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Agricultural Mechanization in Bangladesh – The Future

Workshop Report

CSISA-MEA

Cereal Systems Initiative for South Asia-Mechanization Extension Activity

USAID FROM THE AMERICAN PEOPLE

CIMMYT International Maize and Wheat Improvement Center

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Editor: Frances Hunt

21–22 March, 2022

Grand Ballroom, Pan Pacific Sonargaon, Dhaka, Bangladesh

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Bangladesh is one of the most mechanized countries in Asia when it comes to land preparation. By contrast, the planting and harvesting of the 11 million hectares of rice grown every year in Bangladesh is still largely carried out by hand. At present, all crops grown in Bangladesh are largely planted, weeded, and harvested manually. Increasing labor costs and shortages of labor make growing these crops increasingly expensive and vulnerable to delayed planting and harvesting. Mechanizing these operations has been recognized by the Government of Bangladesh as an important priority in efforts to maintain national food security and to avoid dependence on imports, particularly of rice. With this objective in mind, the Government has introduced subsidy programs which support businesses to invest in advanced, appropriate crop-planting, and harvesting equipment. This is resulting in the rapid adoption of crop harvesting machinery such as combine harvesters and reapers and the planting of rice using rice transplanters.

The USAID Feed the Future Bangladesh Cereal Systems Initiative for South Asia – Mechanization Extension Activity (CSISA-MEA) began in October 2019 and is implemented by CIMMYT in partnership with iDE and the Georgia Institute of Technology. The activity works in the Feed the Future zone of influence in southern Bangladesh and in the Rohingya crisis-impacted zones of the Cox's Bazar district. CSISA-MEA aims to support the mechanization of agriculture in Bangladesh by developing the capacity of the private sector to develop, manufacture, and market innovative new technology which will enable the country's farmers to appropriately mechanize agricultural production. The objective of CSISA-MEA is to enhance agricultural resilience through development of agricultural machinery light engineering companies, and develop a gender-inclusive workforce, with a special focus on the crisis-affected areas of Bangladesh.

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Introduction

Bangladesh has made great strides in mechanizing many aspects of agricultural production since the early 1980s, when manual labor and animal power did all the work. The cyclone of 1970, followed by the War of Liberation in 1971 and then prolonged floods in 1988, changed things to a great degree. To replace quickly the large number of draught animals lost in the 1988 flood, the government withdrew brand and testing restrictions on the import of agricultural machinery and allowed the duty-free import of irrigation engines, power tillers and spare parts. As a result, thousands of low-cost power tillers and irrigation engines were imported, making possible the rapid expansion of mechanization of primary tillage, irrigation and threshing. By the mid-2000s, draught animals in use earlier had been replaced by 300,000 power tillers[1]. Now 700,000 power tillers till more than 97% of cultivated land[2] and 74% of rice is threshed by 370,000 engine-powered threshers. Also, 7% paddy and wheat is harvested by about 5000 medium size combine harvester[3]. This has also led to a rapid expansion of the light engineering sector which makes machines such as multi-crop threshers and maize sheller machines, as well as spare parts for power tillers and tractors. This local manufacturing sub-sector contributes about 32% of agricultural machinery and 79% of spare parts demand of the country, which has reduced the burden of import[4].

However, there is still a long way to go before agriculture in Bangladesh is fully mechanized. For example, almost all of the 11.5 million hectares of rice planted[5] and the 50 million tons of rice harvested each year is transplanted and harvested manually. Growing labor costs and shortages of supply, particularly during the rice harvest period, is now driving a demand for mechanized rice transplanting and harvesting services. The private sector has responded to this through the aggressive promotion and sale of rice transplanters and mini combine harvesters, and the government through the provision of subsidies on the sale price of a range of machines including combine harvesters and rice transplanters. Despite this, adoption of combine harvesters and rice transplanters has been slower than expected, and many crop production activities still continue to be done by hand.

To contribute to addressing these issues, the USAID Feed the Future Bangladesh Cereal Systems Initiative for South Asia Mechanization and Extension Activity (CSISA–MEA) in partnership with Bangladesh Agricultural University (BAU) held a workshop for agricultural mechanization value chain actors on ***"Agricultural Mechanization in Bangladesh – The Future"*** at Pan Pacific Sonargaon, Dhaka, 21–22 March, 2022. Its purpose was to review progress made with agricultural mechanization, the impact this has had on rural society in Bangladesh, and how the increase in the availability of rural labor force will support the industrialization of the Bangladesh economy. Within this context the workshop aimed to identify:

1. opportunities for mechanizing crop production operations which are currently still partly or entirely done manually
2. constraints to accelerating the pace of mechanization and the changes required in government and private sector policy to make this happen
3. how the Bangladesh light engineering sector could be supported to manufacture agricultural machinery and spare parts for domestic and international markets
4. support which rural women and youth need to gain employment in the agricultural machinery sector and establish agricultural mechanization-based businesses
5. innovative ways of financing agricultural machinery manufacture, sales and service provision.

The workshop was attended by 297 participants from a wide range of sectors including agricultural machinery-based light engineering enterprises, machinery marketing companies, machinery service-providing entrepreneurs, public and private sector finance institutions, micro finance institutes, representatives from the Department of Agricultural Extension, national agricultural research stations, the Ministry of Industry, international development organizations, USAID and universities. It was held

[1] Mrema, G., Soni, P., Rolle, R. S., 2014. Sustainable mechanisation across agri-food chains in Asia and the Pacific region, Food and Agriculture Organisation, Bangkok Thailand.

[2] Gurung, T. R., Kabir, W. & Bokhtiar S., M., 2017. Mechanisation for Sustainable Agricultural Intensification in SAARC Region, SAARC Agricultural Centre, Dhaka, Bangladesh.

[3] Alam, M, M., Sarkar, S., 2022. Fourth Industrial Revolution (4IR) and Agricultural Mechanization in Bangladesh, Department of Farm Power and Machinery, Bangladesh Agricultural University, Mymensingh, Bangladesh.

