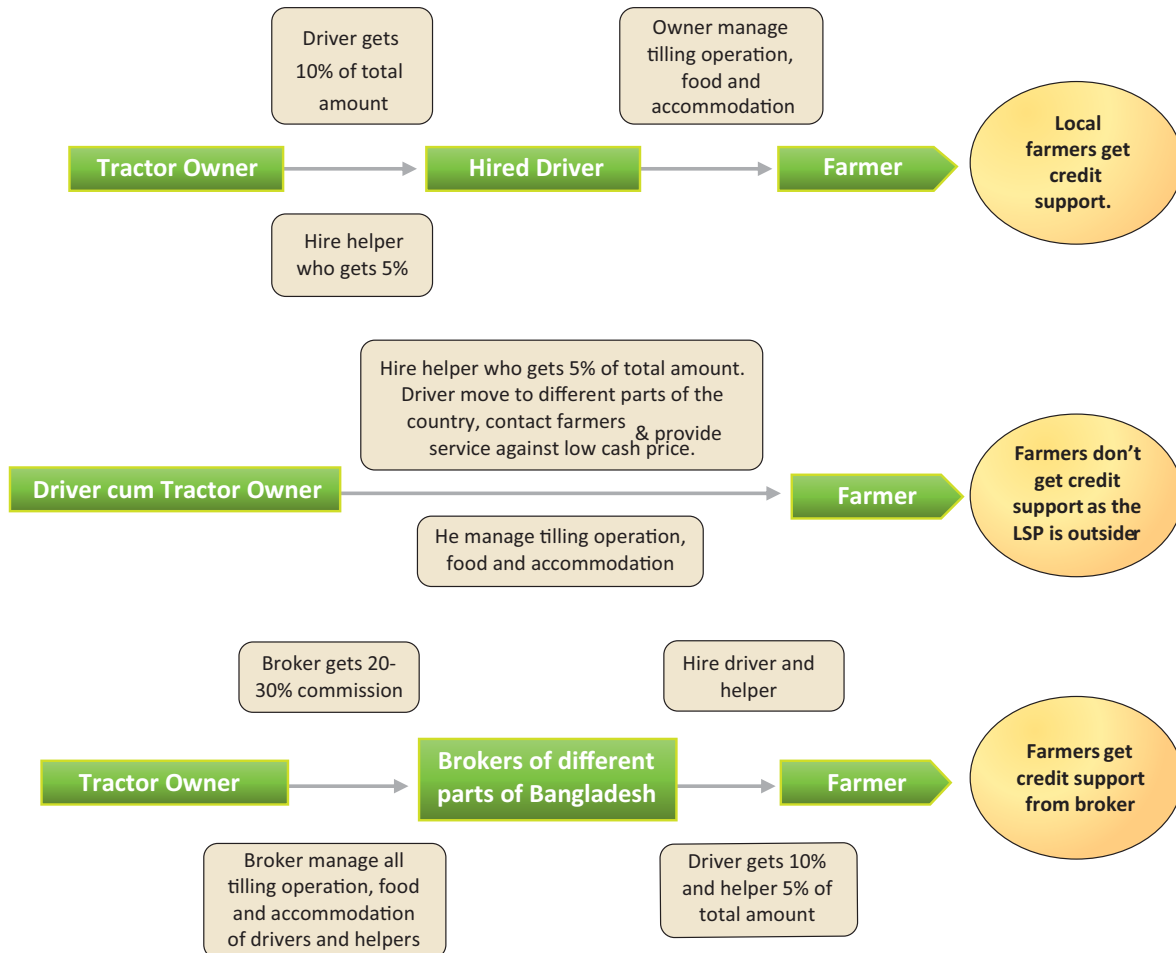


Figure 18: Different modalities of 4WT service business

Emergence of after sales services to safeguard investments

The commercial model of installment payment has created an interesting phenomenon in after sales service provision. In this mode of transaction, since the company's money is at stake, the company usually provides the customer with necessary support services until the full money is received. The company provides an instructor who stays in the purchaser's residence for 2 to 5 days to teach the machine owner/owner's hired driver how to drive it along with other necessary regular maintenance and safety instructions. In addition, the company provides necessary maintenance and repairing services until the money is totally paid back.

Brokers are becoming new 4WT owners leading to shrinking coverage areas

In many districts brokers are becoming the new 4WT owners. They have experienced the profits that the 4WT owners can make, thus have been attracted to own a 4WT by themselves. While installment payment

plans have helped them to purchase new 4WTs, many brokers reported that they are not able to pay the installments except during the 3 major paddy tillage seasons. This is likely the major reason for the increasing number of 4WTs but not the proportionate increase in the 4WT tillage land area.

Power is shifting from 4WT owners toward the Brokers

When there were fewer 4WTs available in the market, 4WT owners had more power than the brokers. Brokers often feared that if they failed to pay their 4WT owner regularly the owner might take away the 4WT in the middle of that season and prevent the collection of money (on credit) from farmers. However, with the increase of 4WT numbers, the **power dynamic appears to have shifted more towards the brokers** as now they have more options to choose from. Since per 4WT coverage areas have been decreasing, now 4WT owners offer brokers higher commission rates (than the existing market rate) and other incentives to access their services.

However, this trend has been affecting owners' installment payments. 4WT owners with weak linkages with brokers (and were not operating as a broker before) were found to have a reduced service area and income than those who enjoyed better linkages. This it is also true that since many new 4WTs are entering the area, many brokers are also facing a decreasing service area. But their credit-based business model has been acting as a crucial factor in enabling their business to survive as most of the farmers prefer taking service on credit.

