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A gendered aquaculture value chain analysis in northwestern Bangladesh

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1. Executive summary

This document presents a value chain study, through an integrated gender lens, of the aquaculture sector in Rajshahi and Rangpur divisions in northwestern Bangladesh. The study forms a foundational part of the Aquaculture: Increasing Income, Diversifying Diets and Empowering Women in Bangladesh and Nigeria (IDEA) project, funded by the Bill & Melinda Gates Foundation and led by WorldFish within the CGIAR Research Program on Fish Agri-Food Systems (FISH). This project aims to contribute to the transformation of the sector in the divisions toward greater inclusion and performance, leading to enhanced production, nutrition and food security, as well as increases in women's empowerment.

The aim of this value chain study was to generate a knowledge base to inform project interventions as well as provide broad baseline information regarding chain composition and both social (including gender) and economic performance. This report provides a functional analysis of the aquaculture value chain, unpacks social and particularly gender and economic performance of the chain, identifies governance-related (power) dynamics that influence performance, and synthesizes strategies for upgrading. It brings these insights together to identify recommendations for the project, both directly within the interventions and points of influence for the project via partnerships including policy.

The study applied a bespoke conceptual framework (Danielsen et al. forthcoming) that was created to help address the common pattern of "gender-blindness" in value chain analyses in aquaculture. It also used a mixed-methods approach to answer research questions related to the composition, functioning, performance and inclusiveness of the aquaculture value chain in northwestern Bangladesh and the factors that influence these outcomes.

The findings presented in this report represent a significant contribution and stepwise change in available sector evidence. The study is the first comprehensive aquaculture value chain analysis in the divisions that offers a gender-informed look at ways forward toward more inclusive, equitable and high performing chains in the divisions. Although this study was designed and undertaken prior to COVID-19, its recommendations are oriented toward and inform the same goals as those for pandemic recovery—building toward more inclusive, equitable, resilient and nutritious aquaculture value chains.

A wide range of species is produced in the northwest, the majority in carp polyculture and mainly in ponds. In this report, we distinguish homestead and extensive ponds from commercial ponds based on the location of the pond, whether backyard or not, and the level of inputs and other resources used. Alongside fish farmers, a multitude of actors is part of the value chain, including three types of actors specific to Bangladesh, known as "*patilwalahs*," "*arotdars*" and "*farias*." *Patilwalahs* are seed traders that provide fry and fingerlings from hatcheries and nurseries to producers, while *farias* buy and sell fish, and *arotdars* facilitate fish auctions. Informal and ambulant retailers, as well as formal retailers that sell from a fixed location, both sell the fish to consumers. Women and men both engage in paid and unpaid fish production roles, but women are not recognized by male household members as fish farmers; rather they are seen as supporters. Men tend to hold decision-making power regarding production. In this study, depending on the pond type, only between 2% and 5% of the interviewed households considered the woman in the household as main decision-maker for aquaculture. Downstream in the chain, no women were found as intermediaries and retailers, or as hired labor for those businesses. However, they do contribute unpaid household labor to their husband's business.

Almost 60% of total production remains in rural areas, through home consumption, gifts to relatives and neighbors or through rural markets. This emphasizes the major role that aquaculture plays in local food and nutrition security in Rajshahi and Rangpur. Productivity, revenues and profit margins vary between production systems. The proximity of the resources identified as most critical to success—seed, feed, market information, medicine and access to intermediaries—differs across villages, which affects performance for those more remote. Financial constraints and a lack of good roads and transportation are generally expressed as constraints to fish farming performance. Women face multiple additional constraints to engaging and succeeding as fish farmers, because their access and/or decision-making power over ponds and the fish produced are more limited than men's. Women also have less access to quality inputs, services and technical knowledge about aquaculture.

Power relations operate throughout the different levels of the value chain. *Arotdars* (auctioneers and intermediaries) have the most powerful influence throughout the chain. They control the prices in the market as well as supply/demand through credit relationships using "dadon," a credit system in which advances are paid (Section 4.5.6). Formal structures and informal structures, such as systems of bribery, were identified as disadvantaging farmers of all genders from lower socioeconomic groups. Formal and informal structural gender barriers (policy and gender norms and stereotypes, respectively) were identified as strongly limiting women's participation and benefits from the aquaculture value chain. This is particularly evident in their lower ownership of key resources needed for engaging in aquaculture—specifically ponds. Women have less decision-making power at all levels. Within the household, men have more say over shared family resources, such as ponds and finances, and overuse of benefits, including income and fish for food. Meanwhile, women have less bargaining power with other market actors, because they are not recognized as farmers. Constraining gender norms, such as those related to women's role as homemakers and religious norms about women's mobility, are a key driver of the inequitable dynamics, reinforcing limits to women's engagement and success. However, there are indications of room for women to maneuver and possibilities for investments to build on momentum for more equitable engagement, benefits and empowerment.

Finances were identified as a key constraint to upgrading, which limits farmers of all genders besides those of higher socioeconomic status, while access to quality inputs and training were identified as barriers for all farmers. Overall, however, men farmers have the networks, access to knowledge and control over resources that give them better ability to upgrade much more than women farmers. Bringing these together, the multiple dimensions of gender relations interact to influence gendered differences in the ability to upgrade. As a result, women produce relatively few fish because they have low decision-making power, access to resources and mobility. This has repercussions in terms of accessing other resources and benefits. At the same time, they have low production, resources, status and reliance on what inputs come to them at the farm gate because of gendered mobility constraints. This means that women are more dependent on actors that supply poorer quality inputs, which feeds back to negatively affect the quality of their aquaculture production and therefore their economic performance. Male farmers, including youths, expressed interest in upgrading along the value chain to become involved in feed, hatchery and aorta businesses.

2. Introduction

This document presents a value chain study with an integrated gender lens of the aquaculture sector in Rajshahi and Rangpur in northwestern Bangladesh. The study forms part of the contextual knowledge foundation for the IDEA project, which works in all 16 districts of Rangpur and Rajshahi divisions. Its ultimate goal is to reach 1 million households for its aquaculture production outcomes and 2 million households for the nutrition outcomes.

The aim of the value chain study was to generate a knowledge base for designing project interventions. These focus specifically on inclusive aquaculture value chains that are both more productive and contribute to poverty reduction, and in which women and youths can be equitably included and benefit in safe and dignified manners.

This report provides a functional analysis of the aquaculture value chain, including all fish farmed in ponds in northwestern Bangladesh and marketed in all product forms, both downstream and upstream as well as vertical and horizontal relationships and power relations. In addition, the report examines constraints and opportunities to the performance of this chain. It also identifies specific constraints and opportunities for women's empowerment and homestead pond and smallholder participation, including women and youths. Finally, it provides some initial ideas for designing interventions that the project can implement. The study was designed on the basis of an innovative conceptual framework (Danielsen et al. forthcoming) that brought together functional and economic analyses of value chains with an often-missing dimension in value chain analysis: an integrated gender lens that draws on current gender theory. This framework provided the basis for a shared understanding of key concepts and conceptual building blocks for staff involved in the project and made the connections between them visible.

This document is structured as follows: After the methodology (Section 3), the report presents a functional analysis of the value chain, including actors, products and seasonality (Section 4). Next, the report unpacks, in an integrated way, the social and economic dimensions of the study, highlighting productivity, profitability and employment (Section 5). Section 6 then describes resource and power dynamics in the chain and how this affects performance. Section 7 highlights insights about strategies, constraints and opportunities for diverse actors to upgrade within the chain. Section 8 provides recommendations for the project and for other value chain actors. The final section presents a short conclusion.

3. Methodology

3.1. Conceptual framework

This study applied a bespoke conceptual framework (Danielsen et al. forthcoming) that was created to help address the common pattern of "gender-blindness" in value chain analyses in aquaculture (Kruijssen et al. 2018). Specifically, the framework aims to enable empirical understanding of aquaculture value chains that not only "counts" where women and men are, but rather brings together functional and economic value chain analysis with gender analysis thinking, informed by theory and current practice.

This integrated approach is intended to inform investments in value chains that go beyond sparking upgrading by more powerful, ready-to-upgrade actors. Rather, this integrated approach is intended to both inform upgrading and, more fundamentally, inform transitions to more inclusive and equitable fish value chains. Figure 1 provides an overview of the framework and its key aspects of analysis.

Gendered value chain composition

- Structural features: functions, nodes, activities, products, locations, types and numbers of value chain actors (sex-disaggregated)
- Volumes of product flows
- Technical features: seasonality of production, production systems, inputs, quality aspects, processing characteristics, waste and losses, etc.
- Governance features: Rules, regulations and policies, coordination efforts, hierarchies
- Gender division of labor
- Social and gender analysis of value dimensions of products, roles and nodes
- Social and gender norms that affect participation of value chain actors in particular tasks and positions

Gendered value chain performance

- Production and transactions (prices, quality, capacity)
- Financial returns, wages and other economic benefits
- Social risks (e.g. terms of engagement and benefits)
- Distribution of economic and social benefits
- Control over outcomes
- Access to and control over economic and social resources required to perform
- Social and gender norms that affect access to and control over resources and benefits

Gendered value chain governance (power dynamics)

- Decision-making in whole value chain, and at node, household and community-levels
- Economic and social resources that affect decision-making
- Social and gender norms that affect decision-making and ability to assert choice and voice

Gendered value chain upgrading

- Economic and social resources that affect economic and social value chain upgrading
- Upgrading strategies of value chain actors
- Effect of gender division of labor on upgrading strategies
- Effect of access to resources on upgrading strategies
- Effect of power dynamics on upgrading strategies
- Effect of social and gender norms on upgrading strategies

Gendered constraints and opportunities in the value chain

- Analysis of interplay among factors and dimensions of gender relations in the value chain to explain constraints and opportunities
- Interventions to overcome barriers and take advantage of opportunities

Source: Danielsen et al. forthcoming.

Figure 1. Gendered value chain analysis framework: key aspects for analysis.

The conceptual framework identifies four key dimensions of gender relations in aquaculture value chains (Danielsen et al. forthcoming):

1. **Gender division of labor**: This is an analysis of women's and men's different productive tasks, roles and positions throughout a given value chain, including roles that are unpaid, hidden or otherwise under-recognized and/or undervalued.
2. **Social and gender norms**: This means investigating the collectively held definitions of how women and men should behave and interact and with what resources (van Eerdewijk et al. 2017). They also frame the context that women and men participate in and benefit from aquaculture value chains, including where men and women can operate and how (Kruijssen et al. 2018).
3. **Access to resources and control over resources and benefits**: This is critical for successful participation in value chains, because a lack of access to resources hinders value chain actors "to choose how and when to use them as input into the value chain or allocate them to other uses" (Kruijssen et al. 2018, 332). Following Kabeer (1999), resources include not only material resources (such as technology, labor, financial capital, assets and infrastructure) but also human and social resources (such as knowledge, solidarity and social capital).
4. **Decision-making**: This concerns the analysis of who is involved in which decisions at different levels in different locations and nodes in the value chain and unpacking the nature of that involvement. It is about control over resources as well as about power relations in the value chain.

3.2. Study questions

The questions guiding the value chain analysis are based in the conceptual framework (Figure 1). The questions are summarized in Table 1. Each question is presented again in its respective section of this report as a preface to the section's key findings.

Component	Key questions
Gendered value chain composition	What is the composition of the chain in terms of products, nodes, actor tasks and roles? How is this divided among different types of people (gender, age, other social markers)? How is this influenced by social and gender norms?
Gendered value chain performance	What are the economic and social value chain benefits? What factors influence the economic and social performance of the value chain? How are value chain benefits distributed between men, women and youths? Why and to what effect?
Gendered value chain governance	How are activities in the value chain coordinated? Who has the decision-making power at different levels (household, community, whole chain, market/economy) of the nodes of the value chains, and why is that so? And how does having decision-making power at a particular node of the value chain have any effect on value chain performance and actor empowerment?
Gendered value chain upgrading	How do different value chain actors (men, women, youths) increase the benefits they derive from their participation in the aquaculture value chain? What upgrading strategies do different actors in the value chain use and what are the outcomes of those strategies? Meaning, to what extent are identified strategies successful? For whom? Why or why not?
Gendered constraints and opportunities in value chain	How can economic and social benefits, including empowerment, from value chain participation be secured and/or increased for different value chain actors (men, women, youths)? What interventions are needed to overcome barriers and take advantage of opportunities?

Source: Danielsen et al. forthcoming.

Table 1. Key questions guiding the value chain analysis.

3.3. Sampling framework and data collection methods

3.3.1. Site selection

Selection of divisions (purposive)

The value chain analysis focuses on fish produced in pond systems in the northwest of Bangladesh. The target area of the project consists of two specific divisions: Rangpur and Rajshahi. While other types of aquaculture exist, such as seasonal cultured water bodies, pen culture and cage culture, the vast majority of product originates from ponds (see also Section 4.2). A wide range of species is produced in these ponds, used for home consumption and sold in rural and urban markets inside and outside the two divisions. The primary target population for the project is small-scale aquaculture farmers (men, women, youths) and their households in northwestern Bangladesh. For this study, we also include all other value chain actors and supporters in the fish value chain.

Selection of districts (purposive)

Although the project takes place in all 16 districts of Rangpur and Rajshahi[1] divisions, there were constraints in terms of what was feasible for collecting data. We selected the district with the largest volume of aquaculture production based on the Department of Fisheries (DOF) (2018). Subsequently, we chose the second district to contrast the first in terms of production level, composition of production (ponds versus seasonal cultured water bodies) and location respective to the first district selected.