[4] Alam, M, M., Sarkar, S., 2022. Fourth Industrial Revolution (4IR) and Agricultural Mechanization in Bangladesh, Department of Farm Power and Machinery, Bangladesh Agricultural University, Mymensingh, Bangladesh.

[5] Year Book of Agricultural Statistic, Bangladesh Bureau of Statistics, April 2021.

over two days, starting with an inaugural session attended by the Honorable Minister Dr. Muhammad Abdur Razzaque, Member of Parliament, Ministry of Agriculture, Government of the Peoples' Republic of Bangladesh. This was followed by sessions titled:

1. Agricultural mechanization in the context of economic development in Bangladesh
2. What have we learnt about adoption of agricultural mechanization?
3. Manufacture of agricultural machines and spare parts
4. Access to finance and business development

Each session was followed by a panel discussion led by a moderator and a panel of sector specialists. Questions from the audience were also taken during the panel discussion.

The full workshop agenda is presented in Annex 1 and the workshop presentations can be accessed through the CSISA website: https://csisa.org/agricultural-mechanization-in-bangladesh-the-future/.

Day 1: 21 March 2022

Inaugural Session – 09:30 to 11:30

Speeches welcoming the workshop participants were given by Dr. Timothy Krupnik, Country Representative, CIMMYT and Prof. Dr. Md. Monjurul Alam, Professor, Department of Farm Power and Machinery, BAU. This included a presentation showing how increasing labor costs and decreasing availability of rural labor were driving the need for agricultural mechanization, and how mechanization was reducing production costs and improving the quality of life for farmers, in particular for female members of farming households.

This was followed by a speech from the Honorable Minister of Agriculture, Dr. Muhammad Abdur Razzaque. He praised the progress made by the Government of Bangladesh in mechanizing agriculture in Bangladesh, with specific reference to the subsidy program implemented by the Bangladesh Department of Agricultural Extension (DAE) and its impact on strengthening agricultural mechanization activities. He expressed appreciation for the continuous support provided by USAID for the development of the agricultural sector in Bangladesh, with particular emphasis on the need to manufacture in Bangladesh spare parts for machines that are currently mainly imported. He said that means should be found for encouraging machinery and spare parts importers to source these parts from Bangladesh manufacturers, which would create employment and reduce the country's dependence on imports. He also emphasized that post-harvest losses were high and could be reduced by mechanizing post-harvest processing. Finally, he appealed to donors such as USAID to encourage investors to invest in industry in Bangladesh, in addition to its welcome provision of food aid.

Brief speeches were delivered by the Secretary to the Ministry of Agriculture, Muhammad Khan, Acting Director, Office of Economic Growth, USAID and Director Generals from BRRI, BARI, BWMRI and BARC (the latter also chaired the sessions).

Session 1 (12:00–13:00): Agricultural mechanization in the context of economic development in Bangladesh

The two key note presentations were:

How is Bangladesh transforming from a predominantly agro-based to a vibrant agro-industrial society? The role of agricultural mechanization. Dr. Shahidur Rashid, Director for South Asia, IFPRI and Dr. Xiaobo Jhang, Senior Research Fellow, IFPRI

The presentation showed that Bangladesh has followed a classic development path, with an initial large pool of rural labor that could be absorbed into urban-based employment without impacting wage rates. As the Bangladesh economy expanded and as the share of national GDP from agriculture dropped from 60% at Independence in 1971 to 13% in 2020, labor demand in urban industry for both male and female workers continued to expand, resulting in a rapid rise in wage rates. The average daily wage in the 1960s through to 1990 would buy 3 kg of rice, a figure which has since risen to the equivalent of 9 kg of rice. A similar scenario has occurred in China where machine power has also replaced animal draught power but where, unlike Bangladesh, ploughing is now largely done by four-wheel tractors and harvesting by combine harvesters. As in Bangladesh, tractors, being cheaper and multi-functional, tend to operate in relatively small areas, whereas combine harvesters are transported up to 1000 km to take advantage of different harvesting seasons and crops in different parts of China. Combine harvester operators often work in groups and use agents to prepare farmers for the arrival of the combine harvester teams. The same trends are starting to appear in Bangladesh, where the movement of combine harvesters from south to north and back, following the seasons, is common. In this way, the combine harvester is able to operate over a longer season and recuperate quickly the cost of purchasing the machine. In China, as in Bangladesh, poor training of operators and aftersales services, and shortage of spare parts and mechanics, hamper combine harvester businesses. The Chinese case shows that agricultural production is divisible and that some steps of production can be sourced to specialized service providers, including harvesting services, which run at a much larger scale.

Achievements and future plan for agricultural mechanization in Bangladesh

Keynote presentation: Mr. Md Benojir Alam, Director General, Department of Agricultural Extension (DAE).

The presentation contained a wealth of information and data about agriculture in Bangladesh, the role of the DAE, and agricultural mechanization. It described the emphasis that government policy has placed on agricultural development since Bangladesh independence in 1971, current labor costs and crop production levels, the role of Government in agricultural development, and the diverse range of activities the DAE is responsible for implementing. The DAE is working to mechanize the agriculture sector in the face of rising labor costs and the lack of interest in farming among the next generation, which is likely to continue if it remains a labor-intensive activity. The presentation discussed details of Government's agricultural machinery subsidy program and the range of machines to be included. Future plans include supporting spare parts manufacture, machinery assembly, establishing a mechanization training centre, spreading the concept of farmers working together to synchronize crop production, and establishing a centre for testing standards for new machinery.

Session 2 (14:00–17:00): What have we learnt about adoption of agricultural mechanization?

The adoption, dis-adoption and constraints to further adoption of new agricultural machinery in Bangladesh. Dr. Brendan Brown, Socio-economist, CIMMYT, South Asia

The Activity conducted a random sample survey to determine to what extent farmers are adopting new agricultural mechanization technology such as combine harvesters and tractors, and what is constraining its further adoption. The survey reviewed the status of 26 pieces of machinery that have been introduced into Bangladesh in recent years. These include two- and four-wheel tractors, tractor-mounted planters, rice transplanters, irrigation pumps including solar pumps, harvesting equipment including reapers and combine harvesters, and post-harvest equipment such as threshers, shellers and fodder choppers.

