

Towards women's access to and adoption of mechanization: Analysis of women's farmer group services and educational needs

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Abstract

The agricultural sector of Bangladesh is increasingly feminized due to out-migration of men. This has advanced women's participation in agriculture however challenges remain. For instance, women have unequal access to mechanization, which would improve the efficiency, productivity, and sustainability of their agricultural practices. Farmers' groups are common throughout Bangladesh and some function in a quasi-entrepreneurial capacity. A needs assessment of four groups that are primarily female in two districts of Bangladesh was conducted in February 2023. From this assessment several lessons were learned. Women stated a preference for access to mechanization rather than operating it themselves. In fact, women would prefer additional training to make their groups more profitable, not practical hands-on training of machines. This preference is a pivot in how gender-responsive adoption of mechanization is typically characterized. To meet their needs, women need better access to male mechanization service providers, which requires that the men are equipped to reach women farmers within a conservative social setting. Finally, the high demand of service providers nationally points to the need for expanded entrepreneurial capacity and activities in Bangladesh. This represents an opportunity for women's farmers groups to operate as service providers. Entrepreneurial education is required, as is the development of sustainable business models for group ownership of mechanization.

Introduction

Bangladesh is primarily an agrarian country, with a majority of its population engaged in agricultural activities for their livelihood, most of whom are smallholder farmers (Aryal et al. 2020). Bangladesh is the third largest producer of rice globally (Food and Agriculture Organization, 2023), and one of the most vulnerable countries to the impacts of climate change (World Bank Group 2022). Changing climate, unpredictable monsoon seasons, and severe flooding have caused significant losses to Bangladesh's recent rice yields (Maiinuddin et al. 2022). Traditional methods of rice production in rural areas are susceptible to climate change and thus mechanization and improved irrigation have the potential to help smallholder farmers adapt to climate change and contribute to both economic and food security in the region (Shahid 2011; Alam et al. 2020). However, Bangladesh's socio-cultural constraints further complicate the adoption of these technologies (Lee, McNamara, and Bhattacharyya 2022).

In recent years, the agricultural sector in Bangladesh has witnessed an increase in feminization due to male out migration to urban centers for employment opportunities (Hossain et al. 2022). Consequently, female participation in agriculture has increased by 136% over the past two decades (Biswas et al. 2022), with rural women now making up over 50% of the agricultural labor force (Ahmad 2019). Despite their vital roles in agricultural production and household management, women's contributions often go unrecognized and unpaid, reflecting the persistent gender gap in agriculture (Thies, Sultana, and Krupnik 2018; International Fund for Agricultural Development (IFAD) 2021). The double workload women face as both farmers and caregivers requires agricultural training and institutional support (Thies, Sultana, and Krupnik 2018). The unique challenges faced by female smallholder farmers in accessing resources like land, credit, information, and technology hinder their full potential in the agricultural (Njuki et al. 2021).

Agricultural mechanization has emerged as a potential solution to enhance farm productivity and adapt to climate change, particularly for smallholder farmers. Mechanization offers more efficient farming practices across the crop production system and processing value chain (Van Loon et al. 2020), leading to improved household economics and reduced labor burdens (Food and Agriculture Organization 2022; Mozumdar et al. 2023). However, many agricultural innovations and technologies are designed without considering the specific needs and preferences of women smallholder farmers, primarily catering to middle-income male farmers and inadvertently excluding women (Manfre, Rubin, and Nordehn 2017; Farnworth et al. 2018). Bridging the gender gap in access to mechanization can have substantial benefits, potentially increasing yields on women-run farms by 20-30% (FAO 2011).

Further, in rural Bangladesh women smallholder farmers face social and cultural constraints that restrict their physical mobility and communication networks beyond their communities (FAO 2023; Lee, McNamara, and Bhattacharyya 2022;

Kaaria et al. 2016). Most rural female farmers have lower levels of education or low levels of literacy, lack access to information and training, and have limited access to assets or credit (FAO 2023; Mitra et al., 2021). In terms of agricultural social norms, it is common and appropriate for women to manage post-harvest tasks such as drying and husking (Biswas et al. 2022). Depending upon religion, caste, and socio-economic status, it may be less common to work in the fields or travel to markets (Lee, McNamara, and Bhattacharyya 2022) Consequently, women's access to agricultural innovations and engagement in markets is limited.

