IFPRI Discussion Paper 01837

May 2019

Gender and Agricultural Mechanization

A mixed-methods exploration of the impacts of multi-crop reaper-harvester service provision in Bangladesh

Sophie Theis

Timothy J. Krupnik

Nasrin Sultana

Syed-Ur Rahman

Greg Seymour

Naveen Abedin

Environment and Production Technology Division

INTERNATIONAL FOOD POLICY RESEARCH INSTITUTE

The International Food Policy Research Institute (IFPRI), established in 1975, provides research-based policy solutions to sustainably reduce poverty and end hunger and malnutrition. IFPRI's strategic research aims to foster a climate-resilient and sustainable food supply; promote healthy diets and nutrition for all; build inclusive and efficient markets, trade systems, and food industries; transform agricultural and rural economies; and strengthen institutions and governance. Gender is integrated in all the Institute's work. Partnerships, communications, capacity strengthening, and data and knowledge management are essential components to translate IFPRI's research from action to impact. The Institute's regional and country programs play a critical role in responding to demand for food policy research and in delivering holistic support for country-led development. IFPRI collaborates with partners around the world.

AUTHORS

Sophie Theis (sophietheis@gmail.com) was a senior research analyst in the Environment and Production Technology Division of the International Food Policy Research Institute (IFPRI), Washington DC, at the time of the study. She is currently a Qualitative Research Specialist for Women's World Banking, New York, NY.

Timothy J. Krupnik (t.krupnik@cgiar.org) is Senior Scientist and Systems Agronomist with the International Maize and Wheat Improvement Center's Sustainable Intensification Program. He leads the Cereal Systems Initiative for South Asia (CSISA) in Bangladesh and Nepal.

Nasrin Sultana (sultananasrin@yahoo.com) is a consultant and specialist in gender in rural development, with expertise in qualitative research methods and data analysis.

Syed-Ur Rahman (syed-ur.rahman@cgiar.org) is lead monitoring and evaluating specialist with the Cereal Systems Initiative for South Asia in Bangladesh.

Greg Seymour (g.seymour@cgiar.org) is research fellow in the Environment and Production Technology Division of the International Food Policy Research Institute (IFPRI), Washington, DC.

Naveen Abedin (n.abedin@cgiar.org) is a research analyst at the Interntional Food Policy Research Institute, Dhaka, Bangladesh.

Contents

ABSTRACT

Farmer hiring of agricultural machinery services is common in South Asia. Informal fee-for-service arrangements have positioned farmers so they can access use of machinery to conduct critical, time-sensitive agricultural tasks like land preparation, seeding, irrigation, harvesting and post-harvesting operations. However, both the provision and rental of machinery services are currently dominated by men, and by most measures, it appears that women have comparatively limited roles in this market and may receive fewer benefits. Despite the prevailing perception in rural Bangladesh that women do not participate in agricultural entrepreneurship, women do not necessarily lack a desire to be involved. Using a mixed methods approach involving literature review, secondary data collection, focus groups and key informant interviews, and a telephone survey, we studied the gendered differences in women's and men's involvement in emerging markets for rice and wheat reaper-harvester machinery services in Bangladesh. We find that women benefit from managing and sometimes owning machinery services, as well as from the direct and indirect consequences of hiring such services to harvest their crops. However, a number of technical, economic, and cultural barriers appear to constrain female participation in both reaper service business ownership and in hiring services as a client. In addition, women provided suggestions for how to overcome barriers constraining their entry into rural machinery services as an entrepreneur. Men also reflected on the conditions they would consider supporting women to become business owners. Our findings have implications for addressing social norms in support of women's rural entrepreneurship and technology adoption in South Asia's smallholder dominated rural economies.

Keywords: gender, cultural norms, agricultural technology, scale-appropriate mechanization, rural machinery service provision, Bangladesh

ACKNOWLEDGEMENTS

This work was undertaken as part of the Gender, Climate Change and Nutrition Integration Initiative (GCAN) funded by USAID in collaboration with the Cereal Systems Initiative for South Asia (CSISA), supported by USAID and the Bill and Melinda Gates Foundation (BMGF), and is associated with the CGIAR Research Program on Climate Change, Agriculture and Food Security (CCAFS), which is carried out with support from CGIAR Fund Donors and through bilateral funding agreements. We thank Shafiq Islam, DB Pandit, DA McHugh and IAA Siddique, Md. M. Rana and A.A. Miah for assistance with field and telephonic research. The results of this research do not necessarily reflect the views of CCAFS, USAID, the United States Government, or the BMGF.

INTRODUCTION

Farmer hiring of agricultural machinery services is common in South Asia. Fee-for-service arrangements have made agricultural mechanization substantially more accessible to smallholder and resource-constrained farmers who no longer need to purchase capital intensive machinery to make use of equipment to conduct critical, time-sensitive agricultural tasks like land preparation, seeding, irrigation and harvesting. Appropriate machinery options can help farmers to reduce their own labor and drudgery, as well as expenditures on hired labor. Conversely, farmers who own machinery can benefit as rural entrepreneurs who offer machinery to farmers on an affordable fee-for-service basis (Baudron et al. 2015; Mottaleb et al. 2016).

However, like many new agricultural technologies and market opportunities in South Asia, it appears that the early adopters, both the farmer-renters and machinery service providers, are predominantly men. This is especially the case in rural Bangladesh, where women face strong social and cultural constraints to participating in paid work outside the home, including agricultural work in the field (Sraboni et al. 2014). While closing the gender gap in women's access to agricultural technology is considered a key strategy for rural women's economic empowerment (FAO 2011), the case of fee-for-service markets in Bangladesh illustrates how there are conflicting explanations in the literature on gender and technology adoption for why this gender gap exists and what should be done about it.

One view in the literature is that there is a gender gap in adopting new technology primarily because women face greater constraints to accessing capital, credit, and information than men do (Doss 2001; Quisumbing and Pandolfelli 2010; Fletschner and Kenney 2014; Peterman, Behrman, and Quisumbing 2014). In addition, women's limited access to complementary inputs, including land and the ability to marshal family or paid labor, can reduce women's willingness to adopt technology (Doss and Morris 2001). Development approaches informed by this view often focus on supporting women's access to the complementary resources needed to adopt technology, including subsidies and direct transfers of technologies. Women's formal ownership is often a goal.

A second perspective in the literature suggests that "ownership" is not necessarily an accurate representation of who benefits or bears the costs from a given technology, especially in households with multiple decision makers and income generation sources (Theis et al. 2018). This strand of literature examines how the benefits of a technology are distributed as people negotiate for control over a technology and the resources associated with its use, both within adopting households (Agarwal 1994; Doss 2001; Njuki et al. 2014) as well as within communities (Rahman and Routray 1998; Kaaria and Ashby 2001; Beuchelt 2016). In this case, subsidies or direct transfers of technologies targeting women are not seen as a guarantee of women's control over the technology, especially for women in male-headed households. At the same time, even if men are considered the formal owner a given technology, women are not completely excluded from rights to make use of or benefit from the technology. Importantly, some technologies might save labor for men but increase time use for women. For example, while irrigation technology can facilitate intensified double and even triple cropping within the same calendar year, it can also increase women's time use and drudgery for weeding multiple crops (Chancellor and O'Neill 2000).

Finally, a third perspective questions whether agricultural technologies available in the market are relevant and useful for women—if they are not, why would women adopt them? This approach emphasizes that women have needs and preferences that can be distinct from men, which are often inadequately taken into account in research and development processes (Doss 2001; Rathgeber 2011; Ragasa 2014). Instead of working to promote women's uptake of technologies they may not want or need, there is increasing evidence that research for development programs can improve the rate of farmer adoption by assessing whether existing technologies are compatible with women's roles and responsibilities (Meinzen-Dick et al. 2014). Willingness to pay for a specific technology can differ for men and women within the same household, as they prioritize reducing drudgery and raising household income differently (Padmaja and Bantilan 2008; Khan et al. 2016). When men hold primary control over household finances and purchasing decisions, they conversely may not necessarily prioritize women's preferences for certain technologies (Rathgeber 2011).

These three views provide different explanations for why women do not use new technologies.

Each explanation suggests different interventions to improve women's equity in access, use and benefits of technology. Policymakers and donors often choose one explanation to guide their policy and programming actions without adequate assessment of the others. But the interpretations of each narrative are not mutually exclusive. Each can be seen as interlocking pre-conditions for women's technology adoption: a woman must have awareness and access (narrative 1) to desirable technologies she prefers (narrative 3) and be able to effectively negotiate the benefits and costs associated with technology use (narrative 2). Rather than choosing a single narrative on an *a priori* basis, if each narrative is investigated in a given setting, development actors will be better able to describe gender dynamics around agricultural technology and choose strategic, multi-faceted actions to advance gender equity.

In this paper, we assess the relevance of these different perspectives in explaining women's apparent limited inclusion in fee-for-service machineries in Bangladesh. In so doing, they can help us articulate what gender equity with respect to agricultural machinery might look like in this context. How women themselves assess their current roles in agricultural technology markets, and in what ways, if any, they wish to expand their participation, is of central relevance when considering the implications of this market on gender dynamics, and what approach would be most effective in advancing gender equity.

METHODS

This research was conducted in three phases. The first phase entailed literature review and secondary data analysis to explore gendered patterns of agricultural machinery use in Bangladesh using a large, nationally representative survey. The second phase consisted of qualitative field research to provide detailed insights as to the gendered aspects of reaper-harvester use in southwestern Bangladesh. During the third phase, a telephone survey was conducted to explore the implications of harvesting machinery on women's daily activities and labor allocation. Ethical approval for the second research phase was obtained from the Institutional Review Board of the International Food Policy Research Institute. Informed consent was obtained from all participants in the second and third phases of research.

We focused on machinery services for multi-crop reaper-harvesters, which enable farmers to rapidly cut rice and wheat, although sesame, jute, and other crops can be harvested. We chose this technology because relative to other agricultural technologies such as power tillers and seeders, reapers only formally entered the Bangladesh market in the last decade and thus present an opportunity to study emerging gender dynamics and opportunities associated with a newly introduced technology. Two types of reapers are common in Bangladesh: the self-propelled 'walk behind' model and the two-wheel tractor-attachable and rideable models (Figure 1A and 1B).