Emergence of 4WT Owners' Associations

This kind of association has emerged recently though it is likely that more associations will grow in areas where 4WT numbers have increased. It was found that 4WT owners at Rajshahi have started organizing themselves into associations for a number of reasons:

- Resolving disputes. There were many complaints from 4WT owners before stating that brokers are not paying their 4WT owners timely or at the end of a season. In the first year the association received around 200 complaints in 1 year. The association now handles these complaints and in 2011 only 6 complaints were received. The association has also been suggesting all the 4WT owners to keep written documents of all their contracts with the brokers.
- Stabilizing rates for the 4WT owners and brokers. New 4WT owners have a tendency to charge higher rates and since brokers enjoy a certain commission, 4WT owners also try to raise the service charge to realize higher profit margins. The opposite was also reported where new 4WT owners were found to lower their service charges in order to gain a foothold in the market.
- Promoting fairer recruitment practices. Expert drivers are not always available. Previously, the new 4WT owners often hired drivers of other 4WT owners by offering them a higher salary/wage. Now, this practice has been prohibited by the association in the middle of their business season unless any valid reason exists.
- Representing 4WT operators to local government and other market actors. 4WTs do not have a road permit. Using this legal condition police often capture 4WTs. In those cases representatives of the association go to the police station and try to resolve the issue.
- Providing support and compensation to families. 4WT drivers too often injured or killed by road accidents. In those cases the 4WT Association tries to compensate the victim's family with concerned 4WT owners own account and/or association's mutual fund.

4WT Migration Routes Continue to Change

4WT migration is a prominent feature of Jessore-based 4WTs and there is no other comparable area in the country. In Jessore, 4WT service business mostly depends on migration to other districts. Brokers play a

crucial role in this business. For example, tillage 4WTs of Jessore migrate to different districts all around the country (including Mymensingh, Rajshahi, Tangail, Bogra, Netrokona, Munshiganj, Madaripur, Shariatpur, Shatkhira, Kurigram, Gopalganj, Kushtia, Hatibandha, Barisal, Narail, Pabna, Naogaon, Thakurgaon, etc). The destinations have been changing rapidly in the last few years because of sudden influx of many 4WTs in the market. For example, before many 4WTs of Jessore migrated to Meherpur. In the last few years many Meherpur locals bought new 4WTs and thus Jessore's 4WT owners lost that market.

Bank financing remains focused upon companies rather than direct customers

Banks have been long been engaged in 4WT financing. They have loan schemes for the customer, however, it was reported throughout the hubs that while accessing loans, customers faced difficulties in meeting the bureaucratic requirements (papers). Banks claim that they can offer a loan to any customer who has the capacity to pay and who possess the necessary collateral. Yet representatives of financial institutions revealed that customers often come from remote villages and there is no system to track these customers. Therefore they often avoid 4WT financing when the customer is a completely new account holder and has come from distant locality.

The companies try to help the banks out. It was reported that company outlets usually recruit a person especially to liaise with the bank. When new customers come to the outlets to buy on-credit, this officer helps to link the customer with the bank. But this is only possible for such customers who have enough land assets to give as collateral. Given all these problems, the banks focus on the companies rather than the customers. Private SME banks have been doing very well in 4WT financing because of their presence at local level. BRAC SME branches have provided credit for 2,000 4WTs worth Tk 1,000 million in last 3 years among farmers.

Lengthening payback periods indicate that the market could fail

The return on investment is decreasing significantly and already companies are experiencing high 'overdue' risk in the market. Projections made based on the current and potential growth of 4WTs reveal that given the current discount rate, the payback period of 70% of the cost price (of 4WTs only) is likely to increase from 1.1 years to 2.2 years. Yet in reality most of the 4WT owners start the service business by including the rotovator and trolley in the fleet and hence total investment is almost double when compared with the cost of the 4WT only. Therefore, considering the full investment required (4WT, rotovator and trolley), the payback time can be seen to be increasing very sharply (from 3.79 years in 2008 to an anticipated 15.51 years in 2015 – see Figure 20).

Emergence of a second-hand rotovator market

Refurbishing second hand rotovators was found to be an emerging business in Jessore hub. This business started 5 years back. Now there are around 8 manufacturers/ workshops who sell a total of around 80 to 90 units per year. They mostly sell 54 tines based rotovators. When making purchases, the manufacturers confirmed that they bought the rotovators with 42 blades from different areas of Bangladesh. Then they remake it to '54 blades rotovator' which has high demand in the Jessore region.

Manufacturers have an **informal network** to receive broken rotovators and repaired rotovators. They buy/ collect used or broken rotovators from different parts of the country. They are well connected with different workshops and spare parts shops and with the Jessore based drivers all over the country. These people are **treated as commission agents** and they get around 1 to 2 thousand taka per unit. Often 4WT owners come to them directly to buy the secondhand rotovators, but mostly they sell through other dealers and workshops.

The biggest buyers of second hand rotovators are the ones that have bought second hand 4WTs, particularly the case with North Bengal districts. The major parts of a rotovator include pinion set, bearing, metal body and the blades. While the blades and metal body can be made in workshops, they directly use imported pinion sets and bearing. Therefore, a workshop does not have to have big set up to assemble parts and produce a rotovator. The quality of these refurbished rotovators was confirmed to be sufficient by LSPs, though generally second hand suppliers of rotovators will not provide after sales service or warranty.

Tension exists between the 4WT and the 2WT tillage service markets

It has been found that in most of the areas **where 4WTs have increased, 2WT markets have reduced**. However, in most of those 4WT intensive areas 2WTs still have moderate business especially during the rainy season when 4WTs cannot operate on muddy tracks as wheel cage has not been introduced. There are a number of reasons for this:

- Farmers take 2WT service after tilling their land with 4WT cultivator to fine till their lands; and,
- Many farms are surrounded by trees and bushes and therefore 2WTs are used in those plots which are either economically too small for or not easily accessible by 4WTs.

The major reason behind the increasing popularity of 4WTs against 2WTs is the cost and time reduction in land preparation in large dry season plots. A comparative analysis of cost-involvement in land preparation for paddy and onion by 2WT and 4WT at a village in Satkhira is provided below:

Table 17: Comparative price of tillage services of 4WT and 2WT

	2WT		4WT		
	No of passes	Cost involved in land preparation for 1 acre	No of passes (cultivator)	No of passes (rotovator)	Cost involved in land preparation for 1 acre
Paddy	4	1920	-	1	1200
Onion	6	3240	2	1	2160

- Often farmers have to level their land after tilling it with 2WT and thus incur more cost. But tilling with 4WT rotovators the land does not need that additional leveling task.
- The 4WT cultivator and rotovators also can till deeper than that of 2WT. Deep tilling is more popular among farmers for many crops.

