INITIATIVE ON
Transforming Agrifood Systems in South Asia

Economics, Demand and Challenges of Mechanization

A data note on mechanization service provision in Bangladesh

Data note 49

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ABOUT THIS NOTE

This note presents data from two surveys (Phase 1 & 2) conducted between December 2023 and February 2024. It assesses the operational status and experiences of 2,608 Machinery Service Providers (MSPs) across 21 districts in Bangladesh. The first phase included MSPs with less than a year to over two years of experience in both coastal and non-coastal agroecosystems. It captured data on the perceived future demand for agricultural machinery and the challenges faced in service provision.. The second phase involved a focused survey of MSPs and farmers to gather insights on the economic benefits and costs of mechanization versus manual labor. This dataset establishes a baseline for understanding the current state of mechanization and informs future studies on scaling mechanization and developmental interventions.

KEY INSIGHTS

1. Investment costs for MSPs range from $300–350 for smaller machines to $30,000–32,000 for the Combine Harvester, with subsidies boosting ROI to 100–120% for the Rice Transplanter and Reaper.
2. Mechanization reduces production costs, with PTOS cutting costs by 45–50%, the Fodder Chopper reducing expenses by $12–19 per ton, and the Combine Harvester saving $78–85 per hectare.
3. Machinery demand varies by MSP experience, with PTOS favored by 55.85% of recent and 59.01% of long-term users, while medium-term users prefer the Combine Harvester (37.35%).
4. Coastal MSPs face issues with accessing spare parts (21%) and operational difficulties (18%), while non-coastal MSPs report higher maintenance (18.2%) and competition challenges (14.6%).

CIMMYT International Maize and Wheat Improvement Center · IFPRI International Food Policy Research Institute · IRRI International Rice Research Institute · IWMI International Water Management Institute · CIP International Potato Center · WorldFish · ILRI International Livestock Research Institute

BACKGROUND

Bangladesh's agricultural sector plays a vital role in the country's economy, supporting nearly half of the population. However, it is increasingly challenged to meet the rising food production demands of a growing population amid a shrinking agricultural labor force (World Bank, 2016; ADB, 2023). Several factors contribute to this labor decline, including traditional land inheritance practices that result in fragmented farm plots, making economies of scale difficult to achieve. While smaller plot sizes could drive the adoption of labor-saving technologies suited for small-scale farming, labor shortages persist as a major issue.

Urbanization and labor migration significantly reduce the availability of agricultural workers in Bangladesh, with rural-to-urban migration accounting for 66% of all migration in the country (Afsar & Hossain, 2020; Alam & Mamun, 2022). In addition, around 0.4 million people leave the country each year for overseas employment, further worsening labor shortages (ADB & ILO, 2016). These shortages are compounded by climate-related displacements from natural disasters like floods and cyclones, which disrupt the agricultural workforce even more. As a result, the labor demand-supply mismatch forces farmers to pay higher wages, increasing production costs. Hired labor often accounts for more than half of a farmer's total expenses. To manage these rising costs, farmers may rush harvests, potentially leading to lower yields and reduced profit margins.

While the National Agricultural Mechanization Policy (MoA, 2020) encourages the broader adoption of mechanization, there is still a lack of data on the economic costs and benefits that Machinery Service Providers (MSPs) incur in their service provision businesses. Additionally, the future demand for machinery among service providers remains underexplored, creating a gap in understanding mechanization's adoption dynamics and planning needs. This note presents survey data on the economic impact of mechanization for farmers and MSPs, and by highlighting the operational efficiencies achieved through the shift from manual to machine-based agricultural practices.

OBJECTIVES

The objectives of this data note are to present the cost-benefit analysis of machinery service provision and highlight the economic advantages of mechanization for farmers over manual labor. It also aims to evaluate the anticipated future demand for mechanization among service providers and identify key challenges faced by MSPs in delivering services in Bangladesh.