Both technologies are designed to reduce drudgery and accelerate the rate at which crops can be cut for drying and/or carrying from the field at maturity. Service providers running reaper businesses often hire skilled machine operators to harvest farmers' fields. Studies indicate that reapers can reduce the time and costs of harvesting by 80% and 60%, respectively, while enabling the rapid clearing of land so that farmers can sow the next crop by the recommended planting date (Theis et al. 2018).

Figure 1. (A) A self-propelled reaper harvesting rice and (B) a two-wheel tractor attachable reaper, also harvesting rice in Bangladesh.

Notes: Credits for photos A and B, respectively: Md. Salahuddi and Md. A. Matin

First research phase: Literature review and secondary data analysis

In the initial phase of research, we conducted a literature review, which aimed to provide insights into women's roles in agriculture in Bangladesh and, more broadly, to assess existing evidence on gender and agricultural technology, with specific attention paid to research exploring how agricultural technology benefits women. Additional insights on gender and rural mechanization in Bangladesh were gleaned from analysis of data from the 2015 Bangladesh Integrated Household Survey (BIHS), a nationally representative, multi-topic household survey in Bangladesh covering 6500 households (IFPRI 2016). Specifically, we conducted a descriptive analysis of agricultural machinery usage among farms of different sizes and of differences in men's and women's time use across a range of activities. Findings from both of these exercises informed the design of the qualitative protocols used in the second research phase.

Second research phase: Focus group and key informant interviews

Field study sites were chosen in late 2017 in coordination with staff from the Cereal Systems Initiative for South Asia (CSISA) project. These included four villages from Jheneidah and Faridpur districts, with an

additional four villages (two in Faridpur, one in Jheneidah, and one in Magura) selected to reach women machinery service providers who were not available in the primarily selected villages. Site selection was based on CSISA field staff's experience and prioritized a high density of machinery service providers and high uptake rates of reaper technologies, while maintaining comparability across sites in terms of agricultural and economic livelihoods and infrastructure. Further selection criteria included whether people in the villages tended to hold more progressive or more conservative gender norms, with sites representing each set of views selected to provide a basis for comparison.

Three categories of respondents were targeted: reaper service providers, farming households using reaper services, and farming households not using reaper services. Reaper service providers were purposively selected with the assistance of CSISA field staff in the district offices. The other categories were selected as advised by local researchers and through snowball sampling while speaking to respondents. Male and female reaper service providers were targeted, as were women and men registered as renting machinery services in databases maintained by CSISA. Husbands and wives (sometimes women and sons-in-law) involved in the service provider business or rental of machinery services were both interviewed, separately. Women in non-mechanized farming households, who had never rented any machinery services, were also interviewed. Along with these three major categories, key informants (e.g., community leaders, CSISA staff, machinery dealers, community leaders, etc.) were also interviewed. Data were collected through semi-structured interviews, focus group discussions, and key informant interviews. The first round of data collection was conducted from October to November 2017 in Jheneidah and Faridpur districts. The first round of data collection interviewed husband and wife machine service providers (18 women, 18 men), men and women who hire these machines for their farms (25 women, 17 men), women farmers in non-mechanized farming households (12 women), CSISA staff (8 men), and community leaders (1 woman, 1 man) (Table 1).

Table 1. Types and number of interviews conducted in round 1 (2017) and round 2 (2018).

	Round 1		Round 2	
	Women	Men	Women	Men
Current reaper service providers (husbands and wives)	18	18	6	4
People who hire reapers for harvesting their fields	25	17	6	2
People in farming households not utilizing reapers	12	-	2	1
CSISA staff	-	8	-	2
Agricultural machinery dealers	-	-	-	1
Community leaders	1	1	-	-
Women's group members	-	-	7	-

Source: Primary data collection

Semi-structured interview guides were developed and translated into Bangla. The interview guides were pre-tested for cultural relevance in communities in Jheneidah. A second round of data collection was conducted from October to November 2018, mainly in Jheneidah district, and focused on clarifying questions with previously selected respondents, as well as additional key informants from CSISA staff and local women's groups. For the second round of data collection, new interview guides were translated into Bangla, pre-tested, and refined to explicitly probe responses provided in the first round. The main topics covered in both rounds included perceived impacts and gender roles in reaper and machine service provision and rental.

All interviews were transcribed verbatim in Bangla, translated into English, and uploaded to NVivo (Ver. 12, QSR International, Doncaster, Victoria, Australia). Interviews were conducted or supervised by one of the authors, a trained Bangladeshi sociologist, and a team of trained graduate-level facilitators fluent in Bangla and English. Interviews were mostly held in a private household compound or at an office (mainly for CSISA staff). Focus group discussions were conducted with men and women separately. They provided contextual information and normative perspectives on how women and men perceive the impact of reaper rental on their lives. Key informant interviews focused on men and women's perspectives on gender roles in the service provider business and in renting reaper services. The transcripts were coded following principles of thematic analysis (Braun and Clarke 2006; Nowell et al. 2017). Data were coded using both pre-set and emergent themes. During data analysis, themes were compared across the transcripts to assess men and women's perspectives on women's current and potential and/or desired roles in local service provider (LSP) businesses and in machine rental. A second

round of data collection further probed the priorities and key barriers identified in the first round by respondents and gathered feedback on options to increase equity in machinery services.

Third research phase: Telephone survey

In the third phase of research, a telephone survey of farm households that hire rice and wheat reaping services was conducted to examine the implications of mechanized harvesting on women's time and labor allocation during the harvesting period, both before and after households adopted reaping services. The CSISA project maintains a database of 6,674 farmers making regular use of machinery services. A random sample farm households was drawn for reaping of rice (n = 254) and wheat (n = 255). All households had hired reaping services for at least two seasons (rice or wheat) over the last two years. Eight enumerators, five of whom were women, were trained to telephone households in March of 2019. Households were called and recalled until contact was made and enumerators were permitted to speak with the primary woman of the household. After being read a standard confidentiality agreement, respondents were asked to estimate the proportion (in hours) of their activities (inclusive of child care, cooking for family members or farm laborers, livestock, poultry or aquaculture activities, harvesting and post-harvest, farm laborer supervision, leisure and other income generating activities and sleep) within a typical 24-hour day during *aman* rice and wheat harvesting prior to and after the household's adoption of mechanized reaper harvesting. Statistical differences in data for before and after reaper adoption were analyzed for each crop and activity individually by employing two-tailed paired T-tests in JMP (Ver. 14) software.

RESULTS AND DISCUSSION

Research results are provided below starting with the first phase that included literature review and exploration of the BIHS survey results. Results from the second phase involving field research are organized into two broad categories: women's roles in providing machine services and women's roles in renting machinery.

Background on agricultural machinery services provision and gender in Bangladesh

The growing fee-for-service model for farm mechanization challenges conventional understandings of what constitutes gender-equitable technology adoption. Policy and development interventions tend to focus on reducing the gender gap in agricultural technology adoption by promoting women's ownership of technologies (Peterman et al. 2014). Conceptually, individual ownership of machinery, rather than rented access or use rights, can increase the value of women's assets and can help strengthen bargaining power within relationships. However, when considering machinery rental or hiring markets, where small- and medium-sized farmers access machines on a fee-for-service basis, ownership is not necessary. This model of agricultural 'services provision' however permits machinery owners to recoup capital investment costs by serving neighboring farmers as business clients (Mottaleb et al. 2016). Owning agricultural machinery is therefore not only a significant financial investment but may also represent a commitment to starting and operating a business. For this reason, promoting women's ownership requires not only the ability to make the initial purchase but also implies the capacity and financial skills to initiate and successfully run a profit-making business.

Conservative cultural norms in Bangladesh however result in a situation in which it relatively uncommon for women to be directly involved in owning/renting-out or renting-in use of machinery services. This situation appears to reinforce barriers to entry for women in either role. Conversely, increasing the number of women as service providers may help to reduce social restrictions for women renters, and vice versa. Mechanized land preparation in Bangladesh using two-wheel tractors (2WTs) has

expanded significantly since import tariffs on 2WTs were removed in 1995. Presently, more than 550,000 two-wheeled power tillers, most of which are made in China under the Sifeng and Dongfeng brands (Alam et al., 2017; Krupnik et al. 2013), are used in Bangladesh. Demand for 2WTs has remained high in Bangladesh, not only because power tillers or reapers can be attached and used for land preparation or harvesting, but also because these implements can be removed and substituted with trailers and used for hauling outside the farm, underscoring the importance of modular equipment and ways for farmer-machinery owners to bundle services and generate year-round income. 2WTs have been used in Bangladesh since the 1980s (Mottaleb et al. 2016) and now have an annual import market estimated at over $50 million per year. Harvesting equipment is conversely newer, with a market value of $1.2 million per year (Alam et al. 2017).

Who accesses and uses agricultural machinery in Bangladesh? Early critique and debate on rural mechanization centered on the themes of labor displacement and uneven access. Use of tractors in South Asia, for example, was reported as favoring mainly wealthier farmers who could afford to purchase imported machinery rather than smaller landholders (Pearse 1980). More recently, data from the 2015 BIHS show that 80.6 percent of farms in Bangladesh used 2WT-operated power tiller services, supplied mainly through fee-for-service arrangements (Figure 2). The BIHS however does not capture data on emerging reaper-harvester service provision markets. The majority (44 percent) of Bangladesh's farmers are small (farming 0.2-0.6 ha), while 36 percent are marginal (cultivating less than 0.2 ha). Conversely, ownership of 2WT is greatest amongst medium (0.6–1 ha) and large-scale farmers (greater than 1 ha; 3.7 and 13.0 percent ownership, respectfully), while only 2.4 and 0.4 percent of small and marginal farms, respectively, own 2WT (Figure 2).

