

Understanding the gender dimensions of adopting climate-smart smallholder aquaculture innovations



RESEARCH PROGRAM ON
Climate Change,
Agriculture and
Food Security



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UNDERSTANDING THE GENDER DIMENSIONS OF ADOPTING CLIMATE-SMART SMALLHOLDER AQUACULTURE INNOVATIONS

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The CSISA-BD project is a United States Agency for International Development (USAID)-funded 5-year project working through an innovative partnership between three CGIAR centers: the International Rice Research Institute (IRRI), WorldFish, and the International Maize and Wheat Improvement Center (CIMMYT). CSISA-BD is funded by USAID's Feed the Future initiative, and aims to test and disseminate new cereal system-based technologies in six hubs (Khulna, Jessore, Barisal, Faridpur, Mymensingh and Rangpur) that will raise family incomes by at least USD 350 for 60,000 farming families. It is anticipated that a further 300,000 farmers will adopt new technology through participation in field days and farmer-to-farmer information and technology transfer.

The USAID-funded AIN project is a 5-year transformative investment in aquaculture, focused on 20 southern districts in Barisal, Khulna and Dhaka divisions, Bangladesh. The project contributes to achieving the Feed the Future goal of sustainably reducing poverty and hunger through four objectives:

- dissemination of improved quality lines of fish and shrimp seed;
- improving the nutrition and income status of farm households;
- increasing investment, employment and fish production through commercial aquaculture;
- policy and regulatory reform and institutional capacity building to support sustainable aquaculture growth.

This study would not have happened without the leadership, vision and guidance of the late Dr. Paula Kantor.

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LIST OF ACRONYMS

AAS	CGIAR Research Program on Aquatic Agricultural Systems
AIN	Aquaculture for Income and Nutrition
CCAFS	CGIAR Research Program on Climate Change, Agriculture and Food Security
CSISA-BD	Cereal Systems Initiative for South Asia-Bangladesh
GHCN	Global Historical Climatology Network
SRES	Special Report on Emissions Scenarios

INTRODUCTION

Climate change poses significant risks for people all around the world, but some regions, communities and people are particularly vulnerable. Communities in southern Bangladesh, for example, are some of the most vulnerable to the current and future impacts of climate change. They are particularly at risk from floods, waterlogged soils and increasing salinity of both land and water (Braun and Saroar 2012); these environmental changes impact people's capacity to retain or enhance their agricultural productivity, with consequences for generating income, ensuring food security and nutrition, and supporting desirable livelihood options.

In response, WorldFish is delivering two climate-smart agriculture¹ and aquaculture innovations (fish cages and pond polyculture) to communities in southwest Bangladesh to increase their resilience in the face of climate risks, as well as generate income, enhance nutrition and provide new livelihood opportunities. Both projects—the Cereal Systems Initiative for South Asia in Bangladesh (CSISA-BD) and Aquaculture for Income and Nutrition (AIN)—have targeted resource-poor and vulnerable households as recipients of smallholder aquaculture innovations, and are making concerted efforts to involve women. However, the experiences of the projects demonstrate that encouraging individual women to adopt or use agricultural innovations is not sufficient for achieving these outcomes, or for achieving gender equality. In fact, *women*-sensitive adaptation projects can have the opposite effect unless they are designed and implemented in a *gender*-sensitive (or gender-transformative) way. Predominant gender inequalities inevitably shape the capacity of the women involved to adopt and sustain the use of innovations, and the dissemination and use of these innovations can either serve to maintain or to challenge existing gender inequalities.

This research study draws mainly on primary qualitative research conducted in four villages in two districts in southwest Bangladesh. It investigates how gender power relations shape the uptake and use of these two climate-smart agricultural innovations. The findings reveal how social differences, including gender-specific differences, do indeed shape the entire process of innovation dissemination, with significant implications for how individuals, households and communities currently use these technologies and how benefits and consequences are divided—with implications for if and how these innovations will continue to be used in the future, among the target group and beyond.

This study aims to provide empirical insights to improve innovation dissemination processes, including targeting of women and households, so that future innovation-driven climate change adaptation efforts are designed in such a way that all members of a household may benefit. It also contributes to understanding which climate-smart innovations are appropriate for which individuals, households, communities and environments to enable scaling up. This may lead not only to more successful adaptation efforts and enhanced resilience for both men and women in households and across communities, but also potentially to improved outcomes in terms of income, nutrition and livelihood opportunities, as well as increases in gender equality.

Disclaimer:

The case study on page 34–35 is based upon an actual person's story; however, the name and other identifying details have been changed to protect the privacy of the individual.

RESEARCH QUESTIONS

The major research questions of the study are as follows:

- How do gender relations shape if and how women and men adopt and use climate-smart agricultural innovations (e.g. fish cages and pond polyculture)?
- How are benefits and consequences distributed among individuals, households and communities?
- What factors encourage or inhibit the future use of these innovations within recipient communities and beyond (i.e. taking these innovations to scale)?



Review meeting with a cage farmer group in Khulna.

Research site selection

Southwest Bangladesh was the geographical focus for this study. It was selected as such because it is the main regional focal area for both CCAFS and AAS in Bangladesh. In order to identify and explore the range of gender-related factors influencing the uptake, use and potential scaling-up of innovations, research sites were chosen from this region that together encompassed (a) both climate-smart innovations disseminated by WorldFish (fish cages and pond polyculture); (b) target sites of both CSISA-BD and AIN projects; and (c) a diversity of religious backgrounds of recipients. In all of the four sites chosen (Bohalia, Jalapara, Sarendrapur and Lakripur),² women were the primary targeted recipients of the innovation.

Research methods

Studies on innovation adoption tend to use quantitative research methods, such as surveys, to understand adoption rates. The research questions guiding this study required methods appropriate to assessing how a range of factors shape the way in which women and men adopt and use innovations, including the intangible aspects of gender and power relations and dynamics. As such, qualitative methods were selected in order to capture the nuances of innovation adoption and the links between adoption and development outcomes for various actors. This study thus

collected in-depth data primarily through focus group discussions (with village residents and innovation adopters) and in-depth interviews (with both women and men in innovation-adopting households, and other key informants). Apart from the field methods, secondary sources such as historical climate data and climate projections were used to contextualize the study.

Focus group discussions and interviews were designed with appropriate tools to facilitate relevant discussion among the targeted research participants, as shown in Table 2. These original tools were used and adapted as required throughout the fieldwork process. In general, the field research teams found the transect walk, village resources map (especially social mapping), seasonal calendar and spokes tools to be easiest to administer and to garner the best data. The social network and wish line tools were not effective and the changing farming practices, livelihood ranking and time line tools were only partially so (depending on who was involved). Overall, limiting the number of tools and being prepared with relevant questions in advance helped conversations to flow. Team reflections on the research process each evening allowed the field research teams to adjust or even exclude tools as appropriate.

	Khulna District		Barisal District	
	Bohalia	Jalapara	Sarendrapur	Lakripur
Innovation (cage or pond)	Cage	Pond	Cage	Cage and pond
Project (CSISA-BD or AIN)	CSISA-BD	AIN	CSISA-BD	CSISA-BD
Primary religious background	Hindu	Muslim	Muslim	Muslim

Table 1. Selection of research sites.

Research method	Who	Why	Tools ³
Transect walk	Field research team	To gain familiarity with the village and help to choose and invite sample for village-level focus group discussions	
Focus group discussion A	Sample from the village (separate male and female focus group discussions)	To understand general village context (environmental, institutional and socioeconomic patterns, including gender)	Village resources map Social network
Focus group discussion B	Sample from the village (separate male and female focus group discussions)	To understand village-level perceptions of how changing climate affects livelihoods and farming practices, including the use of new aquaculture innovations (gender-disaggregated)	Seasonal calendar Changing farming practices
Focus group discussion C	Sample of pond-innovation-adopting households (separate male and female focus group discussions)	To understand adopter perceptions of factors affecting uptake, use and benefit of pond polyculture innovation	Seasonal calendar (adapted) Livelihood ranking Wish line
In-depth interviews	Innovation-adopting households (one adult male and female per household)	To understand adopter perceptions of factors affecting uptake, use and benefits of aquaculture innovation	Interview guide Time line Spokes
In-depth interviews	Key informants (village leaders, project officers, group leaders, non-adopters, independent adopters, etc.)	To understand wider perceptions of the uptake, use and benefits of aquaculture innovation	Interview guide

Table 2. Qualitative research methods and tools.

Data collection

Research design was completed by the study team with contributions by local research partner Shushilan. Two field research teams (each consisting of one supervisor and two male and two female research assistants) then attended a 4-day training workshop in Dhaka in March 2013. A midpoint review and reflection workshop brought the two field research teams back together to share learning across sites and to adapt the research process as required. Despite political turbulence and a near miss by Cyclone Mahasen, the field research teams spent an average of 2 to 3 weeks in two research sites each and all fieldwork was completed by June 2013. In total, the field teams conducted 121 focus group discussions and interviews, which were recorded and transcribed (in Bangla) shortly thereafter. Translators then translated the transcripts from Bangla to English for the analysis.

Data analysis and sample

An initial data coding structure was agreed upon by two lead researchers following the fieldwork. From August to December 2013, a large number of transcripts were coded and analyzed (using collaborative qualitative data analysis software, Dedoose). However, due to the significant amount of data collected in the field, it was not feasible to analyze all of the transcripts. For the purposes of this report, in line with the research questions, it was decided to prioritize analysis of innovation-adopting (both female and male interviewees) interview transcripts while also drawing on the other transcripts as required. This report will therefore primarily present analysis of a sample of 67 innovation adopters (42 female and 25 male). This sample includes all research sites, innovation types (cage and pond polyculture⁴) and the two major religious backgrounds of communities, as represented in Figures 1, 2 and 3.

Research site	Focus group discussions	In-depth interviews (adopting)	In-depth interviews (other)	Total
Bohalia	6	16	9	31
Jalapara	10	6	9	25
Sarendrapur	6	10	9	25
Lakripur	10	18	12	40
Total	32	50	39	121

Table 3. Summary of total transcripts.

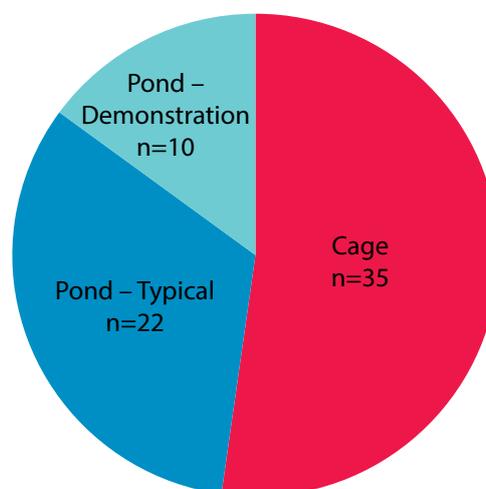


Figure 1. Sample of technology adopters by technology (n = 67).

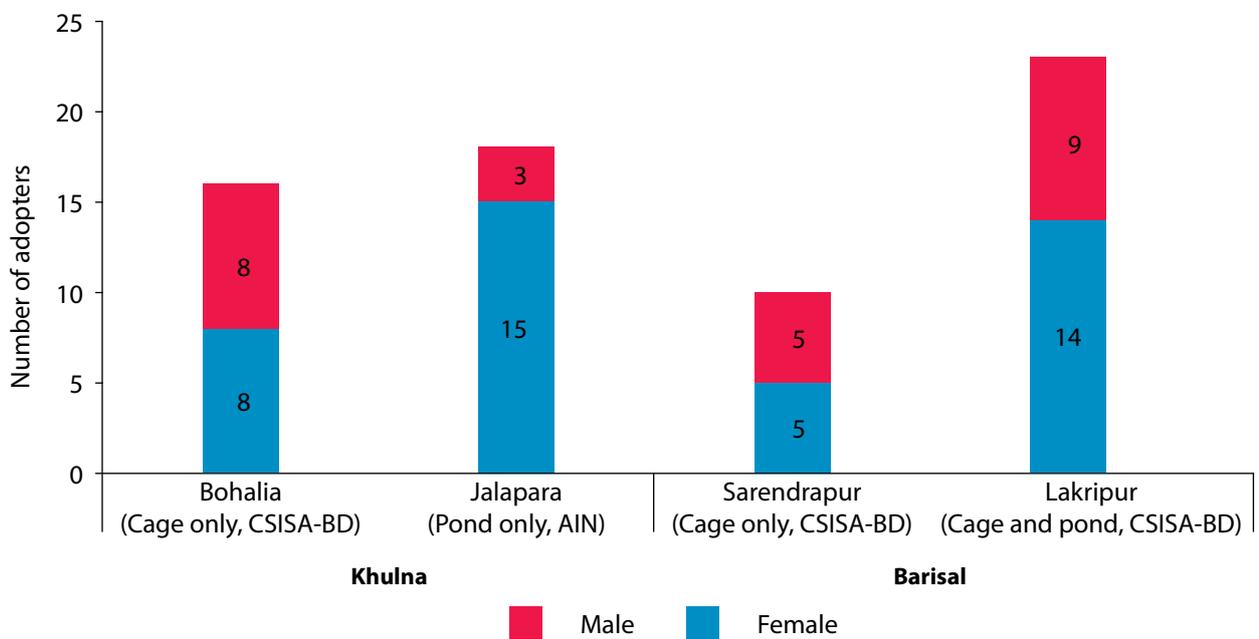


Figure 2. Sample of adopters by site and sex (n = 67).

