

GENDER TECHNOLOGY ASSESSMENT

Appropriate Scale Mechanization Consortium

BANGLADESH: RICE TRANSPLANTER

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August 2019

The USAID funded Appropriate Scale Mechanization Consortium led by the University of Illinois at Urbana-Champaign develops and promotes appropriate agricultural mechanization technologies for smallholder farmers in Cambodia, Bangladesh, Burkina Faso and Ethiopia. ASMC's 'eco-system of innovation' approach includes the development of local Innovation Hubs comprised of relevant stakeholders to promote and enhance suitable, sustainable, and scalable mechanization. In Bangladesh, the Innovation Hub is directed by Bangladesh Agricultural University, Mymensingh.

SUMMARY

Agricultural technologies can improve economic productivity and reduce time spent in agricultural production, processing, and transporting. Men and women have similar propensities to use technologies however; women are less likely to have access to them compared to men. Ensuring women have better access to agricultural technology, inputs, and information can help lessen the gender gap in agricultural productivity and increase agricultural output globally by 2.5-4 percent (FAO 2011).

The Appropriate Scale Mechanization Innovation Hub Bangladesh (ASMIH-BD) project conducted a Gender Technology Assessment of the rice transplanter to identify gender barriers and enablers to adoption of agricultural technologies, and understand intra-household gender norms and women's roles in household technology adoption. This report identifies gender barriers and enablers to adoption of the rice transplanter technology, understands intra-household gender norms and women's roles in household technology adoption. The report concludes with strategies for better design, dissemination, and adoption of the rice transplanter.

Key Findings:

- The transplanter has benefits of providing both women and men with entrepreneurial opportunities in providing operational services or seedlings
- Women can benefit from access to mechanical rice transplanting through income generating opportunities as service providers and by raising seedlings. This can be done individually or through existing women's associations and clubs.
- In order to benefit, women need access to information and training which is tailored to their needs. Training should provide both technical knowledge and business skills in a convenient location, and at a convenient time
- Build public-private partnerships with private sector companies to ensure quality seed supply with proper certification (machine transplanting seed), and provide better warranty or after sales services

BANGLADESH COUNTRY CONTEXT

Bangladesh is among the five fastest-growing economies of the world, with a projection of 7.3 percent GDP growth in the FY 2019 (World Bank 2019). It ranks 136 out of 189 countries on the Human Development index (United Nations Human Development report 2018). Bangladesh is one of the most densely populated countries in South Asia, with nearly 160 million population in an area of 147,570 square kilometers. Of the population, 49 percent are women (BBS, 2015). About 71.9 percent of the total population of Bangladesh lives in rural area and 47 percent of the countries labor forces are engaged in agriculture (World Population Review, 2015).

Agriculture has been the core sector of Bangladesh economy contributing around 17 percent of the GDP, and providing employment to 45 percent of the rural labor force (BBS, 2016). Around 84 percent of the rural people of the country depend on agriculture for their livelihood directly or indirectly (Mirza et al., 2015). Moreover, it is the primary source of employment, livelihood, and food security for the majority of rural people. In 2015-16, the area under paddy cultivation was 74.85 percent and average yield of paddy in Bangladesh was around 4.61 tons per hectare (BBS, 2018). Agriculture contributed 13.41 percent to the GDP in FY 2016-17 (BBS, 2018).

Agricultural Mechanization

The expansion of High Yield Variety (HYV) rice crop in 1970s, increased demand of mechanized irrigation, tillage, pest management and post-harvest processing of crops to attain timeliness of operations and establishment of next crop triggered changes in cropping pattern and cropping intensity. Bangladesh Agricultural Development Corporation (BADC) was in charge of initiating irrigation services to farmers through low lift pumps (LLP), deep tube wells (DTW) and shallow tube wells (STW) schemes. With the increasing demand of mechanized tilling, BADC started four-wheel tractor based mechanized tilling services to farmers and had monopoly of these services (Mandal, 2017). Bangladesh agriculture has gone through a remarkable change since 1990s with the liberalization of agricultural machinery market and emergence of Private Sector Machinery Company in the business. Alongside import and after sale service provisions rendered by the private sector companies, agricultural machinery manufacturing sub-sector in the country has been growing quite significantly.