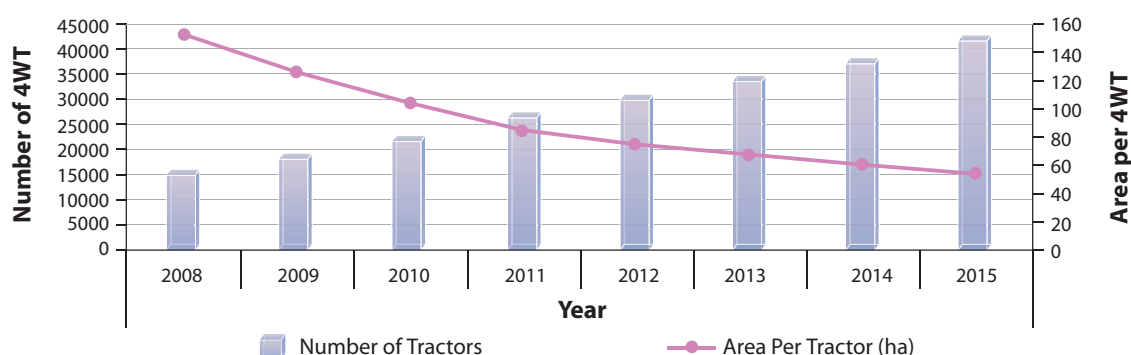


Figure 19: Number of tractors and average land they would till

Increasing numbers of 4WTs leading to decreasing area per 4WT

Even though the 4WT is encroaching the land area that 2WT used to till, in the last three years the average per capita tillage area for the 4WT is also decreasing at a rate of around 17%⁴⁸ whilst 4WT growth is around 21%. Forward projections suggest that this trend is set to continue. Annual tillage area per 4WT is likely to decrease at a rate of 10% till 2015 whereas the growth of the 4WT is likely to be around 11% (given the current growth trend). The decrease of per capita tillage area for 4WT is also evidenced from the drivers reporting less work compared to the previous years and the companies changing their repayment schedules.

6.3 Constraints & Opportunities

- Subsidy has pushed sales but may be insufficient to reach scale that companies are aiming for
- People are buying 4WTs without thorough analysis
- Demand potential not clear to customers
- Promotion of seeder other alternative agricultural services is weak
- Seeder attachment improves viability

Subsidy has pushed sales but may be insufficient to reach scale

From 2010 a new subsidy project of 150 crore taka was undertaken by the DAE. Under this World Bank National Agriculture Technology Project (NATP) funded project DAE has been subsidizing and marketing ten different agricultural machines⁴⁹ through different companies under a 20% subsidy and also provide relevant technical services in some selected upazilas. Seven large agro machinery manufacturing/ importer companies were selected through field demonstrations that have after sales service centers, spare parts availability and workshops in all the selected upazilas under this project. Companies have reported that the government subsidy program on agricultural machineries has contributed towards the recent increases in 4WT sales.

It was found that although most farmers are well informed regarding government subsidies for 4WTs, in most cases farmers are not aware of the formal processes required to access the subsidy. It was found that subsidy is pushing 4WT sales in most of the hub areas. However questions remain concerning whether the subsidy will lead to right incentives amongst the key market actors to underpin sustainability in the market long term.

People are buying 4WTs without thorough analysis

Lack of information is a key problem that exists in the 4WT market system affecting both machinery importers and potential customers. Generally there is insufficient analysis underpinning many customer decisions, with few options for accessing quality information. Promotional business materials produced by 4WT companies highlight the potentially high rewards of employing offered financial products. However, in reality achieving viability in the 4WT business is not always so easy, and companies are finding it increasingly difficult to collect installment money. Investigation with many companies in Bangladesh revealed that often companies base their sales target not from national level market demand analysis but from existing commission based sales growth pattern. Such companies are less sure about overall current and future demand scenarios.

⁴⁸. Calculated based upon land area remaining at 20% for 4WT

⁴⁹. 4W & 2W power tiller, power thresher, maize sheller, combined harvester, rice transplanter, USG applicator, weeder, hand reaper, sprayer and hand reaper

Demand potential is not clear to customers

There are many areas where additional 4WTs and/or 4WT services may help the farmers in land preparation. Companies have been trying to expand their businesses by opening up new outlets in new areas. It was revealed during field investigation that the demand potential for different unexplored areas is not clear to the companies and hence they are less inclined to take risks. It was suggested that district-wise demand data as well as 4WT service market information is very likely to solve the business expansion constraint in new areas.

Seeder Attachment improves viability

While 4WT based tillage and haulage services have been expanding, there was no evidence that seed drills, planters (both conventional and zero till) or other attachments (reaper, etc) are being promoted to the same extent. There is also no evidence that such kinds of seeder attachments have entered the country even though they exist in India, where most of the 4WTs are manufactured, and other parts of the world. Crucially, the addition of a seeder attachment significantly improves the potential payback projection (from 2.21 years in 2008 to 8.45 years in 2015) (Figure 20). Analysis suggests that the adoption of seeder attachments is likely to add 36% additional income for the owners. As per the graph above (Graph 5) the following can be ascertained.