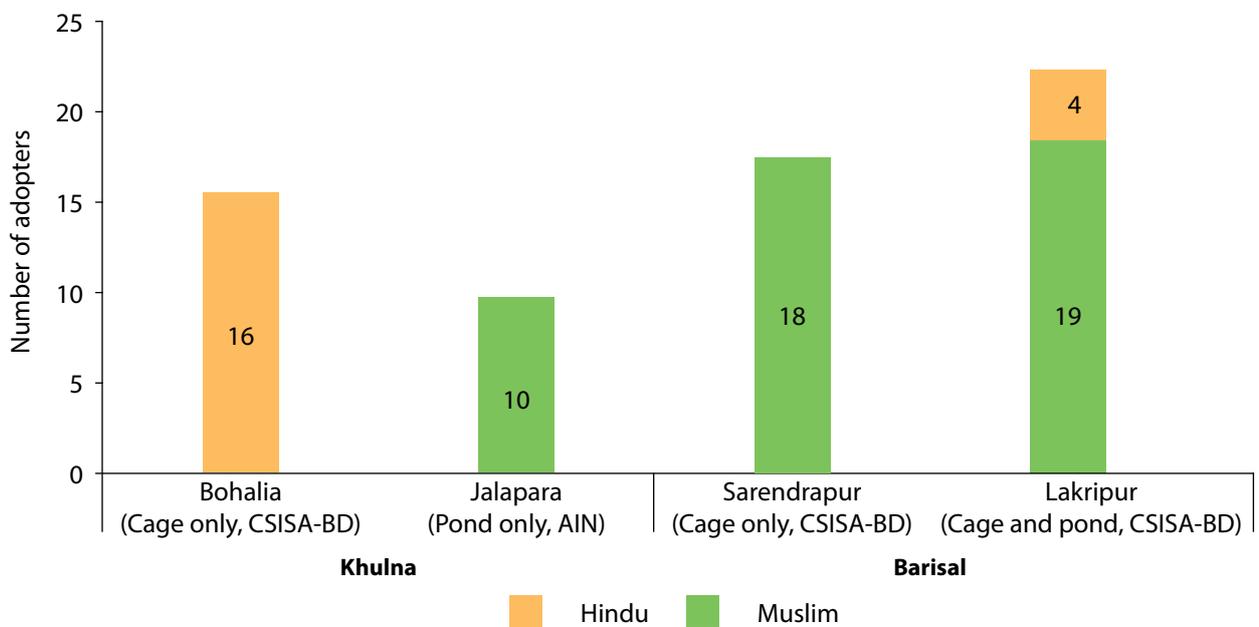


Figure 3. Sample of adopters by site and religion (n = 67).

Research sites

In all four villages, agriculture was reported as the main source of employment. However, who works in agriculture in these villages depends on what source of information is used. According to the recent national-level census (see Table 3), males predominated in all forms of employment, including agriculture. Yet, during the focus group discussions and interviews, villagers cited agriculture as the main source of livelihood and work (including informal work) for both men and women in households. This study reinforces the role of women in critical household agricultural activities not officially recognized by the government (and thus not reflected in the census).⁵ For example, in Lakripur, both men and women agreed that while men planted the rice crop, women boiled, milled, husked and dried the rice, did the vegetable farming, and took care of livestock. Rokeya (Lakripur) said, “Women

have a little more work ... The men just cut the rice and bring it home. Then husking the rice, gathering straw for the cows—women do all this.” Typically only men had access to employment opportunities outside the home (mostly through day labor and migration), which is reflected in the official statistics, while the census seems to categorize the substantial range of women’s work under “household work.”

Bohalia is an exception to the other villages in a number of ways; it is classified as peri-urban due to its close proximity to the city of Khulna, and it has a majority Hindu population. In this village, women reportedly have greater mobility for visiting or work purposes than in other villages. The village also has the highest literacy rates. Among the sample of innovation adopters who reported their educational level (n=57), a greater proportion of adopters from Bohalia reported having secondary education or higher than in the other villages (Figure 4).

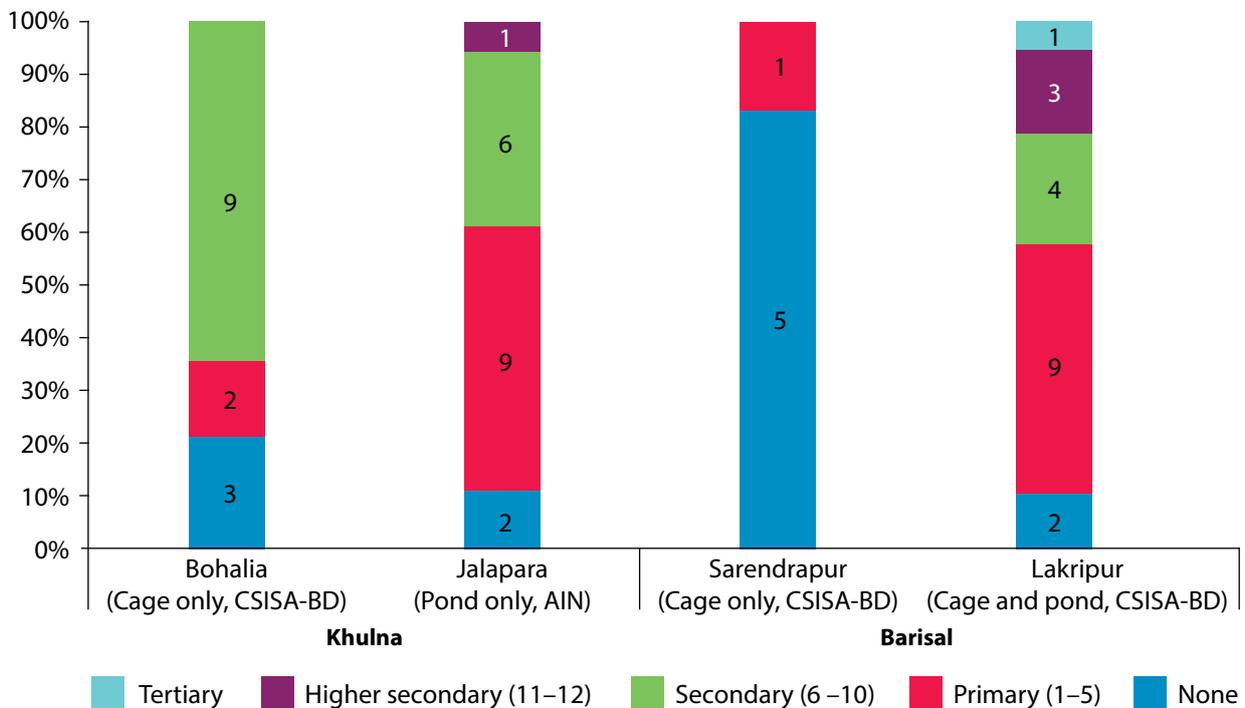


Figure 4. Educational level of technology adopters by site (n=57).

Research site	Population size	Religion	Literacy rate	Employed	Fields of activity	Household work
Bohalia Type: Peri-urban	3,467	1,216 (Muslim) 2,251 (Hindu)	68.2% (male) 59.9% (female)	68 (male) 6 (female)	Agriculture: 50 (male) 3 (female) Industry: 4 (male) 1 (female) Service: 14 (male) 2 (female)	105 (male) 289 (female)
Jalapara Type: Rural	6,102	5,918 (Muslim) 184 (Hindu)	51.3% (male) 52.3% (female)	145 (male) 15 (female)	Agriculture: 53 (male) 3 (female) Industry: 2 (male) 0 (female) Service: 90 (male) 12 (female)	51 (male) 188 (female)
Sarendrapur Type: Rural	3,311	3,080 (Muslim) 231 (Hindu)	55.3% (male) 51.1% (female)	325 (male) 17 (female)	Agriculture: 148 (male) 0 (female) Industry: 97 (male) 9 (female) Service: 80 (male) 8 (female)	7 (male) 382 (female)
Lakripur Type: Rural	4,714	4,560 (Muslim) 154 (Hindu)	62.9% (male) 58.8% (female)	265 (male) 1 (female)	Agriculture: 206 (male) 1 (female) Industry: 5 (male) 0 (female) Service: 54 (male) 0 (female)	5 (male) 358 (female)

Source: Bangladesh Bureau of Statistics (2011).

Table 4. Key demographic data for research sites.

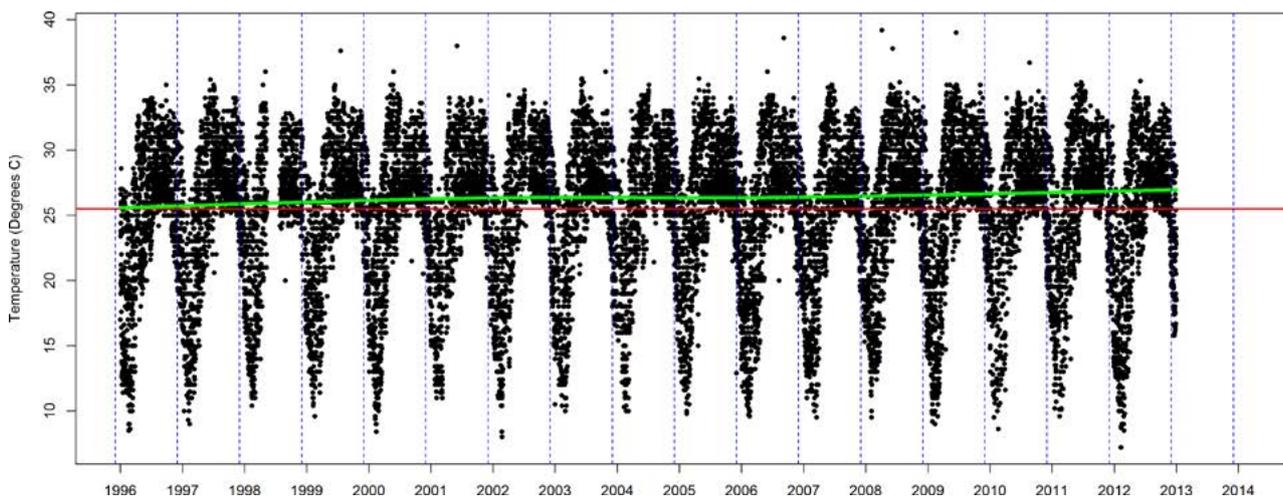
Climate change impacts in the research sites

Communities in southern Bangladesh are considered to be some of the most vulnerable to the current and future impacts of climate change. They are particularly at risk from floods, waterlogged soils and increasing salinity of both land and water (Braun and Saroar 2012). Different districts and villages even within this relatively small region will be exposed to different climate risks. Climate change adaptation initiatives will need to take these geographical specificities into account in order to design climate-smart agricultural interventions appropriate to these risks.

According to historical climate data as well as modelled climate projections,⁶ the four research sites in this study are likely to experience both similar and unique climate risks. While many publications describe historical climate

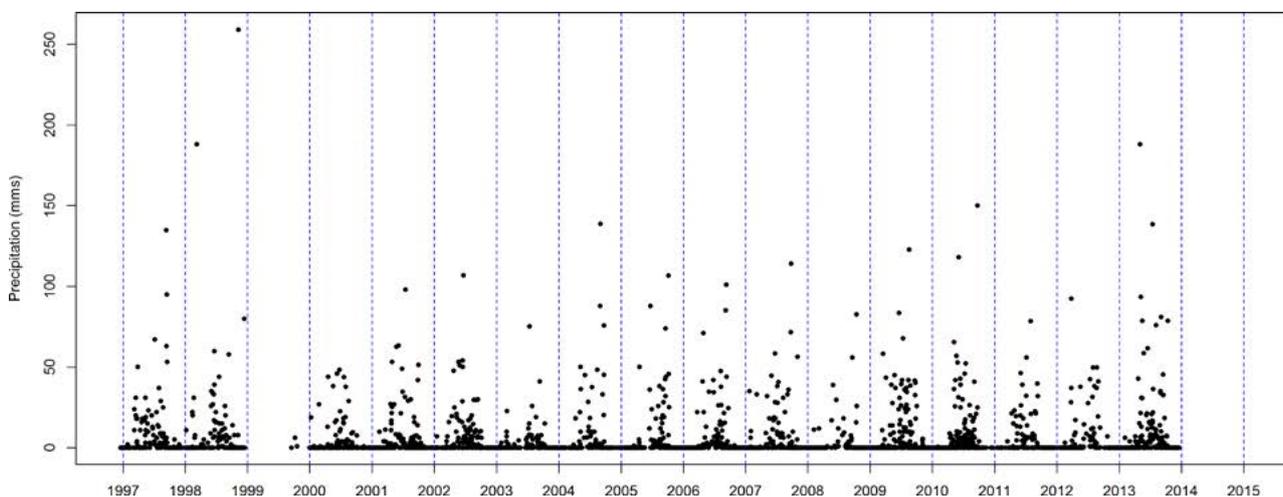
variability in Bangladesh, we could not find any that focuses on the specific geographical sites in which we were interested. We examined data from the Global Historical Climatology Network (GHCN), which spans the globe and is available online free of cost.⁷ The closest meteorological monitoring station to the activities undertaken during the current project is in Barisal.

Both the air temperature and precipitation time series data for Barisal from GHCN have significant gaps. Based on this, analysis focused on the most recent period of largely unbroken data for each. The air temperature data is plotted below at daily temporal resolution (see Figure 5) for the period 1996–2013. It shows an increasing trend in this period. The annual range of temperature is high, ranging from between circa 10°C to circa 35°C. The seasonality peak occurs in July and August each year.



Source: Global Historical Climatology Network.

Figure 5. Average daily air temperature data for Barisal in southwest Bangladesh, 1996–2013.



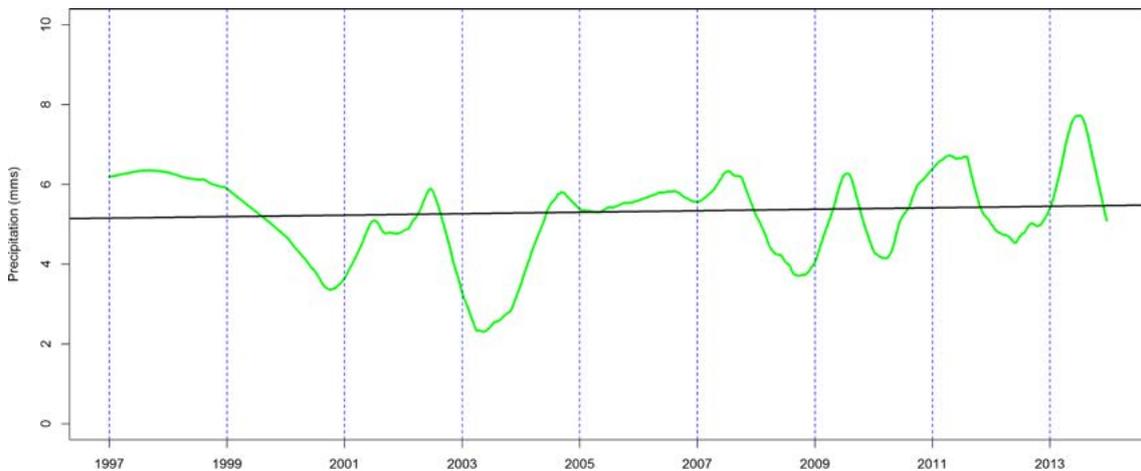
Source: <https://www.ncdc.noaa.gov/data-access/land-based-station-data/land-based-datasets/global-historical-climatology-network-ghcn>

Figure 6. Daily precipitation at Barisal between 1997 and 2013.