Selection of upazilas (random proportional to population size)

Using population data[2] at the upazila level in Bangladesh, upazilas were selected randomly with probability proportional to population size. This implied that more populated upazilas had a higher chance of being selected. For each division, we randomly selected the upazilas with probability proportional to the population size to ensure representativeness of the sample. Using the RAND function of Microsoft Excel, we randomized the upazilas and selected ones that represented 60% of the total population of the selected districts.[3]

Selection of villages

The farmers were the basis for the linked sampling approach. The sample size for the farmer survey was determined based on budget availability and power, so there is sufficient power to detect a meaningful difference in a given sample size or to confidently observe an anticipated effect. With a sample size of 600 observations, it is possible, for example, to detect a change in yields of 10% among the survey population with a confidence level of 90%. The sample size for the market actor survey flowed from this and depended on the number of markets sold to by sampled farmers.

3.3.2. Methods overview

The study used primary data combined with some secondary data, mainly aquaculture statistics from the DOF. Collecting primary data involved consecutive mixed methods. Specifically, it comprised four methods: a household survey, a market actor survey, key informant interviews (KIIs) and focus group discussions (FGDs). The data was collected in two stages. The qualitative data (FGDs and KIIs) was collected first followed by the quantitative data (farm household and market survey). The market survey was also conducted in two phases. The first phase involved following the fish from the farm households to the markets that farmers sell in and the second following the fish from those markets to the ones that market actors sell in. KIIs were also conducted during both market survey phases. The data collection instruments built on tools developed within the context of two CGIAR Research Programs: Policies, Institutions and Markets (PIM) and Livestock and Fish (L&F). They used a methodology that EuropeAid developed for value chain analysis (VCA4D[4]) and used tools for gender-sensitive value chain analysis developed by AgriProFocus, Royal Tropical Institute and the Food and Agriculture Organization. The fieldwork protocol, available upon request, describes the tools and data collection processes in more detail.

Data to address each of the questions summarized in Table 1 has come from multiple sources (Table 2). As much as possible, we have indicated the source of data in the text. We also used multiple sources to triangulate the findings.

The primary data used for this study was collected by Data Management Aid (DMA) in January 2020, just before the global outbreak of COVID-19. The results therefore relate to the situation before the pandemic.

Respondent sampling

To gain a (gendered) understanding of the value chain and its constraints and opportunities, we aimed to capture a diversity of views while being efficient. We used a two-fold linked approach:

1. Farm households of different types were selected and interviewed.
2. We followed the value chain backward and forward by selecting and interviewing the input and service providers the interviewed farmers purchased from and the actors in markets that those farmers sold to, following the fish down the value chain and up to consumers.

Because of this linked approach, and because farmers were selected randomly, we assume that the actors in the subsequent stages are also representative of the whole population.

It was clear that a large number of different production systems, species, intensity levels and practices are found among aquaculture farmers in the northwest of Bangladesh, and this we aimed to capture. However, we did not have information on the number of farmers of each type. For the survey, instead of stratifying the sample by farm type, we therefore chose to randomly select farmers, assuming that each major type of farmer would appear in the sample. We then classified farmers for further analysis and to carry out extrapolation for the entire chain, based on the relative importance of a particular type of farmer in the sample.

Data collection method	Respondents	Purpose: to generate information about what	Question it addresses
Farm household survey	Farm household, main decision-maker, women	Production practices, costs, sales, profits, labor use, women's roles	Composition, performance, upgrading
Market actor survey	Market actors (those who buy and sell fish)	Fixed and variable costs, labor use, sales, women's roles	Composition, performance, upgrading
Key informant interviews	Input suppliers, (seed, feed, ice, other inputs), intermediaries, retailers, stakeholders, consumers	Value chain activities, roles, labor use, constraints and opportunities, key trends, consumption behavior	Composition, performance, governance, upgrading, constraints and opportunities
Focus group discussions	Farmers (men, women, youths in separate groups)	Livelihoods, production systems, roles, social and gender norms, decision-making, power relations, value chain mapping and youth aspirations	Composition, performance, governance, upgrading, constraints and opportunities

Source: compilation based on Danielsen et al. forthcoming.

Table 2. Overview of data collection methods.

For the farm survey, 20 households were selected in each village using a transect technique and a sampling interval based on the number of households in a village. Villages were divided into four zones, conducting five interviews per zone and skipping households based on the sampling interval. Included households were those involved in some type of aquaculture at any scale. The respondent interviewed was the person responsible for aquaculture. Neighbors were used as replacement households where respondents were unavailable after three attempts.[5]

The focus groups were held in communities neighboring those where the survey was conducted to avoid overburdening respondents with multiple data collection efforts. Two sets of tools were developed for focus groups. These were conducted with different groups, again to reduce the burden of long sessions. The groups were separated into men and women only, but they were mixed in terms of types of aquaculture: homestead, commercial, ponds, other water bodies, and species. Local leaders provided support to mobilize participants in the FGDs. Effort was made to ensure that every type of farmer in a particular village was represented. For this study, youths are defined as those men and women in the village between the ages of 15 and 29.

For the market actor survey, a list was subsequently generated of both market actors and also markets where respondents sold their fish. For buyers outside of markets, two respondents of each type were selected for every upazila. In the most mentioned physical markets, at least 10% of market actors present were interviewed using a transect technique applied to market stalls.

Key informants were purposively selected to provide information on specific issues. Information from the focus groups was used to identify key input dealers and service providers (feed, seed, chemicals, health services, credit, etc.), as well as supporting organizations and their location and/or contact info.

An overview of the sample size by respondent type and method is presented in Table 3.

Respondent type	**Farm survey***		**Market survey**		**Focus groups****		**Key informant interviews*****	
	Men	Women	Men	Women	Men	Women	Men	Women
Farm households	543	104	-	-	20 groups (4 youth groups)	20 groups (4 youth groups)	-	-
Intermediaries			52	0	-	-	43	0
Retailers			127	0	-	-	72	1
Consumers	-	-	-	-	-	-	112	61
Input & service providers	-	-	-	-	-	-	56	0
Other stakeholders	-	-	-	-	-	-	13	0

* *The main respondent was male in 84% of the surveys and female in 16%. Questions on roles carried out by women were, in all cases, answered by female respondents to ensure accuracy. In 98% of the cases, these women were interviewed alone.*

** *Each group had 10 participants. In total, there 400 participants in the groups: 200 men (including 40 male youths) and 200 women (including 40 female youths).*

*** *If women were not explicitly visible to the researchers, attempts were made to reach women during the KIIs by asking farmers and market actors about existing women in the value chain.*

Source: fieldwork protocol, available upon request.

Table 3. Sample size, by actor and data collection method.

3.3.3. Data collection

Secondary data

Secondary data from the DOF in Bangladesh was used for the economic analysis, specifically the assessment of the total volume of the sector in the two divisions. This data was then combined with our own primary data to estimate the total volumes traded in the region and the number of jobs in the sector. The extrapolation, done in Microsoft Excel, was based on the proportions of different typologies of producers and market actors in our sample. This enabled us to show the quantities of fish flowing through different sales channels to each of the actors.

Survey data

Survey data was collected from fish farmers and market actors. Firstly, we surveyed a random sample of 647 fish farmers in Rajshahi (341) and Rangpur (306) divisions. Households were interviewed in detail about their production, production practices, costs, labor use, sales and women's roles. Afterward, a market survey was conducted among 179 market actors in several selected markets. These were either intermediaries (30%) or retailers (70%). Market actors were surveyed about their fixed and variable costs, labor use, sales and women's roles.

Focus groups and key informant data

A total of 400 people (200 men and 200 women) participated in the focus groups, including 80 youths (40 male and 40 female). The FDGs were led by a team of male and female qualitative researchers and notetakers in four districts (Natore, Rajshahi, Gaibanda and Rangpur) and eight upazilas of Rajshahi and Rangpur divisions. The tools used in the FGDs were livelihoods and aquaculture production systems, decision-making in the value chain, relationship ranking, value chain mapping and youths. These tools are described in the study protocol, which is available upon request. All the data was recorded with permission, then transcribed verbatim and translated.

The value chain actor and market data collected during the value chain mapping exercise from the FGDs was then used to follow the different actors and conduct KIIs with farmer identified inputs and service actors, NGOs, government, key experts, producer groups, market actors who buy and sell fish, and also consumers. During the quantitative stage, further KIIs were conducted with *arotdars*, retailers and consumers from markets that farmers identified during the farmer survey and later from markets identified by the market actors who they further sell to. This led to interviews being conducted all across the country, as fish were sold to different markets all around Bangladesh.

3.4. Data analysis

3.4.1. Overview

The analysis of data consisted of three types using the following qualitative and quantitative methods:

Functional analysis: This provides a general mapping and description of the main actors, activities and operations in the value chain. It also includes an overview of the products and product flows, the major production systems, a description of the main governance mechanisms in the chain, and a short description of known constraints. The functional analysis formed the basis for the analyses in the other components.

Economic analysis: First, this consists of a financial analysis of each actor type (financial accounts, return on investment), as well as an assessment of the consolidated value chain (total value of production, extrapolation for the sector). Second, it assesses the inclusiveness of the chain by examining income distribution (business income, wages), and employment creation and distribution.

Social and gender analysis: This explores whether the aquaculture value chain is inclusive and where different types of actors sit within the value chain. It delves into equity and power issues among these different value chain actors, including gender and intersectionality, such as age and wealth status. It further looks into equitable access of inputs, output market, information and services, decision-making at the household and community level, and the social and economic upgrading strategies of these actors as they deal with various opportunities and constraints along the value chain, including social and gender norms.

In carrying out the analysis, to create holistic insights useful for systems interventions, these elements are not addressed discreetly, but rather in an integrated way in the results, analysis and recommendations of this study.

3.4.2. Qualitative analysis

The data from the FGDs and KIIs was coded and analyzed through the software N-Vivo 12 using a coding structure based on the gender value chain conceptual framework (Danielsen et al forthcoming).

3.4.3. Quantitative analysis

Survey data was analyzed in the statistical software STATA. First, we cleaned the data and removed the most extreme outlier values—those that exceeded the mean values with more than four times the value of the standard deviation. Next, the variables needed for the analysis were created. Most data was specified per fish species, but this analysis is species-specific.[6] Therefore, data from all species of fish was aggregated. Afterward, both farmers and retailers were classified into categories based on their characteristics. For farmers, these characteristics were input use (especially commercial feed) and hired labor. Retailers were classified into two categories based on their number of fixed assets and whether they hired labor. Furthermore, the team combined data of some variables into summary variables. An example of this concerns combining variables on specific cost posts into one variable with all costs.

Some data manipulation was needed to conduct an analysis of the annual operating accounts. In the first place, the primary unit of analysis for the operating accounts was a year. As some data was presented in a different unit (for example, per day, per week or per month), data was transformed where necessary.

Photo credit: Noor Alam/WorldFish

Gollamari fish market in Khulna, Bangladesh.

4. Value chain composition

This section covers the following research questions: What is the composition of the chain in terms of products, nodes, and actor tasks and roles? How is this divided among different types of people (gender, age, other social markers)? How is this influenced by social and gender norms?

4.1. Volumes

According to national statistics, the total aquaculture production in Rangpur and Rajshahi divisions had a volume of about 487,000 t in 2017–2018 (Table 4), an increase of almost 16% from 2015–2016 (DOF 2017). This comprised 20% of the country's aquaculture production in 2017–2018, which was 1% more than in 2015–2016. The volume produced in Rajshahi was almost double that of Rangpur (330,000 t versus 160,000 t). This is a direct result of the water surface area allocated to fish production in Rajshahi, which is almost twice that of Rangpur. Together, the two districts have allocated about 136,000 ha to aquaculture.

The predominant form of fish cultivation is pond culture. According to official statistics, 93% of total production was produced in ponds in the 2017–2018 period. An additional 6% originated from seasonally cultured water bodies. Other production systems, such as shrimp culture, pen culture and cage culture, were only practiced to a minor extent. Due to the dominance of pond culture in Rajshahi and Rangpur, our analysis focuses on pond culture as the dominant system.

4.2. Value chain map

The composition of the value chain is presented in Figure 2. It should be noted that the share of men and women value chain actors is based on the survey. In the focus groups, we also asked for information on specific cases of women in certain roles. This means that while we found only one woman retailer and no women intermediaries, we report on some women in the qualitative results. The value chain starts with the hatcheries that produce fry and fingerlings. This seed is sold to the four different types of farmers, either directly or through a network of nurseries and also seed traders, known as *patilwalahs*. The volumes shown for each farmer, in the blue boxes, are estimates of the total volume of fish produced in aquaculture by this type of farmer in the two divisions. This is based on the relative quantities produced by farmers in the sample, extrapolated to the entire sector in the northwest, using the official statistics on total production (DOF 2018). The share of self-consumption is based on the mean value of the respondents in our farm survey. Other information given in the figure is the amount of labor provided by men and women. We describe this further in Section 4.4.