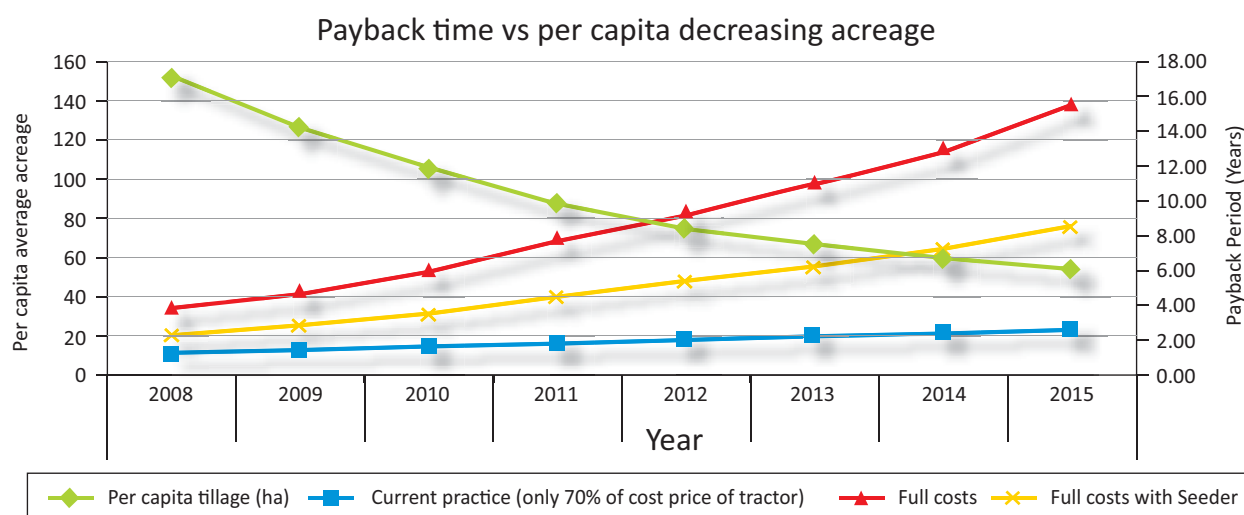


Figure 20: Payback period vs decreasing acreage per tractor

- Per capita tillage area (the blue line below) is decreasing steadily as number of 4WTs increase in the country. At present the average area coverage is 85.4 ha. Projections show that by 2015 the average area coverage is likely to be around 54.25 ha.
- The current practice is that farmers generally pay around 30% of the 4WT (without trailer and rotovator attachments) cost as a down payment, the leaving the remaining 70% to be paid through an installment plan. In this case the payback period is relatively stable at around two years (the red line).
- If the full cost of 4WT is paid through an installment plan (including the 4WT, rotovator and trailer) then projections show that the payback period increases dramatically to nearly 16 years in 2015 (the green line).
- However, adding the seeder service through the addition of a seeder attachment decreases the payback period substantially (the purple line) by around seven years.

6.4 Interventions

- Promotion in new areas
- Increase crop intensity
- Introduce 4WT seeder services
- Promote appropriate financial package
- Promote information at the national level

Several interventions are necessary to create incentives for the tillage and precision sowing (seed drill) service provision.

Promotion in new areas

Broadly, the 4WT tillage service market is concentrated in eastern and western belt of the country. Coastal belt (apart from some Upazilas of Khulna and Satkhira which are adjacent to Jessore) has very little experience of 4WT tillage services. One of the problems found out through the study is that cage wheels for the 4WT have not been introduced. Cage wheels can increase the business volume as they increase the potential area the 4WT can cover, as currently 4WT do not usually operate in the muddy soils of those areas (southernmost areas of Khulna and Satkhira). On the other hand, importers have only recently opened up outlets in the Barisal hub areas and started to sell a few units. Hence, there is a significant scope of increasing the area coverage of the 4WT.

Increase crop intensity

Cropping intensity of Jessore, Dinajpur and Faridpur hub is comparatively higher than that of the Khulna and Barisal Hubs. Hence, the amount of required tillage services is also lower in these southern areas.

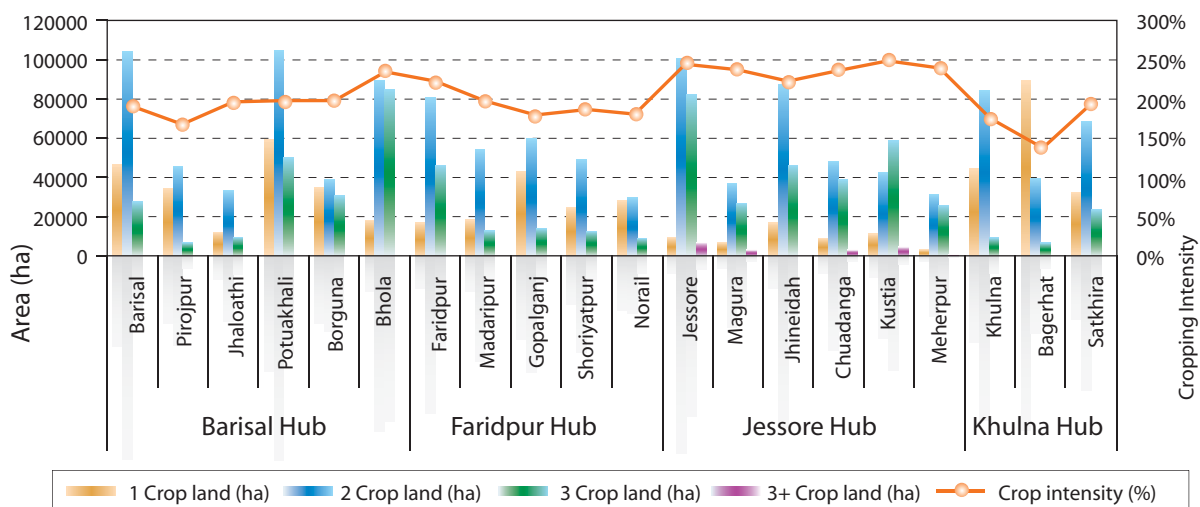


Figure 21: Variations of cropping intensity among the hub districts

Increasing cropping intensity is a key part of agricultural development of Bangladesh and public extension agencies have been trying to increase it by introducing different high value crops in the coastal belts. With the increase of cropping intensity the use of the 4WT will increase accordingly, thereby increasing the average acreage of tilling and serving to decrease the payback period of the 4WT.

Introduce 4WT seeder services

As explained earlier, seeder and other potential attachment services need to be introduced in order to make the 4WT business more viable. However, a detailed analysis of the different areas that 4WTs can serve needs to be undertaken so that there is an evidence base for targeting the most promising areas for this service.

Promote an appropriate financial product

Competition among companies has been creating opportunities for potential buyers as new financial products enter the market. It appears that current offers (monthly installments for a period of 2 to 2.5 years) have been causing problems for the drivers/ owners of the 4WT. Companies require information in order to design their products more effectively. Therefore, detailed financial analysis of the current status of products and modeling of various financial products could be undertaken to support financial product diversification for buyers.

Establish a national platform on 4WT

There are a number of policy issues such as subsidy use, road permits and other licensing issues, and taxation and import duties which need to be fully explored and solutions devised. At present there is also no public or private agency that holds any nation-wide data on key areas related to 4WTs. This information includes areas such as the number of 4WTs, the business status, and changes within the mechanized tillage service. Therefore it is recommended that a national platform on 4WT be formed to frame an appropriate policy mechanism and consolidate knowledge and data on the sector.