The red horizontal line is the mean temperature for the entire series; the green line is a running average smoother which summarizes a long-term trend.

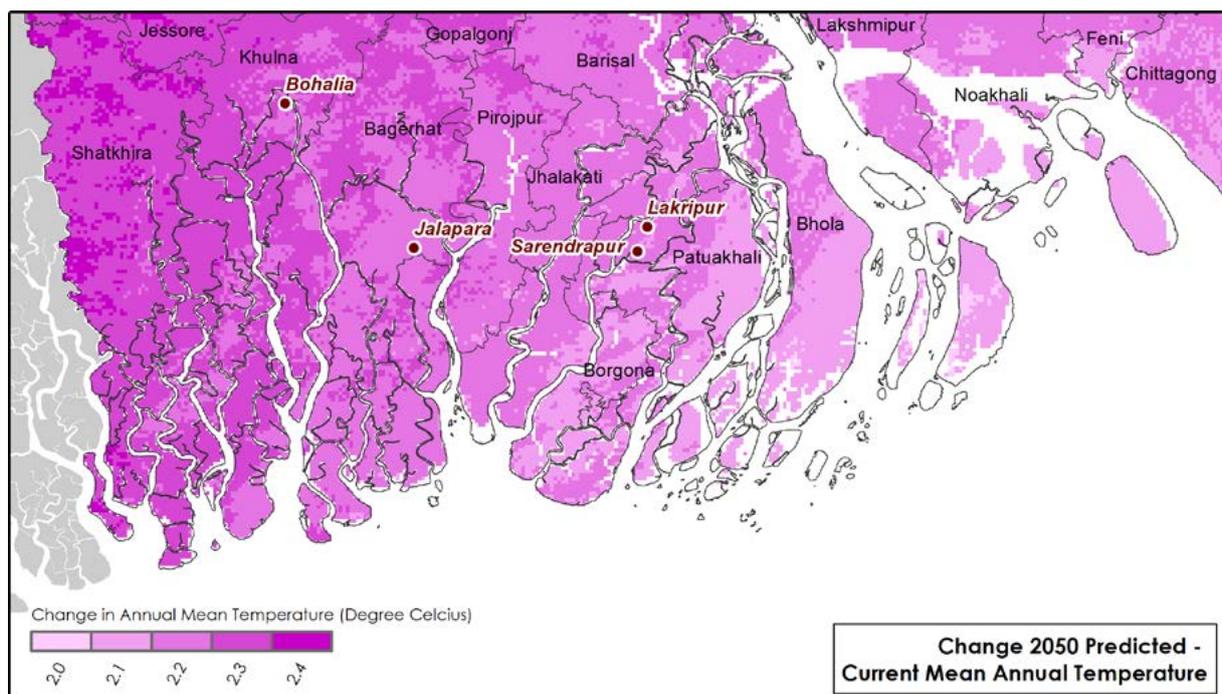
Daily precipitation data focuses on the period 1997 to 2013 and is plotted in Figure 6. There is a clear seasonality, with more rain between May and August and long, dry spells that are most likely to occur in December–February each year. There is a slight upward trend in overall precipitation between 1997 and 2013, although there is much variability (Figure 7).

Investigating modeled climate projections allows a higher resolution and level of site-specific climate risks than the information provided from historical climate data at Barisal district level. The projections for the four villages involved in this study reveal in particular their unique climate risks. Across all four villages, the mean annual temperature is projected to increase by over two degrees from current (1950–2000) levels to 2050 (Figures 8 and 9).



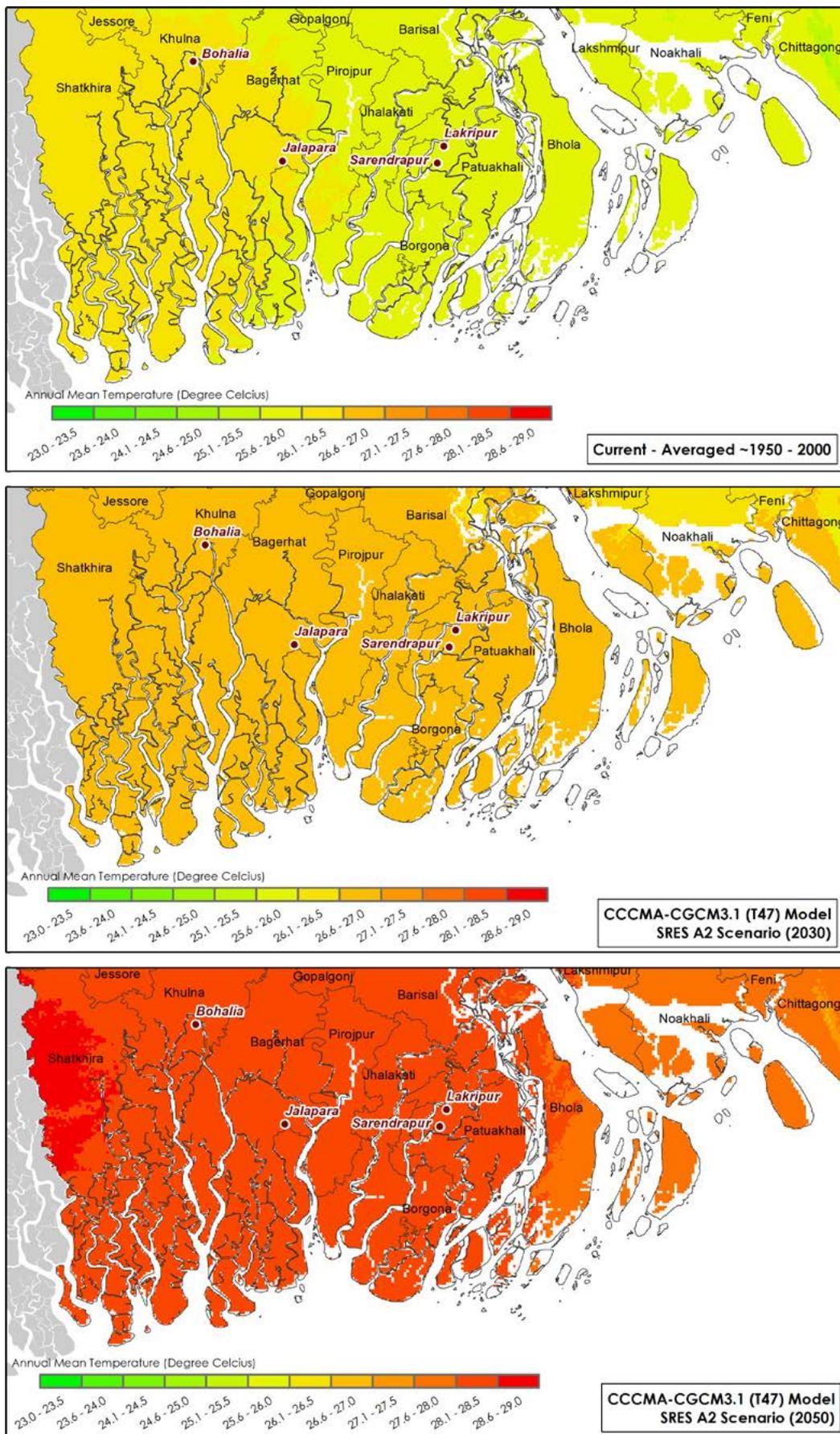
Source: <https://www.ncdc.noaa.gov/data-access/land-based-station-data/land-based-datasets/global-historical-climatology-network-ghcn>

Figure 7. Precipitation at Barisal between 1997 and 2013.



Source: CCAFS GCM Data Portal <http://www.ccafs-climate.org/>
WorldClim-Global Climate Data <http://www.worldclim.org/>

Figure 8. Map showing change in temperature predicted from current levels (1950–2000) to 2050 for Special Report on Emissions Scenarios (SRES) scenario A2.



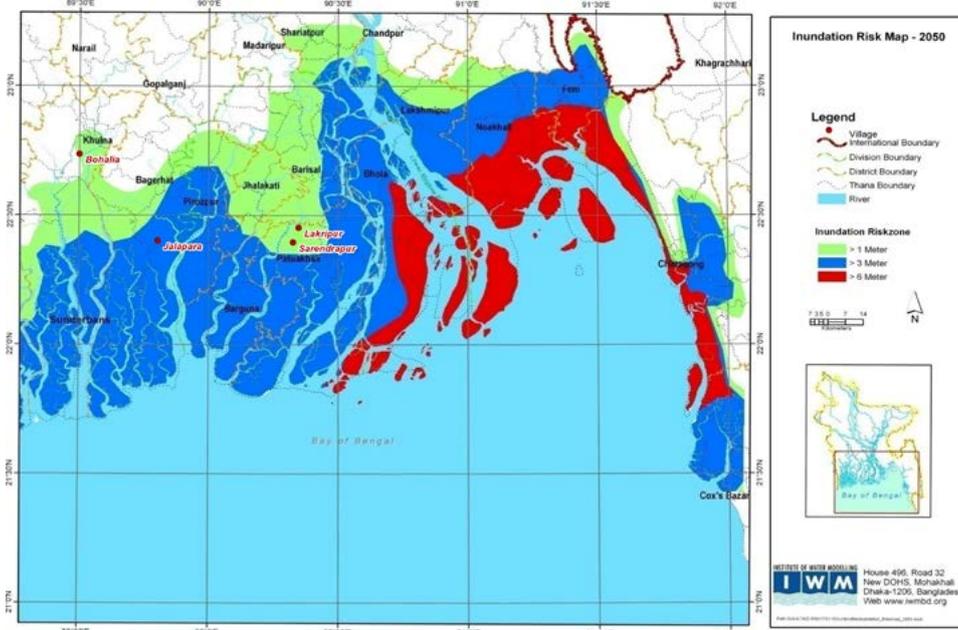
Source: CCAFS GCM Data Portal <http://www.ccafs-climate.org/>
WorldClim-Global Climate Data <http://www.worldclim.org/>

Figure 9. Air temperatures in southwest Bangladesh. Top: Average air temperature, 1950–2000. Middle: Predicted air temperature change in 2030. Bottom: Predicted air temperature change in 2050.

According to the inundation risk map (Figure 10), some of the study villages are at greater risk of flooding (as a combined effect of storm surge and sea level rise) by 2050 than others. Jalapara is likely to experience at least 3 meters of inundation, while Bohalia is much less at risk.

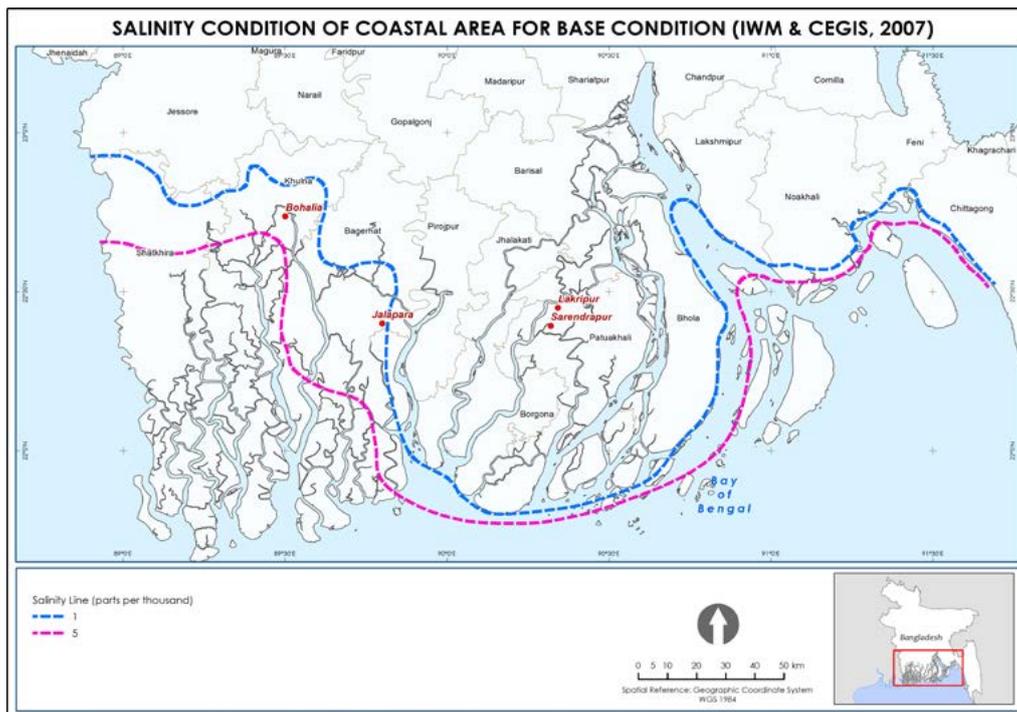
However, of the four villages in this study, Bohalia is most likely to experience higher increases in salinity (over 5 parts per thousand) than the other villages (see Figure 11).

Inundation risk map for combined effect of storm surge and sea level rise for the projected year 2050



Source: <https://www.ncdc.noaa.gov/data-access/land-based-station-data/land-based-datasets/global-historical-climatology-network-ghcn>

Figure 10. Air inundation risk map for combined effect of storm surge and sea level rise for the projected year 2050.



Source: IWM & CEGIS (2007).

Figure 11. Salinity condition of coastal area for base condition.

Village-level perceptions of climate change impacts

There is compelling scientific evidence that climate variability and changes are already affecting agriculture and livelihoods and are projected to do so in the future. However, the adoption of new climate-smart agricultural technologies that help rural people adapt to these changes will partially depend on whether farmers perceive climate change impacts in their lives and work. Thus, focus group discussions were conducted in all four villages in order to understand local people's perceptions of climate change.⁸

Across all villages, men and women farmers were asked to describe the types of problems they faced in their daily life and activities (see Figure 12). Among the issues identified, 43% of responses were directly weather-related, with respondents mentioning the frequency or intensity of rainfall patterns, droughts, floods, cyclones and temperature extremes. While not directly weather-related, lack of water, lack of food, lack of firewood and diseases (which together account for 32% of the responses) were also likely due to the changing climate (at least in part). Rainfall patterns, for example, affect water availability; droughts, extreme temperatures and salinity reduce tree coverage, and all types of weather extremes have a negative impact on food productivity and occurrence of diseases. Weather-related problems were identified in both women- and

men-only focus group discussions. Women expressed a particular concern about the lack of firewood, which is assumed to be related to their role in collecting and using firewood to cook in these villages. Everyone noted that changing weather patterns have had a negative impact on farming practices and on-farm productivity.