Tilling is almost mechanized with 94 percent of farmers accessing power tillers (PT) through custom-hire service, in comparison to only three percent of farmers who had access to tractors. However, timely access to these tilling machines is a challenge and this results in loss of production and cost. Of mechanized irrigation, about 66 percent and 33 percent of the equipment were powered mechanically and electrically, respectively. With mechanized threshing, the shares of pedal thresher, open drum thresher (ODT) and closed drum thresher (CDT) were 14 percent, 15 percent and 45 percent, respectively. However, about 22 percent of hand beating and 4 percent animal treading were still in practice. Rice transplanting was found only 0.1 percent mechanized. Winnowing was found overwhelmingly manual, however, about 12 percent farmers were using PT operated fan and electric fan for winnowing. Drying of crop is manual with farmers using concrete drying floor (Chatal), mud floor, road and tin shed. Mechanized transportation of agricultural commodity, were found to be 8 percent with the tractor and 64 percent with the PT. Farmers use rice mills for milling paddy for their own consumptions. Male farmers dominate field activities of crop production. In contrast, female farmers dominate post-harvest processing of crops. (M.M. Alam and M I N Khan, 2017). Female farmers also take part in some field crop production activities such as seedbed preparation, uprooting and transplanting of rice seedlings, weeding and top dressing.

Gender

In Bangladesh, the gender division of labor in agriculture is not strictly demarcated as assumed, with women being involved in agricultural work both inside and outside the household (Zaman, 1995). Women contribute between 60 and 80 percent of the labor for food production and have high participation rates in crop processing, home gardening, and managing small-scale livestock and fisheries (Rashid et al., 2017). Women's roles in agriculture are not recognized and paid, as women are not perceived as farmers. They represent the most disempowered portion of the society, having no access and control or decision-making power. In terms of women empowerment, the Bangladesh national baseline survey of the Women's Empowerment in Agriculture Index in 2011 found that the domains contributing most to low levels of empowerment were, weak leadership and influence in the community (33.8 percent), lack of control over resources (23.6 percent) and lack of control over income (15.0 percent) (Sraboni et al 2013-14). In this context, providing women income earning opportunities that are not tied to land or which require geographic mobility could be promising avenues for strengthening women's empowerment.

Research shows that a gender bias exists in the agricultural labor market (Rahman, 2010), and remunerative employment or activities of agricultural labor remains associated in favor of men. Females are allowed to be engaged in paid labor mostly when the male labor supply is scarce and in case of destituteness of women in order to survive. In terms of waged labor, women are victims of discriminatory wage rate. Along with these, women's ability to generate income in the agricultural sector is severely constrained by their limited use, lack of ownership, and control of productive, physical and human capital. "Bangladeshi women are disadvantaged relative to men with respect to assets brought to marriage (Quisumbing & Maluccio, 2003), and current productive assets (including land, livestock, and agricultural machinery (Quisumbing, Roy, Njuki, Tanvin, & Waithanji, 2013), and human capital.

The shortage of male labor during peak farming season is becoming a serious challenge. This is due to male's out-migration within or out of the country in search of non-agriculture related livelihood opportunities. Female farmers, who are more likely to be poorer than male-headed households, are now managing and cultivating their farmlands in addition to household work. In view of the labor shortage, higher labor requirements, and male out-migration, mechanization for transplanting in particular, is needed to minimize the cost of rice cultivation and increase production.

ASMIH BANGLADESH

The Appropriate Scale Mechanization Innovation Hub Bangladesh (ASMIH-BD) works with researchers, academicians, extension agencies, farmers, and private companies to disseminate technologies. The project has focused on identifying and promoting planting, transplanting and harvesting technologies for the southern regions of Bangladesh.