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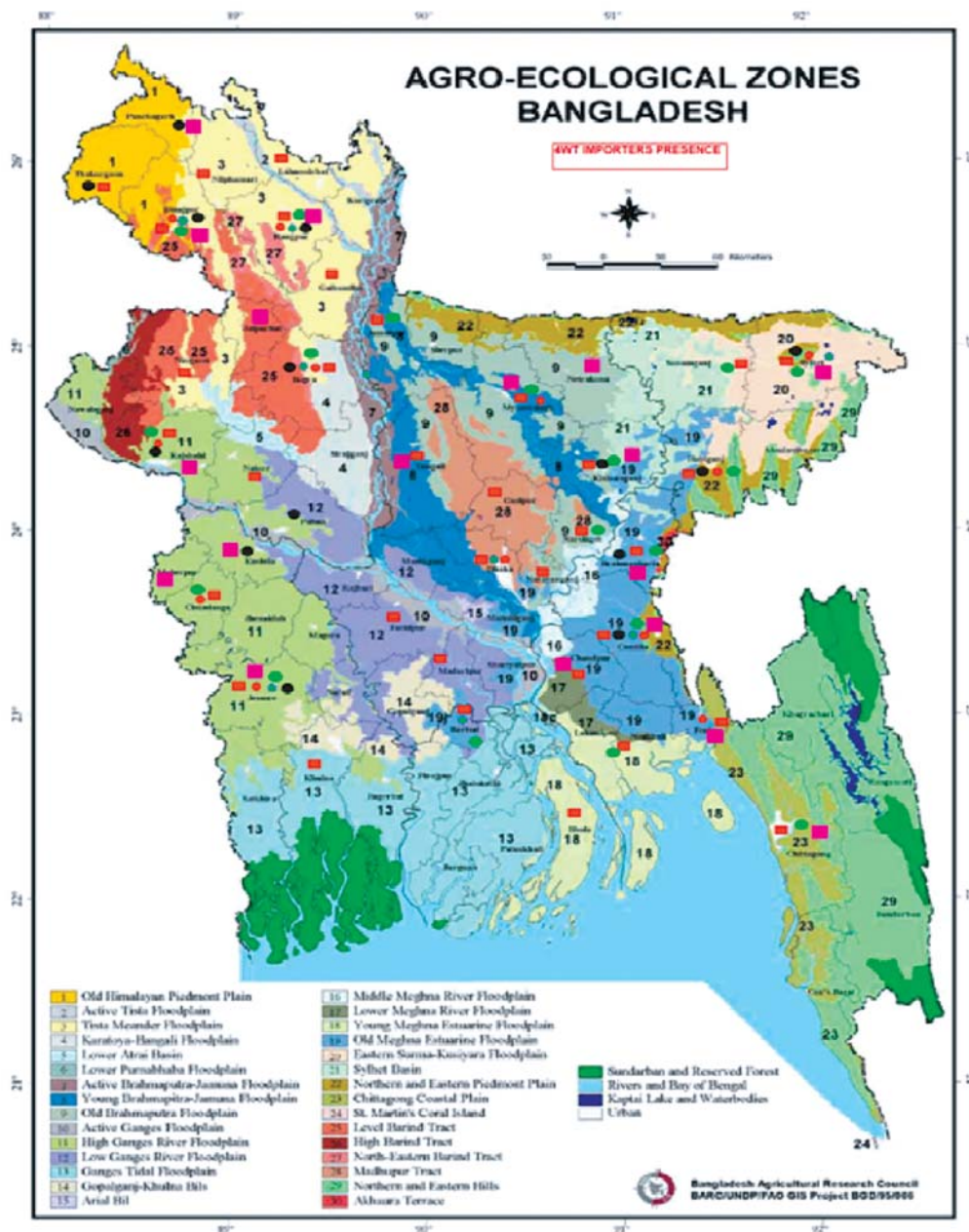
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ANNEXES

PRESENCE OF 4WT DEALERS IN DIFFERENT AGRO-ECOLOGICAL ZONES OF BANGLADESH



Picture 1: Dealers presence in different agr-ecological zones of Bangladesh.

Study Instruments

CHECKLIST OF INTERVIEWS

DAE (LOCAL OFFICE)

1. Number of farmers and categorization
2. Predominant cropping patterns and area
3. Amount of land under boro cultivation (LIV, HYV and Hybrid)
4. What is the number of agri machines in your area?
 - a. 4WT
 - b. 2WT
 - c. PTOS
 - d. Thresher
 - e. Maize sheller
 - f. Reaper
 - g. Etc.
5. What are the agricultural mechanization project have been implemented in your area? Please brief us.
6. Which machine DAE promoted in this area?
7. What are the key successes that this particular DAE office can claim regarding farm mechanization?
8. How DAE is promoting farm machineries in your area? How DAE is providing information i.e. size and capacity of machines, company recommendation etc. regarding various machines?
9. Which is the private sector companies/manufacturer with whom DAE work with at local level?
10. How DAE is playing its role in providing government subsidy on farm machineries?
11. What are the machineries that are locally manufactured? In what volume per anum?

DONOR/ NGO (NATIONAL LEVEL)

Detail about NGO intervention regarding farm mechanization i.e. promotion, transfer, training etc.

DEALER

1. Name and address of the business
2. What are the machines that you sell?
3. What are the names of companies/importer?
4. What is the volume of machines sold per anum?
5. How do you bought and brought your machines?
 - a. Credit facility
 - b. Transport facility
 - c. Storage facility

6. What are the machines that will experience growth in the years to come?
7. Is there any seasonality of machines business? What is the pick and off-pick season?
8. How do you advice on the size and capacity of the machines?
9. Do you have any functional linkage with DAE or other government farms? Have you had any orders from them?
10. Do you have any knowledge on government subsidy? Please detail it?
11. Have you sold any machines to any farmer association?
12. Credit/installment facility? What do you do with overdue problem?
13. Warranty, guaranty and after sales services?
14. Training for machine operation
15. Banking or financing facilities? What are the challenges?
16. Is there any agricultural machineries dealers association? How do you operate? How do you negotiate with banks, GoB institutions etc.