Despite the increasing adoption of mechanization in Bangladesh (Rahman et al. n.d.), institutional barriers and socio-cultural factors hinder women smallholder farmers' ability to own and operate machines, further perpetuating gender inequalities. While service providers (fee-for-service) have made agricultural mechanization more accessible to smallholder farmers, machinery service providers are predominantly men (Thies, Sultana, and Krupnik 2018), which makes it difficult for women to learn about the service and access the providers.

The feminization or expansion of women's participation in agriculture in constrained contexts like Bangladesh creates opportunities for promoting women's equity and empowerment. Agricultural mechanization can benefit women smallholder farmers and act as a catalyst to build resilience and overcome poverty. It is thus critical that efforts related to scaling agricultural technologies assess how female smallholder farmers will access and benefit from them (McGuire et al. 2022).

This study sought to examine the following research question: How can agricultural mechanization be scaled in a gender-responsive manner in conservative socio-cultural settings?

Methods

To answer this research question, a needs assessment was conducted to better understand women's needs and desires as they relate to agricultural mechanization. Focus groups and semi-structured interviews with farmers' groups and male service providers occurred in the Mymensingh and Barisal divisions of Bangladesh in February 2023. Interviews were conducted in Bengali and English and were recorded with participant consent.

Each interview or focus group occurred with two researchers present. One was



Figure 1. Map of Bangladesh with Mymensingh and Barisal divisions marked.

fluent in both English and in Bengali, conducted the interviews, and interpreted for the other team member. The second team member listened and served as the notetaker, taking field notes directly onto a copy of the interview guide during participants' responses to increase the fidelity of the collected data (Adams 2015). Interviews were approximately 45-minutes in duration to avoid participant fatigue.

Both focus groups and semi-structured interviews captured demographic information including household size, landholding, crops grown, yield, levels of education, participation and/or role in local farmers group. These questions were asked alongside a set of questions that elicited data about the types of mechanization women owned, individually or collectively with their farmers group, as well as open-ended questions about social norms and pressures, and the women's specific needs in terms of agriculture and household livelihood. Interviewers used the interview guide as means to elicit understanding about the participants rather than as following a prescribed set of questions (Holstein and Gubrium 2004). Interviewers asked follow-up and probing questions to ensure comprehension.

Findings

Three farmers groups from Barisal and one from Mymensingh participated in focus groups and interviews. One group in Barisal was led by a male farmer, though women were in leadership positions within the group, the other three groups were led by women. Each group owned a range of agricultural machines, as shown in Table 1. For most groups, acquisition of machines began after 2015 and gradually increased through subsidies offered by the government, free machines from donors (e.g., FAO), and group savings. The groups led by females had 2-3 machines each, and primarily those focused on post-harvest activities (drying, sealing) or on poultry incubation. The group led by a man had 8 machines including tractors, a power pump, transplanter, chopper, reaper, and threshers. No group owned a combine harvester, which are becoming increasingly common in Bangladesh and other low- and middle-income countries for their versatility and efficiency.

Data from focus groups of women who belong to farmers' groups (n = 26) and notes from semi-structured interviews of 3 female leaders were inductively coded to better understand the current needs of female farmers in Barisal and Mymensingh. During the analysis process, four themes emerged. Each of these are described below.

Group Location	Leader	Group Membership	Number of Machines	Types of Mechanization
Mymensingh	Female	30 total 25 women 5 men	2	Postharvest
Barisal	Female	171 total 116 women 55 men	4	Incubator Pump Postharvest
Barisal	Female	51 total 40 women 11 men	2	Incubator Pump
Barisal	Male	84 total 41 women 43 men	8	Pump Tractors Planting Transplanting Harvest Postharvest

Table 1. Description of groups interviewed and the types of machinery owned by each group. Harvest mechanization includes reapers, cutters. Postharvest mechanization includes threshers, dryers, and sealing machines.