Mechanized rice transplanting is relatively new in Bangladesh. The rice transplanter was introduced in the southern region of Bangladesh, by ASMIH-BD through the agricultural machinery assistance program by the Department of Agricultural and Extension (DAE). ASMIH-BD conducted experiments on rice transplanting in specific districts that were selected with different stakeholders such as farmers, lead farmers, and agricultural extension officers. The walk-behind transplanter was selected for conducting performance tests due to its economical price in comparison with the riding transplanter. The machines were purchased from two private sector companies ACI Motors and The Metal (pvt) Ltd.; and two models ACI Daedong DP488 and Metal Asia ARP – 4UM were selected for experimental purposes. These two

transplanters were evaluated for their performance in the southern delta zone. The second year, the technologies were tested in Wazirpur in Barishal, and Dumuria in Khulna. In the third year, the technology was tested in Kalapara in Patuakhali and Subarnachar in Noakhali district.

Mechanical rice transplanting requires a different seedling raising technique in comparison with traditional methods. Traditionally rice seedlings are grown in the field by preparing the land using 2WT and proper leveling. In the case of mechanized rice transplanting, seedlings are grown in plastic tray or in polythene mat. The polythene mat method is more cost and time saving compared with the tray method. Trays are imported from China, Korea or Vietnam. Locally available polythene sheet from the village markets are used for polythene mat method. Mud from fields are used to raise seedlings and are regularly watered. In the dry season (*Boro*) and rainy seasons (*Aman*), polythene covers are used to protect the seedlings from the cold and the rain. Typically, a structure is constructed of Bamboo to house the seedlings. The seedlings do not need extra fertilizer, but they do need fungicide application such as Score (broad-spectrum systemic triazole fungicide, WHO classification III) on the fifth day after seed spreading. The seedlings are ready to be transplanted when they are 12-18 cm in height.

The fields are prepared for planting by ploughing by 2WT two or three times and leveled 48 hours prior to transplanting to ensure the puddled soil settles. The water height on the field should be between 3 to 5 cm to ensure efficient mechanical transplanting and proper operation of transplanter. During transplanting, one operator and two laborers are needed to load the seedlings, which are cut in appropriate sizes (from the mat or tray).

ASMIH-BD provided training to farmers, local service providers, mechanics, DAE officials, and private sector staffs through field days, demonstrations and machine fairs.

Training content included operating the rice transplanter, raising seedlings and establishing crops. Both men and women attend field days and machine fairs. The project has undertaken initiatives to specifically target women farmers to build their capacity to raise seedlings as an income generating opportunity. The project is also exploring the introduction of agricultural subsidy program conducted by DAE to assist men and women with purchasing rice transplanter.

Box 1: Rice transplanters were first developed in Japan in the 1960s where the development and spread of rice transplanters progressed rapidly during the 1970s and 1980s. In Bangladesh several companies import rice transplanters from China, Korea and Vietnam. Price ranges between BDT 4,00,000 to BDT 4,50,000 for the walk-behind model and BDT 12,00,000 – BDT 16,00,000 for the riding model.

Conventional manual transplanting requires 44-59 laborers to uproot seedlings from seedbed and transplant them into one ha land. Using mechanical transplanting requires just one operator and two laborers, who can transplant up to two ha in a day. The mechanical transplanter consumes 4.5-4.8 liter of fuel per ha.

The rice transplanter has many advantages such as line transplanting, lower transplanting shock, early seedling vigor, uniform crop establishment, and less time and labor.

GENDER TECHNOLOGY ASSESSMENT

Technologies/mechanization can improve the timing of tasks, reduce drudgery, make labor more efficient; and improve the quality and quantity of food, feed, and fuel. However, they are not inherently gender neutral and differential changes are not always immediately evident (Manfre 2017). Developers need to ensure that new technologies will benefit both men and women farmers. Closing the gender gap in women's access to agricultural technology is considered a key strategy for rural women's economic empowerment (FAO 2011).