MANUFACTURER

1. Name and address of the business
2. Experience in the business
3. What are the machines and spare parts you manufacture? What is the volume per anum? Trend over last few years?
4. From where you get the design/prototype?
5. What is the capacity of your workshop to produce any machine e.g. how many machines per day/month?
6. Retail price of the machines.
7. Is there any seasonality of machines business? What is the pick and off-pick season?
8. How many workers are there in your business?
 - a. How do you provide training for the workers?
 - b. How do you cope with expert staff retention?
9. What is the storage facility?
10. Enlistment with BARI? Is a member of Bangladesh Agricultural Machinery Association?
11. From where you buy the raw materials? Can you buy it on credit?
12. What is your current investment?
13. How much loan do you have from which sources? What are the challenges that you face while accessing loan?
14. How do you provide the after sales services? What are the modalities of this e.g. warranty, service with/without payment etc., on field repair
15. What kind of repairing services you provide?
16. How many large scale orders do you usually get? From whom? What kind of problem that you face while producing in large scale?

17. Is there any distribution network for your produced machines? Draw a map.
18. Which machines do you think will experience more growth in the years to come?
19. How many manufacturers are there in this district? Upazilla wise disaggregated information. If you know beyond your district please share.

COMPANIES

1. Name and address
2. What are the machines that this company imports/manufactures?
3. Last 3 years target and growth achievement of this branch for different machineries?
4. Is there any seasonality of machines business? What is the pick and off-pick season?
5. What are the guaranty, warranty, after sales service options are there? For which machines?
6. Which machines do you think will experience significant growth in the years to come?
7. What kind of original spare parts have you made available?
8. Is there any promotional/extension technique that you follow?
 - a. Demonstration
 - b. FFD
 - c. Meeting
 - d. Rally
 - e. etc.
9. Which machines are at still nascent phase? How are you promoting it?
10. Credit/installment system?
11. Please tell us more about 4 WT?
 - a. How many have you sold without rotovators?
 - b. How many with rotovators?
12. What do you know about government subsidy program? How do you work with customers, banks and DAE regarding this subsidy issue?
13. What are the challenges your branch have been facing?
 - a. With overdue?
 - b. With bank?
 - c. With government?
14. Do you have any functional linkage with DAE or other government farms? Have you had any orders from them?

MECHANIC

1. Name and address
2. Do you have any fixed point business?

3. Experience
4. How many mechanics are there for farm machines in your Upazilla or district? Is there any association?
5. Training from whom and where?
6. What kind of machines that you can repair?
7. What kind of problems that local mechanics cannot solve? Where do the machine owners go in that case?
8. Is there any trend of out migration for mechanic community?
9. Do you work with any dealer/company/workshop? Who are they? What is the nature of contract?
10. From where you buy the spare parts? Are those available in the district/Upazilla?
11. Do you go to customers own household to provide the repairing services?
12. How much have you earned in last 3 months? What is the pick month? What is the off-pick month?
13. How do you promote your business? Do you think that your profession will be more profitable in the years to come?
14. What is the success that you have had so far that you may want to tell us?

LOCAL M/FIS

1. Does this M/FI has any package of loan for local small retailers and/dealers?
2. Detail of the package? i.e. interest rate, repayment schedule, mortgage?
3. What can be the highest amount of money that a retailer/dealer can borrow?
4. Is there any package for the farmers association? Details...
5. Is there any package to buy agricultural technologies be it large or small?
6. If yes, then what is the detail of technology specific financing?

COMPANY HEAD OFFICE

BUSINESS GROWTH

Name of machine	Sales					Retail Price
	2007	2008	2009	2010	2011	
4WT						
2 WT						
4 WT rotavators						
2 WT rotavators						

- Distribution network/Districts included under this branch
- Strategies for promotion (driver training, mechanic training, demonstrations, fair)
- Financial packages offered (to customers, to the brokers)
- GoB Subsidy and Companies view regarding it and how it is involved with subsidy program
- Linkages with Banks (how it helps customer to access bank loan)
- Challenges (overdue, too much competition etc.)
- Coping

FOCUSED GROUP DISCUSSION DATA RECORDING SHEET FOR THE LOCAL MECHANIZED SERVICE PROVIDERS

Activity 1: Availability of agricultural machineries

Note: Ask about the general crops they cultivate over the year. Probe the crops and list down the machineries accordingly.

Name of agricultural machineries are in use in the region	Name of agricultural machineries are currently available in the market that you do not use locally or are used in the neighbouring areas
1.	1.
2.	2.
3.	3.
4.	4.
5.	5.
6.	6.
7.	7.
8.	8.
9.	9.
10.	10.

Activity 2: Use Time line to know the history of agricultural machineries used in the region and changes over the period (Please initiates a discussion with the group to probe the history of farm mechanization in their village/Union/Upazilla and then follow the lead to know the changes till date. Do not take too much time on it but make sure that you have noted down the time of introduction of each kind of machine and the change that happened in terms of total number and user till date i.e. trend of agricultural machineries used in the locality? Average trend of annual purchase in the area.

Activity 3: Access to the machineries

Note: Mention the machineries' according to the list that found from activity 1 and go forward.

Sl.no.	Name of the Machine	Who sells/brought (in locality/ in Bangladesh)	Who manufactures (in locality/ in Bangladesh)	Do the manufacturers/dealers/importers can produce the machine or spare parts based on the requirement by the buyer
1.				
2.				
3.				
4.				
5.				

Activity 4: Positive experience with the machineries

Note: Mention the machineries according to the list that found from activity 1 and go forward.

Sl.no.	Name of the Machine	Positive experience
1.		
2.		
3.		
4.		
5.		
6.		
7.		
8.		
9.		
10.		

Activity 5: Promotional activity of agricultural machineries (within this year)

(In this section please try to understand the promotional activities i.e. farmers field day, demonstrations, rally, meetings, campaign etc.) by different actors.

Sl.no.	Name of the Machine	Government (what and how)	NGO (what and how)	Private sector (what and how)
1.				
2.				
3.				
4.				
5.				
6.				
7.				
8.				
9.				
10.				