It was difficult to assess the degree to which climate change or physical weather conditions contributed to such changes. Flooding, for example, is initially caused by heavy rainfall or cyclone surges on a seasonal basis. These normal weather events (which may vary in duration or severity due either to climate change or changing physical factors) are made worse for vulnerable communities due to lack of drainage capacity, siltation of rivers, and lack of dike maintenance, among other human or social factors. Similarly, lack of food, firewood or water is related to biophysical issues such as vegetation cover or salinity, which vary according to changes in climate but are also related to human-induced problems. Examples include the unsustainable management of wood resources and shrimp farming causing salinity ingress in soil and water. As such, while the issues identified by farmers can be directly or indirectly linked to climate change, there is a complex interrelationship between the multiple physical, human and social factors that combine to emphasize the impacts of climate change on farmers and agricultural productivity.

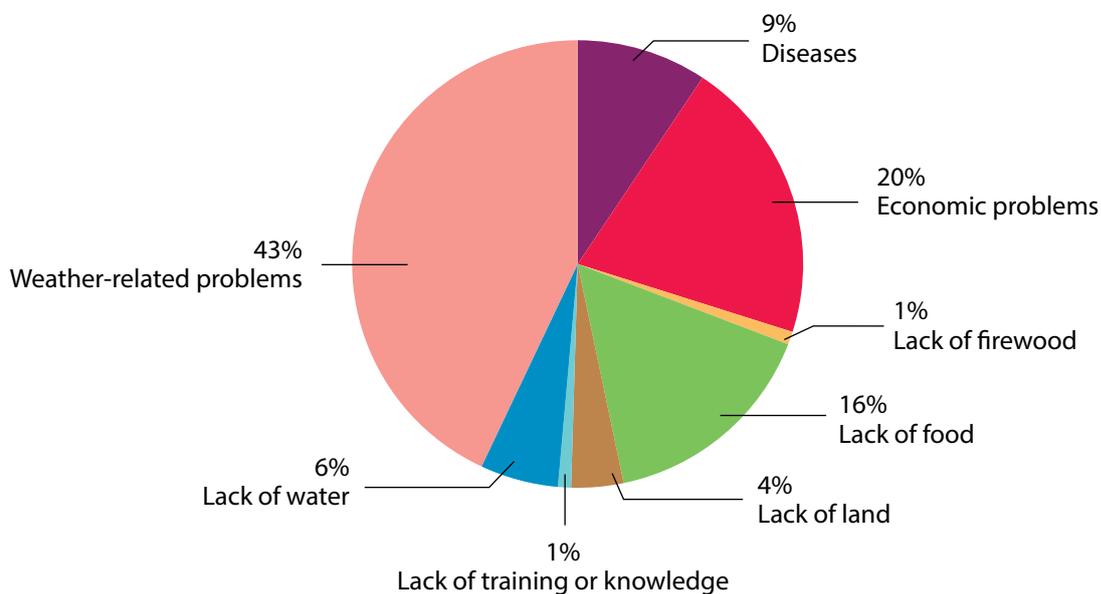


Figure 12. Types of problems faced by farmers (%).

Furthermore, it is important to remember that changing lives and livelihoods since childhood cannot be attributed only to changes in weather patterns or that all changes are considered negative. Farmers also mentioned many non-weather-related reasons for livelihood changes, some of which have had positive impacts (such as new techniques or varieties leading to increased productivity) as well as negative ones (such as increased population and lack of or diminishing land resources). Interestingly, men tended to emphasize the positive, non-weather-related changes more than women. In Sarendrapur, changes in weather patterns were highlighted as the primary driver of change more than in other villages.

During the focus group discussions, men and women farmers were also asked to discuss how they coped with or adapted to changes in weather patterns. Figure 13 shows the range of strategies identified by women and men farmers. Overall, men identified livelihood diversification as their primary strategy, which often meant combining agricultural activities with occasional day labor work, followed by migration. Women did not mention these because, as mentioned earlier, women tend to not have employment opportunities outside the home (except as a last resort for the family). Instead, women are more likely to try to change farming practices first, or lack a coping strategy altogether. Just 11% of respondents admitted to having no coping strategy, and these were mostly women.

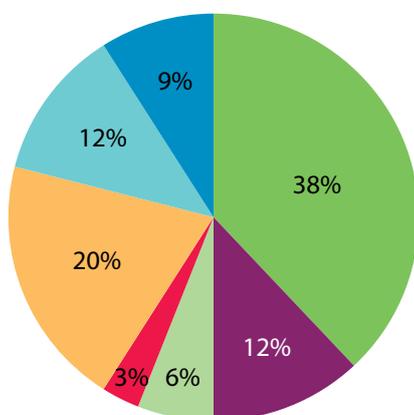
Project context

In these villages, gender inequality (produced and reproduced by dominant gender relations and norms) constrains the real and potential capacity of women farmers to successfully adapt their existing farming practices in the face of climate change or to contribute to stronger, more diversified livelihood portfolios that would improve their and their families' future resilience to social or environmental shocks. Recognizing these challenges to women farmers in particular, WorldFish has been disseminating and testing two climate-smart agriculture and aquaculture innovations (fish cage culture and pond polyculture) through two projects (CSISA-BD and AIN) in communities in southern Bangladesh, specifically targeting women as recipients.

Dissemination of cage aquaculture

In order to test how technically viable the cage aquaculture technology is in varying agroecological settings, the CSISA-BD cage aquaculture intervention commenced as an adaptive research study. The technical features examined included stocking density, feed conversion ratio, productivity and profitability⁹ (in Khulna, Barisal, Faridpur and Rangpur). With the decline in capture fisheries and uptake of aquaculture in *ghers*¹⁰ and ponds, it is usually a prerequisite to own or lease a water body in order to take up such aquaculture practices and access fish. However, with cage aquaculture, such ownership is not required, as interested women or men can use the cages in the common open-access water bodies (e.g. canals) that run

Coping strategies (female perception)



Coping strategies (male perception)

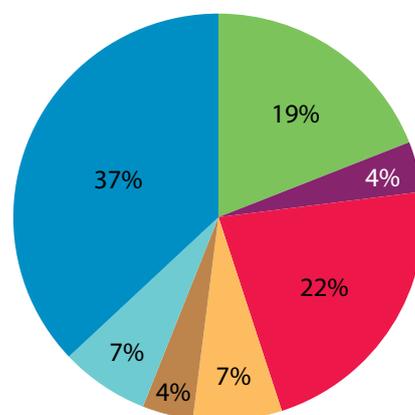


Figure 13. Coping strategies for women and men across all four research sites.

beside many households in Bangladesh. Thus, resource-poor, landless women are a key target for introducing this innovation, and accordingly the project sought women who (1) live close to such open access water bodies; and (2) do not possess any significant productive water resource of their own. The proximity of the water bodies and cages to the recipients' homesteads not only helped to make the cages more easily supervised and guarded against theft but also enabled women to be involved. Proximity to the household accommodates gender-specific mobility constraints, allowing women to have easier access to the resource, thus allowing women to provide labor for this activity while performing their other household roles.

As this was an adaptive research trial, the adopting households were provided with all inputs required—materials to make the cage, feed, and tilapia fry to stock the cage for the first cycle. All recipient households were provided with hands-on training in cage culture. Stocking, feeding, cleaning and taking care of the cage, although done by the households (women were targeted but it was not feasible for women to undertake these activities by themselves), were strictly controlled and monitored by the WorldFish researchers. During harvesting and marketing, WorldFish monitored the sales of the fish, helped to divide the money between the women and deposited the funds in bank accounts. In Khulna, individual accounts were opened for each woman involved; in Barisal, group accounts were opened with two to three main signatories per group. Some of the money was used to reinvest in more fry for the next cycle. WorldFish linked the adopting households to all of these inputs, with the initial purchases and cage-related activities conducted through a group mechanism, especially for bulk purchases, sales and sometimes security. The close WorldFish monitoring required under the adaptive research model was done to test production feasibility with the intention that households would be given full control of the technology by the fourth year of involvement. This research study focuses only on cage-adopting households that received fish cage aquaculture under an adaptive research model.

Also under the CSISA-BD project, in Jessore, women have been involved in cage aquaculture but not as part of an adaptive research trial.

Additionally, the adaptive research trials examined in this study differed from other CSISA-BD innovation dissemination strategies (e.g. for pond polyculture), which typically involve training of 25 farmers, with only one demonstration farmer being provided with a portion of the required inputs in order to demonstrate the results to community members. Other interested adopters invest in the related resources independently.

Pond polyculture dissemination

The household system interventions initiated under CSISA-BD and AIN include polyculture of carp and/or tilapia with small, nutrient-rich fish (*Amblypharyngodon mola*, or mola), as well as encouraging the intensive utilization of space by producing high-value vegetables in homestead areas and on pond dikes, based on a seasonal crop calendar developed under CSISA-BD. AIN is supported by CSISA horticulture experts and has partnered with Save the Children for horticulture support. Many of the homestead-based ponds (lying within the vicinity of the home) that CSISA-BD and AIN targeted were not used to produce to their full potential as a result of traditional fish culture practices. Improved management practices—along with the introduction of nutrient-dense small fish in efficient polyculture systems containing high-value fish such as carp and tilapia—are expected to help combat this productivity issue and thereby generate added income and improve nutritional intake. Mola is readily available for pond stocking, as it occurs naturally in rivers and canals, can be harvested multiple times, and is rich in iron, zinc, calcium and preformed vitamin A (i.e. retinol). Training sessions covered technical aspects of stocking, liming, feeding, etc., and focused on nutrition education, including the benefits of eating mola and the importance of a diverse and balanced diet with plenty of vegetables.

Women were mainly targeted,¹¹ as they have the primary responsibility for many aspects of home garden management, have access to homestead ponds, have mobility constraints, are more vulnerable to malnutrition than men, and play a critical role in ensuring intra-household distribution of food. With diverse nutrient crops within their reach and the knowledge and awareness of utilizing these crops for the benefit of their family, it is expected that women can provide a balanced meal that meets their family's

nutritional requirements, although this assumes that women can apply this knowledge within the family. Diversifying livelihood choices with maximum utilization of space and resources helps combat seasonal food and income variations, reduces vulnerability in times of disaster, gives women an income source apart from fulfilling consumption needs, and helps combat the depleting supply of fish in natural water bodies.

Through both the CSISA-BD and AIN projects, WorldFish is working to improve cropping intensity, productivity and profitability of a wide range of aquaculture systems, while reducing risks inherent in the production process through the development and application of simple alterations in management practices. CSISA-BD and AIN follow similar methods for technology promotion and distribution. This mainly includes training, demonstration farmers¹² and linkage events. A demonstration farmer's pond serves as a learning site for the procedure and benefits of utilizing a particular technology from which the rest of a trainee group (an average of 24 farmers) are given the chance to observe and learn. The hope is that this will enable and motivate them to replicate similar results for themselves. During the linkage events, wider audiences are reached as farmers and market actors from surrounding areas are given a chance to view the methods and results as well; workshops are also held to link farmers. CSISA-BD and AIN are disseminating this homestead-based technology with common aims and methods and through the help of local partner NGOs, but using different training approaches.

CSISA-BD training consists of a 5-hour course over a period of 2 days provided by the project's aquaculture development officers, the *upazila*¹³ fisheries officer and the partner NGO extension staff (who themselves attended a week-long training of trainers course). A refresher course is conducted in the next year in order to reinforce the knowledge gained. A homestead technology training manual and a farmer's guidebook are used. Record books are maintained by each household to help in monitoring production. The demonstration farmer (who is selected in a participatory manner and based on available pond resources) is provided with most of the necessary critical inputs, while the other 24 farmers are provided with stocks of mola,

certain vegetable seeds and orange-fleshed sweet potato vines. The demonstration farmer is expected to play a leadership role in motivating the community.

Under the AIN project, the training duration, manuals and communication products, and inputs provided differ. Unlike CSISA-BD, in AIN not all training groups have a demonstration farmer since demonstrations require time for follow-up and monitoring. Each group is led by a chairperson and secretary. Mola (and orange-fleshed sweet potato vines) are provided as inputs to most farmers, and mola is stocked at 100 grams per decimal in each pond. Eight training modules are delivered: pond preparation; pre-stocking management; stocking management; post-stocking productivity increase, feeding, sampling, problems in fish farming and corrective measures; fish harvesting and pond dike vegetable cultivation; fertilization and nutrition; *horra*¹⁴ pulling; and gender and nutrition awareness. One module is covered in each session. According to the training manual, each session takes at least 2 hours. A 5-day-long training of trainer's course is provided to the partner staff who provide these training courses. Manuals and guidebooks (produced separately under the AIN project) help to guide this process. Various communication materials such as leaflets, stickers, etc., are also used to promote the technology and to raise awareness of the importance of mola.

A comprehensive analysis of a sample of innovation adopters indicates the way in which social variances—including gender—shape the full process of smallholder aquaculture innovation dissemination (including participant selection, implementation and more). This finding has significant implications for how individuals, households and communities use these technologies and how benefits and consequences are divided, and subsequently, if and how these technologies will continue to be used in the future, among the target group and beyond.

Disseminating innovations

Recipient targeting and selection

The process of selecting recipients for the aquaculture innovations differed across villages. In Bohalia, CSISA-BD asked the leader of a local women’s organization to select nine women members who live near the canal to receive fish cages. In the other villages, the project officers were responsible for selecting recipients, largely on an individual basis. In Lakripur, the project aquaculture development officer was careful about choosing an appropriate water body first (a closed canal without many tides); then, following a larger community meeting, he chose five women who lived near the canal and showed interest in the project.

The projects both attempted to target poorer households, and in the case of fish cages, even landless households. Yet the analysis reveals that the recipients selected did not always match this criterion. In fact, adopters perceived that they and other recipients were chosen on the basis of having certain “capitals” already (physical, natural, human or social capital) that would facilitate their successful use of the innovations, rather than due to being resource-poor or landless (i.e. lacking capital). (See Figure 14.)