ASMIH-BD conducted a Gender Technology Assessment (GTA) of the rice transplanter. The GTA aimed to understand gender barriers and enablers to adoption of the rice transplanter; understand intra-household gender norms and identify women's roles in household technology adoption; and identify strategies for better dissemination and adoption. The GTA methodology was adapted from the Technology Assessment toolkit developed by Cultural Practice, LLC within the INGENAES project (Manfre et al., 2017) and the Guidance for Inclusive Irrigation Interventions tool developed by IFPRI-REACH project (Theis et al., 2018). The GTA was conducted over a period of seven days, which included a two-day workshop to train 17 participants that included BAU faculty and graduate students representing ASMC and Post-Harvest Loss Innovation Lab, and research scientists from Bangladesh Agricultural Research Institute. After the training, a four-member team spent four days in data collection and one day in group analysis to organize key findings and develop recommendations for the rice transplanter.

Key informant interviews were conducted in Wazirpur, Barisal and Dumuria, Khulna, sites where ASMIH-BD has conducted numerous trainings on the rice transplanter. Three categories of respondents were targeted: farming households using rice transplanter, farming households not using rice transplanter, and co-operatives providing rice transplanting service. Within households, both men and women were targeted. The team also interviewed extension workers, service providers, lead farmers and conducted focus group discussions with associations. Data was collected through semi structured qualitative interviews. In total 13 male and six female farmers were interviewed. Interviews were conducted in Bangla, and translated into English when needed. The next section of the report discusses agricultural production and access to service provision along three key areas of inquiry: Time & Labor, Income & Assets, and Intra-household gender norms

Time and Labor

Traditional agricultural practices are extremely time and labor consuming. Within male-headed households, men perform for numerous tasks with the seeds such as selecting seed variety, collecting seeds, preparing the seedbed, and sowing the seeds. Men are also responsible for irrigation, applying pesticides and fertilizers, land preparation (tillage), transplanting seedlings, weeding and harvesting.

Women manage 30 percent of pre-harvest and 70-80 percent of post-harvest rice farming activities, especially, when they are home-based activities. Pre-harvest tasks performed by women include seed processing, soaking, sprouting, uprooting, weeding and harvesting. Women are also responsible for post-harvest activities such as threshing, winnowing, cleaning, drying, par boiling and storing the grains. Some women respondents said that they managed decisions such as selecting seed variety or hiring labor for the vegetable gardens.

With increasing male migration, there is a growing number of female-headed households. In such households, women face the double burden of managing both the household and farm responsibilities. In

female-headed households, women make most farming decisions. They perform tasks such as seed selection, processing, soaking, sprouting. They also hire labor for land preparation, seedling bed preparation, seed spreading, fertilizer and pesticide application, weeding, irrigation and transplanting. The women also conduct (or hire labor) post-harvest activities which are perceived as women's responsibilities such as threshing, winnowing, cleaning, drying, storing grains, and parboiling. One female respondent in Dumuria mentioned that she undertook marketing decisions such as fixing the price and communicating with the buyer. However, the same function was restricted in Barisal due to deeply held social norms.

Both male and female-headed households commonly used hired labor. In most cases, hired labor was men. Women laborers were available in Khulna, but were restricted in Barisal due to social and cultural norms. The assessment identified discriminatory labor wages. Male laborers, on average, were paid between BDT 350-500/day but female laborers were only paid between BDT 250-300/day. Both men and women respondents said that the wage discrepancy was due to the perception that women were not as strong as men were and hence had a lower output.

Income and Assets

Male farmers generate income through selling produce, leasing land, selling livestock and by providing labor. Women's primary income sources are from selling vegetables, poultry and occasionally providing labor. Both male and female respondents mentioned that women usually store income from crop production. Although women have access to the income, they do not have decision-making control over it. For example, one of the female respondents said that men took household financial decisions including purchases for the women.

Typical assets mentioned by respondents were land, household furniture, TV, refrigerator, pressure cooker, rice cooker, cell phone and machineries. There was noticeable lack of land ownership amongst women farmers. Most respondent families owned at least one or more cell phone. At least 50 percent of female respondents owned cell phones.

In female-headed households, women had more access and control over assets, and had decision-making agency in the purchase of assets. In one instance, a women respondent said she took the decision to build or improve their houses. However, in certain major purchases the women consulted with husbands or close relatives. All women from female-headed households said that they did not make decisions on purchasing land due to its complexity. This can be attributed to traditional norms in Bangladesh that limit women's ownership of land in their own names (3.5%) and restrict access to and control over other productive assets. Only 3.5 percent of women have land in their own names (Sraboni Esha, 2013).