Division	Ponds	Seasonally cultured waterbody	Shrimp/ prawn culture	Pen culture	Cage culture	Total
Annual production (t)						
Rajshahi	307,410	20,995	47	3	472	328,930
Rangpur	147,345	10,275	39	191	133	157,908
Water surface (ha)						
Rajshahi	69,440	20,016	14	1	N/A	89,471
Rangpur	36,304	10,461	20	118	N/A	46,903

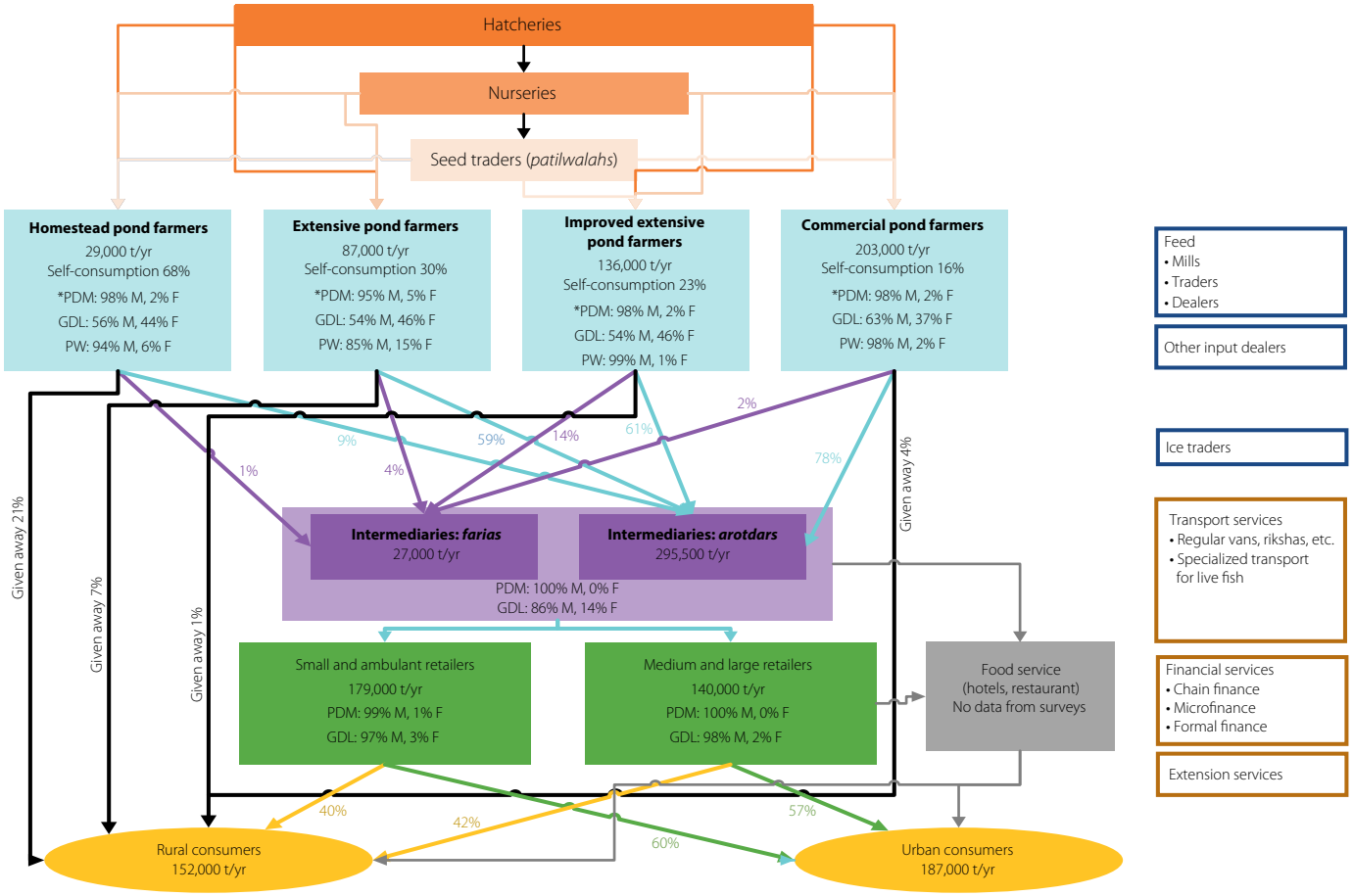
Source: DOF 2018.

Table 4. Total fish production and water surface in Rajshahi and Rangpur divisions (2017).

The arrows show which share of total production is sold to other actors in the chain. For example, all homestead producers together produce about 29,000 t annually. Of this production, about 68% is used for home consumption by the producing households, about 21% is given away to neighbors and relatives, 9% is sold to *arotdars* and finally 1% is sold to *farias*.

The volumes indicated for the subsequent actors in the value chain are based on the flows of product they receive from farmers and other actors. This is to some degree a simplification, as in some cases there are multiple intermediaries between the farmer and the retailer. The retailers are further classified into two categories: (1) small or traveling retailers and (2) medium and large retailers. Slightly more than half of what the fish intermediaries sell goes to small or ambulant retailers (55%) while the remainder goes to medium and large retailers. The food service sector (hotels and restaurants) is another supplier of fish to consumers, in this case served as meals. We do not have quantitative data on this type of actor. Finally, we have classified consumers based on their location of purchase, either rural or urban. The assumption is that all fish given away is consumed by rural consumers. This is further discussed in Section 5.2.

Inputs to farmers include feeds from feed traders (smaller businesses) or feed dealers (larger businesses) who source their feeds from feed mills. Other inputs include fertilizer to enhance pond productivity and chemicals. Fish are generally transported using nonmechanized vehicles or motorized vehicles. Nonmechanized vehicles are flatbed bicycle rickshaws, which are referred to as vans. Motorized vehicles include automated vans, automobiles like *nosimons* and CNG automobiles (four-stroke three wheelers), easy bikes (battery-charged rickshaws with more seating capacity), trolleys, pickup trucks and larger trucks. The live fish component of the value chain has specialized trucks to transport fish. These are either open in design or hold fish in large tanks with aeration, which is a more controlled system. Ice dealers and traders support the iced fish value chain.



Note: **PDM: Primary decision-maker, **GDL**: Household gender division of labor, **PW**: Person that does most work, **M**: Male, **F**: Female*

Source: own data, DOF 2018.

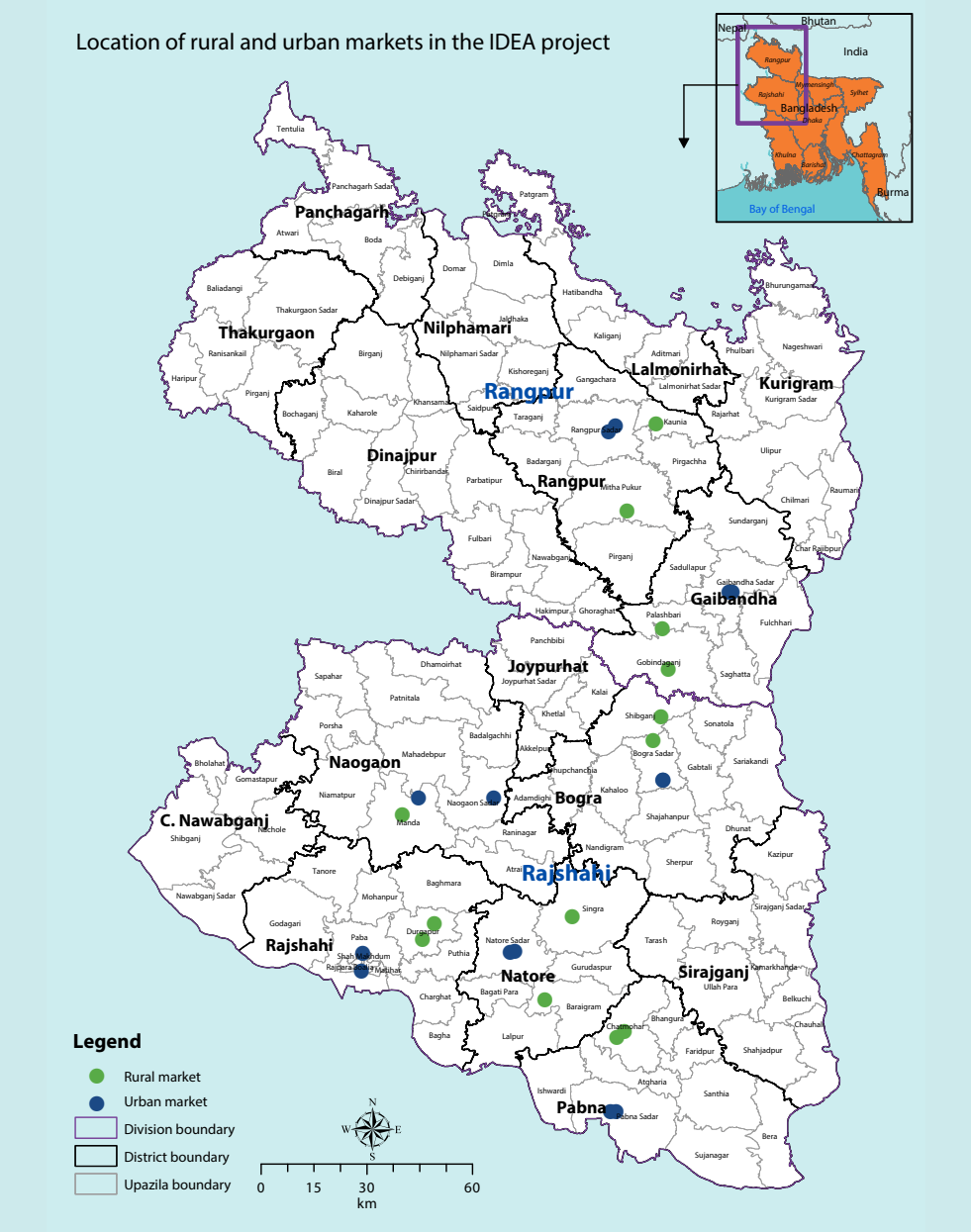
Figure 2. Aquaculture value chain map for northwestern Bangladesh.

The qualitative data shows that although throughout the value chain the majority of transactions are still cash-based, short- and medium-term credit arrangements between actors are common. Most agreements are informal, with only some larger transactions, such as feed, being subject to formal agreements. Fish prices depend on species, size, color, freshness and product form, whether live or iced.

Figure 3 shows the location of the rural and urban fish markets in northwestern Bangladesh. Although there are many rural fish markets in the region, the exact number is unknown. The markets depicted in the map are the ones where WorldFish is carrying out the fish market price survey.[7]

4.3. Products

A wide variety of species is produced and sold in the aquaculture value chain in northwestern Bangladesh. Both men and women prefer local (*desi*) species of fish. According to KIIs with consumers, the top 10 most popular fish among both women and men are, in order, rohu, pangas, tilapia, koi, silver carp, catla, small fish (various), bata, puti and common carp. Generally, the species men and women consumers report buying most frequently are the same. The exceptions are puti and other small fish, which only women mentioned.



Source: WorldFish 2019.

Figure 3. Map of rural and urban fish markets in northwestern Bangladesh.

Fish buyers generally look for five characteristics of fish to determine their worth: size, product form (iced or live), species, color and smell. Overall, consumers expressed a strong preference for live fish. In addition, interviews show that large fish are preferred over small fish, especially in cities. They are also considered tastier than small fish and so are sold at a higher price. For those with a limited budget, smaller, iced fish are preferred because they are more affordable.

According to key informants, the vast majority of fish is still being sold fresh (dead and on ice), but in recent years live fish supplies have increased, to all markets. Live fish are perceived to be freshest and fetch higher prices. This trend is a result of reports of using of formalin (a classified carcinogen) to preserve fish—a practice that can be damaging to both human health and the natural environment. Both men and women show a preference for buying live fish, particularly shing, catfish, koi, tengra and tilapia. But only men expressed limitations in accessing this product form. There is a growing demand for the national fish, hilsa, which is harvested from rivers. There is also an increasing number of complaints about the high cost of some fish, such as rohu and catla, and live fish in local markets.

Among consumers, both males (who made up 65% of the total sample) and females (35%) reported recent increases in fish consumption in terms of both quantities per meal and the frequency of meals with fish. Markets that supply fish have increased in numbers, and they supply a wider variety of fish, including some new species. This is the case both in larger markets as well as small local markets. Some women consumers reported preferring going to markets that have a larger variety and selection of live fish.

4.4. Seasonality

Seasonality in fish production stems from variations in water availability and temperatures. These affect the growth rate of farmed fish, as well as the availability of wild caught fish. These seasonal variations result in temporal fluctuations in species and quantities available, as well as prices and consumption levels. Some farmers have ponds that are seasonal, which only contain sufficient water for aquaculture part of the year; others have ponds that are perennial. In the seasonal ponds, farmers often stock larger, advanced fingerlings (from nurseries) of specific species that can be grown to market size within a few months. The seasonal ponds in Rangpur and Rajshahi are available from April/May to November/December. Tilapia culture is high in those ponds, as this species can be grown to market size relatively quickly.

In perennial ponds, fish culture is done throughout the year, even if the ponds are small. Farmers reported two preferred culture periods: (1) March to February (rohu, catla, mrigal, silver carp, big head, common carp) and (2) July to June (rohu, catla, mrigal, silver carp, bighead and common carp). The latter was reported mainly in Gurudaspur Upazila of Natore District in Rajshahi Division and Paba Upazila of Rajshahi District. Commercial farmers buy fingerlings or advanced fry at low prices from September to November for stocking.

Since seasonal weather patterns dictate the grow-out cycle, there are major peaks in supply just before the winter, when fish growth slows down, the prevalence and severity of disease increases and seasonal ponds start to dry up. This peak in supply, particularly tilapia, means that overall fish prices are low during this period. During the rainy season, the high supply of open water fish, such as hilsa, also contributes to low prices of farmed fish during the rainy season. This is not only a result of higher supplies of fish in general, but also because many consumers prefer wild over cultured fish, though in practice they may not be able to distinguish them. During winter, when supplies are low, fish prices increase.

4.5. Typology of actors

This section describes each of the value chain actors, including input and service providers, and describes the roles and responsibilities that men and women have in each of these functions (Section 3.1). The information in this section is derived from the FGDs and KIIs, unless otherwise indicated.

4.5.1. Seed producers and traders

Hatcheries

Hatcheries produce fish fry from broodstock to sell to nursery operators and *patilwalahs* as well as directly to farmers of all intensity levels, though with increasing quantities and frequency as farm

intensity levels increase. Together, they produce 20 species of fish, of which 12 are indigenous and eight imported. These consist of various species of carp and catfish, together with tilapia, but they usually specialize in one or a few species. Hatcheries vary in size and sales volumes and also in staff employed (between one and 10 employees). During the fieldwork, no women were found to work at a hatchery. Sales are usually conducted in cash, using bKash (a mobile financial service provider) or on short-term credit. Almost all of the clients are men. Only 4% or less are women.