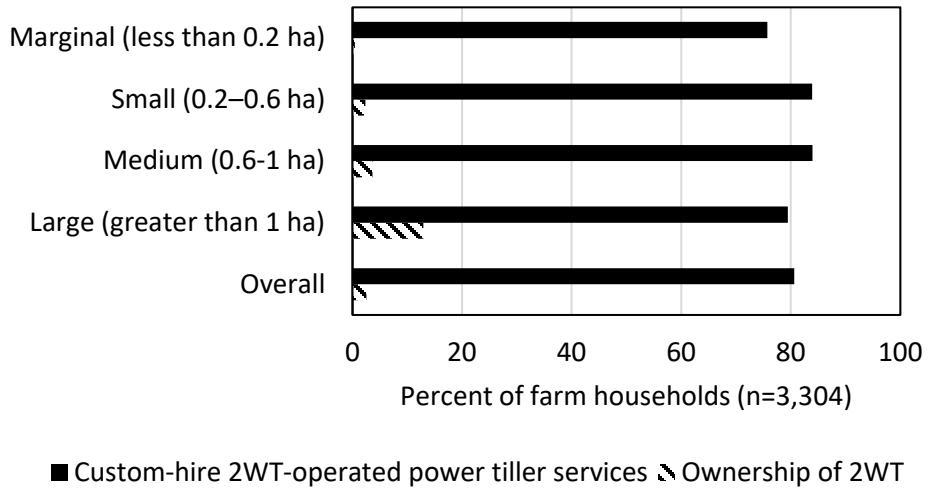

Figure 2. Fee-for-services access to vs. ownership of two-wheel tractor (2WT) operated power tillers for land preparation in Bangladesh by farm size.

Source: Authors' calculations, 2015 BIHS.

Nonetheless, 84 and 76 percent of small and marginal farms, respectively, rented power tillers during the past year (compared to 84 and 79 percent of medium- and large-scale farms, respectively) (Figure 2). In comparison, only 15 percent of farms used draft animals (with little variation by farm size), indicating a clear preference among farmers for 2WT-operated power tiller services.

In terms of gender, the primary users of hired operated power tiller services are male. Of the 82.3 percent of farms that use 2WT-operated power tiller services, 82.5 percent of service provision businesses are exclusively male-managed. A similar gender disparity exists in terms of the providers of custom-hire machine services in Bangladesh. Of the 257 2WT power tiller service providers identified in the 2015 BIHS, 98 percent are male. While additional support may be needed to strengthen access to these services by marginal farmers, mechanized land preparation is nearly equally distributed among small, medium, and large-scale farmers in Bangladesh, with little difference between these groups owing largely to the pervasive system of custom hiring service provision (cf. Mottaleb et al. 2016).

This system is however generally inaccessible to women both as users of custom-hire services or as providers, a result of generally conservative cultural norms in Bangladesh that restrict women's ability to engage in farm production and management. 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 (Zaman 1995; Mahmud, Shah, and Becker 2012; Amin 1997; Bose, Ahmad, and Hossain 2009). Definitions of economic activities often fail to capture women's contributions to household production, and much of women's work is not visible to outsiders (Zaman 1995).

In rural Bangladesh, the practice of purdah, often translated as female seclusion, excludes women from public spaces and restricts women's interaction 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; Mahmud, Shah, and Becker 2012; Ahmed and Sen 2018). Amin (1997) argues for viewing purdah as a broader code of conduct for female morality, with observance granting prestige, and shame and loss of status accompanying violations of the practice. The cultural and religious norms behind purdah reinforce women's economic dependence on men by segregating women's labor to the private sphere while men handle public affairs of the household (Kandiyoti 1988; Zaman 1995; Kabeer 1994). In general, women need to seek permission or at least inform the husband or in-laws when leaving the homestead (Mahmud, Shah, and Becker 2012).

Observing purdah often concentrates rural women's work on home-based or near-home activities referred to as '*bari*' (home-based productive activities with exchange and/or market value, for example including homestead gardening, postharvest processing, livestock and poultry rearing), and a range of other domestic activities. Figure 3 shows a breakdown of the average number of minutes per day devoted to different categories of market (paid) and non-market (unpaid) work activities, for men and women, ages 15-64 years old, in Bangladesh. While men and women both spend roughly 8 hours working each day, the vast majority of men's time is spent in market activities, such as farming, wage/salary employment, or own business work, whereas women's time is mostly spent in non-market work activities, such as cooking, cleaning, and caring for children and the sick and elderly. Considering rice farming activities, women's main responsibilities include pulling seedlings, transplanting, weeding and harvesting (although even these activities may be restricted in parts of the country), while men engage in land

preparation, harvesting, and threshing, which are already largely mechanized (Pandey et al. 2010). Women in many areas assist with manual harvesting and bundling and carrying crops to threshing centers. They also manage most post-harvest rice processing, including drying, parboiling, cleaning, grading and storage of rice. In contrast, men manage field-based agricultural work, market all household products, including those produced by women, and shoulder the socially-assigned responsibility to support the family economically (Zaman 1995; Begum 1985). Women's economic contributions are cost-saving but may not generate cash, and these activities blend with their other tasks within the compound (Amin 1997). According to recent national statistics, the majority of rural women (71 percent in 2005-2006) work as unpaid family workers, compared to 12 percent of rural men (BBS 2015).

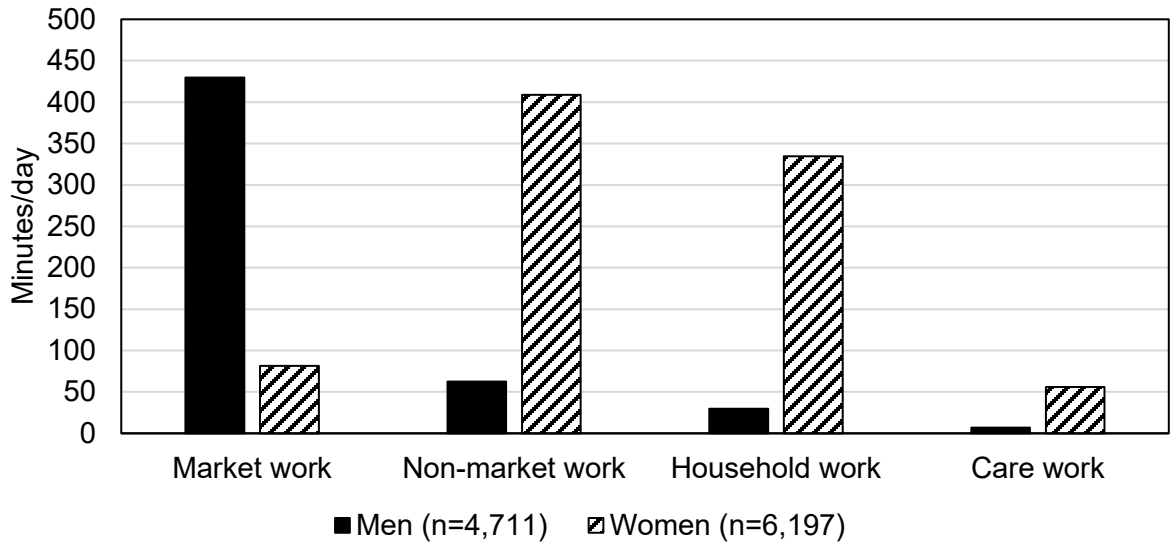

Figure 3. Average time use for men and women (15-64 years old) in Bangladesh. Market work includes employed work, own business work, farming, construction, and fishing; non-market work includes shopping, textile care, cooking, domestic work, and care work.

Source: Authors' calculations, 2015 BIHS

Despite discouragement from engaging in the cultivation of field crops, for many women in poor households, it is not possible to avoid field work. To secure their family's subsistence, poor and landless women, widows, and female heads of household often take an active role in field-based activities on their

own farms, and landless women often work as wage laborers on the farms of others (Zaman 1995). Between 1999-2000 and 2005-2006, men's employment in the agricultural sector declined by six percent, while female labor force participation in agriculture more than doubled from 3.8 million to 7.7 million. As a result, the proportion of women in the agricultural labor force increased from less than 20 percent to 33.6 percent (Jaim and Hossain 2011). These dynamics are also changing as gains from female employment outweigh the potential cost to social identity (Ahmed and Sen 2018). As out-migration of men from rural areas reduces agricultural labor supply, women are beginning to fill roles previously assumed by men (Pandey et al. 2010). Between 2005–2006, about 17 percent of rural men and three percent of rural women worked as agricultural day laborers (BBS 2015). Female wage laborers work at lower wages compared to their male counterparts, and can be paid irregularly and/or in food or in kind (Amin 1997; Rahman and Routray 1998; Kelkar 2009). Women may also assume managerial roles in crop production in the absence of their husbands, but the extent of women's involvement depends on the length of time that the husband is away, as temporary and seasonal migrants will often return to their farms for key activities in the crop production cycle (Jaim and Hossain 2011).

Previous studies have argued for greater nuance around the concept of women's empowerment in Bangladesh. Mahmud et al. (2012) describe how empowerment is more visible in women's self-perceptions and relational aspects of their lives than in their personal autonomy. Despite women's low mobility and control over income, women report relatively high levels of involvement in decision-making and self-esteem (Mahmud et al. 2012). This may represent a strategic "patriarchal bargain" for women (Kandiyoti 1988) and a reflection of the social risks associated with the pursuit of autonomy in personal or economic decisions, as other scholars in South Asia have noted (Kabeer 2011; Rashid 2013).

Women's roles in machine service provider businesses

Starting business as an agricultural machinery service provider can be a significant investment. Considering reaper-harvesters, costs can vary between USD 500 to 2,000, depending on the make and model. While women have some access to finance through village savings and loans and microcredit

offerings, these mechanisms are typically insufficient large capital investments. Men finance the machine through a combination of cash, trade in crops, taking loans from NGOs such as BRAC, renting-out land, and receiving loans from machinery dealers. In focus groups, when women were asked how they would prefer to finance such a purchase, most women indicated that personal savings or selling vegetables or livestock were the best options. Both men and women appreciated potential earnings from reaper services provision, which can exceed USD 1,250 per year from harvesting monsoon '*aman*' season rice in October-December, in addition to wheat in March-April. These crops are typically grown in sequence, enabling reaper service providers to capture at least two harvesting business opportunities within one calendar year.