The survey found that four-wheel tractors are starting to replace two-wheel tractors and that this is most evident in north western Bangladesh. However, the main finding was that adoption of newer technology such as combine harvesters is constrained not just by their availability but by a lack of farmers' knowledge of their functions and even of their existence: in other words, constraints are not just those of cost, relevance to the farmer, or availability, but (lack of) information.

Although availability of subsidies increases the likelihood of farmers considering purchasing a machine, this is beyond the means of most. Machine use will therefore continue to be based on the hiring out of machinery services, provided by the small minority which owns them. Adoption of some of the more expensive machinery (combine harvesters, tractors) will therefore depend on machinery marketing companies identifying those few individuals with resources to purchase a machine (or helping them source finance to do so) and providing farmers with information about services providers and the machines.

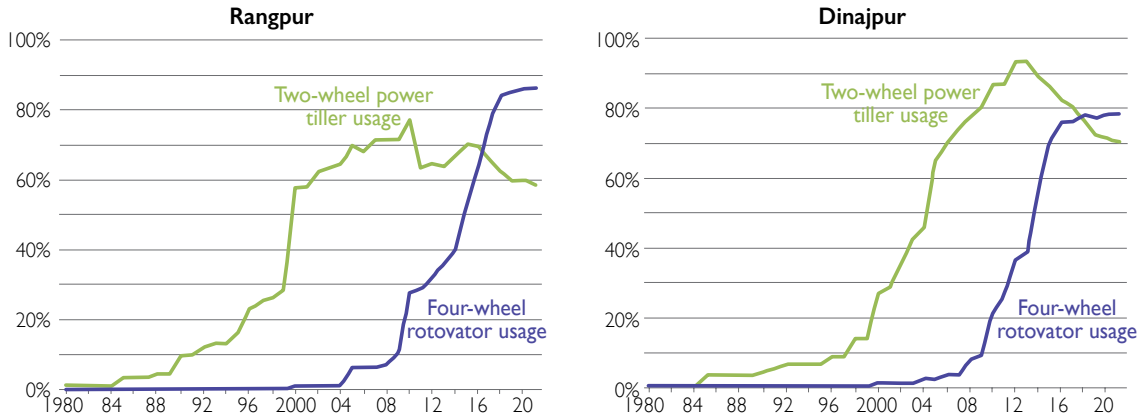


Figure 1. Transition from two wheel to four wheel tractor use in north western Bangladesh

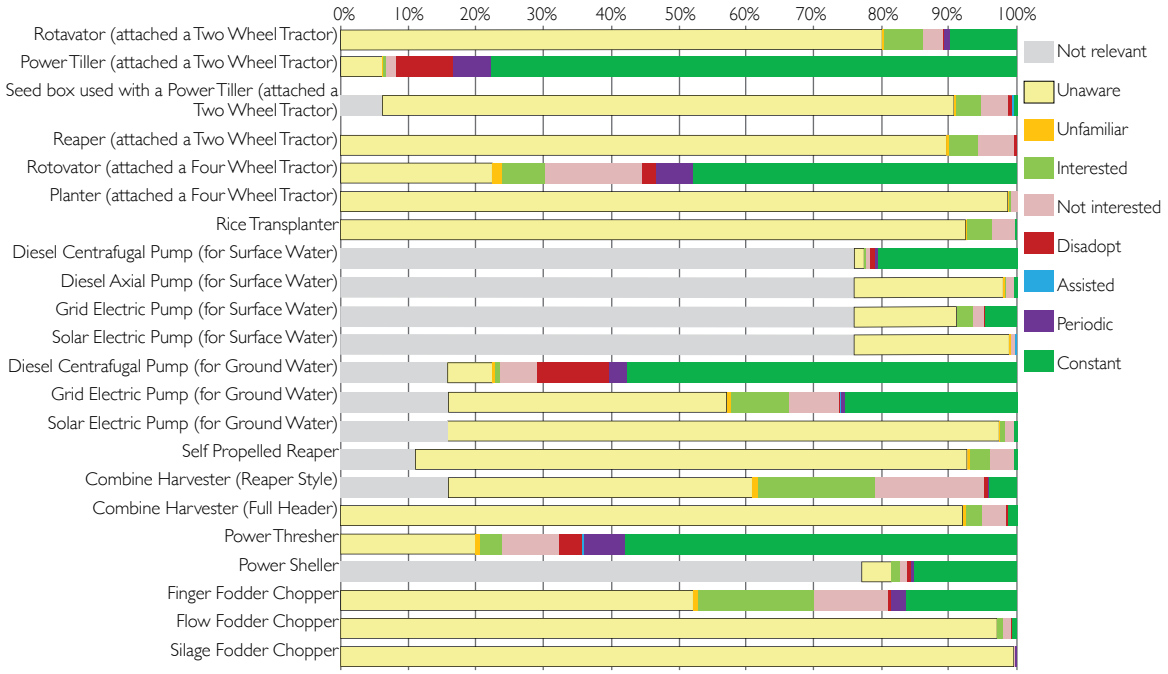


Figure 2: Machinery relevance, awareness, interest in use, adoption, dis-adoption by interviewed farmers. The frequency of use by farmers and if use is part of a program that assists farmers access machinery.