Of all the villages, adopters from Sarendrapur were more likely to identify “lack of capital” as the reason for them receiving the intervention. Anwar (Sarendrapur) provided the following description for selecting recipients: “those who are day laborers, who work hard to eat, who don’t have much land. Those who have to spend more on nutrition, the poor who can live as a result of some income from farming—these were selected.” Rahima (Sarendrapur) also confirmed this sentiment: “He [from WorldFish] said this is for the poor, take two more poor people ... If we have to take someone, it is better to take him. He doesn’t have any sons, any land, any fields, they are like us ... Her husband has a disease, he coughs. I say, let it be, she has no older son ... it is better to take her, we should take the one who deserves to get.” However, in the other villages, the lack of

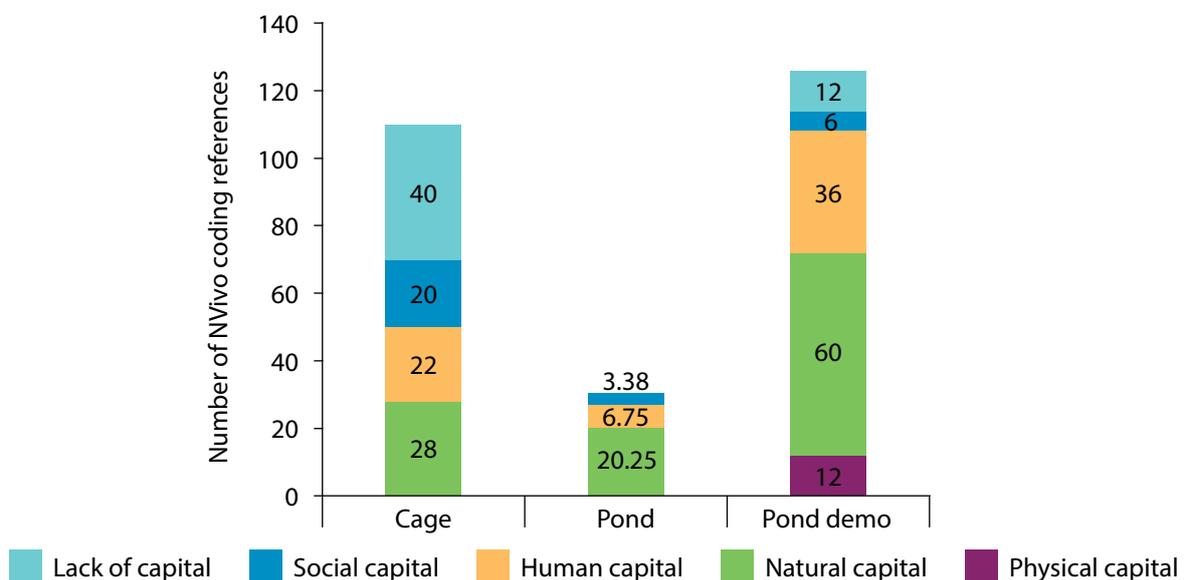


Figure 14. Adopter perceptions of factors influencing the targeting of recipients.

capital meant the adopter was not provided inputs. For Ayesha (Jalapara), the small size of her pond meant she did not receive fish: “Those who can afford to release fish worth BDT 1000–2000, they were given fish, and those who do not have the ability to release fish, they weren’t given fish. That’s why I say that the poor constantly have to bear kicks ... our space is small; that is why we didn’t get fish.”

Pond demonstration farmers in both Jalapara and Lakripur believed their accessibility (“physical capital”) led to their being selected as demonstration farmers and receiving inputs. According to Jashim (Lakripur), “As [my pond] is near the roadside, if any visitor comes they can easily exhibit it; that is why this pond was selected.” Across all innovations and villages, having “natural capital” (such as secure canal access, a large pond or a high-quality pond) was fundamental to receiving assistance. In Lakripur, a small group of farmers together held shares in the canal and were the ones that received the cages. Anwara (Lakripur) explained, “We are able to do cage fish farming because the canal is near our house; it was taken on our own lease.” Also in Lakripur, a pond demonstration farmer explained why her pond was chosen to receive inputs over other ponds in the village: “This pond is the best ... There are no plants surrounding the pond ... The fish can be given there. They will grow better here because there is no shade. In the village there are usually trees on the banks of ponds, leaves fall, they start to rot.”

Innovation adopters also mentioned forms of human and social capital that they felt influenced their receiving innovations. Many said they were recipients because they had prior knowledge and experience with fish, were educated and/or had shown a willingness to be involved. According to Aktar (Lakripur), he received a cage because his demonstrated experience with fish farming meant he was more likely to be successful than those with little experience: “If they got it, they couldn’t have farmed fish like us. They wouldn’t have understood. Because we are connected to fish farming from our childhood.” Ershad (Lakripur) tells the following story:

“After they first came, an officer from Barisal said, ‘There will be problems with fish farming here, because the water is enclosed. The fish might turn black.’ Then we said, ‘No, there is a sluice. There is a little of high and low tide in the water.’ Then they gave us the cage. They said, ‘You understand fish farming well. You will be able to develop.’”

- Ershad

Adopters also mentioned having “social capital,” meaning having previous connections to the project officers, kinship ties or being members of organizations. In Sarendrapur, for example, recipients said their participation in a previous project with a local officer led to their names being put forward to receive fish cages. Rahima (Sarendrapur) explained how a few years ago this officer had come to her village to give training on planting trees, taking care of chickens, etc. She tells the following story:

“One day I said angrily, ‘Will I only take the training? You don’t give anything else.’ Then one day I got four chickens and two chicks ... I said, ‘Brother, let me know if you get any project in front of you, or if any help comes’ ... He had said, ‘Alright, sister. I will let you know if I get anything in front of me; I will give it to you.’ Many days after getting this training, almost 1–1 ½ years later ... he said, ‘Didn’t you say so before? That if I get any help, to let you know? To give you a project? That is why I brought you a project.’”

- Rahima

Finally, many adopters mention the kinship ties that they felt helped them to receive the innovations. For example, Balaram (Bohalia) said, “My younger brother works at the fisheries department. He talked to [people from the project] and then [they] came and gave us the cage.”

This analysis raises issues around who the target group actually is (if it differs from the projects’ intentions), with implications for targeting in future. If these innovations are indeed targeted at the resource-poor, what minimum level of capital is required? Some forms of capital may be necessary for the innovation to be adopted at all (e.g. secure canal access for fish cages). Other forms of capital may help to facilitate the successful use of the innovation (e.g. demonstrated experience with fish farming), but then obviously exclude those who have the most to gain by expanding their knowledge and livelihood options. In the case of adaptive research trials, when innovations are provided to those with more capital or capacities, presumably because they are the least likely to fail, it makes it difficult to assess whether or not they are appropriate for the reported target group (the resource-poor). In addition, if these innovations are in fact only tested on recipients with more capital, this may limit the potential to scale out to those who have much less access to capital.

Implementation

Once recipients were selected, the innovations were disseminated. Recipients received inputs, training or both, depending on the type of innovation. Fish-cage-adopting households received inputs and training, but how the training was delivered and to whom varied.

In households adopting pond polyculture, training was only directed at women, although a few men also attended. Within this larger group of pond adopters, only the few women chosen as demonstration farmers received inputs (see Table 5).

The fish-cage-adopting households reported receiving (or receiving money to purchase) fish cage components (bamboo, iron, pipe, net, thread, needles); fry and fingerlings (monosex tilapia); fish feed; torch lights; signboards; meters and scales; and daily wages for those assembling the cages or sewing the nets. It was generally understood that the projects would provide all inputs for these households to carry out cage aquaculture, as well as training and follow-up support, at least initially during the trial. As Arif (Lakripur) said, “They would help the whole time or during the 5 years that the program would run. They won’t give the money more than once. But for the 5 years, they would see to our good and bad.” While the adopters emphasized that they did not have to contribute “a single taka,” many mentioned their labor contribution.

For all three cage-adopting villages, training was implemented in different ways. In Bohalia, most women attended a 2-day training workshop in the village. Men were invited but did not attend due to being busy or out of the village for work. In Sarendrapur, men and women in recipient households both received training but separately, with women receiving training in the village and some men travelling outside the village to learn how to make the cage. Only in Lakripur were husbands and wives trained together, but on different topics (men were trained in marketing and women in feeding and cleaning).

Research site	Innovation type	Receive inputs	Receive training	
			Men	Women
Bohalia	Cage	Yes	No	Yes
Sarendrapur	Cage	Yes	Yes (outside village)	Yes (in village)
Lakripur	Cage	Yes	Yes	Yes
	Pond – typical	No	Rarely	Yes
	Pond – demo	Yes	Rarely	Yes
Jalapara	Pond – typical	No	Rarely	Yes
	Pond – demo	Yes	Rarely	Yes

Table 5. Dissemination mode according to research site and innovation type.

The main mode of dissemination for pond polyculture was via training (rather than asset transfer and training). In both pond-adopting villages, women farmers were selected and provided training. It was understood that the training was mainly for women, though some men did “come and stand nearby.” Some felt that the men did not attend the training because they were busy and/or not in the village at the time, while others said that it was for women because vegetable farming and fish farming were jobs that were typically done by women.

The majority of households who received training in pond polyculture (the “typical” pond adopters) usually received no inputs for their ponds except for, in their own words, a “few mola fish.” Following the training, it was up to them to buy their own fish to release in their ponds. In Jalapara, women reported buying small amounts of minar carp, silver carp, glass carp, tilapia, puti and/or rui to release in their ponds. In Lakripur, a few women also mentioned buying vegetable seeds, either hybrid seeds bought from the market (which grow quickly and can be sold) or local seeds that taste better (Reshmi, Lakripur).

The pond demonstration farmers, however, report receiving a variety of inputs, including nets to cover the pond and protect the fish; fingerlings (mola, katla, mrigel, rui or rohu, silver carp); fish feed; seeds (or money to purchase seeds), such as amaranth, spinach, cucumber, gourd, hyacinth and others; and orange sweet potato vines. Farhana (Lakripur) also reported receiving financial assistance (USD 3.80; BDT 300) to cover the cost of day laborers who were preparing her land to plant potatoes, since she was recovering from an operation. The pond demonstration farmers mentioned having to prepare and clean their pond in order to receive inputs. This required a commitment of time and money to buy phosphates, manure and lime for the pond in advance or hire day labor to do the work. Once the initial stock of fish feed the project provided ran out they also had to buy their own fish feed. Farhana said she chose not to buy the same feed and instead used a combination of rice bran, grain, oil cakes and husks.

Implementation issues and implications

There seemed to be confusion, especially among fish cage adopters, as to the extent to which the households owned these assets and thus had the right to make decisions on their use and earnings. For some adopters, it was clear that once disseminated, the assets were theirs, and they had responsibility over their use and earnings. For example, Jamshed (Sarendrapur) said he understood that “they [the project] would bear the expenses for the farming, but the earning would be all ours.” However, Gopal (Bohalia) had some reservations: “They never said that this money would have to be returned. Though we have an idea that this money has to be returned or we just have to do whatever they say. We spent the money [cage earnings] but we couldn’t spend it with mental peace.” For Amrita (Bohalia), the opposite was true: “The cage was provided in my name but my only responsibility is to feed the fish and look after them ... the cages, net and bamboo are all theirs [belonged to the project].”

To a lesser extent, there seemed to be disagreement among some of the demonstration farmers about ownership of the assets received. For Farhana (Lakripur), it was made clear to her that the inputs were hers:

They said, your fish, your money, no one will come to take that, no one will come to eat that. Whatever you do [is] according to your wish. Again they said, the fish-selling money can be saved to give fish in the pond. But they didn't tell us to do anything specifically. We released the new fish in the pond due to our needs.

- Farhana

Murshed (Jalapara), felt the opposite and was scared to harvest the fish for his own use: “I still don’t think of the fish as my own. I will eat now but what if I am accountable for it tomorrow ... they didn’t tell us to eat. They told us to grow the fish by giving food and looking after them ... Why would I eat without their permission?”

Why would I become a sinner for no reason?" Clear communication from the start of the dissemination process about who owns the assets and has the right to make decisions over the assets disseminated may help to support the independent decision-making capacity exhibited by people like Farhana and the sustained use of the innovation in future.

A key implementation issue identified by pond adopters was related to the visible inequality created among the typical and demonstration pond adopters when a demonstration pond farmer was chosen from the larger group receiving training. Of the 22 typical pond adopters in total, at least 13 from across both villages revealed feeling some kind of negative reaction due to not receiving similar inputs as the demonstration farmer. Some felt sad that they were not chosen. Sanjida (Lakripur) said, "The training was for everyone. If they leave everyone and give to only one person, then you feel sad." These sentiments seemed to impact these women's motivation to put their learning into practice. Many expressed blame towards the project for not giving them inputs, which (in combination with their lack of financial capital) makes it hard for them to take up new practices. For example, Nandita (Jalapara) said, "I don't give [the training book] much importance; you know why, sister, because we worked hard all month and they didn't give us fish, that's why." Although he did receive some inputs, Asad (Jalapara) said he felt misled because he was promised larger fish and then only received mola in the end. He recommended managing expectations with regard to giving inputs and the kind of inputs given: "Everyone would have been more encouraged if she would've said that you won't be given any fish, you will just learn this here and go home and do this work. But now everyone is a little upset because even though they said they would give fish they didn't."

Ayesha (Jalapara) related her feelings at not receiving inputs to those of failing in an exam: "If anyone fails in any paper in an exam, then how does the heart feel? And this fish that [the demonstration farmer] got, how does her heart feel, and we who didn't get the fish, how do our hearts feel?" Ayesha's husband seemed to have felt as strongly, as she states further, "My husband also says, you go swaying to the

meeting and come back swaying, only [that fisher's] wife got the fish." At least three other women in Jalapara echoed Ayesha in that their husbands also blamed them for not being provided inputs while another woman in their group was. Sadeka said, "When we go home, the husband says, you go for no reason, clicking your shoes to get training, what benefit do you get, they didn't give you fish." This response had repercussions for women's ability to continue to be involved or for future involvement in training opportunities, as can be seen by Ayesha's husband's decision to prohibit her from going to any further meetings: "My husband prohibited me from going to the meeting. You have been going to the meeting for so many days but they don't give you anything. That is why the husband says it's bad or forbids me." Rabeya said her husband had a similar reaction: "My husband got angry because I didn't get [inputs]. He said there is no need to go to the meeting." The sentiment of Ruma's husband—"My husband doesn't help me with my work anymore ... my husband says they don't give you anything in your meeting"—shows it may also have implications for the labor dynamics between men and women in a household, potentially leading to increases in women's workloads.