Intra-Household Gender Norms

In rural Bangladesh, the practice of purdah restricts women's inter action with men outside the family, with important implications for women's mobility, economic activity, and well-being (Feldman and McCarthy 2006; Kabeer 1990; Amin 1997; Bose, Ahmad, and Hossain 2009; Ahmed and Sen 2018). Observing purdah often concentrates rural women's work on home-based or near-home activities such as homestead gardening, postharvest processing, livestock and poultry rearing, and a range of other domestic activities (Theis, et al. 2019). Women do not go to the markets to buy or sell.

The system of purdah has implications on household decision-making. For instance, men control farm decisions such as marketing, selling, how much to sell and how much to keep for households' consumption,

crop variety, and hiring labor. In some situations, men discuss with their wives prior to making major decisions such as the purchase of a machine or adopting new technologies. Men and women take joint decisions with respect to children's education, marriage of daughters and purchasing household items. One of the female respondents said that her husband made all household financial decisions including purchases for her. However, this was also not the same across the board. A male service provider from Dumuria said that he and his wife made joint decisions on hiring labor, service providers, crop selection and household expenses. In some cases, women played a role in household decision making behind the adoption of new technologies. While women did not make the final decisions, men discussed the decision to purchase land or technologies with their wives.

Social norms also dictate men and women's roles within the household and farm. For example, a woman respondent in Dumuria mentioned that, "...women's first priority should be to keep her family happy the way they want. As the male members work outside and earn money, this is enough for her." Another respondent in Barisal perceived that by tradition, agricultural activities are men's responsibility and farm work is not suitable for women. Furthermore, some farmers perceived that operating machines such as the transplanter is men's task, and women should not operate field machines. Reasons given includes that women are weak to work on the farm or that children would be deprived of care if the women engage in on-farm activities.

However, as discussed earlier, the high rate of male rural migration is creating a labor crisis and is causing a shift in women's traditional roles in the farm and the household. Women respondents from female headed households said that they learned everything in the course of time and do not face barriers in accessing or managing resources. The women usually hired labor for field activities and relied on their relatives to help in negotiating prices. One female respondent in Dumuria mentioned that she felt forced to accept labor wages dictated by the laborers, as she did not have a male member to help in the negotiations. Similarly, a woman respondent said that she discussed decisions with her husband over the phone; however, in another instance, a women respondent said her husband trusts her to make decisions.



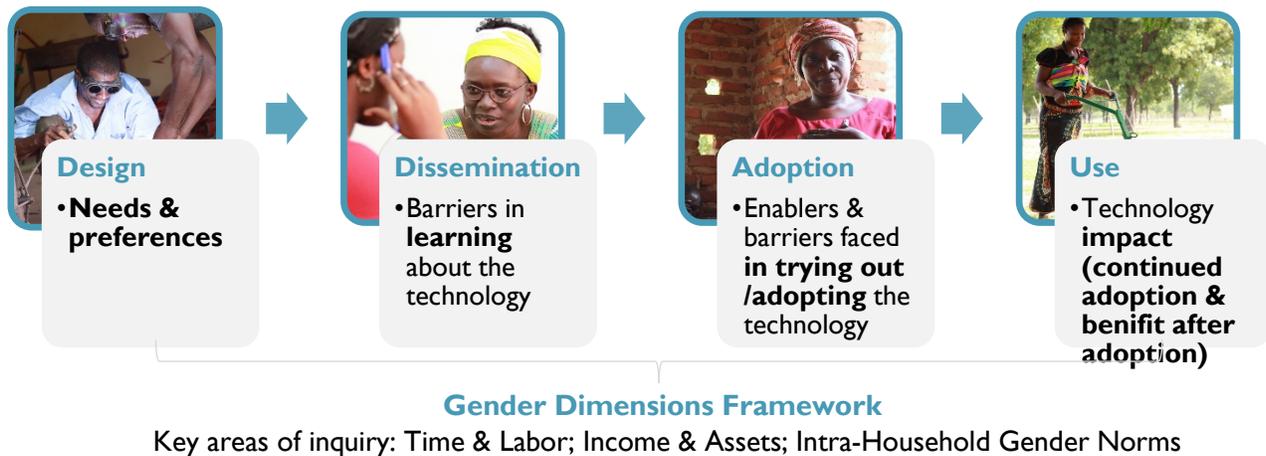
Box 2: Arzina Begum, 35 years old, is a Female headed, non-user farmer from Boratia village of Dumuria, Khulna. She has a family with a 7 years old daughter and husband living and working in Dhaka, who visits her once or more in a year. They have 66 decimal land, which includes household and farmland. Rice is their key crops along with vegetables as second crop. Within the family, without a male member, she has to manage and control everything related to farming, hiring and using of labors, and marketing the yields. Arzina manages all these activities very efficiently, where she has decision-making power and control. However, for major decisions making, such as purchasing or selling of land and machineries, she takes her husband's consents.