Adoption and adaptation of pre- & post-harvest rice farming technologies: the Bangladesh experience. Dr. Md. Monjurul Alam and Dr. Chayan Kumer Saha, Professors, Department of Farm Power and Machinery, BAU

Dr. Chayan Kumer Saha reviewed the objectives and activities of two USAID-financed innovation labs, implemented globally by Kansas State University and University of Illinois and by BAU in partnership with ACI Motors in Bangladesh. These innovation labs are: Appropriate Scale Mechanization Innovation Hub (ASMIH) and the Post-Harvest Loss Reduction Innovation Lab (PHLIL). The aim of ASMIH is the promotion of rice transplanters, two- and four-wheel tractor mounted planters, reapers and combine harvesters, through targeted interventions on polders. PHLIL's aim is the promotion of grain driers and hermetically-sealed storage structures. The presentation provided useful data on the economics of and labor-saving achieved from the adoption of combine harvesters, reapers, rice transplanters, power tiller-operated zero and strip till planters, and the BAU-designed grain driers. The innovation labs have had notable successes with the adoption of hermetically-sealed cocoons for bulk-storing crops in bags and the inclusion of the BAU grain drier in the government subsidy program. Key recommendations were:

- appropriate scale machines and technologies to be made available through innovation, adaptation or adoption
- sustainable long-term capacity building of local service providers, mechanics, operators and local workshops in terms of operation, maintenance and business management to be ensured through formal and non-formal education, training and extension organizations
- aftersales service and spare parts availability to be ensured in cropping seasons and in the farming locality
- an enabling environment to be created for engaging women and youths in mechanized and smart agriculture.
- climate-smart technologies (e.g. conservation, precision agriculture technologies) to be promoted to sustain natural and physical resources and the agricultural eco-system.
- credit from public and commercial banks to be ensured for agricultural machinery value chain actors (e.g. service providers, local machinery producers, marketing companies) to provide sustaining investment in agriculture.

Mechanization of rice harvesting – lessons learned from South East Asia. Dr. Martin Gummert, Senior Scientist, Postharvest Development, Sustainable Impact through Rice-Based Systems, IRRI

Data from South East Asian countries such as Vietnam show that there, like Bangladesh, combine harvesters save considerable amounts of labor, time and cost, with labor use reduced from 34 people per ha per day to two when switching from manual harvesting to a combine harvester, and a 50 per cent cost saving. Data was presented on energy use, profit and loss under different systems, and changes in cropping patterns associated with combine harvester adoption; as in Bangladesh, major constraints are small field sizes, wet harvesting conditions, poor aftersales services, and poor field and road access. Also in Vietnam, cheap machines were introduced initially, with a move over time toward better quality axial flow machines with tracks, a 2–2.5 m wide cutting bar, bagging station or grain tank. The presentation highlighted two key challenges that will need to be addressed in Bangladesh: (1) grain harvested with a combine harvester is wetter than when manually harvested, necessitating the use of grain driers, and (2) straw burning is more common, as rice straw is difficult to collect after combine harvester use.

Agricultural mechanization in Bangladesh and India. Dr. Avinash Kishore, Research Fellow, IFPRI

As in Bangladesh, agricultural mechanization in India is predominately related to land preparation and the renting of tractors and power tillers. Only 21% of India's farmers own these machines (although the largest farmers own 50% of the machines) – 70% of farmers hire them, with the machine rental business now worth USD2.9 billion. However, as in Bangladesh, awareness of machines such as combine harvesters and rice transplanters is surprisingly low. The presentation suggested that subsidies are not the best way of encouraging the adoption of mechanization technology and that payment of incentives may be a better approach. It also pointed to evidence that expensive machines such as combine harvesters are under-utilized, resulting in scarce capital being embedded fruitlessly, and the transfer of machine rents to larger farmers who own them reinforcing existing inequalities in land ownership.

Research and development of combine harvesters under a public-private partnership approach – experience sharing. Dr. AKM Saiful Islam, Principal Scientific Officer, BRRI

The presentation introduced data which compares the capacity of three contrasting combine harvester models. Based on this data a combine harvester was designed that would be well adapted to Bangladesh conditions. This was then manufactured and tested by BRRI in collaboration with Janata Engineering, Chuadanga, Khulna Division. The machine works well, demonstrating that a combine harvester can be produced in Bangladesh using parts and skills available in the country, and which is affordable for farmers and small traders. However, a partner is required to finance the establishment of a production line and commercialization of the machine.

The role of public-private partnerships in the rapid transfer of agricultural machinery technology to farmers – a private sector perspective. Dr. F H Ansary, President, ACI Agribusiness Division and Managing Director, ACI Motors Ltd. and Mr. Subrata Ranjan Das, Executive Director, ACI Motors

The presentation was given by Mr. Subrata Ranjan Das, Executive Director, ACI Motors, summarizing the growth of agricultural mechanization and mechanization in Bangladesh and highlighting key challenges.

Small farms and fragmented land are not suitable for bigger machines with higher capacity

- The number of nuclear families is increasing, consolidating land holdings at the operational level to increase capacity utilization of the machines by the owners.
- Infrastructure development throughout the country is making access to agricultural land easier.

Limited purchasing power of farmers and unavailability of loans

- The ability of small and medium farmers and the majority of small-scale entrepreneurs to procure and maintain agricultural machinery at their own expense is limited.
- Obtaining loans at the local level is not easy.

Limited knowledge of farmers regarding modern technology

- Exposure of farmers to modern technology is very low as there is no demonstration center.
- Farmers have a limited idea of the ROI of these machines.

Lack of skilled manpower and resources

- Technical skills of the subject-based manpower are inadequate.
- The low margin on the sale of machinery makes it difficult to attract bigger investments.

To address some of these challenges, the presentation suggested that the public sector actively pursue public-private partnerships. It pointed out this is already happening with the government subsidy program, whereby the private sector is supported to promote and market new agricultural mechanization technology by purchase price subsidies provided by the government. Other key ways that government can help would be to support low interest loans, establish contract farming schemes and vertical farming schemes in each district, introduce drone-based technology, technology demonstration centers and fresh produce irradiation centers to reduce postharvest losses, and establish light engineering industrial parks in Bogura and Jashore. The presentation ended with suggestions of new technology that should be promoted.