Women as reaper service provision business owners and managers

Three of the women interviewed independently managed reaper service businesses. Their husbands had left agricultural activities to them due to their husbands' physical disabilities or employment as a machinery dealer. A third owned a reaper as a member of a women's group and has an adult son who assists in the business. One woman respondent explained, "I take all the decisions. Starting from appointing the driver, I take care of which field, at what price would be worked upon in addition to the amount of oil required and what to do if the machine gets damaged." However, she notes that, "Even though I do all the work, at the end of the day I have to explain all the expenditures, profits and income to my husband." Though she knows people criticize her behind her back for her involvement, she brushes it off, saying "the business brings me my income. No one else is going to give me this money without reason."

Women play key roles in men's reaper service provision businesses

While over 90% of reaper service providers registered by CSISA are men, their wives often assist in running the business, and men acknowledged their wives' contributions. A key informant estimated that there are "30 percent [women] who actively participate in the service provision business though officially

they are not recognized." Despite women's ownership of businesses, men typically supervise machine operators or drive reapers themselves, although women frequently help in advertising the reaper to other farmers through their social networks. Women also bring fuel for the machine and food and water for the reaper operator while in the field (especially if the field is next to the house). They also engage by cleaning and maintaining the machine when it is in storage. Some men taught their wives how to fix and repair reapers, and others expressed interest in their wives receiving this type of training to assist the business. Some wives also assist with accounting and keeping track of dues that are yet to be paid off by farmers.

Many women also actively communicated with prospective clients when their husband is not at home. One man explained, "If anyone comes to my house to rent the machine, but I am not present, they could easily go to another service provider, however, my wife makes sure that does not happen. She talks to them, which is why no renters go empty handed and…I get saved from facing any losses. This is extremely helpful for me as well."

Operating reapers to harvest crops

Husbands indicated that wives could further contribute to the business if they could collect money from clients and drive the reaper machines but these tasks are not socially acceptable. "Getting payments from people in the market is also something they cannot do," explained one male service provider. Another explained, "It would have been really good if she could drive the machine because then we would not have to hire drivers. However, since she is a woman, she cannot do it." A wife of a reaper service provider said, "I wish I could drive, though, especially when my husband is resting."

Men often noted women's inability to drive machines as a reason for why they were not suited to work in this business. In general, men clarified that they were not personally opposed to their wives driving the machine, but the reactions of others upon seeing a woman driving the machine would be humiliating. A male service provider noted:

> I do not have any problems if my wife or any other women drives machines in the field. But I think it would be better if they could be more focused on the accounting or taking care of the machines. This is mainly because if the women drive the machines, people would demean and mock them… people react in this way because *tader chokhe bhalo lage na* (society does not like seeing a woman driving a machine). However, if they drive the surrounding plots of land beside the house then there would not be any problem.

Another male service provider explained:

> I do not think that a woman driving a machine is something negative. Women do not drive in our area (western part of the country) and there is no norm for them to do so. People would demean and judge them, however personally I do not have any problem and do not think it is bad. I have seen women drive in the east of Khulna District. I think if women and men receive trainings then both of them can drive the machine. I think, *mohilla ra training korle shob e parto, mohilla ra boro army te osthro chalaye tahole training korle aitao parbe*. (training would definitely allow women to drive the machines). If women who are in the army can handle heavy arms in the army, then they can easily drive machines as well.

Women also expressed openness to operating reapers. The wife of a service provider shared, "I would try, in order to expand our business more. If that period comes and the times change, then I would learn to drive, if I am taught in order to run the machine. However, in Bangladesh women do not drive machines."

Effective supervision of machinery operators is a challenge for men and women service providers. Drivers need to be skilled to properly operate the reaper and avoid damaging the farmer's crop or the machine itself. Furthermore, when the operator interacts directly with the farmer, they must be trusted to collect and return the payment to the business owner. Supervising a machinery operator is

however not socially unacceptable for women, at least compared to driving the machines: "If I supervise the machines in the plot of land, the people in my village would not judge and demean me, but they would if I drive the machines" (aspiring female service provider). However, some male reaper operators indicated that they would be unlikely to work for women machine owners, though both men and women are concerned that unsupervised operators will try to exploit them. A woman reaper service provider described, "The operator does not give the earned money back properly. This mainly happens because I am a woman."

Yet women perceived that their particular social relationships could create exceptions. A female service provider explained she "might not get as many renters as a man. They might not value the female service providers as much as a male service provider. The people who would help me such as the driver might think that since I am a woman, they could do my work later." In contrast, she pointed out that:

> Operators in my village would be more understanding and they would say *omuk apa bhabi fupur kaj kore di agey karon amar nijer gramer manush, onnoder gram e emon hobe na* (the relationship between the people in the village, allows the LSPs to think of me as an aunt and therefore they would give importance to my work.) If it is another village, they would not value me as an LSP as much as in my village.

Women's limited mobility and access to information undermines confidence

Interview participants recognized that the problem of operating reapers not the only limitation to women's involvement in the service provider business. Men generally have closer relationships to those knowledgeable about agricultural machinery, such as NGOs, extension, research institute staff and machine dealers, and can ask them questions about the machine, participate in field demonstrations, and discuss the machine in person at the machine dealer shops or tea shops. Men in a focus group comprised entirely of machinery service providers in Jheneidah shared how they first heard about the machine by calling a number on an advertising billboard, watching a video at the tea stall, and a television show

('*Krishi Dibanishi*') that features agricultural activities.

In contrast, women are restricted from spending time with strangers and in public places, thus reducing their chance to learn about new technologies and business opportunities. Women's mobility restrictions were often the first explanation men and women provided for why there are no female service providers. Nearly all respondents acknowledged that it is considered culturally shameful for women to interact in public. A wife of a reaper service in a slightly more conservative area acknowledged, "There is a huge difference between a village and a town. If I get out of my house or go to the market, the people tend to point me out and say that, 'look at that woman, she is going outside'." One woman shared, "I wanted to be involved in buying machineries since the very beginning. The women would be able to run a business if they want to but they would not be able to run the machine directly in the farm or go for work in other areas. How can a woman go to work in another place?"

Asked to identify the most important factors in learning about machinery, most men indicated interaction with extension agents, NGO representatives, or participating in field demonstrations. Most women conversely explained that they learned about machinery through their husband. In addition, interview respondents indicated that extension agents and NGO workers were more comfortable interacting with men than women, and hence target their assistance to men at the expense of women. One woman explained, "The agricultural officers never talk about buying a machine under my name. They always called my husband to buy machines. If there is any meeting, only he is called. If the agriculture officers told my husband to buy a machine under my name, then my husband would have agreed."

In addition, men's social networks of other male farmers allow them to publicize the availability of reaper services through word of mouth and in public spaces, including by displaying their machines at markets and providing field demonstrations in their own and neighboring villages. One man uploaded the reaper machine onto his Facebook page to advertise and sent SMS messages through his mobile phone to his contacts. Sometimes they will operate the machine for free on influential people's farms to increase public awareness and interest. One man noted, "The way men can communicate, a woman cannot. It is not possible for the women to inform about their machine in public places, like a man does."

Women and men recognize social judgment about women's contact with the public as a major constraint to running a business that requires significant interaction with strangers, often on an *ad hoc* basis in response to sudden demand from clients or urgent repair needs. A male respondent commented, "if the woman suddenly needs something, she cannot run over to the market, such as for buying oil or spare-parts". Another explained, "It is not like the woman can go to the market to purchase oil. They would be heavily criticized by society if they are out and about in the market." A third respondent explained "If someone wants to hire a woman's services, it is not possible for her to go immediately…but when it comes to men this issue does not arise." Women respondents also indicated this as a key constraint to taking on more responsibility or starting their own business.

In addition to concerns about being judged for contact with the public, women regarded their lack of experience interacting with strangers not only as an obstacle to doing business but also as a factor limiting their confidence and knowledge. One woman shared her uncertainty about her own competence, tied to her limited exposure to the public. She explained that she and her husband have a mostly cooperative relationship where they "discuss on all household issues." She is empowered to make some decisions for small issues, but "important issues must be decided by my husband if we have a different opinion…such as marrying off my daughter…because as a woman I understand much less. My husband goes out, unlike me, and meets many people, therefore knows more about their attitudes, way of life and their characters, making him more sensible, with better instincts about people." Similarly, a woman described that because her son-in-law goes to the field and the market, "…he has a good idea and experience about the world. According to me, visually seeing is the reality, but hearing is not reliable. In addition to the fact that he understands better." Without experiencing much of this world first hand, she felt uncertain about her judgment and ability to interact in this world. Similarly, another female respondent explained that while her husband listens to her while taking decisions, "…he is more experienced than me and I might or might not understand certain decisions, yet he discusses it with me from a sense of responsibility, therefore usually he does what he thinks is right."

Another woman expressed insecurity about how to act in public. Considering what it would be like if "the business is in my name", she responded that she would have to go to different places for activities like trainings, but "it is difficult for me to go where crowds of people have formed. I usually do not go in these kinds of places but if I have to go, I am concerned about how to do it, how to talk, whether or not I can actually do this. However, I think once I learn, it will get better." "Nonetheless," another woman noted, "if I get started running the business, I would have to meet and work with new people, which would increase my knowledge about the outside world more."

Women's expressions of insecurity about their competence may in part also be a strategy to avoid potential criticism about their arrogance. Women were very concerned not to appear to be displacing their husband in his role the primary income provider for the family. One man explained that "society would criticize her for wanting to own a business, especially if the husband is present. The society would criticize her for thinking she understands more than her husband."