Nurseries

Nurseries supply fingerlings to farmers (mainly homestead, extensive and improved extensive) and *patilwalahs*. The nurseries from the two divisions produce nine indigenous species and seven that are produced from imported (or exotic) species, consisting of various species of carp, catfish and barb. Only one female client was mentioned by all nurseries interviewed. They employ anywhere from one to 12 staff, and all of them are men. Most sales are cash-based, with some short-term credit (15–20 days) or bKash. No formal agreements are made with clients in advance.

Mobile fingerling and fry traders or *patilwalahs*

These sell fingerlings and fry to farmers, both homestead and commercial, by going house to house through spot market transactions. They trade in seven species of fish that are indigenous and eight that are imported, consisting of various species of carp, catfish, barb and tilapia. In terms of business operation capacities, the scale varies significantly, from zero staff to as many as 25 (mainly day laborers), all of whom are men. In terms of financial operations, the payment options include cash and short-term credit (10–90 days), as well as bKash. Between 4% and 15% of their clients are female, particularly widows or women whose husband is absent. Women farmers, especially, appreciate the role of the *patilwalah* because they deliver fingerlings to their homes, which means the women do not need to challenge norms around their mobility. Men value nurseries and hatcheries because they believe the quality is better and they have more choice.

Generally, only men operate hatcheries and nurseries and work as *patilwalahs*. Hatchery owners are from a higher wealth status, while *patilwalahs* are usually poorer. Nursery operators are usually farmers who also farm fish. In the survey, no women were reported as owners in any of the seed businesses, nor as employees in hatcheries, though experts have indicated they do exist. Women are hired as labor in nurseries and farms, but only for digging ponds and removing silt and mud.

4.5.2. Producers

The main role of farmers (or producers), the majority of whom are involved in carp polyculture, is to produce fish. Farmers produced between five and 13 species of fish, including carps, catfish, barbs and tilapia. The top five most popular fish farmed were silver carp, rohu, tilapia, shing and common carp. Farmers mostly sell unprocessed fish on ice, but in recent years a new product form of live fish has gained popularity. The fish are sold to intermediaries (*arotdars* and *farias*), retailers, members of harvest teams, and directly to consumers.

Based on the data collected, and a classification based on pond location, inputs and use of hired labor, we distinguish four types of producers: homestead pond farmers, extensive pond farmers, improved extensive pond farmers and commercial pond farmers. From the survey data, it seems as if these categories do not overlap much—meaning those that report having a homestead pond do not also report having another pond elsewhere. However, the FGDs reveal that some farm households might have both a homestead and a commercial pond.

Table 5 shows the main characteristics for each type of producer. Homestead pond farmers operate backyard ponds. The main purpose of these ponds is usually to produce food for the household, but they are often used for other purposes, such as washing clothes, water collection, bathing, etc. Homestead ponds are relatively large (larger than improved extensive ponds and extensive ponds): on average 0.28 ha. Extensive pond farmers operate ponds to sell part of their produce, but their production levels are low and they use little hired labor or commercial feeds. With an average pond surface of just 0.16 ha (40 decimals), extensive ponds are the smallest pond type. Improved extensive pond farmers typically have one or two hired laborers and use some commercial feed, up to 1000 kg/ha. Finally,

commercial pond farmers have a higher use of inputs and labor and a larger output. In this sample, a producer is classified as a commercial farmer if the use of commercial feed per hectare exceeds 100 kg/ha and at least three hired laborers are working on the farm. Commercial pond farmers produce, on average, 748 kg of fish every year on their entire farm.

Roles and responsibilities

Household labor, defined as labor-input provided by members of the household, is an important source of labor for production and related activities for all farm types. From the focus groups with men and women farmers, we found marked social and gender differences in the type of roles that men, women and youths played, as well as in terms of wealth status in laborer versus farmer. Overall, women play a more active role on homestead farms compared to commercial farms. Generally, fish farming in homestead ponds relies mostly on family labor, whereas for other ponds more labor is hired, usually men. Figure 4 (right) shows the number of household laborers who provide input into production, for each of the producer types, based on the farm survey data. This shows that commercial pond farmers use most family labor: there are on average three household members working on a commercial farm. Homestead pond farmers use the least amount of family labor (2.3 on average). For all categories, it can be concluded that it is most common that family members working in their aquaculture ponds are older than 30 years of age and that more male labor is used than female labor. In terms of the amount of time households use for aquaculture, both commercial and improved extensive farms use about two full-time equivalent (fte) laborers annually, while labor spent on extensive ponds and homestead ponds is about 1 fte per year. Women's share in total labor days is more or less the same for homestead, improved extensive and extensive farms, at 45%, and slightly lower for commercial farms, at 37%, as shown in Figure 4 (right).

From the FGDs, we find that for homestead production, in terms of family labor, women carry out activities such as feeding (most reported), preparing the feed, giving food to hired workers, liming (only reported in one FGD by women), water management, weeding (men and women reported in one FGD each), harvesting for consumption using spears for catching fish, controlling predatory species (women reported in one FGD), pond preparation, silt or sludge removal, and harvesting for sales (mentioned by women in one FGD). Women are also involved in sorting fish, by size and species.

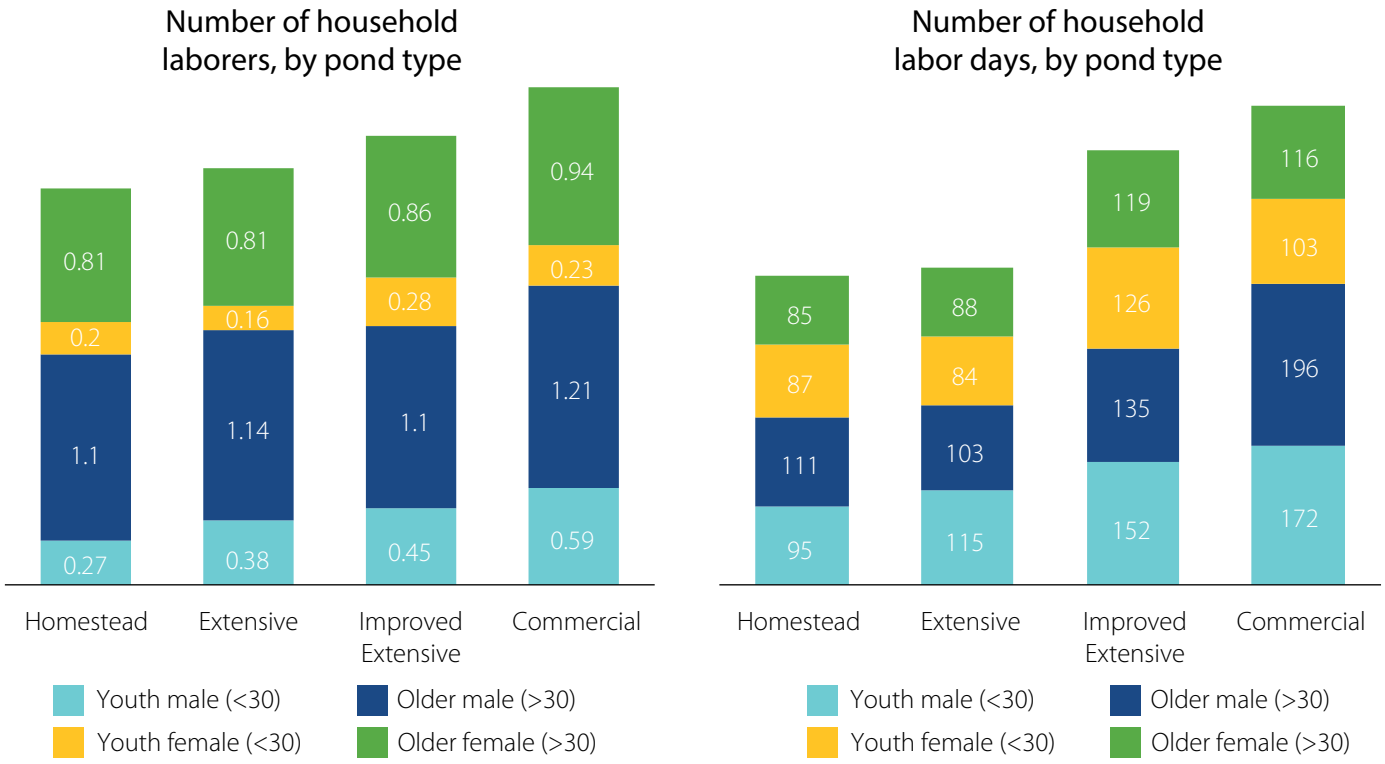
Men also perform these roles, with the exception of preparing feed for fish and the food for laborers. In addition, men reported a more active role in sludge removal, soil management, pond digging, pond preparation, dike repair, controlling predatory species, water management, weeding, harvesting for sale and consumption, liming, fertilization and marketing. The only role that women perform more than men is feeding. Young men (namely sons of the household) were more present than older men in some activities,

	Homestead pond	Extensive pond	Improved extensive pond	Commercial pond
Pond surface (ha)	0.28 (0.26)	0.16 (0.18)	0.22 (0.21)	0.33 (0.28)
Total harvest during the previous 12 months (kg)	106 (91)	319 (382)	500 (607)	749 (608)
Common species	Carp polyculture, especially with rohu (86%) and mrigal (63%)	Carp polyculture, especially with rohu (90%)	Carp polyculture, especially with rohu (95%)	Carp polyculture, especially with rohu (97%)

Note: standard errors in parentheses.

Source: farm survey data.

Table 5. Fish farm characteristics, per producer type.



Source: farm survey data.

Figure 4. Family labor for fish production: number of people that contribute and total number of labor days per pond type, by gender and age group.

such as mud management, pond management, liming, stocking fingerlings, water management, pond digging, pond preparation, controlling predatory species, managing hired workers, soil management, fertilization, feeding, harvesting for sale, and transporting fish to the market. Young women (daughters) in the household do not get involved in aquaculture except for feeding.

Women from fish farming households are found to perform many of the same activities listed for homestead farms in extensive, improved extensive and commercial ponds. From the FGDs, however, we conclude that the extent to which this occurs is shaped by the distance of the pond to the home or whether there is a man available in the household who can do it instead. Daughters do not get involved in commercial aquaculture because the work is deemed too hard for young women.

Hired labor is predominantly concentrated on commercial ponds (Table 6). On average, commercial fish farmers hired workers for 199 days over the previous 12 months. Hired labor among the other types of producers was limited.

	Homestead pond	Extensive pond	Improved extensive pond	Commercial pond
Youth male (<30)	6	0	3	73
Older male (>30)	8	0	6	126
Youth female (<30)	0	0	0	0
Older female (>30)	0	0	0	0

Source: farm survey data.

Table 6. Labor days worked by hired workers on-farm during the previous 12 months, by pond type.

Improved extensive farmers indicated to only hire laborers for 9 days a year, while homestead pond farmers hired labor for 14.

The farm survey results showed hired laborers to be male in all cases, with older males (over 30 years of age) being more common. However, according to the focus groups, some female workers are being hired for a few specific tasks such as pond preparation, including mud and sludge removal, mostly in homestead fish farming. These are mostly older women. Generally, women are deemed unable to perform much of the work that aquaculture requires, except mud and silt removal during pond digging. Their labor is used more for agriculture.

Generally, labor is mainly hired for pond digging, and mud and sludge removal. In some cases, based on need and financial capacity, hired labor is used for dike repair, controlling predatory species, harvesting, liming, fertilizing, weeding and water management. Richer farmers hire labor for almost everything and so do women farmers who do not have able men in the house to help them. Overall, laborers are hired based on pond size and financial capacity of the household. Commercial ponds are usually larger and therefore require more labor. The men and women that conduct the hired labor are from poor socioeconomic classes. For women in particular, it is due to their poverty that their mobility and labor are socially accepted.

4.5.3. Market actors

We distinguish between three major types of market actors: intermediaries (*farias* and *arotdars*), retailers and food services.

Intermediaries

Intermediaries are actors who buy fish from farmers and sell them to other market actors, mainly retailers. Note that an explicit decision was made to include *arotdars* in this category. Typically, they are involved in auctioning fish only, so they do not buy and sell themselves but facilitate transactions. In practice, however, they also increasingly engage in fish trade themselves. They buy fish from farmers with direct payments, rather than taking a commission fee for organizing the auction, and arrange payment between the seller and buyer.

Farias

Farias are traders who buy fish from farmers and sell them to other intermediaries or retailers. They are often mobile and smaller in operations, though some are involved in selling to larger, city markets. They trade in both live and fresh (iced) fish and also sometimes supply fry and fingerlings. The qualitative study recorded one woman faria in Bagatipara Upazila of Natore District who continued her business after the death of her husband. In terms of production, *farias* sell nine indigenous and five exotic fish species, which consist of various species of carp, catfish, tilapia and snakehead.

Arotdars

Arotdars are powerful actors in the chain. They facilitate auctions, so they are considered service providers to the value chain. In practice, however, many *arotdars* also buy and sell fish themselves, so they can be classified as intermediaries rather than solely as service providers. They also sell fish to other intermediaries, retailers and the food services sector. *Arotdars* from the two divisions deal with 14 indigenous species of fish and crustaceans and seven imported species of fish, consisting of various species of carp, catfish, barb, tilapia, snakehead and prawns, as well as some wild fish, such as hilsa. Sales transactions usually are in cash or on credit, though the arrangements vary from short term (2–15 days) up to 2 months. *Arotdars* also use bank transactions and dadon. In addition, they earn commission fees from sales they facilitate and provide credit to farmers, traders and retailers. *Arotdars* have some formal agreements for transactions, but usually this is not the case.