Day 2 – 22 March 2022

Session 3: (9:30–13:00) Manufacture of agricultural machines and spare parts

Trends in agricultural machinery and spare parts manufacture and sale in Bangladesh. Prof. Dr. Md. Monjurul Alam, Professor, Department of Farm Power and Machinery, BAU

The presentation provided a useful summary of the history of mechanization from the 1950s to 2022, the current number of machines available and proportion of production activities mechanized. The market for agricultural machinery has doubled in the five years since 2017 and is now worth USD2461 million; however, only 28% of this market is supplied by manufacturers within Bangladesh. The market for power tillers, threshers and water pumps is levelled or declining, whereas the market for tractors, combine harvesters and maize shellers is rising rapidly. The presentation described the machinery and spare parts that value chain actors provide and made the following important recommendations:

- Recognition that agricultural mechanization is one of the drivers of the ongoing transformation of Bangladesh agriculture from subsistence to commercial agriculture.
- An intervention in the sub-sector to foster a favorable business eco-system. The agricultural machinery and spare parts market in Bangladesh is growing, and local manufacturing has the potential to capture a major share of the market.
- Establishment of agri-machinery production zone (APZ) on the outskirts of Bogura and Jashore towns to accommodate existing and potential agri-machinery industries and workshops.
- Establishment at each APZ a facility that would provide services related to heat treatment, material testing, standardization, and advisory services.
- Modernization of local foundries through collaboration and experience-sharing with SAARC and industrialized countries.
- Capacity building for technicians (in casting, heat treatment, fabrication, and of repair and maintenance of agri-machinery) and management personnel (in marketing and financial management skills).
- Access to information for manufacturers on markets, exports potential, modern capital machinery and improved production technology .
- Continued zero tariff on capital machinery imports and tax exemption on selected spare parts (with more components added to the list).
- Ensured access to soft, flexible long- and mid-term credit facilities for capital machinery and working capital.

Current practices and perceived constraints of agricultural machinery manufacturers in the light engineering hubs of Bogura and Jashore. Prof. Dr. Jonathan Colton, Georgia Institute of Technology, USA

The presentation discussed findings of a report which provides estimates of the size of the agricultural machinery spare parts market and the current proportion of parts manufactured in Bangladesh. To improve their quality there is a need to:

- use drawings rather than copying parts
- use accurate measuring instruments
- use computer-controlled machines (e.g. milling machines)
- introduce advanced technical training for staff
- hire engineers educated to degree level.

The light engineering sector currently uses 39,000 tons of cast iron and 26,000 tons of mild steel annually, with little knowledge of its chemical composition. The quality of this scrap metal varies considerably, resulting in the following challenges:

- The locally manufactured spare parts and machines made from this scrap are also of uncertain quality.
- ABLE enterprises buy most of their metal from ship breakers, but this represents a tiny percentage of the scrap metal marketed by the ship-breaking industry, so they cannot negotiate low prices.
- The cost of imported raw materials is prohibitively high as a result of 10% to 15% import duty, 15% VAT, and 5% advanced tax.
- Recent ferrous scrap metal prices increased by 60 percent.

As a result, lead firms are reluctant to procure parts locally due to their high costs and lack of guaranteed quality. The report presents an excellent set of solutions and recommendations based on the challenges listed in the presentation. These are summarised below:

- Enhance Raw Material Quality and Lower its Cost
  - Reduce import tariffs and taxes for raw material and metals. This would remove the disadvantage local production has compared to imported machines and spare parts

    - Identify dealers/ intermediaries who will buy in quantity and sell small lots
    - Organize manufacturers to buy in quantity – possibly around Business Associations
- Increase access to tools and training to improve quality
- Provide access to measurement, certification, and testing facilities
    - Located in regional/city light engineering manufacturing clusters
    - These facilities should provide results quickly and at a reasonable price
- Heat treatment of metals to increase hardness and properties
    - To reduce the cost of heat treatment large quantities of metal should be submitted to facilities offering heat treatment. This could best be done by manufacturers to submitting metals for treatment as a group. Business Associations may be able to facilitate this collaboration between manufacturers
- Machining facilities
    - Introduction of accurate and efficient manufacturing machinery such as computer aided lathes and drills that would increase the quality and quantity of parts produced.

PRABRIDDHI supporting development of the light engineering sector. Ms. Mehjabin Ahmed, Senior Manager, Private Sector Development, Prabridhdhi. Local Economic Development, Swisscontact

The presentation provided a description of the light engineering industry in Jashore town. This consists of 256 workshops of which just 18% are involved in the agricultural machinery manufacture sector. Others are foundries (39%) and manufacturers of a diverse range of machinery (30%). The sector serves a wide range of industries including agriculture, a bakery, jute processing, textiles, fish feed, construction, and automobile and saw mill industries. There is considerable potential to develop the sector, so it can (1) manufacture machines and parts as substitutes for imported machines and parts, and (2) export machines and parts. However, there are a number of key constraints:

- The sector is still largely informal without proper licensing/ registration.
- Backward linkages need overhauling – sourcing quality raw materials is problematic, production processes are constrained by the lack of skilled workers, the use of traditional manufacturing technology, lack of technical support, limited product innovation, lack of quality consistency, and lack of specialization.
- Marketing and outreach are based on a referral system – this lacks commercial linkages with lead firms and product branding.
- Investment and expansion is constrained by limited access to finance, business planning and expert support.
- There is an absence of structured policy support for standardization, certification, environmental licensing, workplace safety and security, regulation, and compliance.

The PRABRIDDHI project supports the light engineering sector in Jashore through (1) the introduction of digitization through an online directory and E-marketplace product development and (2) innovation-exploring initiatives to support backward and forward market linkages and entrepreneurship development.

Innovative approaches towards sustainable provision of skills training for agriculture-based light engineering enterprises. Ms. Bharathi Parupalli, Lead Training Coordinator, CSISA–MEA, CIMMYT Bangladesh

Approximately 600,000 are employed in the light engineering sector, most with little or no formal training despite the wide range of government, NGO and development organizations providing or supporting training programs. Needs-based training is essential if the existing workforce is to improve its skills, to provide formal training for apprentices and newly employed staff, and tailor-made courses for specific part/spare part manufacture. CSISA–MEA facilitates training to develop basic skills, then specialist skills, and finally advanced training in, for example, the operation of new manufacturing equipment through cost-sharing agreements.