When asked if women could be involved in the business in the future, a male service provider acknowledged that working in a business would be an important opportunity for women to develop new skills. He noted that lack of knowledge is not innate to being female, but rather a result of not having had exposure to these ideas. He explained:

> I do think women will come in future. Women involving them in the business can be good. They should not idly sit about. Involving themselves would allow them to increase their knowledge. If they practice, they would slowly understand. If we do not tell them or make them understand the issues, they obviously would not be able to do it. Now they can do it by themselves. If the women are given the knowledge, then they would also be able to do what a man does. If the women are given opportunity from the family and community, they would come.

Cultural hegemony influences machine ownership

In most cases men made the decision to invest in a reaper, sometimes only informing their wives afterwards. But when asked to reflect on who is the owner of the machine, most men said that they were the joint owner of the machine with their wife, one male service provider explained that "I consider us both to be the owners of the machines. This is because we are both part of this family and therefore the machines cannot just belong to one individual. Apart from this, we both take decisions regarding the income-expenditure and any other factors related to our family and business."

Respondents were asked to reflect on whether women could be joint or individual owners of the machine and run the business. Many men thought their wives capable of running the business, but only after men had established initial relationships with farmers and operators. Most men and women did not expect that women's ownership would affect husband and wife's respective roles in the business ("whether it is in her name or mine, it is the same"). Most also did not perceive this would affect their day-to-day relationships. However, some were concerned with the effect ownership could have on inheritance. One male service provider explained:

> Personally, I do not see any advantages or disadvantages in buying a machine in my wife's name, but I do not think there is any risk if I end up doing so. We already have two children, so I do not worry anymore. Many men can be anxious about the fact that if there are properties in their wife's name, then their daughters would get more share than their sons. Maybe this is one of the reasons that the men who do not want to buy machines in their wife's name, especially those men who just have daughters. They worry that all their properties would be inherited by their daughters, when they are not there anymore. However, if there is one son and one daughter, these men might feel differently.

Because this respondent has both a son and a daughter, he is comfortable with the ownership of the machine being in his wife's name. According to Islamic law, sons inherit more property than daughters if the property belongs to the father, but daughters inherit more if it is in the mother's name. If he only had a daughter, there would be a risk of shifting the property to another location and family, since after marriage girls usually go to a husband's home, often in a different village. Since he has a son, most of the assets and property will remain in this man's family, so they do not need to worry about property in his wife's name.

One man articulated the value to his relationship of increasing his wife's ownership: "Moreover, my wife also has certain wishes and wants. She might think, *ami eto kichu kori, tumi amar jonno ki korcho* (contemplate on the fact that she does so much for me, but exactly what do I do for her). Therefore, her being a legal owner might be a way to show that she is valuable as well. The mutual understanding between us really good." Another respondent explained that now that he and his wife are middle aged, there is no risk if the machine is bought in his wife's name. Earlier in their marriage, there could have been a concern of his wife leaving him and taking this property with her. However, after many years of marriage and having children together, they have developed a mutual trust and cooperative relationship reducing fears of abandonment.

Women were often interested in buying the machine jointly with their husband, parents-in-law, or other household member. Respondents noted how this would diffuse risk associated with the investment and help them run the business, especially in the most socially unacceptable tasks for women of operating the machine and collecting money from farmers. In addition, women suggested that their husband would not support them in a solo business and may even mock them for proposing to start her own business. One woman explained, "Even in the future I am not interested in buying a machine in my name, it should be under my husband's. This is because if I buy it under my name, my husband will say, 'Since the machine is in your name, then you should give the money for the machine and you earn,'" which she knew she would have difficulties doing completely on her own. Similarly, another woman in Jheneidah district worried that her husband would say, "You own it so you should run it." Though men might be the

owners and expect women's support, women sensed that if they proposed independent ownership their husbands would challenge them to do it on their own, rather than help them, perhaps to emphasize the futility of the idea.

In a focus group discussion in Jheneidah with women in households that hire reaper services, women described how they and their families would face scorn if they were individual owners of the machine: "…people will say 'the wife has been keeping her husband under her feet'" and "People would laugh and say 'See! The machine is owned by the wife!'"

In contrast, another woman affirmed, "I do not listen to what other people say, however as long as my husband does not say it, everything is fine. If I have money, anyone who talks to me would think before they speak. My value would also increase in the society if I buy a machine in my name and start a business as a woman LSP." This woman described her and her husband as having a "good understanding" by saying:

> We never use loud voices against each other. He is concerned about me just the way I am concerned about him…When he comes home working the whole day and sees that I have not finished all my work, he never questions why I have not been able to finish, even though it is quite late, and tends to ask if I have eaten or not. I have an important and valuable position in the family and it will stay like this in the future and will not change. In fact, if I start the business, it would increase more.

Attitudes about women in business

In addition to concerns about women's roles in reaper service business, men and women had broader reservations about women's involvement in economic activities. Men and women often pointed to fear of social scorn. In a focus group in Jheneidah, men said, "We fear about what people will say about us. Our fear is, if the women start running a business their family status will decrease. People will not respect us."

In general, men were cynical about women's ability to participate in economic activity, let alone

lead a business venture. In a focus group discussion with male farmers who rented machinery, they shared comments such as: “My wife would remain under my authority, I would not be under hers”; “If my wife starts earning money she would be acting like she is the leader;” “It is a rule that in every sector, women should be behind the men;” and “However, the women should not be too far behind, but definitely behind. They can never come leading.”

Disparagement against working women often focused on how her economic activity reflects on male household members’ ability to provide for the family. A female respondent explained:

> The society would criticize my husband saying…, ‘Why you are living for? Your wife took over the responsibility and started operating machine in the field, it will be bringing huge income now, you should die!’ It means, according to them, my husband is not man enough to handle his work, so his wife is taking over, who would earn more, and he should die out of shame. All these sarcastic judgmental comments would be hurtful. People would treat me like a laughing stock and ask my husband that maybe I should work in their farms as well to mock him.

A female respondent from a mechanized farming household explained that her mother-in-law criticizes her poultry business, saying “Men should earn and women should spend what earning comes from the men, women should not think about this income issue, it’s men’s job not women’s.” Sons may also feel ashamed by their mother working. A wife in Jheneidah explained that while she used to work in the field when her sons were young, she does not work in the farm anymore because her sons forbid her. She explained, “If I go, then people would criticize me by saying ‘What a shame that the mother is working in the farm, while she has two adult sons!’” This same woman has a homestead poultry farm but gives her earnings to her husband, who she said tells her, “You give all the money to me. If you need it, I will give you. It is not good for women to keep money with them.” She explained that “he is very *kaachal parra lok* (unnecessarily argumentative), therefore I give all the money to him in order to avoid any kind of dispute.” At the same time, she was secretly saving money, presumably from these earnings, in an *Akti*

Bari Akti Khamar (One House One Farm) group, despite her husband saying it is "forbidden" to generate interest.

Some men and women suggested that familial support could override social contempt towards women's work. Women expressed that if they have their husband's permission and earn money, social norms such as *purdah* would not be an obstacle, and the increased income would raise their status and earn them respect. Many men agreed. A male service provider in Faridpur explained that women could say, "This is my work, so I have to do it. No matter what others say. Those people, who talk, do not give me food to eat. If the husband supports and helps their wives, what others say should not matter." Men in a focus group discussion in Jheneidah pointed out that women will not become service providers because "they have no interest" and "family does not support the woman to do this business. Family and society is in fact the main barrier for women to become women service providers or start the business." Wives of service providers in Faridpur explained, "The reason for no women service providers is the husband would not let them conduct any business. They [men] believe that *mohilara porda poribeshe khabar dibe* (a women should remain veiled and serve food only"). It the husband's job to provide food for them. In these cases, even if the family is supportive, however the husband does not give his consent, then it is his wishes which gets priority."

Another wife of a service provider proposed that in the future, more education in the village would "encourage more women" to see that "it is not wrong to work to provide food and shelter for the family. …Even if their husband is present, they would be able to do everything (including business)." Her quote illustrates the perception that the husband decides whether she can start an enterprise or not. It also reflects a common view held by women that women without husbands or male family members, or from families where the men are incapacitated, can exercise relative autonomy in their economic activities ("those women can work").

One woman, whose husband remarried and lives with the other family, shows how separated or single women can have more autonomy and might even be admired for starting a business. She explained:

> It would increase my value in the family and the society as a woman, if I could start this business. The people would in fact say, 'See, being a woman, she has bought a machine!' In other words, people of the society would be at awe and be surprised that being a woman, I have bought a machine. In addition, my sons do not argue or speak over in terms of decision-making. In fact, for the service provider business… my sons would be dancing with joy if I bought a machine for the service provision business.

Other women echoed this idea when they suggested that even in the future, women without husbands were most likely to be able to become business owners. One wife of a service providers shared:

> I think the women who do not take any orders from their husband, and live according to their wishes, independently, they can do anything in life, and those women are the ones who can run their own business…In the future, if the environment in the village gets better…there will be a group of women would be able to run a business, who have no husband, since if they have a husband, he would not let his wife work.

Women's roles and experiences in hiring reaper services

Most families hiring reaper services appear to be switching from employing wage laborers to harvest wheat or rice paddy to machinery services. Respondents describe that a shortage of wage laborers and increased rural labor costs during the peak season prompted them to hire the reaper services as an alternative to manual harvesting . Identifying, negotiating with, contracting, and supervising hired laborers is a source of stress and uncertainty for farmers, given the time-sensitive nature of the harvest. Moreover, harvesting time for wheat and *aman* rice corresponds with a period of unpredictable weather and heavy rains, so the ability to complete the reaping in a shorter period of time (for example, one day versus five days) with the machine is another advantage over laborers. Farmers also indicated that the speed of reaping with also allows farmers to proceed more quickly in preparing fields for the next crop

grown in rotation. In addition, reaping with a machine is considerably less costly than hiring wage laborers, and both men and women appreciate greater flexibility in paying for the reaper services after the market day (hat bazars) or in installments instead of the immediate pay required by wage laborers. As with the service provider business, most of the farmers hiring reaper services are men. However, women in these households note that they experience some specific positive changes from mechanization, particularly in their workload and their involvement in decision-making. Men also recognize these benefits for women.