Arotdar staffing varies from two to 17 people, but they do not report any women employees. In terms of social and gender profile, men of higher wealth status dominate ownership of these businesses. No women were present. *Arotdars* reported that women are not interested in this type of fish-related business because they are busy at home. Even if they are interested, *arotdars* claim, they are unable to obtain permission from their spouses. Yet, they said their own wives were supporting their business, though we have no further details on how. Interestingly, they reported a growing engagement, in terms of participation, among male youths. Male youths also expressed an aspiration to engage in aquaculture as *arotdars*.

Retailers

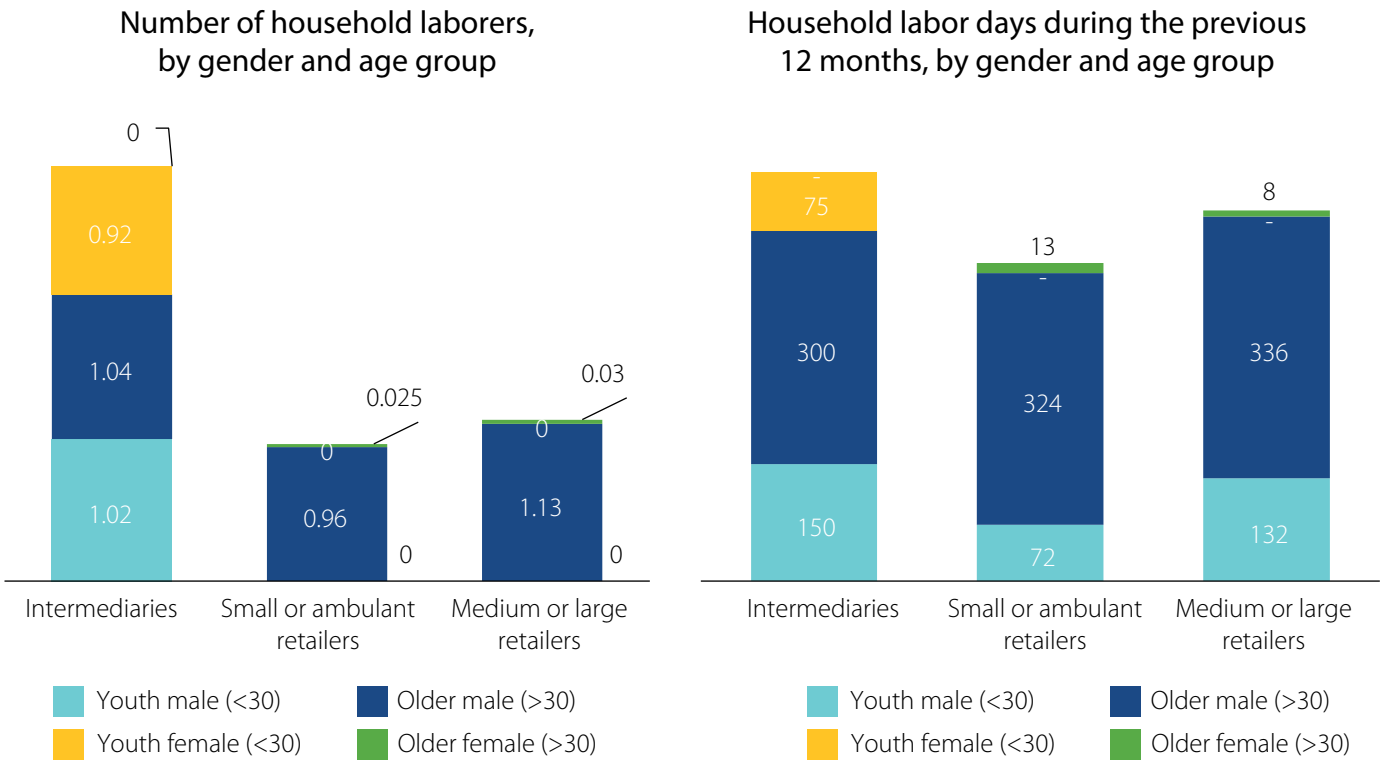
For the economic analysis, we further classify retailers by size. Small and ambulant retailers possess a limited number of fixed assets and do not make use of any hired labor. The average annual revenues for this type of trader are BDT 4,849,228. Medium or large retailers own a number of fixed assets, such as buildings, motorized transport and equipment. They also make use of hired labor, though this is not the case for all medium and large retailers. Medium and large retailers reported an average annual revenue of BDT 7,300,259. In terms of social and gender profile, retailers, particularly small and ambulant ones, are dominated by men of poor wealth status, as defined by participants in the focus groups. While the survey data only found one female retailer (less than 1% of the sample), focus groups indicated there are at least two more. A total of three women were reported, all in Rajshahi Division: two in Mohishal Bazar in Godagari Upazila and one in Singra Bazar in Singra Upazila of Natore District. They were engaged out of necessity, due to poverty and in the absence of a male income earner in the family.

Food service

In the farm and market surveys, for unknown reasons, none of the respondents mentioned the consumer food service sector as a buyer of fish. This term includes all types of business that serve meals and snacks for immediate consumption, such as restaurants and hotels. Respondents in the FGDs did highlight this as another market channel for consumers. As we do not have quantitative data on this actor, we are unable to estimate the size of the product flow through this channel. However, we assume it does not have a major impact on the relative volumes that end up with rural and urban consumers.

Roles and responsibilities

All interviewed market actors depend to a large extent on household labor. Figure 5 (left) shows that market actors spend between 525 (intermediaries) and 409 labor days (small and ambulant retailers). Household laborers are primarily male, though market actors also work with some female household members. Figure 5 (left) shows that intermediaries make use of family labor in their business, though this is less common for retailers, who only report on one person from the family contributing. Many women below 30 years of age work in the business, though this adds up to only 14% of the total amount of family labor that is contributed.



Source: market survey data.

Figure 5. Family labor for fish selling activities: number of people who contribute and labor days per market actor type, by gender and age group.

Intermediaries generally make most use of hired laborers. They hired on average almost 12 paid workers. Small and ambulant retailers did not hire any laborers, while medium or large retailers hired about five. These numbers are in line with expectations, since intermediaries trade significantly larger volumes and therefore need more laborers. As was the case in fish production, all hired laborers in fish trade were male. Intermediaries hired more older men, while medium and large retailers primarily hired youths. Young men often "hang out" in the markets looking for casual labor opportunities to help their families, and their labor is availed by these retailers. *Arotdars* generally need more experienced staff for the auctions. From the KIIs, all retailers and intermediaries (including *arotdars*) reported family members (son, daughter, wife) helping in running their businesses. In the market survey, *arotdars* reported hiring only male employees. During survey testing, however, the field team found *arotdars* who had hired women as casual employees to clean the fish baskets after the auctions.

4.5.4. Consumers

Consumers are those who purchase fish for consumption in their household. Among the interviewees, consumption varied from daily to monthly, but most bought fish every 2 to 3 days. They buy from local bazaars, fish markets and the bus station. They buy in the area where fish is the cheapest, in the markets closest to the house (up to 15–30 minutes or 0.25–1 km away), particularly women, and where weight is measured properly. In our sample, across different markets, 35% of consumers were women. Interestingly, while women are not permitted to sell fish in the market, they are able to visit them to purchase groceries. There were no major limitations reported in accessing the desired fish from the markets, though men reported some limitations in the amount of live fish available.

4.5.5. Input suppliers (feed and ice)

Feed mills or factories

Feed mills or factories manufacture formulated feeds from raw and processed ingredients. They sell feeds to feed traders and dealers, subdealers and farmers. In terms of production, they provide feed for six local and two exotic species, including carps, catfish and a barb. Moreover, 50%–100% of their feeds are for fish farming. No female clients were recorded during the field visits. They employ between two and 15 staff, including some women. Sales transactions are mostly cash (70%), but also based on credit (30%). They use bank transactions and bKash, and often there are formal agreements with clients.

Feed dealers

Feed dealers supply aquaculture feeds to farmers (all sizes) and feed traders who operate smaller feed businesses. They get their fish feed directly from a feed processing factory (feed mill). Most companies provide (in-kind) credit to feed dealers, but small feed companies provide comparatively more credit than larger ones. Feed dealers provide feeds for 10 local and five species of exotic fish, including carp, catfish, a barb and tilapia. They employ one to four workers, who are all men. Sales transactions are cash, or based on credit, often using bank transfers. For the two divisions, feed dealers reported between zero and three

	Intermediaries	Small or ambulant retailers	Medium or large retailers
Youth male (<30)	157	0	48
Older male (>30)	512	0	10
Youth female (<30)	0	0	0
Older female (>30)	0	0	0

Source: market survey data.

Table 7. Number of days worked by hired laborers, by market actor type.

female clients. Men dominate the feed dealer business, with only one reported woman feed dealer, according to men in one FGD. Feed traders get their feed supply from feed dealers, after which they sell and distribute feeds to farmers of all types, particularly improved extensive farmers and larger ponds. Traders supply feeds for carp and other fish that can use them. This includes 10 local and five exotic species, including carps, catfish, a species of barb and tilapia. Between zero and 10% of their clients are women, and they dedicate 10%–100% of their business to fish feeds, though some provide training to farmers. In terms of their capacities for business operations, they have zero to four staff. In terms of finances, some operate on cash, with short (2–15 days) and long-term credit (2–12 months). Some use a memo to cover credit. Credit terms for a 25 kg sack include a BDT 50 extra charge. Only a small number default.

In terms of social and gender profile, feed suppliers are mainly men from a higher social profile. The fieldwork encountered one woman feed seller in the city of Saidpur in Badargani Upazila of Rangpur Division, according to male FGD participants. The same FGD also reported that one woman deals with other companies, like Kohinoor. No other women feed sellers were reported. Male farmers expressed a desire to start a feed business along with farming because it is profitable. Male youths were also interested in this business.

Ice sellers

Ice sellers sell ice in larger quantities than ice traders. They sell to aquaculture and commercial fishers, as well as traders in various sizes of operations and sectors, but also to farmers, intermediaries and retailers, all of whom are men. We found eight ice sellers in the study area, all men. They usually work at night, so key informants consider this an inappropriate activity for women. There were no women clients either. In terms of their capacities for business operations, ice sellers had one staff, who is male. They operate on cash and short-term credit (1–2 days) and no formal agreements. The constraints they face include paying electricity bills and competition from one other business in the area. The opportunities include more ice warehouses, higher demand than supply, an increase in the number of businesses needing ice, and higher profits and finance, for example through BRAC.

Ice traders

Ice traders focus solely on providing their services to the aquaculture sector. In terms of business operation capacities, they have zero to two staff. They operate on cash or short-term credit (2–3 days). The challenges they are facing include other ice "mills" in the area, which decreases the need for ice. There are opportunities, however. These include more fish production in the area, which requires more ice.

Other inputs

For other inputs such as fertilizers and medicine, men dominate, with no women sellers of either. Many of the feed sellers also sell fertilizer and medicine and are of a higher wealth status. The proximity of the shop is what determines which input dealer farmers source from.

4.5.6. Service providers

Financial services

The FGDs and KIIs roughly distinguished between three main types of financing for the aquaculture value chain available in northwestern Bangladesh (for more information see Section 6.2.6):

- Chain finance: This is comprised of short-term loans from suppliers or buyers within the value chain, including a type of arrangement that in Bangladesh is referred to as dadon, in which market actors advance money to farmers on condition that their fish is sold to them only, sometimes at predetermined prices.
- Microfinance: This consists of financial services from microfinance institutions, NGOs and moneylenders.[8] These loans are generally easier to get than commercial bank loans, but often have high interest rates. Often it is easier for women than men to get loans from NGOs, and sometimes women's membership in a microcredit group is required to be able to get a loan. Some of these institutions also have women loan officers.[9]
- Commercial/formal finance: This is made up of formal loans from banks, such as Krishi and Janata Bank, with lower interest rates, but strict requirements on collateral. These loans generally require a significant amount of paperwork, such as land deeds. These are therefore often accessed for larger loans only and mainly by men, who

usually are the titleholders on deeds. These banks do not offer specific loan products for the aquaculture sector. Different actors of the aquaculture value chain require access to credit at various times (Table 8).

Extension services

According to our FGDs and KIIs, information on farming comes from a variety of sources, including the DOF and other farmers, while market information is available from buyers (*farias* and *arotdars*). For extension services, the DOF is the main formal provider. It has a mixed gender field team, including some women fisheries and extension officers, and it reported reaching 35% women in their training session. Generally, men in the FGDs reported being satisfied with the quality of the women's work. The DOF also provides technical information on request, and it advises farmers on how to reduce the cost of production.

4.6. Gender norms and their effects on types of work

Gender norms are the second key dimension of gender relations described in our conceptual framework (Section 3.1), after gender division of labor. Gender norms are collectively held beliefs of how men and women should behave and with what resources. As such, they frame the context for women's and men's participation in aquaculture. In particular, gender norms about work and mobility help explain the gender division of functions and roles in the aquaculture value chain.

Norms about work

There are many types of work that respondents deemed unfit for a woman, such as physically demanding labor, especially with able men around the home, who are perceived to have more strength, experience and knowledge. Women are also expected to perform their care/reproductive roles, which are unpaid and leave them with little time to engage in aquaculture. Still, they spend about 3 hours every day on various aquaculture-related tasks in all types of farms. Interestingly, gender norms hinder women of lower social class less because some women are hired to do the tasks of laborers. Gender norms also influence who is recognized as the aquaculture farmer and what types of other functions women can play in the aquaculture value chain.