CSISA–MEA training for employees has resulted in measurable increases in product quality and productivity, acquisition of new skills, and adoption of health and safety measures. Training for managers and owners has led to the adoption of more efficient factory layouts, proper inventory management, greater gender sensitivity, safety equipment being installed, workers' roles and responsibilities revised, the purchase of modern measuring tools and machinery, improvements to sanitation facilities and strengthened business networks. Novel training approaches have also been adopted, including the installation in factories of equipment for on-line training, and the creation of WhatsApp groups that facilitate self-learning and access to technical information. Perhaps the most innovative of approaches used has been to contract the more advanced light engineering companies to act as trainers for staff from other enterprises. With technical support from CSISA–MEA this led not only to the training of staff in a practical "hands-on" environment but also to a developed capacity of light engineering companies to provide training as a business, creating a pathway to establishing a training program that is industry-financed.

New perspectives on innovation processes for agriculture. Mr. Arnoud Hameleers, Country Director, IFAD Bangladesh

The presentation clearly indicated that Bangladesh is still way behind other Asia countries in terms of investment and crop yields:

- Per capita investment in agriculture is just USD16 in Bangladesh, compared to USD43.5 in Thailand, USD34.4 in India and USD26.6 in Myanmar.
- Per capita value addition in agriculture is just USD1037 in Bangladesh, whereas the average investment is USD1820 in South Asia, USD1840 in Myanmar, USD1992 in India and USD2408 in the lower middle-income countries.
- Bangladesh's average paddy production is 4.73 t/ha, compared to 7.05 t/ha in China and 6.68 t/ha in Japan

The presentation asked why progress seems to be stalling, suggesting that this is because (1) public institutions are project-based within competing and duplicating institutions, (2) universities only devote 1% of their time to research, and (3) there are many international organisations and NGOs duplicating activities and wasting resources. It suggested a need to develop innovation platforms that include private as well as public sector actors to develop and implement innovations jointly and in a coordinated manner. Potential problems could include the difficulty of managing diverse actors; advantages would be the pooling of experience, combined research with extension with results accessible to everybody, less duplication, increased adaptation to reality. This approach would generate knowledge faster, coordinate actors, and be cheaper.

Session 4: (14:00–16:30): Access to finance and business development: enhancing agricultural mechanization through access to finance. Ms. Tanzila Tajreen, STS – Access to Finance, iDE CSISA–MEA

The presentation provided an overview of the agricultural market size, estimating that sales of combine harvesters, tractors and rice transplanters alone over the next five years would be worth USD523 million, and that sales of other smaller machines might equal that value. However, the market faces the problem of finance for loans. Currently, machinery marketing lead firms offer loans for machine purchase but lack the capacity to recover these if the customer defaults; as a result, many hold large amounts of unpaid debts. Small and medium enterprises (SMEs) – such as agriculture-based light engineering (ABLE) enterprises and machinery service providers (MSPs) – prefer to take out loans from banks rather than from micro finance institutions (MFIs) because of the lower interest rates; at the same time however, banks fail to offer seasonally-based repayment loans and require collateral. Ways to resolve the access to finance issues include the use of land valuations rather than property as collateral, financial literacy training, asset-based finance, and using trackers on machines to ensure recovery if loans are not repaid.

Assessing current and alternative financing products and delivery channels in the agricultural machinery market. Ms. Tamanna Sohanee, Business Consultant, LightCastle Partners

To develop a better understanding of the constraints to securing access to finance, CSISA–MEA commissioned a survey of agriculture machinery value chain actors from LightCastle Partners. This found the following:

- The majority of SME workshops and foundries in Bangladesh have accessed credit; about a third have had loan applications rejected.
- Around a third of MSPs have applied for loans, roughly half of which had their applications rejected.
- Lack of collateral is the main challenge to obtaining a loan.
- Lack of documentation is also a major factor.

The main issues for lenders are:

- Establishing and managing branches is expensive in remote areas where SMEs operate.
- There is a risk of not being able to recover loans on machines which are untraceable after sale.

MFIs are better equipped to provide loans through their large network of village-based agents but only offer small loans at high interest rates. Improving financial literacy and documentation, and a buy-back and resale system for second-hand machines would help. LightCastle suggests testing three models:

1. Banks lend to MSPs through dealers, with a guarantee from lead firms that they would buy back machines recovered from creditors who failed to repay loans.
2. MFIs act as agents for lead firms, selling machines to MSPs with loans that would be repaid through mobile repayment systems and, to reduce interest rates, earn a commission on the sale of machines.
3. Financing through the purchase of shares in businesses by venture capital companies.

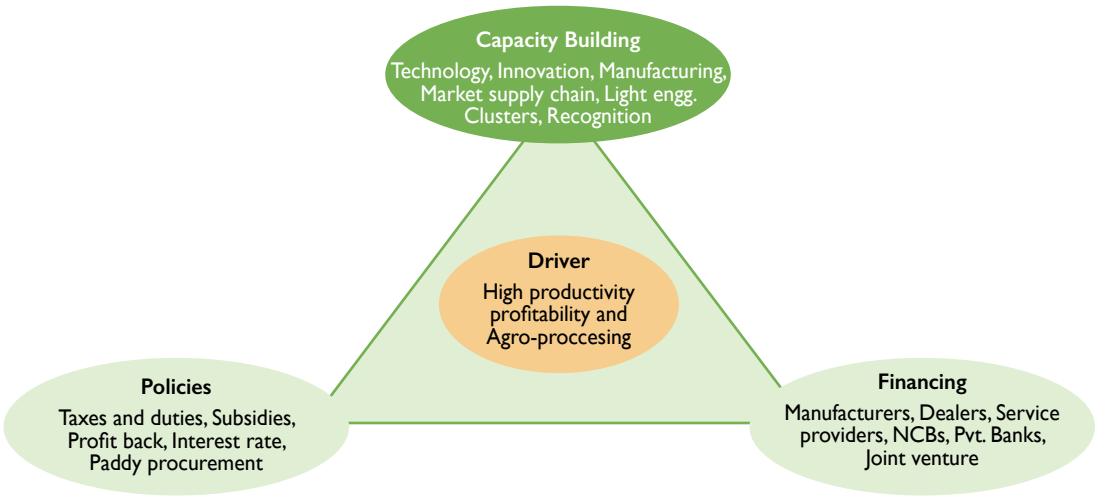
Participation of women and youth in agricultural mechanization businesses: employability and entrepreneurship opportunities. Ms. Bidowra Khan, Regional Gender and Inclusive Development Advisor, ACDI/VOCA

The presentation highlighted the business potential of attracting women and youth into the agricultural mechanization sector by helping establish service provision businesses. An example of what can be achieved is the USAID RDC activity working with LightCastle Partners, which provided business training to 60 women from an initial 400 applications from women entrepreneurs. The training enabled the women to develop business proposals for presentation to investors who supported the women to develop new businesses or expand existing ones.