The way pond innovation training in particular was targeted only or mainly at women highlights another key implementation issue. Both men and women adopters stated that men (not just women) should also attend training. Jolil, who supports his wife (a pond demonstration farmer in Jalapara), said it would be better if they provided the training to him as well since he had to support her work anyhow. Similarly, Rokeya (Lakripur) said that albeit the household received inputs, it was only her who received the training: "In a family, it isn't enough if one person is aware. If [training] is given to everyone in the family, then all the members will be aware. Benefits can come."

Targeting only or mainly women for this kind of training may also have the unintended consequence of shifting responsibility for fish farming activities to women and increasing women's workload. In Jalapara, there was general agreement among the women that their workload had increased, and this was partly attributed to their husbands not being included

in the training. According to Selina (Jalapara), “[Husbands say,] ‘You have learned everything, fish farming along with vegetable farming, we (husbands) don’t have to do anything, you can do it all!’ Saying this, they leave it to us. Now [because of] training I am in another hassle; now the husbands don’t do, we have to do.”

Even though the women innovation adopters did manage to mostly attend the training, some did have to face major barriers. In some cases, the barriers even prevented them from attending all together. Parvin (Lakripur), for example, provides details of the resistance she faced in attending the training from her entire family, from her husband to her mother-, father- and brother-in-law. At first Parvin defied the opposition and attended the trainings, as she liked them and could learn new things. However, she explains how she finally had to succumb to the dominant gender norms around mobility and roles that led her to stop her association with fish farming.

My husband also doesn't like all this. He also doesn't like that I went to the meeting. The woman should stay at home. Fish farming is done by the men ... I stopped farming fish. It was difficult for me to go to the training. I have a small child, I have household work ... Again there are outside men at the training. They see us ... I didn't go any more after those 3–4 days. I didn't go anymore because I have hassles here.

- Parvin

She said she would have preferred if they were able to give the training in her house. Murshed (Lakripur) also revealed how his neighbor warned him to not let his daughter-in-law attend the training on pond polyculture for similar reasons:

Although it seems that most of the women innovation adopters in this study were able to bypass or negotiate these more traditional gender norms and attitudes in order to attend training, no doubt these, along with gender-related roles and responsibilities, will continue

Our neighbor, he said don't go give and take with the NGOs. When your daughter-in-law will go for training, her cover (cover from males) will be revealed. He spoke from Allah's perspective. If a woman goes to the market or [away from the village] then according to Allah's law it will reveal her cover ... Apart from that she has two young kids; they have to be cooked for and fed. Then there is also an aged mother-in-law at home ... Now when she goes for training to [another village] what if her child drowns in the water and dies?

- Murshed

to present serious constraints on the future dissemination of aquaculture innovations to women adopters.

Adopters were able to identify some key features that supported women’s attendance at training and would be important to consider for the future. These included the following:

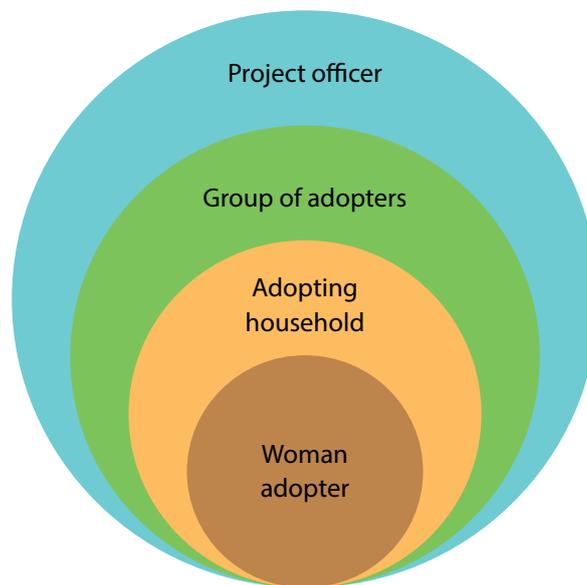
- holding the training in the village;
- including only women and having a woman trainer, preferably one that men and women farmers already know and trust;
- allowing women to bring their children with them;
- using an easy and accessible training style. (Topics should be explained in an easy way, in steps, using big, colorful pictures and books, and involving practical elements. According to Rokeya [Lakripur], “They explained to us really well. If an uneducated person wasn’t able to understand, she understood from others. Once someone explained five times.”);
- choosing a topic that is useful and of interest to both men and women. (Asad [Lakripur] said he was not angry that his wife attended the training because what they were teaching was for everyone’s well-being. When his wife came back from the training, she said, “You don’t have to do anything by yourself anymore. Now the two of us will do fish farming together.”);
- providing certain incentives to attend, such as snacks or food, money to cover transport and/or time, stationary (notebooks, pens), and books about fish farming.

Still, there may be women who cannot attend training for various reasons. As an alternative to attending training, some women adopters mentioned learning and sharing knowledge among themselves following the training. For example, Shornali (Bohalia) could not attend the training but said she learned how to do it by seeing others and following the advice of her sister-in-law next door when feeding. In this case, it is worth also considering how to encourage intra-community or group knowledge-sharing.

Innovation use

The previous section emphasized that the way that smallholder aquaculture innovations are disseminated in villages has implications for who uses and benefits from these innovations, now and in the future. This section explores adopters' perceptions of their roles and responsibilities in using the innovation—from technical and financial decision-making to labor activities—regarding the roles that the project officers, the group and/or other members of their household have.

Although the innovations are targeted at women, it was rare for women to express that they felt capable of independently doing the work required or making decisions (financial and/or technical) related to the innovation. For many of the women adopters, the men in their household or groups of men made the key decisions about the innovation and did most of the physical labor, while women either just played a supporting role or were not involved in the labor. Despite efforts to transfer innovations to women and set up bank accounts for women, in many instances this was in name only. Beyond the intra- and inter-household relationships that shape the levels of independence and self-efficacy of adopting women in this study, there were also extra-village relations (between the adopting households and innovation project officer) that contributed to the perceived capacity and independence of targeted women adopters and adopting households as a whole. (See Figure 15.)



Source: Morgan et al. (2015).

Figure 15. Multidimensional factors affecting current and future innovation use.

Extra-village relations

In two fish-cage-adopting villages in particular (Bohalia and Sarendrapur), adopters said that the project officer had both a technical and a financial role. In addition to providing technical advice on how to build and maintain the cage, what fish to stock, when to harvest the fish, and so on, the officer was also involved in financial decision-making, from selling the fish to banking, saving, reinvesting and spending the proceeds.

In Bohalia, the project officer kept the profits from selling the fish and used it to buy the fish feed and directly supply the adopters. Although women owned the fish cages, most had little understanding of how to buy inputs, what their expenses were and how much profit they were able to make from the cages. According to Balaram, "They [officers] use that money to buy fish, feed and we do not know anything. If we bought on our own and if we could sell them then we would keep track." Aroti made it clear that this had implications for their independent capacity to use the cages in future: "Now if they leave the cage to us then we will have to bring the fish and food ourselves. Because they [officers] stay and bring [fish and feed] for us we don't remember anything." The project officer seemed to also have a role in decisions involving the bank accounts that were set up in the names of the cage-adopting women. Very few women knew the status of their banking account, perhaps because, as Achinta states, "Although the account is in my wife's name, [the officer] looks after it." Finally, adopters perceived that the officer also had a role in deciding how to spend the profits. A few adopters mentioned needing to ask for permission from him before withdrawing money from the bank account to spend on family needs. This is likely only to have been for the first cycle of sales. It was not clear from the interviews if ownership and decision-making over the profits has changed for future cycles.

The project officer in Sarendrapur also had an influential decision-making role with regard to both technical and financial issues. According to adopters, the officer went with all 10 adopters (5 women adopters, along with their husbands) to open the account at Grameen Bank, which was opened in the names of two adopting women. He was present when money

was deposited and had accounts of all money spent. As Renu describes, the project officer was influential in encouraging the group to save the profits: "[The officer] has the strongest voice there ... he told us to [not spend the money, but keep it in the bank]. He also said for our own benefit. If you do this you will be improved. After he told us, we five decided together." Adopters also mentioned that he made the decision to give out some of the money as an *Eid* "bonus" of BDT 1500 to each adopter.

The levels of external control, support and dependence seen in Bohalia and Sarendrapur may only be temporary. There seemed to be an understanding, especially in Bohalia, that the project officer would slowly turn over responsibility (technical and financial) to the adopters and that indeed he was coming less often to provide support. As Trina said, "They told us in the beginning that 'we will run it for 3 years; we will give the fish and the food. After that onwards you have to run it yourself.'" Also, in Sarendrapur, Anwar showed his understanding of the adopters' changing role vis-à-vis the project officer: "We are supposed to handle this year. We have to carry on with the money in our account. If needed they [project officers] will help us."

The fish cage innovation seems to lend to more involvement and tighter control by the project officers as opposed to the pond polyculture innovation, at least initially. Perhaps this is because it is adaptive research, and because of the large amount of capital that is required for investment and reinvestment. Among the pond adopters in Lakripur and Jalapara, apart from the training, external officers seem to play more of a technical or monitoring role, occasionally dropping by to check on the fish, test the water and provide advice when consulted. Pond adopters in both villages mention being encouraged to be independent from the project. According to Rabeya (Jalapara), the project officers told the pond-adopting women, "Don't stay reliant on us." Similarly, demonstration farmer Jashim (Lakripur) emphasized self-sufficiency: "Above all, they [project officers] taught us how a poor farmer can be made self-sufficient. As a way to becoming self-sufficient, they talked about fish farming with developed technology."

In the other fish cage village in the study (Lakripur), the role of the project officer (especially in financial matters) was rarely mentioned in the way it was in Bohalia or Sarendrapur. Only Anwarul mentioned that the WorldFish project officer had encouraged them to save their money collectively: “They said, ‘You are poor people, the money might get spent if it is in your hands.’ That is why we keep it in the bank, so that it can be spent later.” Beyond the type of innovation, the village context and the personalities of the project officer and the adopters may be other contributing factors to the level of support and involvement of the project officers, leading to more or less dependence of the adopters on extra-village support.

Inter-household relations

In all three fish-cage-adopting sites, adopters use the innovations collaboratively to some extent. The group mechanism, however, varies across the villages. In Lakripur, collective shares in the canal bind the five adopting households together in working and making decisions about the fish cages. They decided that all five adopting households would divide the responsibility of feeding the fish, get the permission of all five before selling fish and keep a joint bank account. Of the five adopters in Sarendrapur, four of the five adopting households come from the same extended family; an extra adopting household was added when the project officer asked them to “create a society of five” (Aminul, Sarendrapur). As in Lakripur, the group divides the work and makes technical and financial decisions together. According to Rahima, the group made the decision to open the account in the women’s names: “We [the women] said, open the account in your [men’s] names. They said, ‘No. If we open the account, then if we don’t have any work, we will withdraw TK 5000. The women will never take it out despite all difficulties.’”

In Bohalia, the nine cage adopters were chosen from members of an existing women’s organization. The son of the organization’s president seemed to play a coordinating role and provides in-village support for the adopters on technical and financial issues. Adopters mentioned him helping with a range of matters, including inspecting cages, releasing fish, harvesting and selling fish, and depositing and

withdrawing money from the bank account. The women adopters also consult with one another about how to use the cage and attend monthly meetings. Unlike in the other two cage-adopting villages, in Bohalia financial matters are decided upon at the household level, rather than at the group level.

Adopters mentioned benefits and drawbacks of the group mechanism. Pooling labor, skills and financial resources as a larger group enables those who cannot manage to provide any of these sufficiently on their own. This is arguably a necessity for most, as initial investments and input costs are high and the cage is physically too large to move alone, but would particularly benefit women’s capacity to take up and use fish cages successfully. According to Arif (Lakripur), the group mechanism provides a backstop that helps his wife to take care of the cage without him: “If I’m away, [my wife] can call our neighbors, like my brother’s wife. That is why this project was kept jointly.” The group mechanism can also help to efficiently solve common problems. Trina (Bohalia) explains how during a meeting the group was able to find a solution to the collective problem of sourcing good-quality young fish for their cages: “We decided together that we will all release some fish in a pond and breed them there for some time and then from there we will give fish to everyone.”

That said, a few issues have been identified with the group approach. The first is around the unequal allocation of work among adopters. Anwara (Lakripur) said the following:

“

When doing it together, someone does more. The person’s house that the food is in, he gives food on two extra days. The person who doesn’t have the food in his house, he doesn’t remember, he stays busy in other work. And if each one is on his own, they will remember about the work, that the work of looking after the fish has to be done first. Otherwise one sits in expectation of the other.

- Anwara

”

Another key problem was around financial decision-making as a group, especially regarding decisions to buy inputs and how to spend the profits. Again, Anwara preferred the idea of making decisions on her cage independent from the rest: “Each person’s cage will become different, the money will also be kept separately ... each will bring fry according to own wish and keep it in the pond to grow big, each will give fingerlings in the cage according to wish.”

In Sarendrapur, some conflicts have surfaced around group finances. According to Aminul, he wanted the group profits saved or spent on buying fish feed but instead the group withdrew the money:

We five had problems among ourselves the second time we were selling the fish ... the next time when they are told to save the money from the fish sold, they say they won't keep the money saved now. They will save it later. This time they keep BDT 5000 of the fish-selling money saved in the bank and the rest of the money they take for themselves. Even if they talk about buying the fish food, at that time no food was bought ... I had said, all the money will remain in the bank, no one can use any of the money for their personal use. But they keep BDT 20,000 in the bank, and spend the rest of the money. This money is spent by the other four members of the society, except me.

-Aminul

Aminul, as part of the non-family couple in the group from Sarendrapur, expressed how he felt powerless in the group (“among them I am very weak”). Besides not having decision-making power, he also felt that the others took advantage of the group profits from the cage without him or his wife: “I have to give food in the cage, I have to repair the cage, but my name isn’t there when it is time to divide the money.” Despite his obvious dissatisfaction with the group, he said it was “impossible” to take

the cage without having some kind of group mechanism to help with the physical labor. But on money matters he was hoping to be able to separate himself from the group in future: “This time I will divide the money immediately after the fish are sold [from the other adopters]. Now I am realizing that we all have equal divisions in this cage.” Aminul’s perceptions were not supported by the other members of the group, perhaps due to their relationship. For example, Anwar said he did not suffer “hard feelings” about the way the finances were controlled by the group leader—his uncle.