Changes in women's daily time allocation following adoption of reaper services

Both men and women pointed out that one of the main benefits for women from hiring a reaper is that it frees them from the responsibility of providing meals and accommodation to the laborers over the days or weeks that hired harvesting laborers work. Women describe how they have to make food that laborers prefer, provide cigarettes and betel leaf, and "keep them happy," or else "endure their anger" if the food does not taste good. Further exploration of these issues in focus groups indicated that because of reapers, women feel that they do not need to go to the field to bring the laborers food, which in turn increases their feeling of social status. Women also indicated they were pleased that their husbands do not have to work alongside the laborers in the field. Some women can even coordinate with the reaper operator, freeing the husband to take part in other economic activities during this time. If women in poorer families are able to afford machinery services, they strongly value the time, labor, and cost savings from mechanization. These women appreciated the respite from heavy physical labor, and say they spend time resting, with family, participating in religious activities, or pursuing other economic activities.

These findings were backed by telephone survey results that indicated significant reductions in women's time spent cooking for harvesting laborers (a mean reduction of 2.45 and 1.63 hours/day during rice and wheat harvesting periods, respectively) harvesting, bundling, carrying, threshing and bagging activities (reduction of 3.04 and 3.30 hours/day for rice and wheat), and also supervision of laborers (reduction of 0.35 (rice) and 0.33 (wheat) hours/day) (Figure 3).

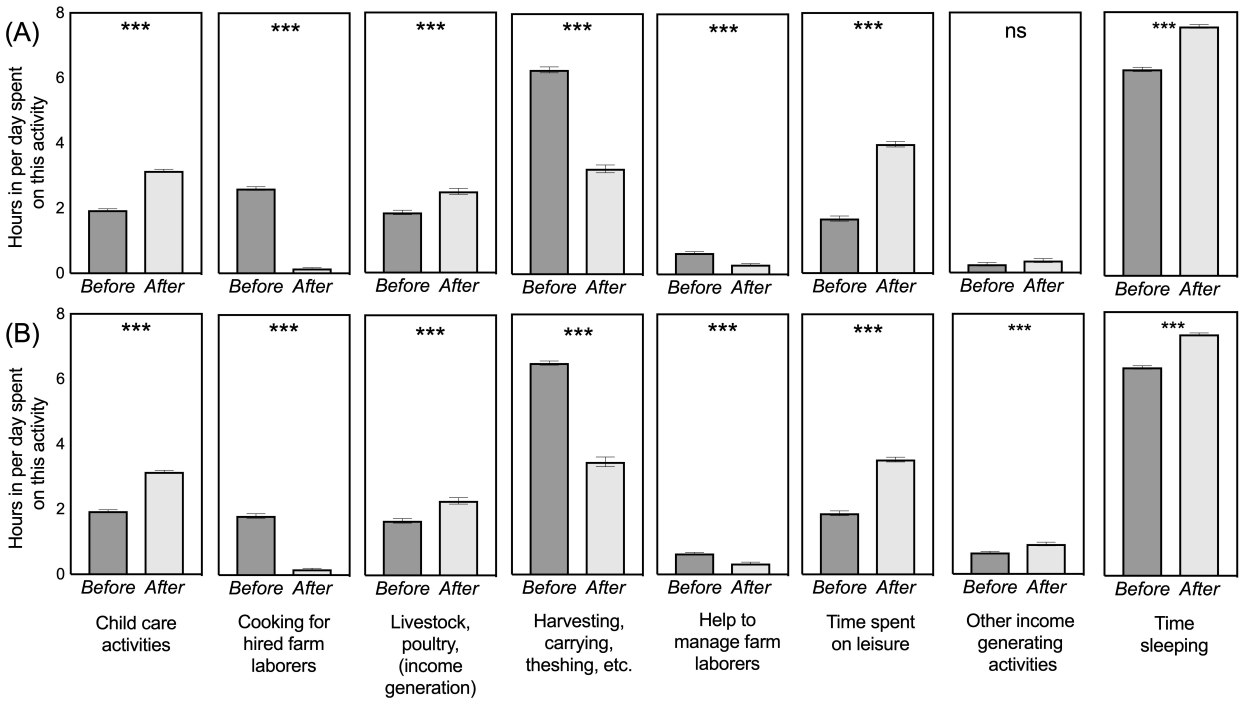

Figure 4. Change in hours for daily activities during cereal harvesting periods reported by women in households before and after adopting mechanized (A) rice (*n* = 254) and (B) wheat (*n* = 255) harvesting services in southwestern Bangladesh. Bars indicate the standard error of the mean. *** indicates $P < 0.001$. ns indicates not significant.

Source: Primary data collection

Reductions these activities resulted in significant increases in time allocated to child care (a mean increase of 1.13 and 1.10 hours/day during rice and wheat harvesting periods, respectively) cooking for family members, (increase of 0.38 (rice) and 0.37 (wheat) hours/day), livestock and poultry arearing associated with income generation (increase of 0.64 (rice) and 0.60 (wheat) hours/day), leisure time (increase of 2.29 (rice) and 1.66 (wheat) hours/day), and sleeping (increase of 1.30 (rice) and 1.00 (wheat) hours/day). Other income generating activities were significantly different yet minor for wheat only (increase of 0.25 hours/day).

Women in focus groups echoed these findings and also reported reductions in post-harvest labor from using machine services for the harvest. Both men and women in focus groups noted that harvested

wheat is 'cleaner' when reaped with a machine than with laborers; this saves women the chore of cleaning the wheat of soil and other particles before mechanical threshing. In addition, the reaper can harvest the entire plot in a day, so that women can "..thresh and beat all of them [paddy crop] together, therefore finishing all the work together at once" rather than over the five days that laborers would take to complete the harvest. Some women, however, still need to provide labor for bundling the reaped crops and carry them to the house if they are not able to hire a wage laborer to do so.

Some women also used to work alongside the laborers to harvest, bundle and carry rice or wheat from the field to the compound for threshing. Given strong cultural opprobrium toward women working on the farm, women who labor in the field are usually from lower income families, though not as poor as women who work as laborers on others' plots of land. To hide the fact that they needed to work in the field, two women in focus groups whose families lease and sharecrop land to farm, said that they used to help with the harvest by cover of night, "…since if I cut them in the morning the society would heavily criticize me by saying that being a mother, a daughter and a wife, how I could cut the crops in the farm." Other women pointed out it is acceptable for them to work in the field if the land is next to the house, but not if it is far away. Women were strongly aware of the scorn towards women who work in the field, but it was rare that women internalized this notion, and instead characterized it as a rule that they had to comply with, whether they agreed or not, for the sake of their families' reputation. Many women echoed the words of a woman in Jheneidah, who said, "I personally think, there is nothing wrong working in the field, but my thought cannot change anything until the society thinks it is acceptable."

Changes in intrahousehold decision making

In focus groups, several men and women mentioned that after hiring reaper services, women's involvement in intrahousehold decisions had increased. One man pointed out that his wife had become more involved in agricultural decisions. Previously, "she had no idea about how many wage laborers to appoint or when to appoint," but now she "communicates with the service provider and keeps information about this. Even though she has not had any direct role in terms of selling, but the usage of the money …

is part of her role now as well." Similarly, several women noted that the savings generated from switching to the reaper from laborers provided an opening for greater joint decision-making within the household. One woman explained:

> If I say something to my husband he listens to me now. Previously he would not, since in poor families there is no time to listen... The crops that were produced were used for our food, therefore leaving no crops to sell, so why would he listen to me? The money that gets saved [now] can now be used for other expenses such as my children's education or the household and that is my decision. I do not have to tell my husband.

A man from a different mechanized farming household echoed this pattern, saying "After starting to use the reaper, I and my wife started to take decisions in terms of the family income usage. I never used to get time before to discuss anything properly, however using reaper saves time and therefore I can discuss with my family where and when money needs to be spent." Changes in decision making are far from an inevitable outcome from mechanization, and many other variables are likely at play. However, it is clear that for some families, the time and cost savings from shifting to the machine reduces stress in the family and raises household status. In addition, women take on a new role with machine services, helping to supervise the reaper machine rather than serving the laborers.

Women farmers directly hiring machine services

Most service providers interviewed mentioned that they do have a few female clients. They pointed out that these women are all from families where male family members are absent—husbands have migrated, passed away, are sick or incapacitated, or are occupied with non-farm employment. These women are already more directly involved in agricultural activities and often earn lower incomes. Wives of service providers in an focus group conducted in Faridpur explained, "All those women whose husbands do not really understand [agriculture], those women do not really have any option, other than come as

customers." As such, most service providers did not consider it likely that more women would hire machines in the future. They explained that there is only a small group of women who are both involved in agriculture and able to afford machine services. Women who have agricultural land and whose husbands are absent often lease or sharecrop their land to other farmers rather than work it themselves. Poorer women with little or no landholdings, on the other hand, either harvest themselves without hiring laborers or machines or, if they have no land, work as laborers on others' farms.

It seems that for the women who do hire machine services, they are already non-compliant with dominant gender norms, and thus are comfortable speaking to men or women service providers. Wives of service providers in Faridpur explained that women who seek reaper services will speak to men or women, noting, "This cannot be considered as something which is bad, since the work needs to be done first." If they keep *purdah* they would only talk to women in the service provider household, but this is rare as it is nearly impossible to keep strict purdah if a woman needs to provide for her family.

Whether women farmers are more comfortable renting from women service providers remains to be seen, since it is still rare for women to take on either role. But there is some indication that women farmers are more comfortable seeking out advice from women service providers. In one case, a prominent woman service provider described how women, including very poor women, come to consult with her. "Six to seven women came in, saying that they wanted to cultivate wheat, and asked my opinion on what they should do. That is when I rented the seeder and tiller machine both out to them." About a quarter of her clients are women, higher than for other male service providers. She said that these women had learned about the reaper service from their involvement in a *Boithok* (training session) called *Krishok Math* (farmers field). She also indicated that at times she provides services for free to poor women.