Above: A farmer examining rice seedling in his farm; photo: CIMMYT

DATA AND METHODS

The data collection process consisted of a two-phase survey targeting Machinery Service Providers (MSPs) and farmers in Bangladesh. The survey aimed to evaluate the economic impact of mechanized versus manual agricultural operations, assess the future demand for mechanization among MSPs, and identify challenges associated with providing mechanization services.

PHASE 1: IN-PERSON SURVEY OF MSPS

The phase-1 data presented here are based on a survey conducted between December 2023 and February 2024 to update the operational status of MSPs, classifying them as either active or inactive. A non-probability judgmental sampling method was employed for the selection of districts and MSP respondents. A pre-existing list of MSPs and their respective districts was available from the Cereal Systems Initiative for South Asia - Mechanization and Extension Activity (CSISA-MEA) project. To provide insights into how geographical conditions influence mechanization adoption, the districts were divided into two distinct agroecosystems: non-coastal and coastal.

Table 1: Surveyed MSPs in Non-Coastal and Coastal Agroecosystems (Phase 1)

Machine	Non-coastal agroecosystems (n)	Coastal agroecosystems (n)
Axial Flow Pump	60	261
Chopper Machine	22	0
Combine Harvester	202	53
Power Tiller/Seeder	1489	50
Reaper Machine	194	227
Rice Transplanter	38	12
Total (N)	2005	603

Twelve districts with high agricultural productivity and riverine landscapes—Jashore, Kustia, Magura, Jhenaidah, Chuadanga, Faridpur, Rajbari, Gopalganj, Shariatpur, Madaripur, Narail, and Meherpur—were selected for data collection in the non-coastal agroecosystem. Nine coastal districts—Satkhira, Khulna, Bagerhat, Patuakhali, Barguna, Barisal, Bhola, Jhalokathi, and Pirojpur—were selected for the coastal agroecosystem, characterized by proximity to the coast and biophysical challenges such as saline soils and vulnerability to climate variability.

From each of the 21 districts, MSPs with over two years of operational experience were targeted to ensure the sample represented established service providers with enduring business models. The first-phase survey included 2,608 MSPs (Table 1), sampled from the census of 4,483 MSPs identified by CSISA-MEA, spanning both coastal and non-coastal agroecosystems to capture a broad range of regional and environmental contexts.

Table 2: Surveyed MSPs and farmer respondents (Phase 2)

Machine	MSPs (n)	Farmers (n)
Combined Harvester	15	6
Rice Transplanter	15	6
Reaper	15	6
Power Tiller/Seeder	9	4
Fodder Chopper	7	7

PHASE 2: MIXED-MODE SURVEY OF MSPS AND FARMERS

The second phase data shown here are from a focused survey conducted through a combination of telephonic and in-person interviews. This phase aimed to assess the economic benefits and costs of mechanization compared to manual labor in specific regions. A smaller sample of MSPs was selected from Faridpur, Jashore, and Cox's Bazar, based on their use of machinery for at least two seasons (Table 2). This sample included both MSPs and the farmers they served, with the objective of collecting data on the measurable benefits of machinery adoption, particularly in terms of cost savings and productivity improvements.

STUDY FINDINGS

Table 1 presents cost-benefit analysis of machinery service provision carried out on the data collected from Phase 1 survey, capturing the economic aspects associated with service provision of agricultural machine. The findings are presented below:

INVESTMENT COSTS INCURRED BY THE MSPS

The dataset shows that the price of machinery without subsidy ranges from $300–350 for the Power Tiller Operated Seeder and Fodder Chopper to $30,000–32,000 for the Combine Harvester. With subsidies, the costs are reduced to $350–360 for the Power Tiller Operated Seeder, $1,500–1,600 for the Rice Transplanter, and $15,000–16,000 for the Combine Harvester, while the impact of subsidies on other machinery prices is minimal.

ANNUAL INCOME FROM SERVICE PROVISION

Annual income data reveals a range from $700–800 for the Fodder Chopper to $20,000–22,000 for the Combine Harvester. Income generated per hectare is also provided, with values such as $50–60 for the Power Tiller Operated Seeder, $80–85 for the Rice Transplanter, and $4–5 for the Fodder Chopper.