While the group approach to using and managing fish cages has many benefits—and arguably is necessary in some form, particularly if women are targeted—unequal power relations within groups have a distinct effect on the ability of group members to make decisions that suit the differential preferences of the different households involved in the innovation or allow them to secure equal benefits for all. Furthermore, such inequalities can be a serious source of conflict affecting productive group functioning. Another dimension to consider is the unequal gender power relations at the level of the group. In Sarendrapur in particular, the adopter “group” making decisions was in actuality the five male members of the family, rather than the women that the innovation was targeted at and disseminated to. As Roksana reveals, “Whenever any decision is made, we are all present. The men make the decisions and we [women] stand nearby.” Women already face a difficult challenge in negotiating unequal gender relations within the household, without having to confront an extra layer of entrenched power at the group level that reinforces undesirable gender roles and responsibilities.

Intra-household relations

Within adopting households, women have varying levels of responsibility and decision-making power relative to the husbands, fathers, brothers, fathers-in-law or other males in their household who are meant to be supporting them to effectively use and benefit from the innovations. In some households, the men are the ones who are mainly responsible for using the fish cages while the women provide support, pointing towards women’s lack of control over the technology, it being in their name only. In other cases, women do most of

the work, including making crucial financial and technical decisions, with the men providing support. Again there are other households where couples work in a complementary way, making joint decisions and sharing the labor.

Patterns can be observed across villages and innovations. In Sarendrapur, adopters universally agree that men are primarily responsible for using the fish cages, though the assets and bank account are in the women's names. As Anwar states, "Even if it came in my wife's name, buying, selling, leadership, we [men] are doing everything." Adopters comment that the men do everything while the women just help their husbands if required. Their role is more to "stand and watch [and] go forward if anything is needed." Women's role is acknowledged, but minimal. According to Aminul, "Even if they don't do anything, even if they stand beside us, they can still support us in some way." Aminul's relationship with his wife does seem to differ from the other households in Sarendrapur, though, as he recognizes the contribution his wife makes to the household and as the primary financial manager:

“

It is good for women to have wealth. Like if my wife buys something, it will stay in my household. She doesn't give it somewhere else ... The household can't run without the woman. The women do a lot of work in the household. Everything in my household is bought by my wife. All my earnings stay with my wife.

”
-Aminul

The situation in Lakripur among the fish cage adopters is similar to Sarendrapur in that men are primarily responsible for using the fish cages. Men seem to dominate all the decisions, from the initial decisions to take up the technology ("I made the decision ... I didn't discuss with anyone" [Arif]) to the decisions of when to sell and what to do with the money. Again, the fish cages and bank accounts may



Homestead-based woman farmer observes her fish production with her husband and sons, Jessore.

be in women's names but they have little more responsibility than that. The women report standing by and watching, looking after cages only when the men are not at home, and knowing less than the men about the accounts. The men confirm this. Ershad states, "We men do most of the hard work. Their names were given; we have to do all the work." While Jhuleka says that the men give women the money after the fish are sold, according to Anwarul it does not matter if the money appears to be in the women's hands: "Even if the money stays in their hands, we are the ones who spend it ... they don't spend anything. They bring the money and put it in our hands." Arif said the women get more benefits from the cage, in that they get money to spend on the family.

Of the fish-cage-adopting sites, Bohalia again stands out as the exception. In the majority of adopting households, responsibility for the innovation seems to be jointly shared. As Indrani states, "We, husband and wife, do everything equally." Both men and women adopters emphasize that the decision to take up the fish cages was made jointly within the household. They also stress that it has become everybody's responsibility in the household to take care of cages—all family members, including children—whenever anyone has an opportunity to do so. Since it is not possible for everyone to do everything, everybody contributes in whatever way they can in order to take care of the cage collectively. Even though women may not have the physical strength to move the cages around, in general men's and women's abilities and labor can and do complement one another. According to Chandra, "Actually, whoever gets the opportunity looks after it. Maybe if my wife is busy with something, I will go and feed the fish." In fact, Chandra says that the reason he is involved is not because he thinks women need the help but because he himself is excited: "In the other cages, I have seen the women doing everything. We all are involved because we are excited."

While the majority of responses in Bohalia can be characterized as indicating joint responsibility between men and women adopters in a household, a few adopters also lean towards women being primarily responsible for using the fish cages, with their

husbands supporting them if required. For some of these cases, even the profit is owned and controlled by women. For instance, Balaram said, "It's her money. I don't have any interest in that money. It is not my concern what she does with that money." Rupan also said he thought of it as his wife's income and that she could spend it in "any way she wanted." Also, in her advice to a fellow cage adopter, Trina reveals what she believes is the norm when it comes to women keeping the profits from the cage:

“

From those who have been selected there is only one hard-core poor person, Aroti Sarkar. She works as a day laborer. Her husband married twice. We give a lot of advice to her too. She comes often to ask 'what shall I do with what,' 'what will I do with the cage;' we give advice to her too. Her husband is a bit strange. When she gets the cage fish he comes to take a share. I tell her, 'Don't give him a share. He doesn't give you to eat, doesn't give you to wear, doesn't give you a single penny. You will not give a single penny when you bring your money.'

”
- Trina

For the most part, in pond-adopting households in both Lakripur and Jalapara, women are primarily responsible for adopting and using the innovation. Both women and men say that women do more of the work and men support them when they are available. Women in Lakripur said they made the decisions to release fingerlings into their ponds or adopt vegetable gardening on their own. Women like Tripti (Lakripur) said they are able to maintain the new techniques they learn during the training without the help of men: "Women stay at home all the time. They can give feed to fish, can give water to plants. The men stay abroad. That's why women can do this." There are instances where women may need men's help, with heavy labor or in work outside the home, but women are able to arrange this. Various adopters mention hiring day laborers or asking the fish sellers or traders to come directly to their house so they can sell their

fish without leaving the house. Not all adopting households in the village are the same, though. A few adopters mention using and making the decisions on their ponds and finances jointly. A few other adopters identify men within the family as driving decision-making. In the case of demonstration farmer Jashim, as the pond he works on belongs to his uncle, his uncle makes decisions and receives all the profits from it.

In Jalapara, men and women adopters strongly emphasize the responsibility of the woman adopter over the innovation. Demonstration farmer Asad said his wife was the one who made the decision to take the training and try the new techniques. Another demonstration farmer, Jolil, said his wife was fully capable of doing all the work, even better than himself. He said, “She can do it better than us. She is like that. I come later to see that everything is fine. She even looks after the cows and goats.” She even orders him to help her: “She tells me that you are not paying much importance to this because the fish is in my name? She instead orders me.” Reshmi also echoes this sentiment, asserting, “The men cannot give food properly, so I give my own myself.” Another demonstration farmer, Murshed, works together with his daughter-in-law on the ponds and says she can do it on her own, and he only

looks after things if she is away: “It’s easy, she can do everything. Even if I am not home for 10 days she can look after everything. She is also sufficient alone in doing the agricultural work. She doesn’t need me on many occasions.”

As in Lakripur, pond adopters in Jalapara emphasize the ease with which women can use the innovation because they are at home. If tasks come up that require help, such as applying lime and manure to the pond (which demonstration farmer Asad believes that women cannot do because it requires going into the pond) or selling the fish, then they hire men to do so. Female demonstration farmer Komal says the following:

“Suppose I have to sell the fish. If my husband isn’t home then I would get people to harvest the fish. After pulling them out, I would weigh the fish and get the people to lift the fish onto a van and I would go with the van. I would sell the fish and come back.”

- Komal



Men and women farmers observing production from a model demonstration farm on improved tilapia farming with vegetables on dikes in Rangpur.

Maliha

Age: 19

Status: Married

Location: Lakripur

Last year, Maliha received a fish cage. Her stepmother was not home at the time and a woman's name had to be given in order that her father could receive the cage, so she put her name forward. She was not able to ask permission from her husband before agreeing to it but she was confident he would give it. "My husband is good", she says.

She has many duties to see to on behalf of her in-laws in another village, so she is not able to take care of the cage much. "I am in a state of coming and going. My father-in-law is ill. I go to see him." If she wants to visit the cage and her own father, she has to get permission from her father-in-law:

"I always get permission when coming [to see the cage]; I get my father-in-law's permission. I touch his feet and do salam before coming. I will go when they will tell me to. If they say no, then no. Even when I am going to my in-laws' house I tell my father. I go if my father gives me permission."

Because she cannot take care of the cage often, other women in the group take on her work. But this can lead to resentment.

"We look after it more. We do most of her work ... I do [get upset about this]. One who can take a portion when it is being divided, can't she do her share of the work? Sometimes her father comes by and does it ... Sometimes [quarrels] start ... Because she can take the same portion, but she can't come all the time. She says, my house is a little far off, you do it for me."



Despite having the cage for over 1 year, she says she still does not understand it or have self-confidence about using it in the future. Although the cage is really only hers in name, she still values the title and sees how it may be useful to her in future:

“The cage is in my name. Even if I am far away, everything is still mine ... If it’s needed in the future, for example, the condition of my in-laws’ place might become bad. Then the cage will come in useful for me. Fate is a big thing. We can survive by holding on to this.”

“ I always get permission when coming [to see the cage]; I get my father-in-law’s permission. I touch his feet and do salam before coming. I will go when they will tell me to. If they say no, then no. Even when I am going to my in-laws’ house I tell my father. I go if my father gives me permission.

- Maliha

Disclaimer: The case study included is based upon an actual person’s story; however, the name and other identifying details have been changed to protect the privacy of the individual.



Women in farming and fisheries, Bangladesh.

As for financial decision-making, Asad says that he and his wife share this, including the profits from the pond polyculture intervention: “Actually, even if we spend BDT 2 in our family we ask one another. Suppose if I spend BDT 2, I ask my wife, and if she spends BDT 2, she asks me. We live like this.”

Overall, the findings suggest that the nature of the innovation (fish cages versus pond polyculture) blended with the local setting, social norms around intra-household decision-making and a wide range of interpersonal relationships add to the equation around who uses, who decides on and who benefits from the innovations in each site. Moreover, the findings indicated that even though aquaculture innovations may be targeted at women, in practice, multidimensional power relations—and specifically gender power relations at every level from extra-village to intra-household—affect the degree to which women actually use and benefit from these innovations.

The findings also indicate that the two pond-adopting sites (Jalapara and Barukhali) are progressing towards the project goal of enabling women to use and benefit from the new innovations. While this outcome is potentially desirable in some ways or to some actors, there may also be serious labor and workload implications, especially for women.

Women’s labor and gender roles

While targeting women for pond innovation training can increase women’s capacity and independence, it could also have the unintended consequence of shifting responsibility for fish farming activities to women and increasing women’s already heavy workload. Women pond adopters in Jalapara said that since the training their workload had increased. Most women say it takes approximately 1-2 extra hours per day spread across two feeding times (morning and evening). For some, the effort to prepare the fish feed is well integrated into existing tasks (cooking). However, Salima found it took her more time: “I spend 5–6 hours ... my child is

small; I have to feed him once, then go and again come back. I stop doing one thing and do another. I work like this so I need much time.” Men like Jolil noted the increased workload of women, which cut into their previous leisure time:

“Earlier she used to spend that hour talking or taking rest. So there is no problem in that. She just makes [the extra work] fall into a system. Earlier she could sleep a bit but now she can’t anymore. She wakes up in the morning but doesn’t get to sleep anymore in the afternoon.”

- Jolil

The work on the ponds that the adopting women are now doing used to be done predominantly by men, so it is unsurprising that the increase in workload is unidirectional; that is, experienced only by women in adopting households. As Asad said, “I had to do all this work myself before. Now I don’t have to do all this work myself anymore ... only her workload increased.”

For some of the women adopters, this additional work is troublesome, especially if their husbands leave it all to them (as Selina’s earlier quotation reveals: “I am in another hassle, now the husbands don’t do, we have to do”). However, for Salima, the new livelihood opportunity is worth sacrificing her leisure time: “It has been good that my rest period has become shorter because I don’t like to lie down or sit down idle all the time because in that case my household cannot make progress ... I cannot think of it as hassle. Because with that I am being able to make development.” From Murshed’s perspective, the extra work for his daughter-in-law is welcome: “She cannot sit and eat rice peacefully. She has one work after another ... she was like this before also. Ever since we brought her (after marriage) she is always like this.”

The women fish cage adopters have not experienced a similar increase in workload as a result of taking up the innovation, with many reporting that they have seen little change in their daily routine. While it may not be ideal in some ways that men take primary responsibility for the fish cages although these are targeted at women, it means that adopting a fish cage does not have the same labor implications for women as for the pond adopters.

Apart from the change in the *amount* of work, it is also worth considering how both agricultural interventions affect the *type* of work that men and women do—and whether these technologies are changing what is considered acceptable for men and women to do. The work activities that men and women do are conditioned by what they are perceived to be capable of doing (gender expectations and roles). Table 6 shows the different labor activities reportedly done by men and women in adopting households. It is important to note that innovations are not being used only by couples (husbands and wives) in a household, but by various combinations of men and women, boys and girls. In general, for the fish cages, despite the amount of time women spend on the fish cage, women considered men to also be indispensable in carrying out the required work. While men are capable of doing all the tasks that women typically do, there is the perception that women cannot do many of the tasks that men are typically responsible for, due to limitations in physical strength or knowledge or because of social norms limiting women's mobility or entry into the water.

Fish cage adopters (both men and women) provide a number of reasons for the gender division of labor around cages, specifically the limitations women have in doing “men’s” work. Almost all adopters mention the physical difficulty or impossibility of women moving or lifting the heavy cage in order to clean it or check on it. Most say that women cannot do it at all. Even if it is possible, says Anwara (Lakripur), it is just not efficient to do so:

A man can alone lift up one side of the cage, and if not, two women have to hold on to two corners of one side. To lift up one cage to see the cage, two men are sufficient and women need four to five people ... even if two men can do it, four women can't lift up a cage filled with fish from the water ... it's not that they can't. It will be a very difficult task for women.

- Anwara

A few people mentioned some limitations in knowledge that affected the gender division of labor. In Bohalia, Chitralkha said only her husband sews the net for the cage because he received training to do so: “We don’t know how to sew. We held the needle to pose for a picture. They took the pictures and left ... If they would show us how to sew then I would definitely be able to do it.” It would be worth further investigating what activities men and women want to be involved in related to smallholder aquaculture to find opportunities for them to be involved in relevant training activities.