Activity 6: Credit facility for machinery

Sl.no.	Name of the machine	Available credit facilities and packages	Who provides these packages	Who would be potential actors to extend credit facilities if deemed required	What is your recommended credit modality?
1.					
2.					
3.					
4.					
5.					
6.					
7.					
8.					
9.					
10.					

Activity 7: Repairing and Maintenance (R&M) of machineries

Sl. No.	Name of the machine	Who are the R&M service providers?	What are the usual ways to have the maintenance services	Who sell the spare parts	Who produces the spare parts
1.					
		2. 3.			
2.					
3.					
4.					
5.					
6.					
7.					
8.					
9.					
10.					

Activity 8: Mechanized service provision

Sl.no.	Name of the machine	Structure of machine service business
1.		
2.		
3.		
4.		
5.		
6.		
7.		
8.		
9.		
10.		

Activity 9: Associated problems and ways-out

Sl.no.	Issues	Problems	Reasons
1.	Training to operate machines		
2.	Size and capacity of the machine		
3.	Credit facility		
4.	Maintenance		
5.	Service business		

Activity 10: Coping strategies with the problems

Note: Mention the issues that found from activity 9 and go forward.

Sl.no.	Category of issue	Coping strategies
1.	Importing / manufacturi	
2.	Training to operate machines	
3.	Size and capacity of the machine	
4.	Credit facility	
5.	Maintenance	
6.	Service business	

Activity 11: What to be done more to reduce the problem/ how this can be improved

Note: Mention the causes of problems that found from activity 9 and go forward.

Sl.no.	Category of issue	Main 3 activities should be done/ what needed to Strengthen the system	Specific activities that should be done	Who will do/Who could be active agent (service providers,traders, financial institutions, manufacturers)	How will do/ How can more entrepreneurs be encouraged	Risk factors
1.	Importing / manufacturing					
2.	Training to operate machines					
3.	Size and capacity of the machine					
4.	Credit facility					
5.	Maintenance					
6.	Service business					

Activity 14: Impact projection of the locality

Sl.no.	Name of the machine	Demand of no. of machines/could potentially be sold	Total No. of farmers would be benefited?	No. of service provider needed	Impact of the intervention
1.					
2.					
3.					
4.					
5.					
6.					
7.					
8.					
9.					
10.					

FOCUSED GROUP DISCUSSION DATA RECORDING SHEET FOR THE USERS OF LOCAL MECHANIZED SERVICES

Activity 1: Availability of agricultural machineries

Note: Ask about the general crops they cultivate over the year. Probe the crops and list down the machineries accordingly.

Name of agricultural machineries are in use in the region	Name of agricultural machineries are currently available in the market that you do not use locally or are used in the neighbouring areas
1.	1.
2.	2.
3.	3.
4.	4.
5.	5.
6.	6.
7.	7.
8.	8.
9.	9.
10.	10.

Activity 2: Use Time line to know the history of agricultural machineries used in the region and changes over the period (Please initiates a discussion with the group to probe the history of farm mechanization in their village/Union/Upazilla and then follow the lead to know the changes till date. Do not take too much time on it but make sure that you have noted down the time of introduction of each kind of machine and the change that happened in terms of total number and user till date i.e. trend of agricultural machineries used in the locality? Average trend of annual purchase in the area.

Activity 3: Access to the machineries services

Note: Mention the machineries' according to the list that found from activity 1 and go forward.

Sl.no.	Name of the Machine	From where they get the service (person/company)	Who sells/brought (in locality/ in Bangladesh)	Who manufacture (in locality/ in Bangladesh)	Do the manufacturers/dealers/importers can produce the machine or spare parts based on the requirement by the buyer
1.					
2.					
3.					
4.					
5.					
6.					

Activity 4: Positive experience with the machineries

Note: Mention the machineries according to the list that found from activity 1 and go forward.

Sl.no.	Name of the Machine	Positive experience
1.		
2.		
3.		
4.		
5.		
6.		

Activity 5: Promotional Activity of Agricultural Machineries (within this year)

(In this section please try to understand the promotional activities i.e. farmers field day, demonstrations, rally, meetings, campaign etc.) by different actors.

Sl.no.	Name of the Machine	Government (what and how)	NGO (what and how)	Private sector (what and how)
1.				
2.				
3.				
4.				
5.				
6.				

Activity 6: Credit Facility for Machinery Purchases

Sl.no.	Name of the machine	Available credit facilities and packages	Who provides these packages	Who would be potential actors to extend credit facilities if deemed required	What is your recommended credit modality?
1.					
2.					
3.					
4.					
5.					
6.					

Activity 7: Mechanized service provision

Sl.no.	Name of the machine	Structure of machine service business
1.		
2.		
3.		
4.		
5.		
6.		

Activity 8: Associated problems and way-out

Sl.no.	Issues	Problems	Reasons
1.	Operating machines		
2.	Getting information		
3.	Credit facility		
4.	Service business		

Activity 9: Coping strategies with the problems

Note: Mention the issues that found from activity 8 and go forward.

Sl.no.	Category issue	Coping strategies
1.	Operating machines	
2.	Getting information	
3.	Credit facility	
4.	Service business	

Activity 10: What to be done more to reduce the problem/how this can be improved

Note: Mention the causes of problems that found from activity 8 and go forward.

Sl.no.	Category of issue	Main 3 interventions should be done/ what needed to Strengthen the system	Specific activities should be done	Who will do/Who Could be active agent (service providers, traders, financial institutions, manufacturers)	How will do/ How can more entrepreneurs be encouraged	Risk factors
1.	Operating machines					
2.	Getting information					
3.	Credit facility					
4.	Service business					

Activity 11: Impact projection

Sl.No.	Name of the machine	Demand of no. of machines/could potentially be sold	Total no. of farmers would be benefited?	No. of service provider needed	Impact of the intervention
1.					
2.					
3.					
4.					
5.					
6.					

GUIDELINES TO PREPARE PROCESS CASE STUDIES

SPS, Subsidy, R&M, Service Access – NLSP

Following are the case basis some questions to be considered. To get a whole picture of the system relevant more questions should have to be asked with different relevant people. After getting all answers a comprehensive story should be drawn.