Most of the women interviewed had husbands, sons, or sons-in-law who facilitated renting the reaper, but in a few cases, women were interviewed who had sought out machine services themselves because they were widowed or had a husband who "seems to live in another world." A widow with a small son who leases land first heard about the reaper from her neighbor who works as a service provider and as an agricultural officer. Sometimes she pays in cash directly, but she also works as a wage laborer

in his field as payment. For her, the time savings of using the reaper is valuable so that “other works [economic activities] do not get hampered,” and she pursues other jobs like weeding, tilling, road construction, and working in other people’s houses.

DISCUSSION AND CONCLUSIONS

Though there is a readily apparent gender gap in the formal ownership of reaper service businesses and hiring of reaper machines in study locations within Bangladesh, women play key roles in both ownership and hiring dynamics, and they relay generally positive impacts of harvesting technologies on their lives and livelihoods. Many women in male-headed households contribute to activities essential for running service provider business and completing harvests, and they perceive this for the most part as within the bounds of social acceptability. When women are involved in either service provision business activities or hiring of machine services, it appears to increase their self-esteem and their husband's respect for them. Women's involvement with machinery, only visible upon closer examination, problematizes the idea that they are completely excluded from machinery service markets.

In reaper service provider business, women are involved, in some way, in many activities. The major exception is in operating the machine, which is widely considered unacceptable for women given cultural norms in Bangladesh. However, many male service providers supervise machine operators, rather than drive the machines themselves, so if women do not drive the machines it is not a disqualifying factor from their involvement. Indeed, it is a challenge for both men and women to effectively supervise the driver and ensure he operates the machine properly. Many male service providers, having witnessed the contributions of their wives, believe that with proper training and support, women are capable of running the business as well as men. Men who had worked as service providers, and thus understood the work and had benefited from their wives' involvement, were more enthusiastic about opportunities for women in this business, compared to men who had rented machines but never run the business.

For women who hire reaping services, they strongly value the time and cost savings. The former frees time for increased child and family care, income generating activities, leisure, and sleep during harvesting periods. In addition, they imply an increased sense of social status when women switch from serving wage laborers and meeting all their needs by cooking and serving them during harvest to supervising and assisting a machine operator. Some women and men noted there are new opportunities

for women to participate in agricultural and income decisions with their husbands now that they have slightly more time and money.

At the same time, it is clear that women do not have the same opportunities to participate in this market as men do. Above all, they are constrained by strong social disapproval of women's mobility and involvement in economic activities. Women's restricted mobility not only reduces women's chances of learning about new technologies and business opportunities—men were much more likely to initially hear about reapers through spending time in the market and through their contacts with extension officers, machine dealers, and other farmers—it makes it difficult to run a business that relies on interaction with male strangers to advertise and coordinate machine services. Women also strongly noted that their lack of exposure to the public — common given cultural hegemony and *purdah* in Bangladesh — undermines their confidence in general knowledge of the world and their ability to make sound decisions. This was commonly cited by women as a reason they would not begin a reaper service provision business. While some women and men believed that women's work is unacceptable on religious grounds, others were not personally opposed, but noted that women's economic activity tends to reflect negatively on male family members — husbands, fathers, fathers-in-law, and even sons within a village. Women across social classes weigh to what extent to limit or hide their economic involvement to avoid judgment.

While few women run a service provider businesses on their own, some women from poorer households, who take on agricultural duties in the absence of male family members, are hiring reaper services. If women do not have male family members or are very poor, they work in agriculture out of necessity. Still, some try to hide their labor by working at night or only working if the field is near the house. This market segment of women, severely time and resource-constrained, is perhaps most directly benefited by this technology, as compared to women who are less involved in agriculture and come from wealthier or male-headed households. It is also more socially acceptable for women to rent machines if they do not have male family members, as these women are usually already parting with social norms given the necessity of their involvement in agriculture and economic activities. They do not seem concerned by social disapproval in renting the machines as the advantages are too great, but others

acknowledge that it is the "helpless" women who tend to rent machines. Most of these women managed to learn about reaper technologies when they saw them being used in their village, rather than through their contacts with NGOs or extension workers or interaction in the marketplace. In the absence of male family members, these women have fewer mobility restrictions than those in male-headed households, but they are still not as likely to be aware of new agricultural technologies as men. In households with adult males, many men and women relay that they jointly own the machinery, and some men were open to the idea of women's formal ownership of a machine, as long as men continue doing most of the work. Some women perceive that their husbands will not be supportive if they start a business individually, implying that they would rather see them fail. For these reasons, most women preferred to have joint ownership over the machine and business, rather than individual in their name.

Despite their lack of individual ownership over the machines, and less visible roles in providing and renting machine services, women manage to benefit in important ways through the current arrangements. Women are cautious about increasing their involvement through individual ownership or management of the business, because of the broader constraints they face to mobility and interacting with strangers and social disapproval towards women in business. Against the current landscape of social norms, many women do not perceive that the possible rewards of business involvement are worth the social risks, although some husbands are supportive of ownership in their wife's name as long as the work is still jointly managed. Women point out that even if their expanded role is somewhat socially non-conforming, they are willing to do it as long as their husbands are supportive. When they believe that their husband would not support them, they are not however interested in attempting business on their own. On the machine rental side, focus group results suggested that the women who benefit the most from mechanization are also likely to be those who are least likely to have access to the machines, given fewer financial resources and more restricted exposure to new information about the machines. Some pay for the services with their own labor, indicating that they may still value saving this labor if only as a way to substitute it for more remunerative work.

The results presented in this paper complicate conventional wisdom about how to leverage new

agricultural technologies for women's empowerment. Machinery ownership is not necessary for farmers to benefit from machinery use in their own fields. This is clearly evident given Bangladesh's and South Asia's large fee-for-service machinery market. There are, however, opportunities on the service provider side to expand women's ownership over machines, especially as service providers consider purchasing additional machines and have experience working with their wives running the business. Though women's ownership in this context rarely conveys women's control over the asset or even the earnings, focus group respondents clarified that legal ownership of the asset in the wife's name can provide her with a safety net in case of separation or death of a husband. Importantly, some women say they would be proud to have a machine in their name. Our results also highlight the scope to build women's skills and confidence in the business, especially in advertising, accounting, and mechanics/maintenance roles.

However, as with other agricultural technologies, women still lag behind men in learning about the technology, especially when they have mobility restrictions, more gender-segregated social networks, and less contact with machine dealers or extension officers. This restricts women's access both to renting the machines and to starting or participating more confidently in their husband's business. Joint learning opportunities for husbands and wives, as well as for women without adult male family members, could encourage rental of reaper machinery services. Reaching women through their networks—including savings groups and NGOs—would help equalize their access to information, which is currently skewed towards men. These groups could also be used to collectively hire reaper services for use in fields partially or wholly managed by women. In addition, donors or government programs could assist with reducing the direct and transactions costs associated with the rental of machinery services for female-headed households, who benefit substantially from these services, but note that the cost is high and sometimes even pay for these services with their own labor.

The common narrative that women would adopt technology if constraints to access (financial, information, complementary resources) were alleviated appears to apply only to a limited extent to poor women renting machinery services. However, it is less relevant to women in male-headed households renting machines, or to women engaged in service provider businesses. Though men nearly always tend

to be the owners and renters of machines, this does not mean that their wives do not contribute or benefit. There are therefore important opportunities for development initiatives to build on the women's roles that are currently socially acceptable, as initial entry points to expand respect for women's competence, strengthen their asset ownership, and widen the bounds of socially acceptable behavior and engagement in agriculture and remunerative activities. Distinguishing between ownership and the opportunities provided women's roles is an important place to start, and should be recognized in the design of appropriate public policy and rural development initiatives.

REFERENCES

Agarwal, Bina. 1994. *A Field of One's Own: Gender and Land Rights in South Asia*. New York, NY: Cambridge University Press.

Ahmed, Tanima, and Binayak Sen. 2018. "Conservative Outlook, Gender Norms and Female Wellbeing: Evidence from Rural Bangladesh." *World Development* 111: 41–58. https://doi.org/10.1016/J.WORLDDEV.2018.06.017.

Amin, Sajeda. 1997. "The Poverty-Purdah Trap in Rural Bangladesh: Implications for Women's Roles in the Family." *Development and Change* 28 (2): 213–33. https://doi.org/10.1111/1467-7660.00041.

Baudron, Frédéric, Brian Sims, Scott Justice, David G. Kahan, Richard Rose, Saidi Mkomwa, Pascal Kaumbutho, et al. 2015. "Re-Examining Appropriate Mechanization in Eastern and Southern Africa: Two-Wheel Tractors, Conservation Agriculture, and Private Sector Involvement." *Food Security* 7 (4): 889–904. https://doi.org/10.1007/s12571-015-0476-3.

BBS. 2015. "Labor Force Survey 2015." 2015. http://www.bbs.gov.bd/.

Begum, Saleha. 1985. "Women and Technology: Rice Processing in Bangladesh." In *Women in Rice Farming*, edited by IRRI, 221–43. Aldershot, UK: Gower Publishing Company.

Beuchelt, Tina D. 2016. "Gender, Social Equity and Innovations in Smallholder Farming Systems: Pitfalls and Pathways." In *Technological and Institutional Innovations for Marginalized Smallholders in Agricultural Development*, edited by F.W. Gatzweiler and J. von Braun, 181–98. https://doi.org/10.1007/978-3-319-25718-1.

Bose, Manik L., Alia Ahmad, and Mahabub Hossain. 2009. "The Role of Gender in Economic Activities with Special Reference to Women's Participation and Empowerment in Rural Bangladesh." *Gender, Technology and Development* 13 (1): 69–102. https://doi.org/10.1177/097185240901300104.

Braun, Virgina, and Victoria Clarke. 2006. "Using Thematic Analysis in Psychology." *Qualitative Research in Psychology* 3 (2): 77–101.

Chancellor, F., and D. O'Neill. 2000. "The Role of Treadle Pumps in Changing the Working and Economic Environment of Women Irrigators: Some Considerations from Africa with Particular Reference to Zambia." In *6th International Micro-Irrigation Congress, Cape Town, South Africa, 22-27 October*.