OPERATIONAL COSTS OF MACHINES

Annual expenses associated with machinery use show significant variation, ranging from $300–400 for the Fodder Chopper to $8,000–9,000 for the Combine Harvester. The dataset also includes per-hectare expense data, with costs such as $30–40 for the Power Tiller Operated Seeder, $20–30 for the Rice Transplanter, and $2–4 per ton for the Fodder Chopper.

PROFITABILITY OF SERVICE PROVISION PER HECTARE

The net profit per hectare varies across the equipment, with recorded values including $20–25 for the Power Tiller Operated Seeder, $50–55 for the Rice Transplanter, and $2–4 per ton for the Fodder Chopper.

RETURN ON INVESTMENT (ROI)

The ROI data indicates a wide range without subsidies, from 35–40% for the Rice Transplanter to 250–300% for the Power Tiller Operated Seeder. With subsidies applied, the ROI improves, reaching 100–120% for the Rice Transplanter, Reaper, and Fodder Chopper, and 80–90% for the Combine Harvester.

Above: A machinery solution provider operating a combine harvester in Rajbari district, Bangladesh; photo: CIMMYT-Bangladesh

Table 3: Cost-Benefit Analysis of Machinery Service Provision

Benefits and costs	Power Tiller Operated Seeder	Rice Transplanter	Reaper	Combine Harvester	Fodder Chopper
Price (without subsidy)	$300-350	$4,000-5,000	$1,500-2,000	$30,000-32,000	$300-350
Price (with subsidy)	$350-360	$1,500-1,600	$800-900	$15,000-16,000	$300-350
Annual Income (USD)	$2,000-3,000	$2,500-3,000	$1,500-1,700	$20,000-22,000	$700-800
Income per hectare (USD)	$50-60	$80-85	$60-65	$100-200	$4-5
Annual Expense (USD)	$1,000-1,500	$800-900	$700-750	$8,000-9,000	$300-400
Expense per hectare (USD)	$30-40	$20-30	$20-30	$60-70	$2-4*
Annual Profit (USD)	$900-1,000	$1,500-2,000	$900-1,000	$10,000-15,000	$300-400
Net profit per hectare (USD)	$20-25	$50-55	$30-40	$80-85	$2-4*
Return on Investment (without subsidy)	250-300%	35-40%	50-60%	40-45%	100-120%
Return on Investment (with subsidy)	250-300%	100-120%	100-120%	80-90%	100-120%

Note: Data sourced from surveys conducted with Machinery Service Providers (MSPs) in Faridpur, Jashore, and Cox's Bazar. *For the fodder chopper, the benefit-cost analysis is presented on a per ton basis. *For the PTOS and fodder chopper, subsidy is not applicable.

COST SAVINGS FROM THE FARMERS' PERSPECTIVE

Mechanization offers farmers substantial cost savings across various operations. According to data from the CSISA-MEA surveys conducted with Machinery Service Providers (MSPs) and farmers in Faridpur, Jashore, and Cox's Bazar, mechanized solutions present a compelling economic advantage over manual labor.

Analyzing the cost differentials reveals striking benefits of machinery adoption. Take, for instance, the Power Tiller Operated Seeder (PTOS). While manual tillage and seeding operations cost $110-120 per hectare, machine operation using PTOS reduces this expense to $65-70 per hectare, resulting in a significant saving of 45-50% on a hectare. Similar trends are observed across other machinery types.

The Rice Transplanter, excluding seedling costs, shows a reduction from $200-205 to $140-145 per hectare, offering a benefit of $55-60 per hectare. Similarly, the Reaper and Combine Harvester exhibit substantial savings, with benefits of $55-60 and $78-85 per hectare, respectively. Notably, the Fodder Chopper stands out with remarkable cost savings. While manual operation costs $15-20 per ton, machine operation reduces this to $1-3 per ton, resulting in a substantial benefit of $12-19 per ton.