Generally, it is not considered appropriate, nor safe, for women to move beyond the homestead. This is a key issue that hinders women's value chain participation. This negatively affects women's access to commercial ponds, as well as markets and market information. Women face risks to their reputation if they are seen outside. This hinders them from assisting their husbands, even when it would save men production costs. Anything

Actor	Peak in finance needs
Hatcheries	Summer (April–June), wet/monsoon (June–August), autumn (August–September) and to a lesser degree in spring (February–April)
Nurseries	Throughout the year, with the exception of March
Patilwalahs	Summer (April–June), wet season/monsoon (June–July) and to a lesser degree in spring (January–April)
Ice traders	Limited need of finance, but some credit during autumn (June–August)
Feed millers	March–June, and September
Feed traders	Throughout the year, with the exception of December–March
Feed dealers	Throughout the year, with the exception of October–January
Farmers	Spring (February–April) and summer (April–June/July)
Arotdars	Throughout the year, with the greatest need during winter (November–February)

Source: KIIs.

Table 8. Peaks in credit requirements.

women do has to be done from the homestead, which is why they value *patilwalahs* as well as farm gate services, like feed delivery to their homes. Women require permission from male relatives for everything. This includes what role they can play in aquaculture, where they can go and what resources they can purchase to invest in agriculture/aquaculture.

4.7. Summary of the value chain composition

Rajshahi and Rangpur divisions together produced almost 500,000 t of farmed fish in 2018—about 20% of the country's total aquaculture production. The majority was produced in pond systems as opposed to cages, ghers and beels. Pond systems, the majority of which are carp polyculture, produce a wide range of species; for the majority this includes rohu. Mrigal (*Cirrhinus cirrhosis*) is mainly found in homestead ponds, less so in other pond types. Other common species include pangas (*Pangasius pangasius*), tilapia, koi, silver carp, catla and small indigenous species. Consumers have a strong preference for live, fresh, larger fish.

Hatcheries, nurseries and *patilwalahs* provide fry and fingerlings to four types of pond producers, varying in their degree of intensity and the main purpose of production (home consumption or sales): homestead, extensive, improved extensive, and commercial. Homestead ponds are backyard ponds, while the other three are described as "commercial." For each subsequent type, volumes of fish being sold and investment levels increase, with associated wealth levels of the owners of the farm. At the intermediary level, we distinguish between *farias* (those who buy and sell fish) and *arotdars* (who facilitate fish auctions for a fee and do not own the fish). However, in practice, many *arotdars* also fulfil the role of faria, so they also at some point own some of the fish. Retailers range from small and ambulant to large with a fixed selling location in markets. Both sell fish to rural and urban consumers.

Across all functions of the value chain, men are reported as being the main actors and decision-maker by both men and women; only between 2% and 5% of ponds have women as main decision-maker. There are women at all functions, especially at the producer level, but male household members recognize them only as "supportive spouses." Their culturally defined role as "homemakers" limits the time they can invest in aquaculture, as well as their decision-making power and therefore their ability to fully participate in and benefit from the value chain.

Women participate in many types of work (roles) along the chain. Depending on the production system, they provide about 45% of (unpaid) household labor at the farm level in homestead, extensive and improved extensive ponds, and 37% in commercial ponds. Yet only 2% of women from the sample are recognized as farmers by people in their communities. These are women working in commercial production without their spouse, because he is absent, sick or deceased. At the farm level, in all pond types, women are mostly involved in pond management, especially feeding, but rarely have the power of decision-making and leadership. Women's labor contribution declines further downstream in the chain, providing 14% of total labor days at the intermediary level and 3% at the retail level. In markets, less than 1% are women, and those who are present are usually poor or vulnerable. Women can also be found in other functions along the chain as input providers, particularly feed. These women tend to come from households without "able" men.

Norms define what roles, such as types of work for aquaculture and within the home, are perceived as appropriate for men and women and where women and men are accepted to be physically. This division of tasks and recognition explains who is considered an aquaculture farmer. Situations where it is socially acceptable for women to deviate from the norm often relate to higher wealth status or necessity, such as poverty or the loss of an able man due to death or divorce. These norms also influence what resources women and men can access to engage in the chain and what decisions they can make (Section 5), which in turn affects participation.

Only wealthier men of higher socioeconomic status with better social connections are involved in high value positions, such as feed sellers, *arotdars* and hatchery owners. Men of a lower social class, who are poorer, are present in role of *patilwalahs*. Male youths said that they aspire to roles with higher socioeconomic status. In comparison, young women said that they were more interested in pursuing higher education and blue-collar jobs, but they are afraid they will be married off and so unable to complete their dreams. Some female youths see opportunities in being nursery operators as well.

5. Social and economic performance of the value chain

This section covers the following research questions: What are the economic and social value chain benefits? What factors influence the economic and social performance of the value chain? How are value chain benefits distributed between men, women and youths, and why and to what effect?

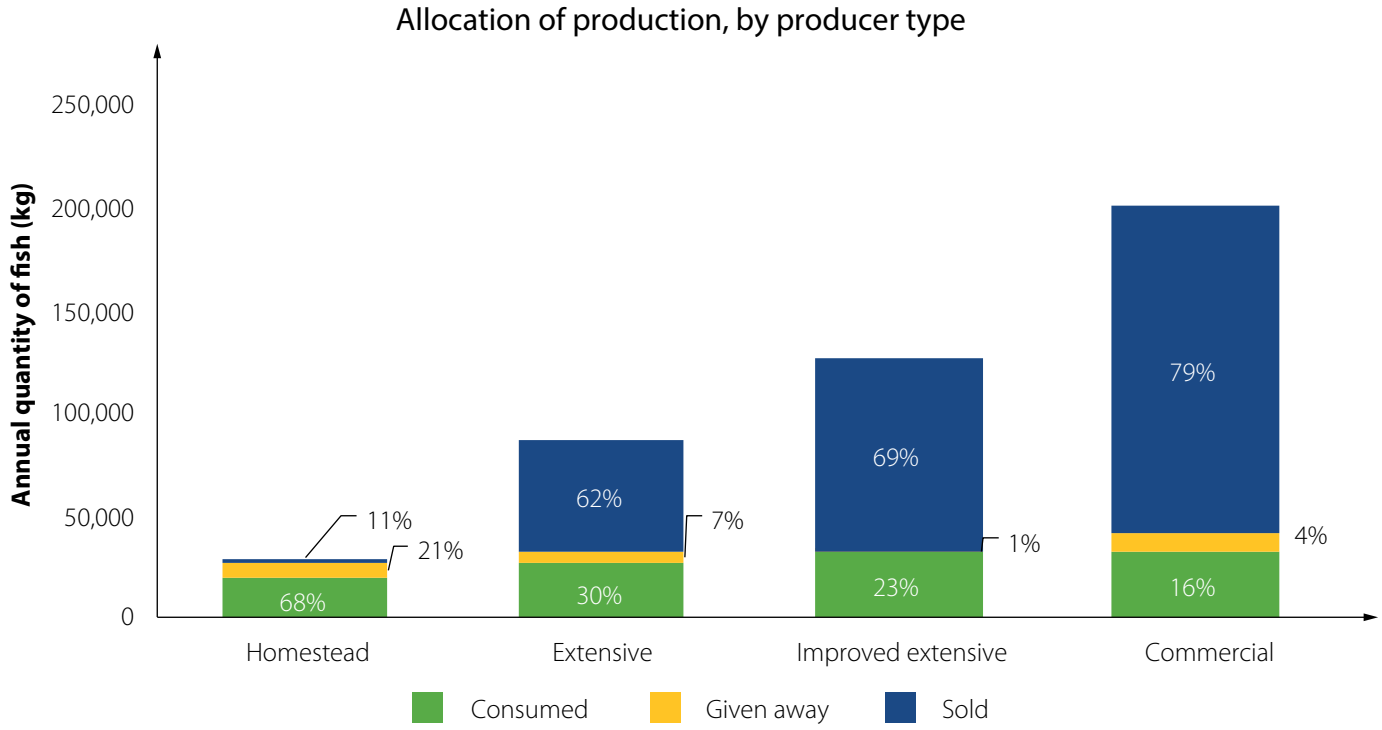
5.1. Use of fish

The farm survey data provides insight into how producers use fish. The share of output used for home consumption is highest among homestead pond farmers (68% of what is produced), followed by extensive (30%), improved extensive (23%) and commercial farmers (16%) (Figure 6). Similarly, homestead pond farmers also give the largest share away (21%). However, when examining absolute quantities consumed at home and given away, we find that they do not vary as much between the four types. In all cases, it is the surplus that is sold. This emphasizes the major role that aquaculture plays in food and nutrition security for all fish farming households. The quantity of fish given away also emphasizes its use as a tool to maintain social networks. Focus groups, however, also revealed that fish is used to pay local goons (so-called "mastaans") who extort farmers with threats of ruining their business (Section 5.6.2).

When it comes to making decisions about what fish is used for home consumption versus what is sold, the FGDS revealed that men tend to try and sell larger fish, while women might want to keep them for home consumption.

5.2. Productivity

Productivity levels vary between the four farm types (Table 9). Productivity increases with the level of intensity of the farm, ranging from 2226 kg/ha in homestead ponds to 3196 kg/ha in commercial ponds. We have also calculated the labor productivity, or the amount of labor reported as required for the production of 1 t of fish. This ranges from 81 kg per fte for homestead ponds to 286 kg for commercial ponds.



Source: farm survey data.

Figure 6. Allocation of production, by pond type.

Major determinants of productivity levels, as reported by farmers in focus groups and perceived by key informants, include the following (Section 6.2):

- Knowledge of good aquaculture practices: Technical knowledge on aquaculture production is not evenly spread among farmers, and access to technical information and extension services is lacking.
- Lack of reliable water supplies and irrigation: Farmers who operate seasonal ponds are particularly constrained in the production by the availability of water. Sufficient water was available in the monsoon season, but insufficient water was observed in the dry season.
- Disease: Diseases were widely reported by farmers across all types and of all wealth levels, but the ability to afford appropriate treatments varies with wealth levels. Shing cultivators, most of whom are large farmers, face most disease problems. Knowledge on common diseases and potential treatments is lacking. It is therefore also doubtful to what degree interviewed farmers correctly identified diseases, viruses and bacterial infections.
- Quality of inputs, including feed and medicine: The quality of products being sold is still perceived to be highly variable. For example, medicine being sold could at times have passed the expiry date, which can be ineffective or even harmful to fish. Feeds from big expensive brands maintain their quality, unlike the cheaper brands, which is why farmers advocated for feed quality monitoring.
- Access to and quality of seed: There were village-wise differences in proximity or availability of nurseries, hatcheries and *patilwalahs*. In addition, farmers had concerns about the quality of seed being produced.

5.3. Profitability

5.3.1. Producers

The analysis of net profits, based on farm survey data, sheds light on the cost structure and production efficiency. This section describes indicators according to the four main pond types. The annual operating accounts for all four are displayed in Tables 9 and 10. Figure 9 at the end of this section provides a graphical representation of the cost structure of the four main pond types.

	Homestead pond	Extensive pond	Improved extensive pond	Commercial pond
Average annual output (t)	0.28 (0.26)	0.16 (0.18)	0.22 (0.21)	0.33 (0.28)
Water surface area (ha)	106 (91)	319 (382)	500 (607)	749 (608)
Pond productivity (kg/ha)	2227 (1939)	2432 (1780)	2672 (2210)	3196 (2405)
Labor productivity (kg/fte)	81	244	323	286
Feed conversion ratio (kg of feed/kg of fish)	0.9 (0.8)	0.6 (0.9)	0.8 (1.7)	1.8 (0.9)

Note: standard errors in parentheses.

Source: farm survey data.

Table 9. Fish farm characteristics, per producer type.

	Homestead pond farmers	Extensive pond farmers	Improved extensive pond farmers	Commercial pond farmers
Sales	13,259	29,978	92,257	352,790
Self-consumption	10,206	1487	1495	2765
Total output	**23,465**	**31,465**	**93,752**	**355,555**
Consumables	11,829	26,021	34,482	66,094
Labor	149	-	3,059	85,785
Land	5718	5500	18,497	20,071
Market fees	36	1285	2108	3225
Taxes	-	-	-	-
Depreciation	366	522	600	855
Total costs	**18,098**	**33,328**	**58,746**	**176,030**
Economic performance indicators (including value of self-consumption)				
Net operating profit per year	5367	-1863	35,006	179,525
Net added value per year	11,636	5444	59,270	289,461
Profit margin (%)	23%	-6%	37%	50%
Return on investment (%)	30%	-6%	60%	102%
Economic performance indicators (excl. value of self-consumption)				
Net operating profit per year	-4839	-3350	33,511	176,760
Net added value per year	11,636	5444	59,270	289,461
Profit margin (%)	-21%	-11%	36%	50%
Return on investment (%)	-27%	-10%	57%	100%

Source: farm survey data.

Table 10. Annual operating accounts, by producer type (BDT).