Doss, Cheryl R. 2001. "Designing Agricultural Technology for African Women Farmers: Lessons from 25 Years of Experience." *World Development* 29 (12): 2075–92. https://doi.org/10.1016/S0305-750X(01)00088-2.

Doss, Cheryl R., and Michael L. Morris. 2001. "How Does Gender Affect the Adoption of Agricultural Innovations? The Case of Improved Maize Technology in Ghana." *Agricultural Economics* 25 (1): 27–39. https://doi.org/10.1016/S0169-5150(00)00096-7.

FAO. 2011. *The State of Food and Agriculture. Women in Agriculture: Closing the Gap for Development*. Rome, Italy: Food and Agriculture Organization of the United Nations. https://doi.org/ISSN 0081-4539.

Feldman, Shelley, and Florence E. McCarthy. 2006. “Purdah and Changing Patterns of Social Control among Rural Women in Bangladesh.” *Journal of Marriage and the Family* 45 (4): 949. https://doi.org/10.2307/351808.

Fletschner, Diana, and Lisa Kenney. 2014. “Rural Women’s Access to Financial Services: Credit, Savings, and Insurance.” In *Gender in Agriculture and Food Security: Closing the Knowledge Gap*, edited by Agnes R. Quisumbing, Ruth Meinzen-Dick, Terri L. Raney, Andre Croppenstedt, Julia A. Behrman, and Amber Peterman, 187–208. Food and Agriculture Organization of the United Nations.

IFPRI. 2016. “Bangladesh Integrated Household Survey (BIHS) 2015.” Harvard Dataverse. 2016. https://dataverse.harvard.edu/dataset.xhtml?persistentId=doi:10.7910/DVN/BXSYEL.

Jaim, W. M. H., and Mahabub Hossain. 2011. “Women’s Participation in Agriculture in Bangladesh 1988-2008: Changes and Determinants.” Paper presented at the pre-conference event on “Dynamics of rural livelihoods and poverty in South Asia” at the 7th Asian Society of Agricultural Economists International Conference, Hanoi, Vietnam.

Kaaria, Susan K., and Jacqueline A. Ashby. 2001. “An Approach to Technological Innovation That Benefits Rural Women: The Resource-to-Consumption System.” Working Document CGIAR Systemwide Program on Participatory Research and Gender Analysis, No. 13.

Kabeer, Naila. 1990. “Poverty, Purdah, and Women’s Survival Strategies in Rural Bangladesh.” In *The Food Question: Profits versus People*, edited by Henry Bernstein, Ben Crow, Maureen Mackintosh, and Charlotte Martin, 134–48. London: Earthscan.

———. 1994. *Reversed Realities: Gender Hierarchies in Development Thought*. London: Verso.

———. 2011. “Between Affiliation and Autonomy: Navigating Pathways of Women’s Empowerment and Gender Justice in Rural Bangladesh.” *Development and Change* 42 (2): 499–528. https://doi.org/10.1111/j.1467-7660.2011.01703.x.

Kandiyoti, Deniz. 1988. “Bargaining with Patriarchy.” *Gender & Society* 2 (3): 274–90. https://doi.org/10.1177/089124388002003004.

Kelkar, Govind. 2009. “The Feminization of Agriculture in Asia: Implications for Women’s Agency and Productivity.” New Delhi.

Khan, Tajuddin, Avinash Kishore, and P. K. Joshi. 2016. “Gender Dimensions on Farmers’ Preferences for Direct-Seeded Rice with Drum Seeder in India.” 1550. IFPRI Discussion Paper. International Food Policy Research Institute, Washington, DC.

Krupnik, Timothy J., Santiago Santos Valle, Andrew J. McDonald, Scott Justice, Israil Hossain, and Mahesh K. Gathala. 2013. *Made in Bangladesh: Scale-Appropriate Machinery for Agricultural Resource Conservation*. Mexico, D. F.: CIMMYT.

Mahmud, Simeen, Nirali M. Shah, and Stan Becker. 2012. “Measurement of Women’s Empowerment in Rural Bangladesh.” *World Development* 40 (3): 610–19. https://doi.org/10.1016/j.worlddev.2011.08.003.

Meinzen-Dick, Ruth, Agnes R. Quisumbing, and Julia A. Behrman. 2014. “A System That Delivers:

Integrating Gender into Agricultural Research, Development, and Extension." In *Gender in Agriculture: Closing the Knowledge Gap*, edited by Agnes R. Quisumbing, Ruth Meinzen-Dick, Terri L. Raney, André Croppenstedt, Julia A. Behrman, and Amber Peterman, 373–91. Dordrecht: Springer.

Mottaleb, Khondoker Abdul, Timothy J. Krupnik, and Olaf Erenstein. 2016. "Factors Associated with Small-Scale Agricultural Machinery Adoption in Bangladesh: Census Findings." *Journal of Rural Studies* 46: 155–68. https://doi.org/10.1016/j.jrurstud.2016.06.012.

Njuki, Jemimah, Elizabeth Waithanji, Beatrice Sakwa, Juliet Kariuki, Elizabeth Mukewa, and John Ngige. 2014. "A Qualitative Assessment of Gender and Irrigation Technology in Kenya and Tanzania." *Gender, Technology and Development* 18 (3): 303–40. https://doi.org/10.1177/0971852414544010.

Nowell, Lorelli S., Jill M. Norris, Deborah E. White, and Nancy J. Moules. 2017. "Thematic Analysis: Striving to Meet the Trustworthiness Criteria." *International Journal of Qualitative Methods* 16: 1–13.

Padmaja, Ravula, and Ma Cynthia Serquina Bantilan. 2008. "Gender Issues in Aquaculture: Learning Lessons from the International Crops Research Institute for the Semi-Arid Tropics." *Development* 51 (2): 271–77. https://doi.org/10.1057/dev.2008.21.

Pandey, Sushil, Derek Byerlee, David Dawe, Achim Doberman, Samarendu Mohanty, Scott Rozelle, and Bill Hardy, eds. 2010. *Rice in the Global Economy: Strategic Research and Policy Issues for Food Security*. Los Baños, Philippines: International Rice Research Institute.

Pearse, Andrew. 1980. *Seeds of Plenty, Seeds of Want: Social and Economic Implications of the Green Revolution*. Geneva: United Nations Research Institute for Social Development.

Peterman, Amber, Julia A. Behrman, and Agnes R. Quisumbing. 2014. "A Review of Empirical Evidence on Gender Differences in Nonland Agricultural Inputs, Technology, and Services in Developing Countries." In *Gender in Agriculture and Food Security: Closing the Knowledge Gap*, edited by Agnes R Quisumbing, Ruth Meinzen-Dick, Terri L Raney, Andre Croppenstedt, Julia A Behrman, and Amber Peterman, 145–86. Food and Agriculture Organization of the United Nations.

Quisumbing, Agnes R., and Lauren Pandolfelli. 2010. "Promising Approaches to Address the Needs of Poor Female Farmers: Resources, Constraints, and Interventions." *World Development* 38 (4): 581–92. https://doi.org/10.1016/j.worlddev.2009.10.006.

Ragasa, Catherine. 2014. "Improving Gender Responsiveness of Agricultural Extension." In *Gender in Agriculture: Closing the Knowledge Gap*, edited by Agnes R. Quisumbing, Ruth Meinzen-Dick, Terri L. Raney, André Croppenstedt, Julia A. Behrman, and Amber Peterman, 411–30. Dordrecht: Springer. https://doi.org/10.1007/978-94-017-8616-4_17.

Rahman, Sanzidur, and Jayant Kumar Routray. 1998. "Technological Change and Women's Participation in Crop Production in Bangladesh." *Gender Technology And Development* 2 (2): 243–67. https://doi.org/10.1177/097185249800200204.

Rashid, Syeda Rozana. 2013. "Bangladeshi Women's Experiences of Their Men's Migration: Rethinking Power, Agency, and Subordination." *Asian Survey* 53 (5): 883–908.

Rathgeber, Eva M. 2011. “Rural Women’s Access to Science and Technology in the Context of Natural Resource Management.” Expert Group Meeting Enabling Rural Women’s Economic Empowerment: Institutions, Opportunities and Participation. http://www.un.org/womenwatch/daw/csw/csw56/egm/Rathgeber-EP-6-EGM-RW-Oct-2011.pdf.

Sraboni, Esha, Hazel Jean L. Malapit, Agnes R. Quisumbing, and Akhter U. Ahmed. 2014. “Women’s Empowerment in Agriculture: What Role for Food Security in Bangladesh?” *World Development* 61: 11–52.

Theis, Sophie, Nicole Lefore, Ruth Meinzen-Dick, and Elizabeth Bryan. 2018. “What Happens after Technology Adoption? Gendered Aspects of Small-Scale Irrigation Technologies in Ethiopia, Ghana, and Tanzania.” *Agriculture and Human Values* 35 (3): 671–84. https://doi.org/10.1007/s10460-018-9862-8.

Theis, Sophie, Nasrin Sultana, and Timothy J Krupnik. 2018. “Overcoming Gender Gaps in Rural Mechanization: Lessons from Reaper-Harvester Service Provision in Bangladesh.” Gender, Climate Change and Nutrition Integration Initiative (GCAN) Policy Note 8; the Cereal Systems Initiative for South Asia (CSISA) Research Note 9. Dhaka, Bangladesh.

Zaman, Habiba. 1995. “Patterns of Activity and Use of Time in Rural Bangladesh: Class, Gender, and Seasonal Variations.” *The Journal of Developing Areas* 29 (3): 371–88.

ALL IFPRI DISCUSSION PAPERS

All discussion papers are available **here**

They can be downloaded free of charge

INTERNATIONAL FOOD POLICY RESEARCH INSTITUTE
www.ifpri.org

IFPRI HEADQUARTERS
1201 Eye Street, NW
Washington, DC 20005 USA
Tel.: +1-202-862-5600
Fax: +1-202-862-5606
Email: ifpri@cgiar.org