Benefits of Mechanization

All women stated that there are time and labor savings accrued as a result of using mechanization, in addition to an increase in productivity. For instance, a Barisal group stated that the use of mechanization has allowed them to increase their productivity and grow better quality crops, citing better color as evidence. The group in Mymensingh uses a grain dryer developed by the Bangladesh Agricultural University (BAU), and stated that its members, primarily female, can use the dryer for free and are more efficiently drying their seed as a result of using the dryer. This group's female leader and some of its members mentioned that profits have increased by 50% from improved postharvest practices and by aggregating their seeds together.

While all participants acknowledge that mechanization reduces human labor, not one woman indicated that time savings were converted into activities of her choice. Rather, female farmers were clear that time savings were used for other domestic chores. One participant stated that she has "no time," and pointed out that cattle rearing and growing crops takes time. On the rare occasion that she has free time, she prefers to spend "quality time" with her children. Nevertheless, the reduced labor was stated as a motivating factor for why these women joined the groups by a number of participants.

Group Finances, Mechanization, and Diversification

All groups charge for the usage of their machines and thus operate as a business to some extent. The groups' members pay a nominal fee, or pay for the operator's time only, for access or usage of the machine, while non-group

members pay a retail price. However, the overall funds for the groups seem to be not managed well if the group is to continue to operate as a business long-term by investing in new assets to strengthen the group and its members' livelihoods. The group leader in Mymensingh acknowledged that her group members currently had access to the grain dryer for free as a way to build capacity, but that she had plans to implement rate hikes to make the endeavor profitable. Female leaders in Barisal mentioned that they were "dreaming of" owning a combine harvester, but even with current subsidies and the groups' savings, this was out of reach for the groups.

Two of the groups in Barisal were focused on diversifying their group's activities as a way to generate income. The male-led group is doing this in two ways. First, the group owns several machines that are useful throughout the growing season from field preparation and planting, to harvest and postharvest (Table 1). The diversification of mechanization allows the group to operate in a way that is similar to that of local service providers who own and operate several machines for a fee across the growing cycle. Another group in Barisal is focused on providing non-agricultural skills to support young people in the community. The group recently opened a digital center in a nearby market. They rented space and purchased desktop computers, internet connection, printer, photocopier, tablets, and a generator. Two group members run the digital center offering youth who have passed Grade 10 low-cost courses in digital literacy skills and are trained for freelance computer jobs. Additionally, several members of this group make use of an agriculture app to support their crop production. Both of these groups also offer advice to non-members and to people outside of their communities by utilizing their group meeting space as a call center. The female-led group offers advice beyond agriculture and is committed to maternal health and prioritizing girls' education over early marriages.

Adoption and Access to Mechanization

While all of the group leaders expressed interest in acquiring more machines for the group, only one female leader and no female members were interested in operating the machines themselves. The exception was one of the groups that owned a grain dryer. The female leader expressed a desire for practical, hands-on training so that she and other women in her group could use the dryer themselves. Currently, when the dryer is being used, they pay a man to operate it. However, this same leader discussed mechanization for use during earlier stages of crop production (e.g., tilling, transplanting, harvesting, etc.) as being provided by a hired male operator.

Female members stated an increased desire for having access to the machines, rather than owning and operating the equipment themselves. They were keen to hire services either directly from service providers or through their groups. No group members expressed a desire for operating the machines themselves, even when explicitly asked.

Women's Empowerment

The 3 interviewed female leaders want to see the groups succeed and have a vision for future activities. These activities include diversification in terms of the services that they provide their members and communities (e.g., health and digital services), acquisition of additional machines to further reduce labor of crop production systems or for adding value to their crops (e.g., rice puffer). These 3 women all spoke of the changes that they have seen in their own communities in terms of increased decision-making power in the home, increased support from their spouses and other men in the community over time, elevated social standing, and the ability to inspire other women to leadership roles.

Female members, of both female- and male-led groups, also reported feeling empowered and more confident in participating in decision-making processes within the group and at home. They pointed out that women were serving as accountants and bookkeepers for groups, and were in leadership positions within group committees. Female members, like their leaders, indicated that participating in income-generating activities as part of the group positively impacted their social standing and recognition within their households and communities. Several women pointed to the changing social norms of their community as a result (e.g., more freedom of movement, or ability to communicate with others, especially men, outside of their homes) and indicated support for this progress. One female leader felt strongly that men needed training to learn to better communicate and engage with women as customers.