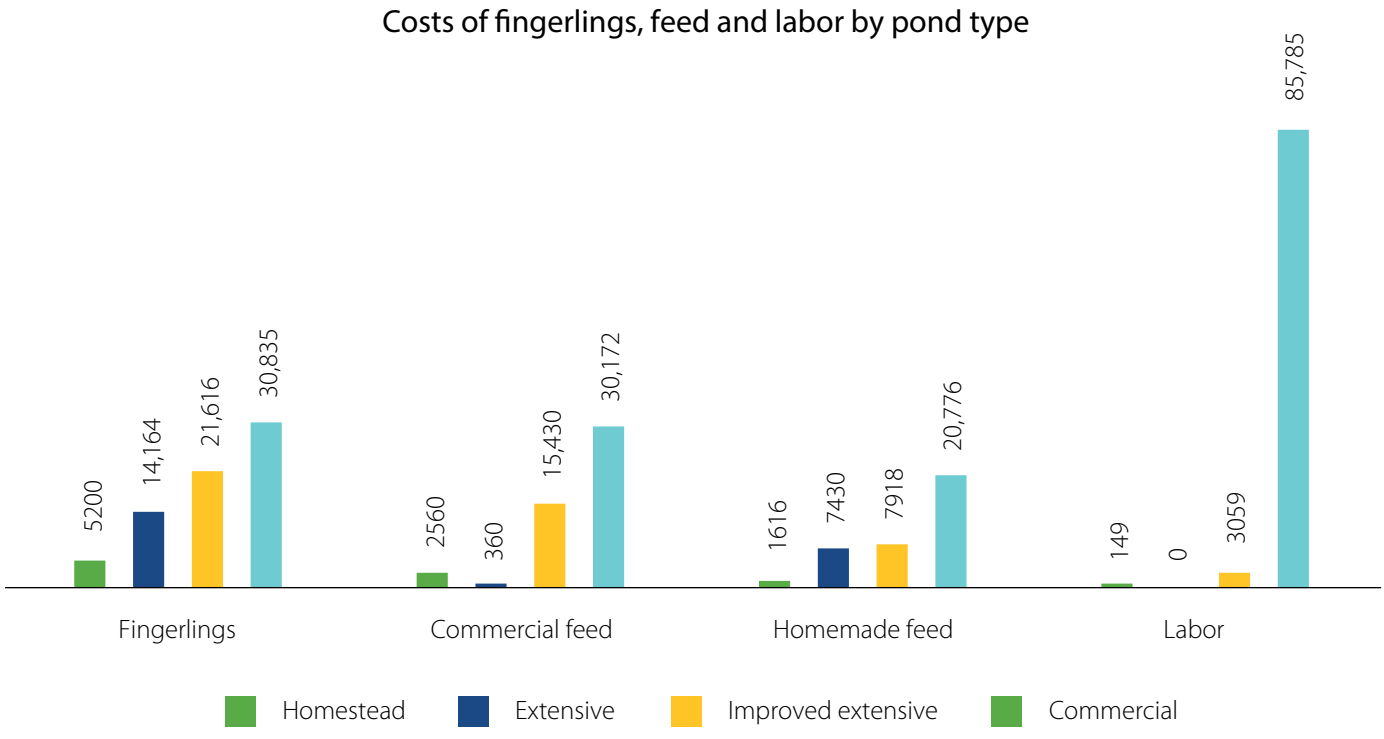
As shown in Table 10, the net operating profit margins vary according to the different producers. The homestead pond farmers mainly produce for home consumption. Production is typically extensive, with low labor and input use. Only 11% of the production of homestead pond farmers is sold, yielding an average value of BDT 13,259. Including the value of what is consumed at home and given away, homestead pond farmers were still able to reach profit margins of 23%. This is mainly due to their low investment. When only considering direct income from fish sales, excluding the value of home consumption, this changes to a loss of 21% (Table 10).

Extensive pond farmers are characterized by low input use. This translates to their costs being twice as small as those of improved extensive farmers and less than a fifth of the costs of commercial farmers. Despite these low costs, the average annual net operating profit is still negative, indicating that extensive ponds are not viable. The cost structure of extensive farmers is largely made up of consumables, such as costs for fingerlings, ingredients for homemade fish feed and transportation costs. These extensive production systems have an estimated average annual production per enterprise of about 319 kg/year.

With some additional investments compared to the extensive ponds, the improved extensive pond farmers are able to run successful businesses and make good profits. The net operating profits are almost BDT 60,000 on an annual basis, and the profit margin is 37%. Fish sales yield an average annual revenue of BDT 92,257.

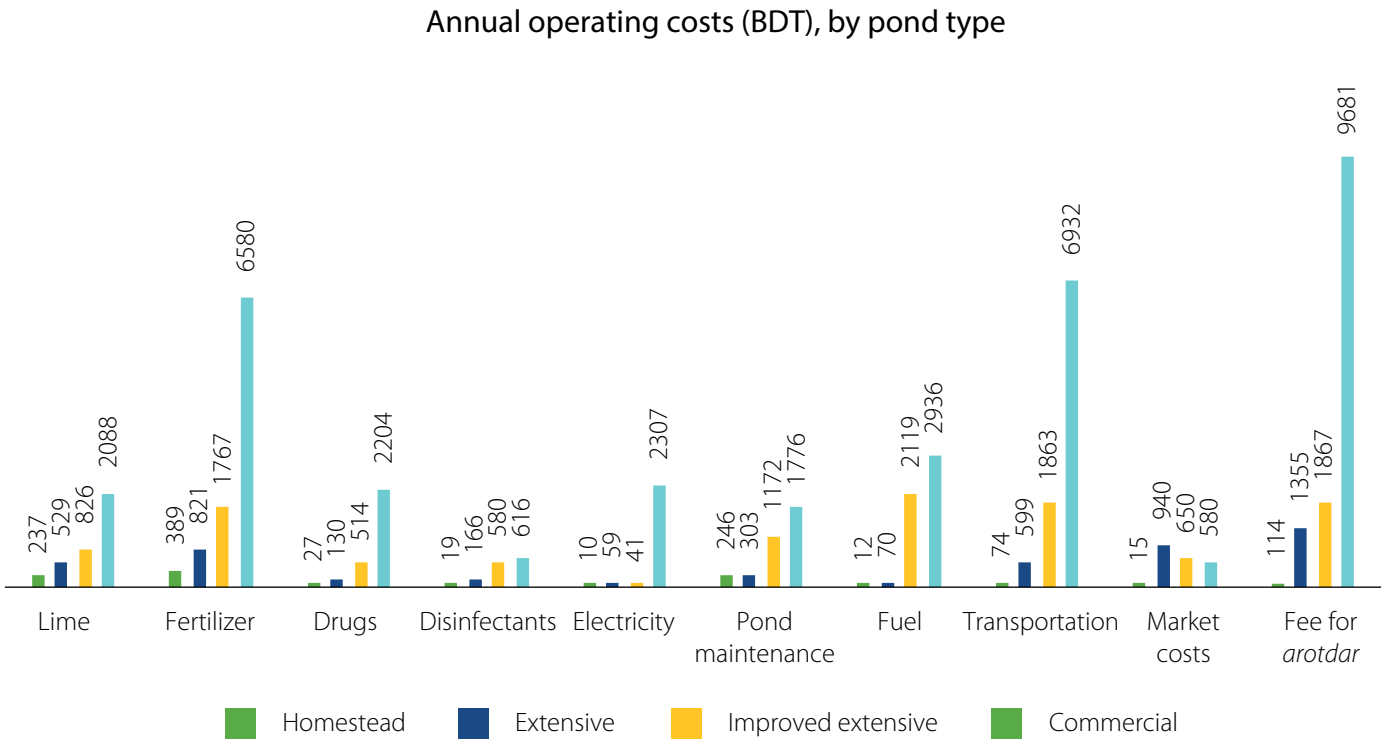
With profit margins of about 50%, commercial pond farmers are the most viable. Total investments are higher among producers in this category, but so is the return on investment (102%). Farmers in this category report an average annual sales value of BDT 352,790 and total annual costs of BDT 176,030.

Figures 7 and 8 show the costs of inputs for each type of producer.[10] Homestead and extensive pond farmers use a substantial amount of homemade feed, though this is still lower than improved extensive and commercial farmers. Furthermore, commercial pond farmers use, by far, most commercial feed and labor.



Source: farm survey data.

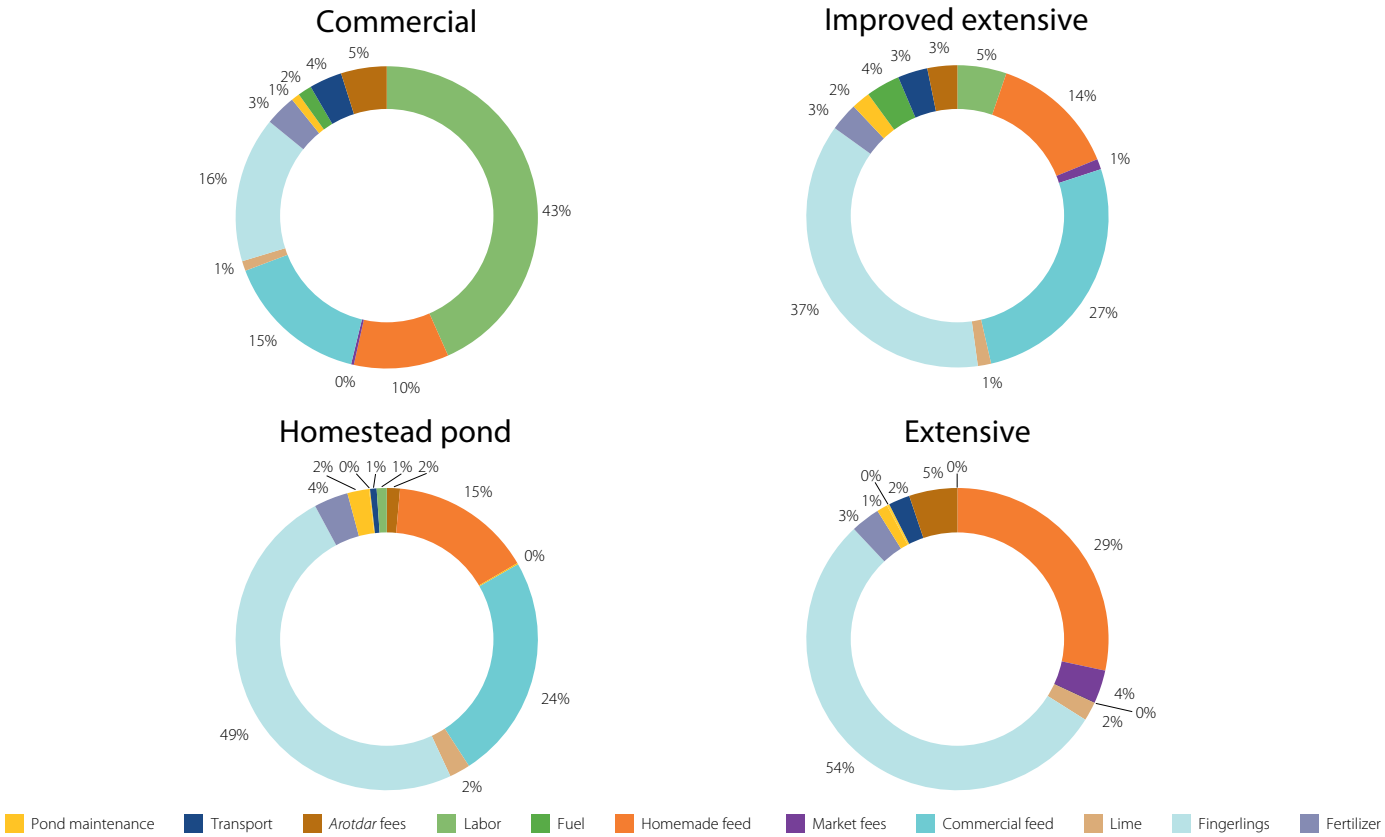
Figure 7. Annual costs for fingerlings, feed and wages (BDT), by farm type.



Source: farm survey data.

Figure 8. Other annual operating costs (BDT), by farm type.

Figure 9 shows the same cost items, but in this case expressed as the relative share of total costs. Among all costs, fingerlings are the input that has the highest share in total costs for homestead, extensive and improved extensive pond farmers, while for commercial farmers it is labor.



Source: farm survey data.

Figure 9. Cost structure (consumables, fees and labor) (%), by pond type.

5.3.2. Market actors

As indicated in Section 4.6.3, we distinguish between three main types of market actors: intermediaries, small or ambulant retailers, and medium or large retailers. Table 11 shows the annual operating accounts for each of these market actor types.

As Table 11 shows, intermediaries break even in terms of profits. The table shows high revenues and costs for this category of traders (over BDT 37 million). This is mostly caused by the inclusion of *arotdars* in the sample. Besides playing a role in auctioning, *arotdars* were also involved in actual fish trading. The largest cost, by far, was purchasing fish. Besides that, intermediaries, on average per year, spent over BDT 500,000 on labor costs and BDT 775,451 on consumables—mainly loading and unloading services, hired transportation and commission fees (Figure 8). In addition, intermediaries had an annual depreciation on their assets of BDT 27,201. The fees that *arotdars* receive for their auctioning services are not included in the calculations, so the 0% profit margin only applies to the fish trade itself. This additional income is most likely significant.

Small or ambulant retailers have an average revenue of BDT 4,849,228, with a profit margin of about 10%. Investments are generally low among small retailers. They do not work with hired laborers, and at BDT 43,400 their annual costs of consumables are also low. Small or ambulant retailers generally have few fixed assets and therefore also lower capital deprecation. When looking at operating costs, the largest cost for intermediaries is hired transport, followed by bags and other packaging materials (Figure 8).

Profit margins are similar for medium and large retailers, though their revenues and costs were significantly higher. Medium and large retailers have more assets (and therefore higher depreciation) than their smaller colleagues. They also spend more money on labor, despite the use of hired labor being generally low. None of the actor types indicated paying any taxes. In terms of total operating costs,

	Intermediaries	Small or ambulant retailers	Medium or large retailers
Sales	37,256,596	4,849,228	7,300,359
Total output	**37,256,596**	**4,849,228**	**7,300,359**
Fish	35,802,624	4,337,553	6,488,487
Consumables	775,451	43,400	59,303
Labour	510,324	-	11,114
Land	-	-	-
Market fees	223	120	-
Taxes	-	-	-
Depreciation	27,201	1930	3911
Total costs	**37,115,823**	**4,383,003**	**6,562,815**
Net operating profit per year	140,773	466,225	737,544
Net added value per year	678,521	468,275	752,569
Profit margin (%)	0%	10%	10%
Return on investment (%)	0%	11%	11%

Source: farm survey data.

Table 11. Annual operating accounts of market actor types (BDT).

medium and large retailers spend most of their money on hired transport (40%) and tolls (15%).