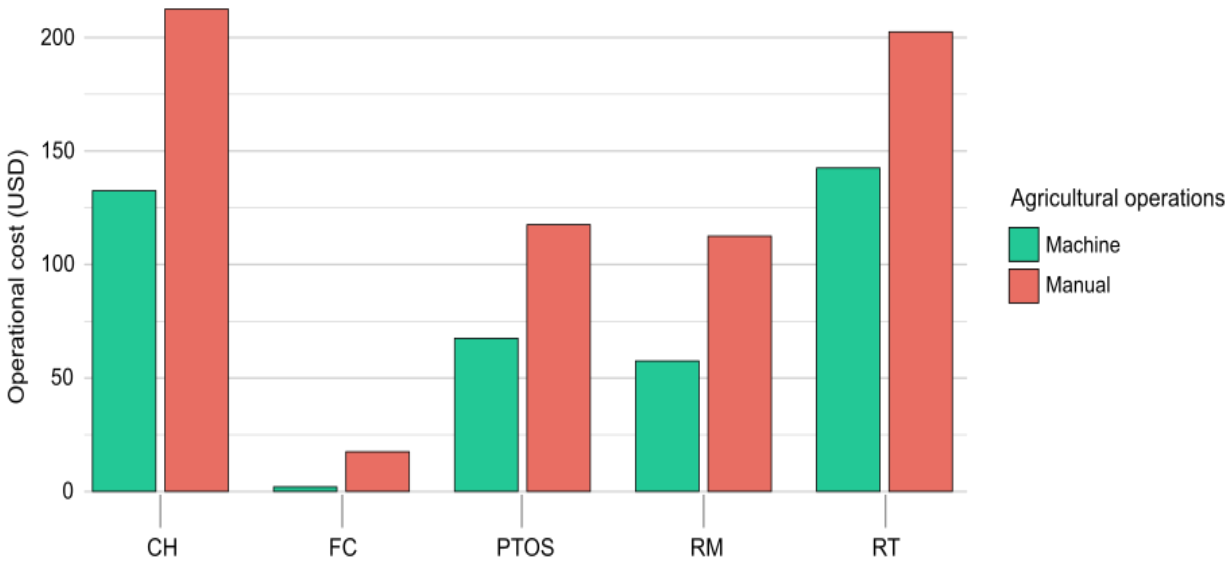

Figure 1: Costs of agricultural operations per hectare for selected machinery, except for Fodder Chopper (FC), which is per ton. The abbreviations on the x-axis represent Combine Harvester (CH), Fodder Chopper (FC), Power Tiller Operated Seeder (PTOS), Reaper Machine (RM), and Rice Transplanter (RT). The cost for Rice Transplanter excludes seedling costs.

These findings presented in Figure 2 underscore the tangible economic advantages of mechanization for farmers. By reducing labor costs and increasing operational efficiency, mechanized solutions not only enhance profitability but also improve the economic viability of farming ventures.

FUTURE DEMAND FOR MACHINES

Figure 1 shows the distribution of perceived future demand for different agricultural machines across categories of Machinery Service Providers (MSPs), classified by their years of operation: Recent users (<1 year), Medium-term users (1–2 years), and Long-term users (>2 years). Each bar represents an MSP category, with segments indicating the proportion of different machines used, and percentages labeling the share of each machine type.

Recent Users (<1 year): The largest share is for the Power Tiller Operated Seeder (PTOS), accounting for 55.85% of recent users. Other machines, such as Combine Harvester (14.62%), Reaper (7.68%), and Fodder Chopper (1.92%), have smaller proportions.

Medium-term Users (1–2 years): The Combine Harvester constitutes the largest segment, with 37.35% of medium-term users, followed by PTOS at 22.51%. Other machines, including the Reaper (5.80%), Fodder Chopper (8.35%), and Rice Transplanter (3.48%), have lower shares.

Long-term Users (>2 years): Among long-term users, PTOS also has the highest proportion, at 59.01%, followed by the Reaper (16.14%) and Axial Flow Pump (12.31%). This indicates a continued preference for PTOS in future mechanization plans.