She hires labor with BDT 500-600 per day, which is a little bit higher than normal rate. She thinks having no male member in her family; she has to accept the higher rate. She passes a very busy day working 7-8 hours/day in full season and 1-2 hours/ day in off-season in farm activities. She has to manage all household activities including a new role of schooling duty of her daughter. Although, her family has not uses ASMIH transplanter. She uses and can make decision on technologies like, 2wt.sprayer and irrigation pump on rental basis, hiring service providers as well. She thinks that the ASMIH transplanter is too expensive and not appropriate for small farmlands. She manages a very high quality, clean and healthy house with good water and sanitation facilities.

GENDER CONSIDERATIONS WITHIN TECHNOLOGY ADOPTION

Technology design and dissemination reflects the current priorities, perceptions, and norms both about agricultural systems and about gender. Technologies are not inherently gender neutral and there is a need to understand the needs of the users – both male and female prior to design. While the most visible gender gaps between men and women appear in the hands-on use of technologies, in the case of agricultural machinery, gender differences also arise in farmers' ability to learn about, rent or hire machinery.

This section explores rice transplanters' adoption by men and women through the four stages of technology adoption: design, dissemination, adoption, and use (see figure below). For this report, we do not address 'use' because the technology is still in its early stages.



Design

The transplanter reduces the time and labor associated with manual transplanting. It provides benefits such as line transplanting, lower transplanting shock, early seedling vigor, and uniform crop establishment. The transplanter also has unique design challenges – such as it cannot be operated in low land where drainage facility is absent or in flooded land during rainy season. The transplanter also requires quality seedlings and seeds, which are not easily available in rural areas. Furthermore, the transplanter requires a different seedling raising method that requires more time and labor than conventional practice ([see ASMIH Bangladesh](#)).

Female laborers in Dumuria, Khulna are significantly involved in seedling uprooting and manual transplanting. Male laborers also assist with manual transplanting. A possible unintended negative consequence of mechanization is the displacement of female (and male) landless wage laborers who perform manual transplanting. ASMIH-BD has been training women to raise seedlings to be used by the transplanters, which could serve as an alternative livelihood for landless laborers. Women's participation in raising seedlings is also a contextually feasible activity since it can be near the home or along with their current homestead gardening practices. Currently, women's participation in raising seedlings is decided by both the husband and the wife.

Due to social norms, both men and women perceive that fieldwork is for men, and that women should work within the household. Both men and women perceive women operating machines as unacceptable behavior; and hence women are not encouraged to try field-based machineries such as the transplanter. Additionally, since women are not used to working with field-based machines they lack confidence in operating machines. Women respondents also said that there are no machines made for women.

Design Recommendations

- Ensure farmers have technical capacity to address transplanter challenges such as ensuring proper drainage system in low lands prior to using the transplanter
- Build public-private partnerships with private sector companies to ensure quality seed supply with proper certification (machine transplanting seed), and provide better warranty or after sales services
- **Service Providers or Operators:** Provide operators training and long-term technical assistance in operating and maintaining the machines, even if they have previous experience with power tillers or tractors. Operators should receive training on basic mechanic skills, business skills, and skills to raise seedlings in the nursery

Dissemination

To introduce mechanization in agriculture among women, it is necessary to know the level of their access and participation in technical trainings. Public extension officers organize learning events such as field days. While both men and women attend village-level extension events, upazila-level events are targeted towards and male farmers. In Khulna, extension agents mentioned that their training programs are targeted towards men.