Agricultural Mechanization in Bangladesh: What have we learnt and unlearnt? Prof. Dr. M.A. Sattar Mandal, Emeritus Professor, Department of Agricultural Economics and former Vice-Chancellor of Bangladesh Agricultural University, Mymensingh (BAU), former Member of the Planning Commission (General Economics and Agriculture Divisions), Government of Bangladesh

The diagram below presents an overview of the workshop findings:

Agricultural Mechanization Triangle



Summary of workshop findings

Progress with mechanizing agriculture in Bangladesh

1. Bangladesh agriculture is transforming from subsistence to semi-commercial agriculture; agricultural mechanization is one of the important drivers of this change. Reducing poverty and hunger status through agricultural mechanization is the first priority of Government. Done properly, agricultural mechanization will contribute to Bangladesh economic growth achieving the status of a middle-income country by 2025.
2. A proper guideline and collaborative effort between public and private sector actors is needed to synchronize agricultural mechanization activities (research, planning and policy-making, knowledge dissemination, training, financing, manufacturing, supervision, marketing, aftersales service, monitoring and evaluation).
3. The rising cost of labor and saving of time for farm operations is a key driver of agricultural mechanization in Bangladesh. Maintaining high profit margins from crop cultivation by the farmers is a precondition for accelerating the pace of mechanization.
4. Land preparation, irrigation and threshing activities are significantly mechanized while planting and harvesting activities are barely mechanized. In particular planting and harvesting of rice, wheat and maize need to be mechanized.
5. Mechanization of agro-processing i.e. grain processing, drying, value addition, low-cost storage and post-harvest loss is yet to develop.

Spare parts availability and quality

1. Limited spare parts supply often constrains the efficient use of expensive, imported agricultural machinery
2. Implementing the National Agricultural Mechanization Policy 2020 and Mechanization Road Map requires that local manufacturers be supported through awareness-raising programs and training to fabricate modern agricultural machineries and spare parts.
3. A large proportion of spare parts sold are imported; however, agricultural machinery and the spare parts market in Bangladesh is growing, and local manufacturing has the potential to capture a major share of the market.
4. Locally manufactured machines and spare parts are not considered to be as good quality as imports.

Availability and quality of steel and other raw materials

1. Most steel and other metals used in the manufacture of agricultural machinery and spare parts in Bangladesh is purchased from ship-breaking businesses in Chattogram. A limited availability of metal-testing services results makes it difficult for the light engineering industry to determine the quality of raw materials they are using, resulting the agricultural machinery and spare parts they produce being of very variable quality.
2. Imported steel and other metals of known quality are taxed at higher rates than imported agricultural machines and spare parts, making it difficult for Bangladesh's light engineering industry to compete. A review and revision of taxation systems is required to address this.
3. Supporting the establishment of metal testing businesses within the light engineering hubs of Jashore and Bogura would improve the quality of machinery and parts produced.
4. Proper guidelines need to be prepared and followed for manufacturing spare parts, including quality controlled production lines.

Establishment of industrial parks

1. Establishment of the APZ on the outskirt of the Bogura and Jashore towns to accommodate existing and potential agri-machinery industries and workshops.
2. Establishment of a common facility centre at each APZ involving, among other things, the public and private sectors, development partners to facilitate quality services related to heat treatment, material testing, test and standardization, and advisory services.

Skills training

1. Workers and managers of light engineering enterprises rarely receive training in the skills needed to produce quality machines and parts, and training programs (face-to-face and online) are needed. This training needs to be financed by the light engineering sector with government support and to provide formal, certified and nationally recognized qualifications.
2. Training is needed in factory floor layout, spare parts and machine design and making and reading drawings to enable the precise manufacture of agricultural machines and spare parts.

3. Capacity building related to casting, heat treatment, and fabrication of agri-machinery (for technicians) and in marketing and financial management skills (for management personnel) is needed.

4. Access to information is needed for manufacturers on markets, export potential, modern capital machinery, and improved production technology options.

5. Local foundries need to be modernized through collaboration and experience-sharing with SAARC and industrialized countries.

6. There is a need for capital machinery (e.g. CNC, laser cutters, 3D printers, lathe machines) and training in how to use them. In many cases these investments will require funding from financial services institutions or equity investors.

7. Banks and investors need to be better informed about the prospects and opportunities that exist for financing the light engineering sector.

Agricultural machinery service provision and technology adoption

1. Bangladesh farmers are poor and unable to buy machines, even with the benefit of a subsidy program. However, the country has entrepreneurs who can use the subsidy to buy machines and provide services to the community.

2. Initiatives to promote mechanization such as the National Agricultural Mechanization Policy 2020 and the 50%–70% subsidy for procuring machines may not be enough. Banking credit policies, trade policies, quality regulations, and provision of extension services all need to be addressed; public-private partnerships setting policy direction are also needed to reduce the time taken to achieve adoption of new agricultural mechanization technology.

3. There is a need to increase awareness among farmers of agricultural mechanization technology and where machinery services can be obtained.

4. There is a need to support the private sector to provide better aftersales services by establishing training programs for machinery operators and mechanics.

5. Infrastructure (approach roads, access to fields) needs to be adapted to enable larger machines like combine harvesters to gain access to all farm land in Bangladesh.