SPS (Service provision system)

- When, where and how agri machineries service provision kick off in the locality? Which machine? (get the story)
- Who are the LSPs?
- Why the LSPs do this business?
- How the LSPs buy agri machineries? With what condition I.e. loan, installment etc.
- What is the existing machinery services practiced in the locality?
- Is it increasing? If so or not, what are the underlying causes? To what extent it is increasing?
- What the changes are over the period of service provision modality from commencing period to present date?
- Who fix the service provision modality? How?
- What about the pick and off pick season? (get a story of boro season)
- What is the cost benefit scenario of machinery services?
- What is the LSPs' service related problems with the user? When? Why?
- What are the other factors that hamper LSPs' to provide smooth services?
- How LSPs cope / mitigate with the problems? (get a story of coping mechanism)
- Is there any formal or informal association or network of LSPs? If so, how that works?

Subsidy

- What do the farmers know about government subsidy on farm machineries?
- What is the selection criterion to get a government subsidy?
- For which machine farmers get government subsidy?
- What are the steps to get subsidy? How long it takes?
- Where goes the subsidy?
- How a farmer goes with the steps? (get a story)
- What is the process of final selection?

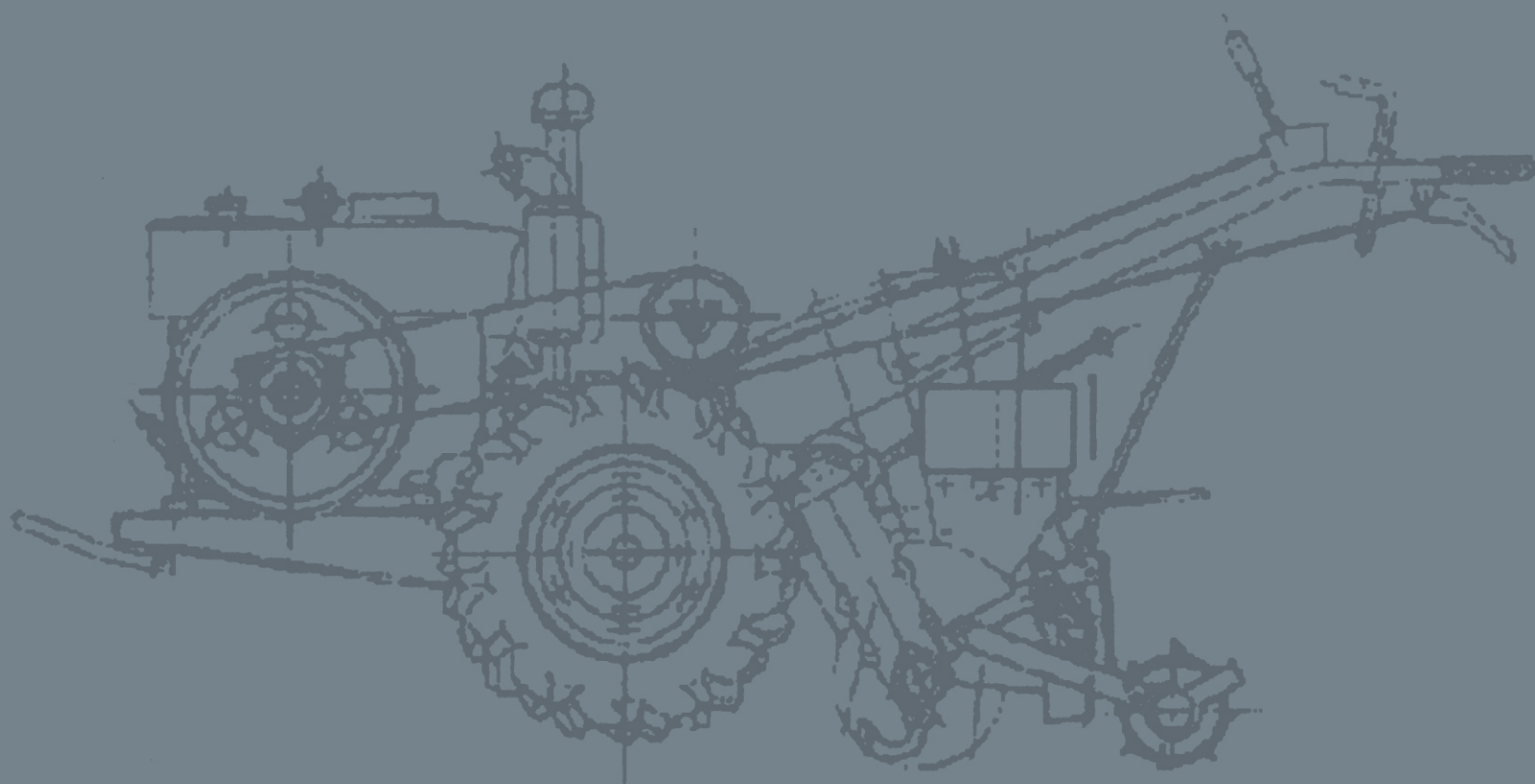
- What is the gap between two – who got subsidy and who didn't?
- Who are the informal and formal actors involve with the process? Why and how?
- What is the role of each actor?
- What is the cost benefit of subsidy?
- What is the general attitude of farmers regarding subsidy?
- What about the company services regarding subsidy?

Repair and Maintenance (R&M)

- How far the farmers know about maintenance of the machineries? How do they learn to do regular maintenance operations?
- To what extent the engineering service points are there in the locality? What is the category of R&M service providers?
- How far the farmers have to go to engineering services?
- What is the general frequency of servicing?
- What is the average maintenance cost of each machine?
- Try to understand the frequencies for different machines
- How they get spare parts?
- What are the problems regarding maintenance? (get story)
- How they cope with the problems?
- What is the impact of services to the users regarding maintenance?
- What is the role of companies regarding maintenance?
- Get step by step stories of R&M of each machine from LSPs

Service access – from service buyers perspective

- What are the types of contract of getting services for different machines?
- What is the formal and informal mechanism of getting services? (get story)
- What about the pick and off pick season?
- What are the problems of getting services? Why? What are the key barriers?
- How the farmers cope with the problems?
- Is any kind of dispute occurs regarding services?
- Who are the actors involve with the system? What is their role?
- What is the socioeconomic impact of existing service system?



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