ASMIH disseminated information on the transplanter through a mix of trainings and field demonstrations (see [ASMIH Bangladesh](#)). Due to social norms (see [Intra-Household Gender Norms](#)) that require women to be separate from men, women respondents attended field demonstrations but did not attend trainings. In fact, women respondents self-identified the lack of access to formal training as a barrier to technology knowledge and adoption. Women respondents in Barisal and Khulna cited training location requiring travel as a barrier. The further the travel distance from the household, the more important it was for women to get permission from their husbands or elderly household members to attend the training. Additionally, women were concerned that the travel distance and duration of training could affect their household responsibilities or childcare.

In addition to trainings, men and women learn about new technologies through farmers associations such as Integrated Pest Management (IPM) or IAPP clubs. Women, specifically cited neighbors as sources of information. Female-headed households cited brothers in law as trusted sources of information. Future designing of information dissemination strategies should consider gender-based constraints to ensure men and women have equitable access to technology.

Dissemination Recommendations

Knowing about technologies puts women in a better position to manage farms alongside their husbands, if the farms are jointly managed. Additionally, with the out-migration of men, Bangladesh's rural economies are changing with women becoming more involved in farming. Training both women and men on technology usage can enable women to access information and ensure the project's activities are gender transformative. Specific demographics of women to train include female-headed households and female landless laborers. During trainings, ensure:

- **Separate training groups for men and women:** so women can attend trainings without facing social barriers
- **Accessible location:** ensure location of field days and technology demonstrations are close to the homestead where women can easily participate. For crop establishment demonstrations, choose women's nearby household plots as demo sites
- **Tailored content:** so the training caters to participant's needs. E.g.: train women on overall knowledge about the technology and its benefits
- **Trainings cater to lower literacy among women:** by using local dialect, simplified concepts and visuals

Encourage Universities, Research Organizations, DAE, Ministry of Agriculture, NGO, Micro Finance Institute and Commercial Banks to facilitate technology trainings, demonstrations, and provide subsidies or loans. Women may be encouraged to join trainings alongside their husbands.

Barriers & Enablers to Adoption

In Bangladesh, mechanical rice transplanting is an early-stage technology, which poses unique barriers to adoption. Barriers include – limited availability of the machines, lack of post-sale service, spare parts, local dealers and skilled mechanics who can maintain the machine.

The transplanter is also expensive at BDT 4,00,000 (USD 4,700). Although the DAE is providing 50 percent subsidy bringing the price of the transplanter down to BDT 2,00,000 (USD 2,352), it is unaffordable for most rural farmers. In fact, most interview respondents cited the high price of the transplanter as a major challenge in adoption. The prices also poses a barrier to women farmers who may have the capacity to own or operate a business providing machine services.

Service Provision

Fee-for-service arrangements or custom service provision business have made technologies substantially more accessible to resource-constrained farmers who no longer need to purchase capital-intensive machinery to make use of technologies. Access to service provision will also enable more farmers to adopt the technology. Additionally, there are employment opportunities in operating, repairing and maintaining technologies. The transplanter has benefits of providing both women and men with entrepreneurial opportunities in providing operational services or seedlings. The business of raising seedlings can provide women with an additional source of income without requiring women to travel or leave the homestead.

Female-headed households tend to manage and make both farm and household decisions. If provided access to finance through micro-credit organizations and relevant technical knowledge, women could be owners of such service provision businesses. In addition, training women on mechanization will change their perception and understanding about the benefits of machines, which could serve as a motivational factor for other farmers.