6. A Government of Bangladesh policy change is needed to facilitate businesses to test and introduce drones for pesticide and fertilizer application.

7. Postharvest losses of fruits and vegetables are high and need to be reduced through appropriate interventions.

Access to finance

1. Access to finance is a common problem for all stakeholders in the agricultural sector.

2. Loan repayment systems need to be designed to take account of the seasonal nature of the sector. Agricultural machinery and spare parts are mainly procured and used during the cropping seasons, and therefore need to be made before the season starts to be ready in time for customers to buy in advance. This means that banks need to provide loans to the manufacturers and machinery service providers (MSPs) well ahead of time. Income between seasons is low, and loan provision and repayments will therefore be very seasonal.

3. Other often-cited problems for machinery manufacturers and MSPs are (1) the need to provide collateral when applying for loans, (2) limited availability of the business records that would allow banks to assess the credit worthiness of loan applicants, and (3) the long distances to the bank branches.

4. By contrast to banks MFIs have extensive networks of field staff. They are therefore easier to access than banks for rural entrepreneurs living some distance from the larger regional towns where banks have offices. However, MFIs charge high interest rates and provide small loans, which may limit MSP interest in taking out loans from MFIs.

5. Establishing a registration system for combine harvesters and other similar machines, and installing GPS trackers in combines and tractors, would help banks recover machinery from creditors who default on loans.

6. Bangladesh Bank has a guideline, "Agricultural and rural credit policy and program for the FY 2021–2022" which is in line with government policy and facilitates the provision of loans to farmers and SMEs. This fixes interest rates that banks can charge SMEs for loans at 9%, which might not be high enough to cover the costs of disbursing loans and collecting loan repayments.

7. If the light engineering industry is to expand and become a major sector in the Bangladesh economy, foreign investment is needed. To encourage this will require incentives to make it easy for investors to invest in Bangladesh and, most importantly, repatriate these investments.

Women and youth entrepreneurs

1. Rural, educated women and youth will be the main driving force in the light engineering and agricultural machinery service provision sectors. Systems therefore need to be put in place to provide them with the business skills training, financial support and incentives required to encourage them to become rural-based entrepreneurs in the agricultural mechanization sector.

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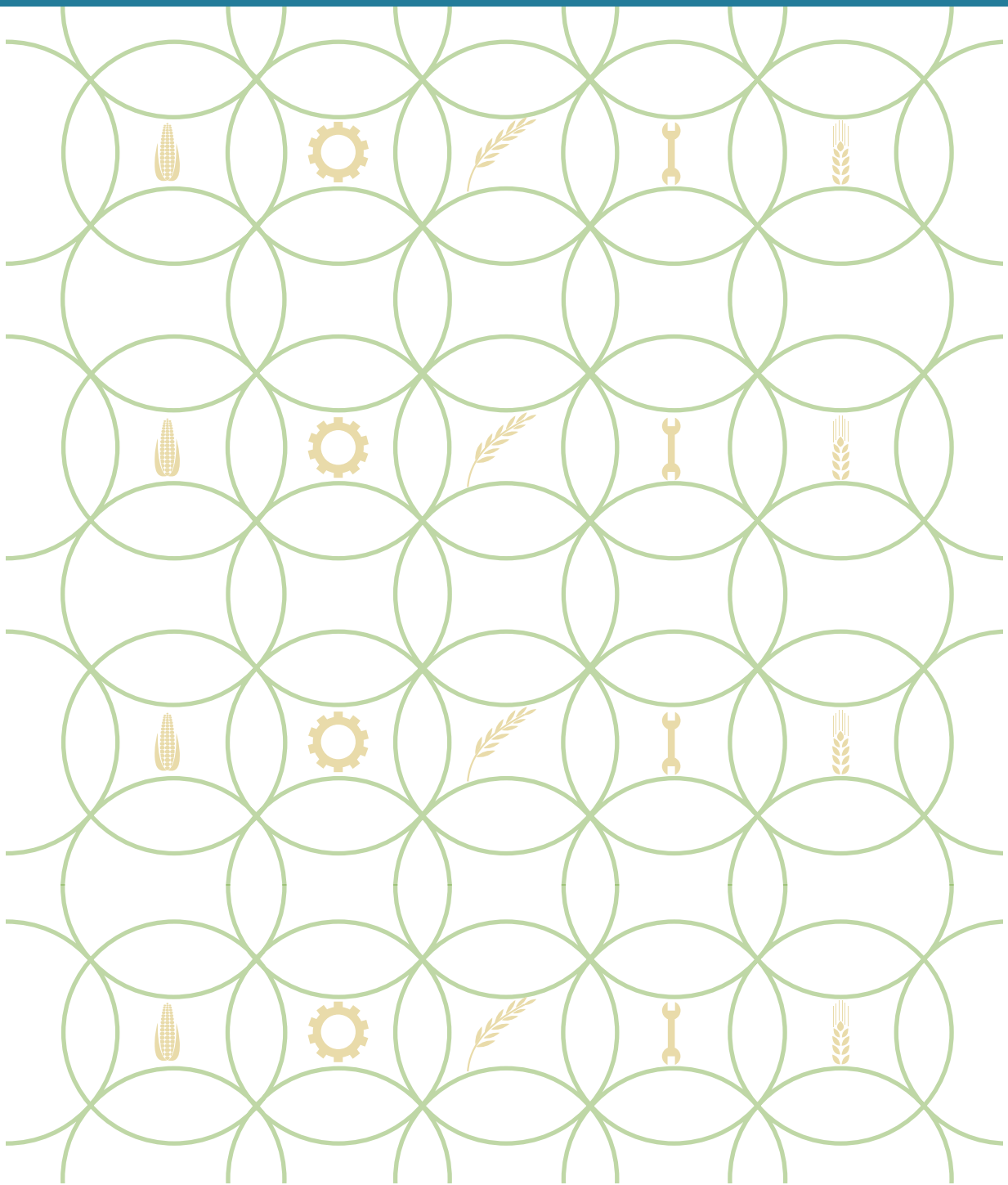

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