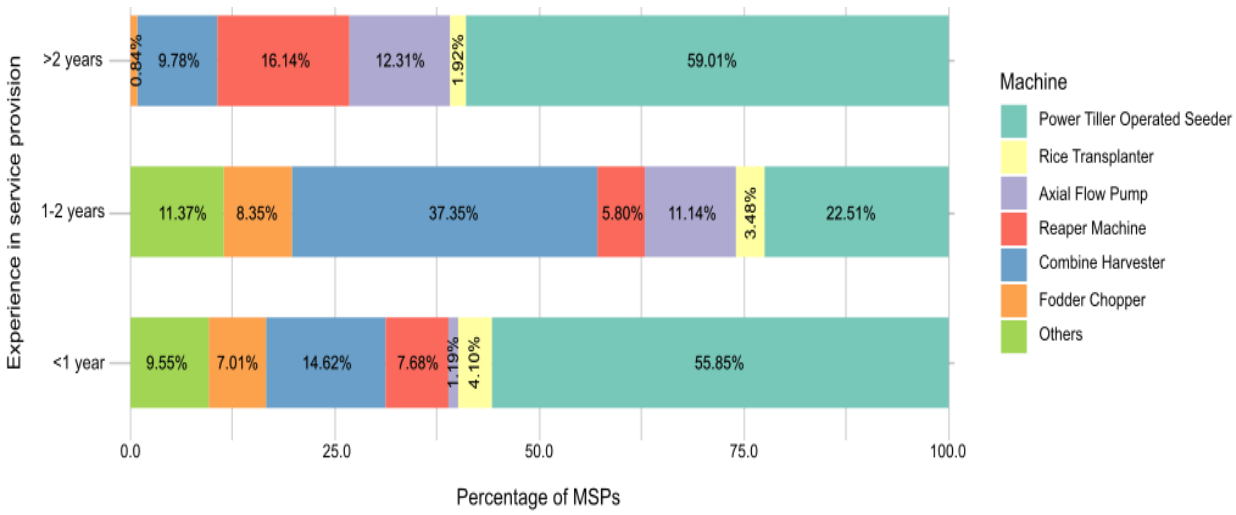

Figure 2: Distribution of perceived future demand for various agricultural machines across different categories of Machinery Service Providers (MSPs)

CHALLENGES FACED BY THE MSPs

The figure illustrates the distribution of challenges reported by Machinery Service Providers (MSPs) in coastal versus non-coastal regions, highlighting differences in the nature and intensity of barriers faced across these agroecosystems.

The data reveal distinct regional differences in the challenges faced by Machinery Service Providers (MSPs) in coastal and non-coastal areas. A higher percentage of MSPs in non-coastal regions (24.5%) reported "No challenges incurred" compared to only 12.4% in coastal areas, suggesting that non-coastal MSPs may encounter fewer operational barriers overall.

In coastal areas, the most significant challenges reported were "Lack of availability of spare parts" (21.0%) and "Operational difficulties" (18.0%), indicating that access to resources and efficient operations are more problematic in these regions. Additionally, coastal MSPs were more likely to cite "Lack of demand among farmers" (7.0%), reflecting potential market limitations for mechanization services.

Conversely, non-coastal MSPs faced higher levels of "Maintenance and repairs" challenges (18.2%) and "Competition between MSPs" (14.6%) compared to their coastal counterparts, highlighting maintenance and market competition as significant concerns. "Lack of access to credit" was also reported more frequently in non-coastal areas (15.8%) than in coastal areas (13.6%), indicating that financial constraints are a persistent issue across both regions.