Group leaders and several female members stated a need for additional trainings around entrepreneurship, financial literacy, and postharvest agricultural practices (e.g., drying and the processing of fresh vegetables) that would add value to their crops and group activities.

Discussion:

These interviews conducted with farmers groups in the Mymensingh and Barisal districts of Bangladesh through semi-structured interviews and focus groups revealed three key lessons for the scaling of mechanization to benefit women: a pivot in how we think about adoption is required, male mechanization service providers must be equipped to reach women farmers, and sustainable business models for group ownership of mechanization must be developed.

Scaling Mechanization to Benefit Women

Women in four groups from two districts stated a clear preference for access to machinery through local service providers rather than wanting to operate the machinery themselves. This represents a shift in how we think about gender-responsiveness in terms of the adoption of mechanization. Typically, recommendations are made for the designs of machines to be more gender-inclusive which often means designing with ergonomic benefits in mind. However, when asking women in rural Bangladesh about what they wanted from

the machines, they stated a desire for access to them. When aspirational acquisition of larger machines were stated by group leaders, this future ownership was discussed in terms of someone else, presumably a male, operating the machine.

This finding is important because it reveals 3 related questions that must be considered. First, women *do* express interest in ownership of agricultural mechanization. Current policies in Bangladesh prioritize women for loans and subsidies for agricultural machines. The extent to which women are able to take advantage of these programs for their own benefit - and not for a male relative's benefit - is an area worthy of future research. Second, the assumption that women aspire to own and operate machines is not a correct picture in all contexts. Women must be engaged in the agricultural mechanization value chain - from design to small business development - so that their specific needs, which are situated in socio-cultural norms and constraints, are met. Third, because women *did not* express interest in operating machines, with the exception of postharvest machinery like grain dryers, adoption constructs must change. Rather than "owning and operating," adoption can be thought of as "owning and utilizing" or even simply as "having regular access to." Reconceptualizing what the adoption of mechanization looks like in Bangladesh points to structural changes.

Women's Access to Local Service Providers

One such structural change occurs when improving women's access to service providers who are predominantly male. At present, demand for service providers is high and the demand is not fully met. Too few entrepreneurs in an area make it difficult for women to contract services for their own landholdings. Women are finding creative ways around this by synchronizing their cropping patterns so that a service provider can provide services for multiple farms in one visit. However, given the constrained social norms in some areas which limit communication between women and men, women are put at a disadvantage in securing mechanization services from a local male provider. Both male and female participants expressed opinions that social norms were changing and that the prevalence of mobile phones was facilitating increased inter-gender communication. Yet, female group leaders pointed to the necessity of gender-sensitivity trainings for male service providers such that more female customers were reached. This has implications in two ways. The first is that given the high demand for service providers, especially when considering additional female customers, agricultural entrepreneurial potential is high in rural Bangladesh. Second, an opportunity arises for female farmers groups to fill this need through their group's activities.

Entrepreneurial Training for Women's Farmers Groups

In order for women's farmers groups to operate as service providers in an entrepreneurial capacity, new forms of training and education are needed. Female leaders of groups expressed a need for entrepreneurial education for

themselves and their members. The leaders mentioned wanting information and skills development in financial literacy, marketing and communication, and ways to diversify and add value to their current operations and production systems. Financial literacy training within the context of an entrepreneurial group model would help address groups' current challenges of managing their savings and finances. In order for groups to operate in an entrepreneurial capacity, sustainable business models for group ownership of mechanization must be developed. We see this as an urgent area of continued research.

Conclusion:

This study revealed three key lessons for the scaling of mechanization to benefit women: a pivot in how we think about adoption is required, male mechanization service providers must be equipped to reach women farmers, and sustainable business models for group ownership of mechanization must be developed, particularly those that are led by women. Moreover, it is equally important that the approaches and measures used ensure that women can benefit from mechanization are not only cognizant of contextual socio-cultural beliefs and practices but engage women as collaborators to co-determine the most appropriate models of access. This study recommends increased entrepreneurial education for women's farmers group, alongside continued research into effective and productive farmers groups business models.

References

Ahmad, Reaz. 2019. "Empowering Women in Agriculture." Dhaka Tribune, April 13, 2019.