Both men and women adopters said that it was not possible for women to go into the water to wash the cage, though it was not clear why women avoided the water. In Bohalia, a few people say it was because women were scared to go into the water because of leeches: “The women start to scream when leeches attack them ... if a leech catches a woman we have to take her to a handyman to remove it.” But it may also be due to social norms around women swimming and/or a lack of confidence in the water. According to Anwara (Lakripur), women can do some tasks related to raising fry but ultimately they cannot go into the water to catch them because “people speak negatively about them” if they do. Across the cage sites, social norms limiting women's mobility mean only men are perceived to be able to guard the cage at night and—significantly—go to the bazaar to sell the fish.

In contrast, for the pond adopters, there are fewer constraints to women's labor activities. Women were perceived as being able to use the innovation largely independently. Men and women have found ways to get around even the more deep-seated constraints. For example, when it comes to constraints due to gender norms around mobility, both men and women pond adopters have suggested hiring labor to do the work or asking people to buy inputs or sell the fish on their behalf. Murshed (Jalapara) even said he thought it would not be a problem if the women went to market by themselves: "Now women can go and get it [inputs] from the market. Most women go to the market."

This comment by Murshed reveals that targeting women for pond innovation may even open up spaces for bending or negotiating with dominant gender norms and roles. Conversely, the labor activities that fish-cage-adopting women do and don't do (and the reasons given for their limitations) may mean that new technologies serve to reinforce existing norms. Women's new capacities, realized by themselves and recognized by others, open up new livelihood options for themselves and may free up time for others in the household to pursue other work. However, it is not surprising that because women are *seen* to be capable of doing so much more in terms of pond innovations, they end up *doing* so much more. Changes in the type of work that men and women do, and are perceived to be capable of doing, must be balanced against the amount of work required, for whom and for whose benefit.



Woman homestead pond farmer watches as her husband casts a net in their pond in Khulna.

Research site	Men (husband, father, brother, son, grandson, brother-in-law, day laborers)	Women (wife, daughter, mother, stepmother, mother-in-law, sister-in-law)
Bohalia (cage)	<ul style="list-style-type: none"> Maintain cage (move or lift cage, dive underwater, check for damage to net or cage, clean net or cage, sew net, adjust the cage) Sample the fish for growth Guard cage (night) Feed fish (if women are busy) Catch fish Sell fish at market 	<ul style="list-style-type: none"> Sew net Help to clean cage Feed fish Guard cage (daytime) “Look after” cage and fish Bank account
Sarendrapur (cage)	<ul style="list-style-type: none"> Maintain cage (lift cage, move cage, check for damage to net [underwater], fix cage, clean cage) Guard cage (night) Buy fish feed Feed fish Catch fish Sell fish at market 	<ul style="list-style-type: none"> Clean fingerling pond Release fish Help to clean cage (remove waste, plants) Feed fish Guard cage (daytime) Support husbands to take fish out Bank account
Lakripur (cage)	<ul style="list-style-type: none"> Catch fry Maintain fingerlings (clean waste) Maintain cage (lift cage, clean cage, fix cage, sew nets) Check condition of fish Guard cage at night Feed fish (sometimes, especially if woman is sick) Sell fish at market 	<ul style="list-style-type: none"> Release fry in pond to put in cage Feed fish Maintenance (clean net, sew net) “Look after” cage and fish Bank account
Lakripur (pond)	<ul style="list-style-type: none"> Prepare pond (cut pond, build dikes) Buy inputs for pond at market (food, nets, lime, fertilizer) 	<ul style="list-style-type: none"> Check water quality Decide if inputs are needed Feed fish
Jalapara (pond)	<ul style="list-style-type: none"> Prepare and maintain pond (clear bushes; mix manure in water; apply lime, mustard cake, urea and/or phosphate; spread net in pond; clean pond) Release fish Test water Check health of fish Guard pond at night Feed fish Buy inputs for pond at market Sell fish Vegetable farming 	<ul style="list-style-type: none"> Monitor pond (water quality, fish, amount of food required) Release fish Prepare fish food (boil rice) Feed fish Spread net Vegetable farming (prepare soil, fertilizer, plant seeds, harvest) Take care of grandchild (when daughter-in-law feeds fish) Pond demo: Teaching other women in village

Table 6. Labor activities of men and women.

This study explored how climate-smart agricultural and aquaculture innovations may lead to more successful climate adaptation efforts and enhanced resilience for both men and women in households and across communities, as well as to improved and equitable outcomes in terms of income, nutrition and livelihood opportunities. Specifically, it investigated efforts to target women with household aquaculture innovations to understand (1) if such approaches enable women to use or benefit from them; (2) if and how usage impacts the sustained use of these innovations; and (3) if it would be possible to scale out these innovations to achieve large-scale development outcomes. This meant going beyond testing and refining the actual aquaculture innovations to understanding who used the innovations and how to improve the process of disseminating and implementing them.

The study elucidated that there are multiple issues or factors shaping sustained use and wider uptake, and that these exist at multiple scales from family through project level and beyond. These key issues—and the recommendations that emerge in response from this study (which addressed up to the project scale)—are presented by scale in Figure 16.

Expanding on the above, the following lessons emerged for projects in particular as being significant to enhancing gender-equitable use, uptake and sustainability:

- Projects taking steps to build independent capacity and ownership at the village level and to model and encourage more open and transparent processes of decision-making across and within adopting households emerged as important.
- Even if targeted at individuals or households, the successful uptake of smallholder aquaculture innovations often requires mutual support (to share labor requirements and pool resources); projects can play a key role in supporting these.
- In order to benefit the target group of resource-poor women, additional support is required to shore up gender-specific limitations in capacity. This may include external financial support or negotiation skills training, among others.

- In targeting women, more sustainable outcomes can be achieved if men are engaged with alongside women in the households. This may consist of including men in trainings and/or disseminating innovations to men and women together (a “household approach”) so as to inspire the men to support adoption of the innovation and in doing so enhance the prospects for communication and benefit sharing among the family members. Attention needs to be paid to ensure understanding of ways to do this that lead to win-win situations for the entire household.
- Specific insights that emerged are the following:
 - a. Re-evaluating the mechanisms utilized to spread innovations may be advantageous so as to ensure they enable the intra-community sharing and learning required for horizontal scale-out.
 - b. The study highlighted how the size and materials of the cages may present a particular challenge for women to take up and use. Investigating how to change cages to become more affordable and lighter may change uptake, sustained use and gender power relations.

This study additionally raises key issues that can improve monitoring and learning in and from existing and future interventions, including the following:

- In connection with women-targeted technologies, incorporating changes in labor patterns and time to monitoring systems would add value to learning about overall impacts.
- In an adaptive research trial, it would be useful to understand the diverse motivations, challenges and capacities behind different socioeconomic user groups’ adoption and use of innovations. This can be achieved by deliberately selecting such an array of trial adopters from the very beginning and trailing their development outcomes. In this manner, the technical solution can be merged and tested with the social realities that frame these user groups and provide a holistic idea behind uptake that can then inform scaling strategies.

Gathering a multidisciplinary team to design, implement and monitor such interventions is vital to achieving this.

- As the control and decision-making over aquaculture innovations transfers more to adopters over a project time line, it would be useful to capture and learn from how different user groups adapt these innovations to their own contexts (environmental and social).

In sum, although aquaculture innovations may be targeted at women, in practice, the degree to which women can use and benefit from these innovations is affected by multi-dimensional gendered power relations.

Sustained and equitable impacts will thus rely on a focus on gender—rather than a focus on targeting women—being included at the very start of the design and dissemination process. This focus would need to recognize and incorporate the needs and interests of the target groups as well as the wider context, which shapes decisions regarding adoption and use of technologies (see Figure 16).

How seriously and how well this challenge is taken up will have implications for whether and how these innovations will continue to be used in the future, among the target group and beyond, and therefore on the technologies' ability to deliver more equitable and resilient livelihood options at scale.

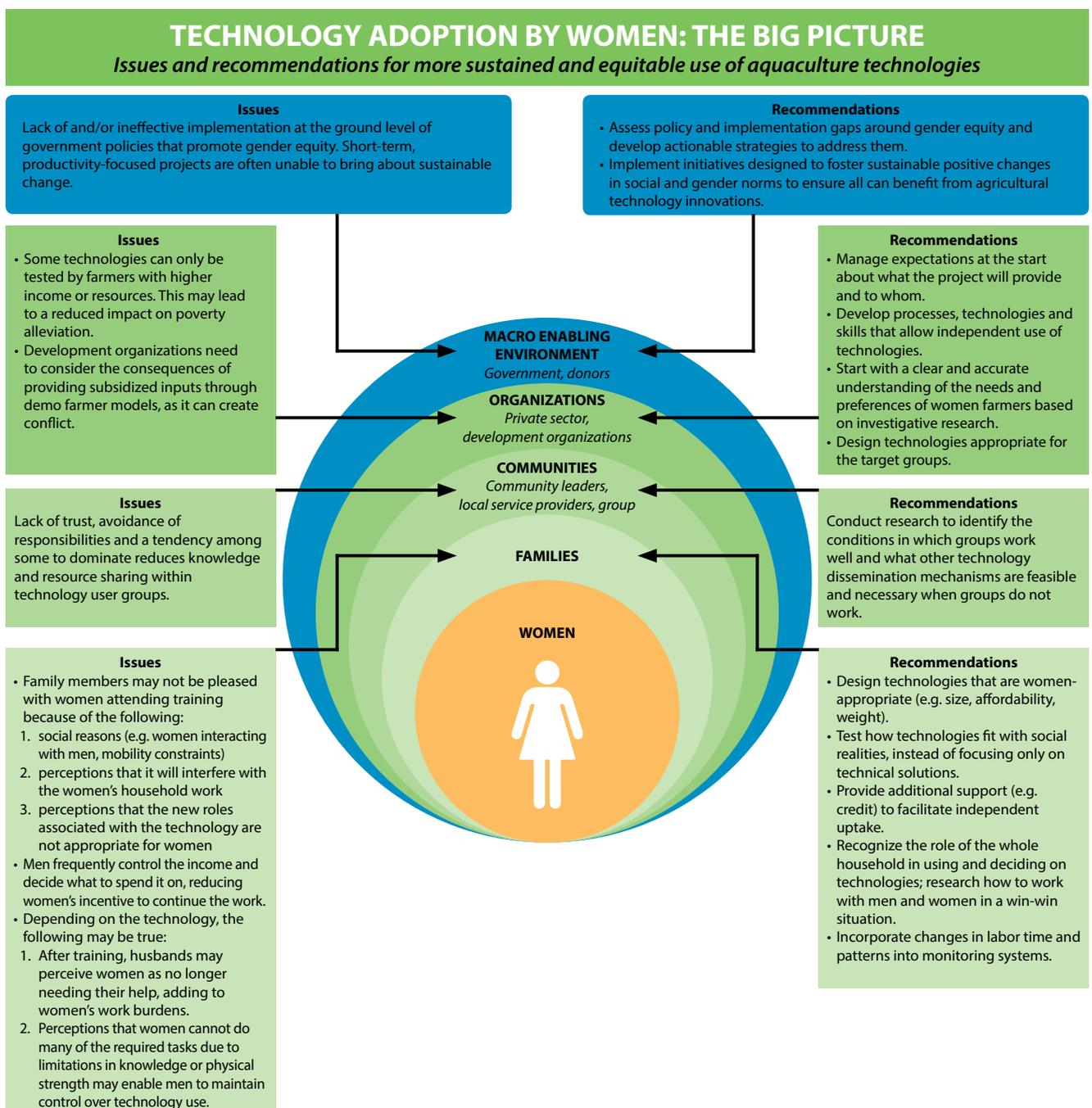


Figure 16. Key issues and recommendations.

- ¹ Climate-smart agriculture is defined as “agricultural practices and systems that sustainably increase productivity and resilience (adaptation), reduce or remove greenhouse gases (mitigation), and enhance achievement of national food security and development goals” (Chaudhury et al. 2012).
- ² Pseudonyms have been used for research sites and participants.
- ³ The tools were chosen through country-level discussions and by consulting a range of sources. The CCAFS/FAO Training Guide was particularly useful and deserves a mention here.
- ⁴ Adopters of pond polyculture innovations are broken down into two categories: typical and demonstration farmers. This is because dissemination processes were significantly different between typical and demonstration farmers, leading to different outcomes and thus requiring distinct analysis.
- ⁵ For background on the government’s failure to recognize the official role of women in agriculture (and thus inability to include women farmers in agricultural extension services, see IRIN [2011]).
- ⁶ Drawing on the SRES A2 Scenario, CCCMA-CGCM 3.1 model (<http://www.ec.gc.ca/ccmac-cccma/default.asp?lang=En&n=1299529F-1>) and Delta method to downscale the projected climate data (http://www.ccafs-climate.org/statistical_downscaling_delta/). Baseline gridded climate datasets to calculate “Current” baseline (1950–2000) are from WorldClim: <http://www.worldclim.org/methods>.
- ⁷ <http://www.ncdc.noaa.gov/oa/climate/ghcn-daily/>
- ⁸ Although we invoke the term climate change for this report, at village level focus group discussion participants are asked about changes in weather patterns. During the focus group discussion farmers were not initially asked to comment directly on the impact of changing weather patterns in order to pinpoint whether they themselves attribute agricultural and livelihood changes to climate change.
- ⁹ Adaptive study here means a trial that evaluates the feasibility of a technology by observing the technical outcomes as a result of applying the technology in different settings in a prescribed manner and accordingly tweaking the parameters of the technology to respond to the demands of those settings.
- ¹⁰ *Gher* systems are modified rice fields with high, broad peripheral dikes.
- ¹¹ CSISA-BD targets 100% women, while AIN targets a majority of women but with a mix of men as well.
- ¹² The name varies according to project; they will be referred to herein as “demonstration farmers.”
- ¹³ An *upazila* is a geographical region used for administrative purposes, functioning as a sub-unit of districts.
- ¹⁴ *Horra* is made up of a rope fixed with several sinks. When it is pulled, the sinks hit the surface of pond bottom and help emit toxic gases from the pond.

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Approximately 500 million people in Africa, Asia and the Pacific depend on aquatic agricultural systems for their livelihoods; 138 million of these people live in poverty. Occurring along the world's floodplains, deltas and coasts, these systems provide multiple opportunities for growing food and generating income. However, factors like population growth, environmental degradation and climate change are affecting these systems, threatening the livelihoods and well-being of millions of people.

The CGIAR Research Program on Aquatic Agricultural Systems (AAS) seeks to reduce poverty and improve food security for many small-scale fishers and farmers depending on aquatic agricultural systems by partnering with local, national and international partners to achieve large-scale development impact.

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