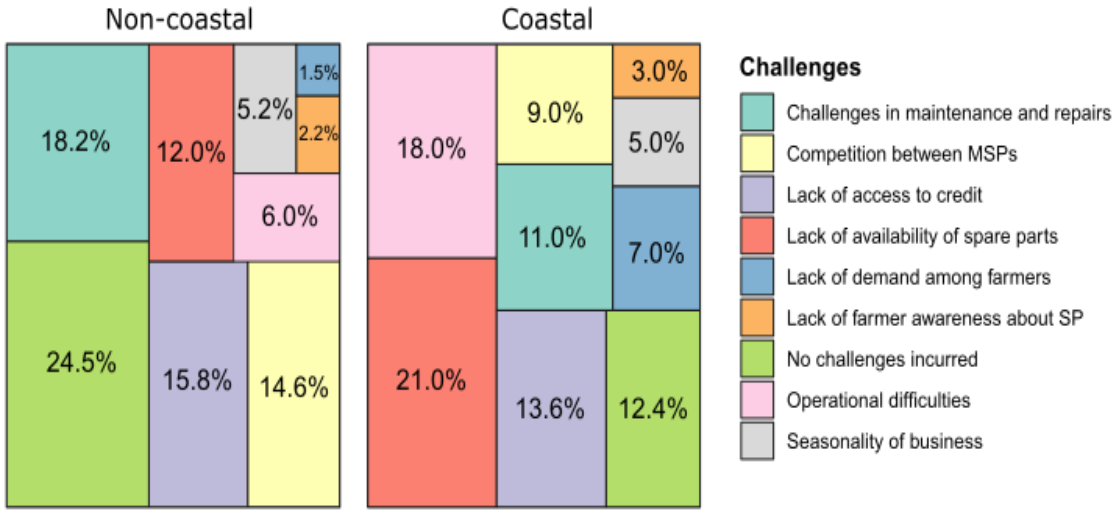

Figure 3: Tree map showing the proportion of MSP respondents reporting specific challenges in service provision across non-coastal and coastal agroecosystems

These findings suggest that coastal MSPs struggle more with resource access and operational challenges, while non-coastal MSPs are more affected by maintenance issues, competition, and credit access. Addressing these region-specific barriers could enhance mechanization service delivery and better support MSP operations in both areas

CONCLUSIONS AND RECOMMENDATIONS

The data in this note presents the economic benefits of mechanization service provision and compares cost savings for farmers using mechanization versus manual labor in agriculture. It also highlights the future demand for machinery among service providers and identifies key challenges that limit the broader use and scaling of mechanization in Bangladesh.

The survey data were collected from MSPs and farmers across 21 districts, with a focus on capturing diverse experiences and operational contexts in both coastal and non-coastal agroecosystems in Bangladesh. The data demonstrate that mechanization offers substantial economic advantages for Bangladesh's agricultural sector by reducing labor costs, improving operational efficiency, and enhancing profitability for both farmers and MSPs. This contributes to strengthening rural economies through increased income generation.

The consistent preference for the Power Tiller Operated Seeder (PTOS) across different MSP categories, particularly among recent and long-term users, indicates its critical role in future mechanization strategies. However, evolving demand for other machines, such as the Combine Harvester among medium-term users, should also be considered.

The data highlights the need for region-specific strategies to address the distinct challenges faced by MSPs. Coastal areas would benefit from tailored interventions to improve resource access and operational efficiency, while non-coastal regions require solutions targeting maintenance issues, business competition, and credit access. Strengthening financial support systems and expanding training programs for both farmers and service providers are essential steps for maximizing the benefits of mechanization. Such efforts will contribute to building resilient rural economies, enhancing food security, and securing a sustainable future for agri-food systems in Bangladesh.

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Above: A machinery solution provider operating a rice transplanter; photo: CIMMYT

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ABOUT TAFSSA

TAFSSA (Transforming Agrifood Systems in South Asia) is a CGIAR Regional Integrated Initiative that supports actions improving equitable access to sustainable healthy diets, that boosts farmers' livelihoods and resilience, and that conserves land, air, and water resources in a climate crisis.

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USAID funded project CSISA-MEA aims to support the growth and expansion of agricultural mechanization in Bangladesh by making it affordable for smallholder farmers to access cost and resource-saving machinery for sowing, irrigation, harvesting, and other agricultural activities. CSISA-MEA assists various market actors across the value chain, including machinery manufacturers, importers, retailers, dealers, mechanics, spare parts vendors, and local service providers who deliver services directly to farmers.

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