Alam, M.A., C.K. Saha, M.M. Alam, M.R. Manir, M.M. Rana, and M.M. Rashid. 2020. "BAU-STR Dryer for Rough Rice Drying at Farmers and Small Trader's Level in Bangladesh." *Journal of Science, Technology and Environment Informatics* 9 (01): 629–38.

Aryal, J.P., T.B. Sapkota, D.B. Rahut, T.J. Krupnik, S. Shahrin, M.L. Jat, and C.M. Stirling. 2020. "Major Climate Risks and Adaptation Strategies of Smallholder Farmers in Coastal Bangladesh." *Environmental Management* 68 (1): 105–20.

Biswas, Rumana, Anika Tahsin Mou, Afsana Yasmin, MD Zonayet, and Nahid Hossain. 2022. "Women Participation in Agriculture of Bangladesh." *Journal of Global Economics, Management and Business Research* 14 (2): 30–39.

FAO. 2011. "State of Food and Agriculture. Women and Agriculture: Closing the Gender Gap for Development." Rome.

FAO. 2023. "The Status of Women in Agrifood Systems." Rome.

Farnworth, C.R., T. Jafry, S. Rahman, and L Badstue. 2018. "Leaving No One behind: Supporting Women, Poor People, and Indigenous People in Wheat-Maize Innovations in Bangladesh." CDMX, Mexico.

Food and Agriculture Organization. 2022. "Sustainable Agricultural Mechanization."

Food and Agriculture Organization of the United Nations. 2022.

FAOSTAT, n.d. "FAOSTAT Crops and Livestock Products."

International Fund for Agricultural Development (IFAD). 2021. "Struggle, Strength and Wisdom: Snapshots of Bangladesh's Women Farmers." IFAD. April 26, 2021.

Kaaria, S, M Osorio, ... S Wagner - *Journal of Gender, and undefined* 2016. 2016. "Rural Women's Participation in Producer Organizations: An Analysis of the Barriers That Women Face and Strategies to Foster Equitable and Effective Participation." *Ageconsearch.Umn.Edu* 1 (2): 148–67.
<https://ageconsearch.umn.edu/record/246035/>.

Loon, J Van, L Woltering, T.J. Krupnik, F. Baudron, M. Boa, and B Govaerts. 2020. "Scaling Agricultural Mechanization Services in Smallholder Farming

Systems: Case Studies from Sub-Saharan Africa, South Asia, and Latin America.” *Agricultural Systems* 180: 102792.

Maiinuddin, M, J.L. Peña-Arancibia, F Karim, M.M. Hasan, M.A. Mojid, and J.M. Kirby. 2022. “Long-Term Spatio-Temporal Variability and Trends in Rainfall and Temperature Extremes and Their Potential Risk to Rice Production in Bangladesh.” *PLOS Climate* 1 (3): e0000009.

Manfre, Cristina, Deborah Rubin, and Caitlin Nordehn. 2017. “Assessing How Agricultural Technologies Can Change Gender Dynamics and Food Security Outcomes: Part One.”

Mozumdar, Lavlu, Kazi Shek Farid, Md. Masud Rana, and Sumitra Saha. 2023. “Farm Performance and Family Livelihood of Bangladeshi Vegetable Farmers: Does the Use of Modern Agro-Technologies Matter?” *SN Business & Economics* 3 (2).
<https://doi.org/10.1007/S43546-023-00438-Z>.

Njuki, Jemmah, Sarah Eissler, Hazel Malapit, Ruth Meinzen-Dick, Elizabeth Bryan, and Agnes Quisumbing. 2021. “A Review of Evidence on Gender Equality, Women’s Empowerment, and Food Systems.” Bonn.

Shahid, S. 2011. “Impact of Climate Change on Irrigation Water Demand of Dry Season Boro Rice in Northwest Bangladesh.” *Climatic Change* 105 (3): 433–53.

Thies, Sophie, Nasrin Sultana, and Timothy J Krupnik. 2018. “Overcoming Gender Gaps in Rural Mechanization: Lessons from Reaper-Harvester Service Provision in Bangladesh. GCAN Project Note 8. CSISA Research Note 9. .” Washington, DC.

World Bank Group. 2022. “Bangladesh Country Climate and Development Report.” Washington, D.C.