Farmer Associations

Khulna and Barisal have active farmer's groups or associations such as Integrated Pest Management (IPM) clubs, Integrated Crop Management (ICM) clubs and organizations formed out of the Integrated Agricultural Productivity Project (IAPP). Most organizations have both men and women as members and do not charge a fee. IPM clubs are very active, meet in farmers' households and receive training on a variety of topics such as agriculture and livestock production, health, and gender based violence prevention training. IPM clubs can as a communal operation hub for owning capital-intensive machinery such as the transplanter and provide services to its members. Farmer associations also would serve as a source of information about technologies, better agricultural practices and access to markets.

Adoption Recommendations

- **Women-led farmer's associations:** Form or connect to existing women's group to assist women farmers with multiple resources such as:
 - Accessing machinery through subsidies
 - Accessing service providers or cooperatively own the machine and operate a service provision business
 - Accessing financial support through credit scheme or micro-credit providers. Ensure credit is not tied to land as women do not possess any land
 - Provide tailored assistance to women led associations to operate businesses such as custom hire service provision or seedling raising business
- **Work with female-headed households** to promote technology ownership and manage service provision business. Female headed households with men who have out-migrated, are severely time and resource-constrained and will most directly benefit from transplanter, especially in comparison to women who are less involved in agriculture and come from wealthier or male-headed households (Theis, 2019). Encourage such women to become service providers (manage service provision business).
- Similarly, **engage female landless laborers** in training them to become machine operators or raising seedlings. These women are already breaking social norms given the necessity of their involvement in agriculture and economic activities, and will most likely be open to learning and operating machinery. Ensure that they receive technical training and business training
- Help interested male and female farmers in getting **government subsidy**. Connect farmers with **credit providing organizations** (gaining information and help in procurement).
- Encourage private sector companies to introduce sales centers in rural areas

CONCLUSION

Agricultural technologies are never gender neutral. While the most visible gender gaps between men and women appear in the hands-on use of technologies, in the case of agricultural machinery, gender differences also arise in farmers' ability to rent and hire machinery (Manfre 2017). When assessing how agricultural technology can serve women's strategic interests in Bangladesh, it is important to recognize that women play important and growing, but less visible, roles in agriculture than men.

While conservative cultural norms in Bangladesh restrict women's ability to engage in farm production and management, women represent untapped potential in agricultural technology markets as both clients of service providers and as business providers. Especially female-headed households with men who have migrated for work and female laborers serve as target demographics encourage owning/ leasing the technology or operating the technology. Knowing about the technologies puts women farmers in a better position to manage the farms alongside their husbands, especially if the farms are jointly managed.

Women can perform as efficiently as male producers if served with equal access to resources, training, and services (USAID, 2011). Amplification of opportunities for women in agriculture can have widespread impact on productivity and agriculture-led growth. But those roles are rarely recognized and paid, "owing to the assumption that women are not involved in agricultural production and because of cultural and gender norms that value female seclusion and undervalue female labor" (Sraboni Esha, 2013).

Women's access to mechanical rice transplanting can be as service providers and or as seedling raisers. To achieve this, women need to have access to both technical training and business skills. Women also need access to credit and support from the community, which can be achieved through existing associations and clubs. Machine dealers, extension agents, and service providers can play a role in encouraging women's participation in service provision.

ACKNOWLEDGEMENTS

The authors would like to thank the following individuals for their contributions:

- Dr. Monjurul Alam, Dr. Chayan Saha in guiding the efforts to conduct the Gender Technology Assessments in Bangladesh
- Dr. Md. Ashik-E- Rabbani, Shahana Begum, Surajit Sarkar, and Md. Samiul Basir in sharing their expertise, time and conducting the assessments in the field
- Shahana Begum, ASMIH-BD Gender Specialist for her support in developing the questionnaire
- Cristina Manfre, TechnoServe Gender Director for guiding the development of recommendations for this report
- And countless staff at Bangladesh Agricultural University, who helped organize logistics for trainings and the assessments

This report is made possible by the support of the American People provided to the Feed the Future Innovation Lab for Sustainable Intensification through the United States Agency for International Development (USAID). The contents are the sole responsibility of the authors and do not necessarily reflect the views of USAID or the United States Government. Program activities are funded by USAID under Cooperative Agreement No. AID-OAA-L-14-00006.

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