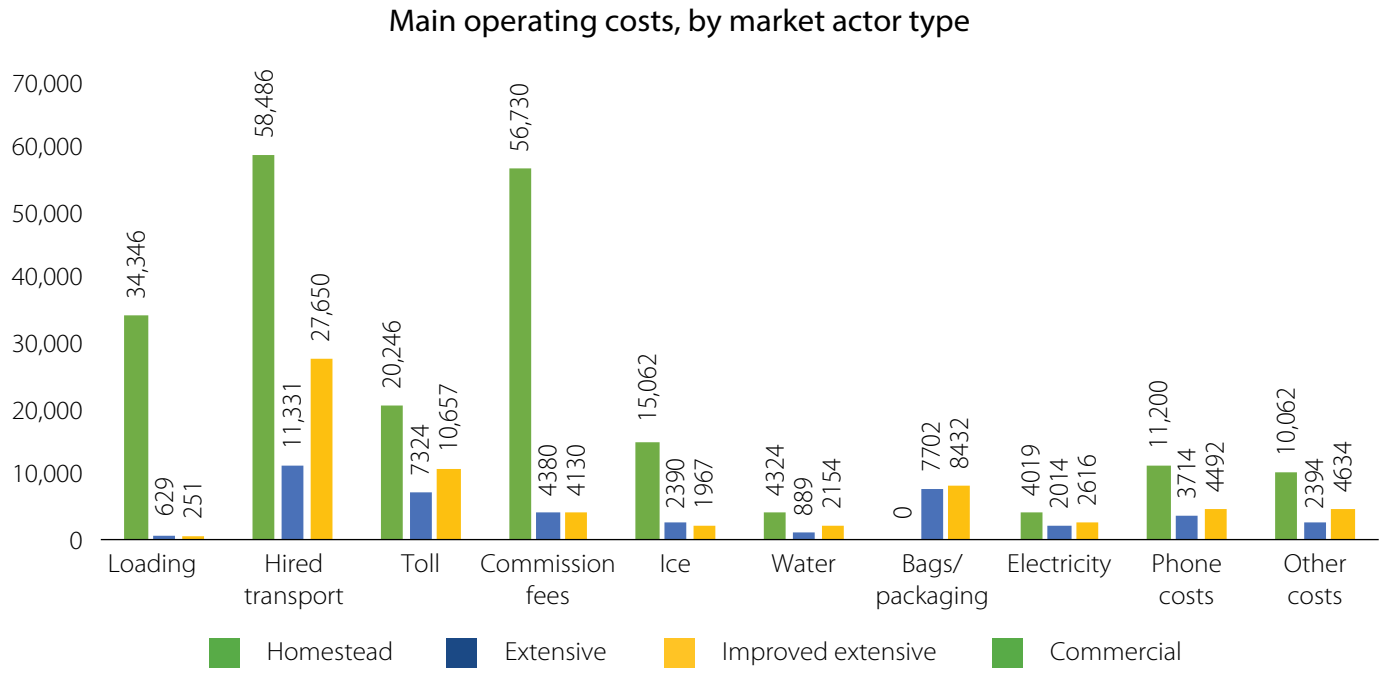
Figure 10 shows the main operating costs for each of the market actors. The largest costs for all market actor types are loading and unloading services, hired transportation, tolls and commission fees. Intermediaries have significantly higher costs than retailers, except for packaging. The large operating costs intermediaries face are in line with expectations, given the large volumes they trade. Intermediaries have no costs for packaging, because they generally do not sell directly to consumers.

5.4. Employment

5.4.1. Producers

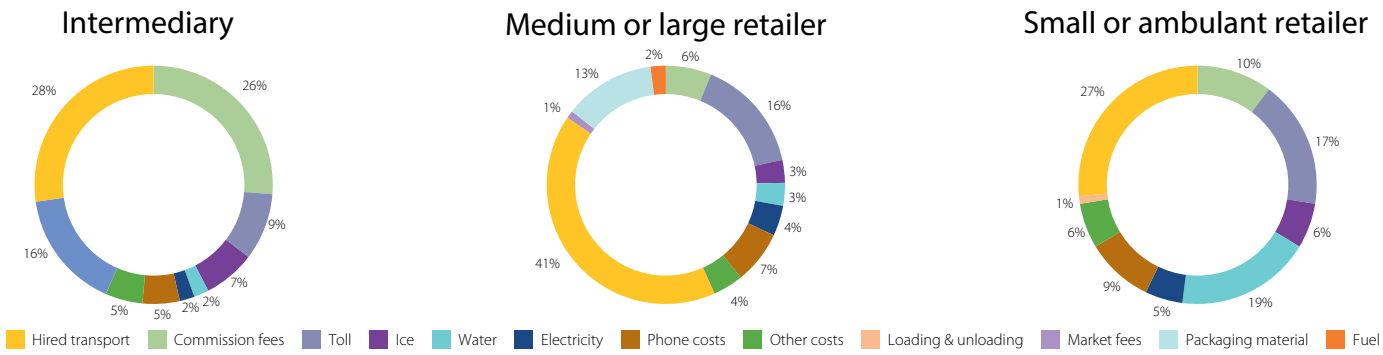
This section discusses the amount of employment created in fish production. We start with an elaboration on household labor, followed by an analysis of labor wages. We finish with a discussion of the total estimated number of jobs in fish production in the northwest.

Table 12 shows the extrapolated number of self-employed jobs in the wider region. According to our calculations, commercial ponds in the northwest provide 531,591 fte of self-employed jobs. Of this, 37% is labor contributed by women of all ages and 47% by youths of both sexes. In addition, improved extensive ponds provide self-employment equivalent to 481,783 fte (46% women, 52% youths), extensive ponds 353,187 fte (44% women, 51% youths) and homestead ponds 342,319 fte (46% women, 48% youths). This brings the total in Rajshahi and Rangpur divisions to over 1.7 million fte of work in self-employment. Table 12 also shows that labor productivity is significantly



Source: market actor survey data.

Figure 10. Main annual operating costs (consumables), by market actor type.



Source: market actor survey data.

Figure 11. Cost structure (consumables) (%), by market actor type.

lower for homestead ponds, because it takes more time to produce 1 t of fish than on other types of farms (e.g. 12 fte/t for homestead versus 3.5 fte/t for commercial ponds). This is due to the inefficient nature of homestead production, as well as the low productivity of such ponds, which are often shaded. There could also be some over-reporting of labor that has gone into homestead pond farming, as it is often done in between other work.

Extrapolating the hired labor data, we conclude that there are approximately 200,000 paid jobs in fish production. About 180,000 are in commercial pond culture, of which 37% is fulfilled by youths (all male), about 8000 are in improved extensive pond culture (33% youths) and about 13,000 are working on homestead ponds (43% youths). None is in extensive pond culture. Focus groups did report that some women were hired as laborers for tasks such as pond digging and mud removal, particularly in homestead ponds. They also indicated that women generally earn lower daily wages than men (BDT 200 per day versus BDT 300–400 for men), mostly because they are deemed unable to do the difficult work. Our hypothesis is that respondents in the survey either do not think of hired women's labor as important or are reluctant to report it. With an average wage rate of BDT 314 per day, commercial farmers pay their workers the most. Workers at improved extensive farms earn,

	Homestead ponds	Extensive ponds	Improved extensive ponds	Commercial ponds
Average production per farm (t)	0.11	0.32	0.50	0.75
Average productivity (kg/ha)	105	319	748	500
Total production in northwest (t)	**29,000**	**87,000**	**136,000**	**203,000**
Self-employment				
Household labor/farm (fte)	1.3	1.3	2.0	1.8
Jobs per t (fte/t)	11.9	4.1	3.5	2.6
Total self-employed (fte)	342,319	353,187	481,783	531,591
% women (all ages) in self-employment	46%	44%	46%	37%
% self-employed youths (male and female)	48%	51%	52%	47%
Wage jobs				
Wage labor/farm (fte)	0.05	0	0.03	0.7
Jobs per t (fte/t)	0.4	0	0.1	0.9
Total wage jobs (fte)	12,678	0	8150	180,216
% women in wage jobs	0%	-	0%	0%
% youths in wage jobs	43%	-	33%	37%
All jobs				
Total jobs (fte)	**354,997**	**353,187**	**489,933**	**711,807**

Source: farm survey data, DOF 2018.

Table 12. Annual household and wage labor, by producer type.

on average, BDT 304 per day, while homestead pond farmers pay daily wages of BDT 288. These differences in wages between production systems were not confirmed in the FGDs.

Together, self-employment and wage labor are estimated to contribute about 1.9 million fte of work in fish production in northwestern Bangladesh, with the large majority self-employed.

5.4.2. Market actors

Average wages in fish trading are lower than in fish production. Intermediaries pay their workers average daily salaries of BDT 291, and medium and large retailers on average BDT 228.

Table 13 shows the total estimated number of people engaged in fish trade in the northwest, which is equivalent to a total of 16,621 fte. The large majority of these jobs (over 15,000) are self-employed, of which 7% are fulfilled by women and 32% by youths. In addition, there are about 1078 fte of paid jobs, of which 28% are fulfilled by youths. According to the survey data, however, none of them are women.

5.5. Summary of social and economic performance

At the farm level, the share of production used for home consumption ranges from 16% for commercial farmers to 68% for homestead farmers, but the absolute quantity of what is consumed at home is similar across the four production systems. Out of what is sold, a significant share (about 40%, 187,000 t) ends up in urban markets. Yet almost 60% of total production remains in rural areas, either through home consumption, gifts to relatives, neighbors and through rural markets. This emphasizes the major role that aquaculture plays in local food and nutrition security in Rajshahi and Rangpur.

Productivity levels per hectare are lowest for homestead farmers and highest for commercial farmers, but the differences are not as large as might be expected. Commercial ponds were reported to produce 3.2 t/ha annually and homestead ponds 2.2. Average annual revenues for fish farmers range between BDT 13,000 for homestead farmers and BDT 353,000 for commercial farmers. Meanwhile, profit margins, defined as profit divided by total revenue, are highest for commercial farmers (50%) and lowest for extensive farmers, who appear to operate at a loss, even when the value of what is used for home consumption is included. At the intermediary level, profit margins appear to be slim, close to 0%. This figure, however, does not represent the dual role of the *arotdars* and so it does not include the income they earn from auction (commission) fees. In practice, *arotdars* have much higher profit margins. Retailers are found to have a profit margin of about 10%.

	Intermediaries	Small or ambulant retailers	Medium or large retailers	Total
Total self-employed jobs (fte)	294	9470	5779	15,543
% women (all ages) in self-employment	14%	3%	2%	7%
% youths (male and female) in self-employment	43%	21%	29%	32%
Total wage jobs (fte)	374	0	704	1078
% women in wage jobs	0%	-	0%	0%
% youths in wage jobs	23%	-	83%	28%
Total number of jobs (wage + self-employed) (fte)	**668**	**9470**	**6484**	**16,621**

Source: market survey data, DOF 2018.

Table 13. Total employment in fish trade by business category.

6. Resource and power dynamics that affect performance of the value chain

This section covers the following research questions: How are activities in the value chain coordinated? Who has the decision-making power at different levels (household, community, whole chain, "market/economy") of the nodes of the value chains and why is that so? And how does having decision-making power in a particular node of the value chain have any effect on value chain performance and actor empowerment?

6.1. Access and control regarding key resources

The performance of the aquaculture value chain is highly influenced by access and control over economic and social resources of different value chain actors, which is also the third key dimension of gender relations (Section 3.1). When it comes to access to critical resources, there are a number of constraints in the aquaculture value chain that affect all farmers, while others are specific to certain groups, such as women and men with a low wealth status.

Sections 6.1.1 – 6.1.8 present general issues all farmers experience, as well as particular concerns of women and other social groups due to different dimensions of gender relations (gender division of labor, gender norms and decision-making) and intersectional concerns. The data comes from separate focus groups with men and women farmers about key resources for operating in the chain. Where possible, we also draw on discussions about who controls these resources and the implications for the performance of the chain.

6.1.1. Ponds

General issue: Access to ponds was noted as critical for all farmers. To encourage land use for agriculture, government policies do not allow farmers to dig ponds as they want. Although farmers want to increase production by leasing, lease prices are high and they are not always granted the lease. Furthermore, the government sometimes halts aquaculture to clean the canals.

Social and gender dimensions: Only richer farmers can afford to pay bribes to the government to dig ponds, while poorer farmers are unable to do so. Men usually inherit land and ponds from their families, and this ownership provides them with decision-making power over the resource. Men make most or all decisions around assets and resources, though they might consult women and other family members, such as their father or an older brother, or eldest son.

Women rely on their husband's access to ponds to engage in aquaculture. Women also do not usually inherit land from their fathers or do not claim the land that they do legally inherit (Muslim women). Both women and men mentioned that women can buy land if they want to, but they usually do not have the financial resources. They do not have easy access to commercial ponds, because these are usually away from the home and women also have restricted mobility. Women have decision-making power if they own the resource or have knowledge about it, but they claimed that men make all decisions regarding the pond. However, women also mentioned that they would not want to make such decisions about ponds and assets, even if they had the chance to do so, because they do not want to take the risk of being blamed for a negative outcome.

Intersectionality: Young men inherit property from their families and have more decision-making power because they take over their father's business. Young women are expected to marry and join their in-laws' household where they will be taken care of and their spouses will share their resources with them. There are differences among women. Women without able men in their households (such as widows, and women with migrant husbands or sick husbands) inherit their husband's aquaculture business. Yet they do face constraints due to norms around their mobility and the type of work they can perform.

6.1.2. Transportation

General issue: Live fish fetch higher prices, but transporting them is difficult. Furthermore, low quality roads, police harassment and the distance of markets make transportation harder. This also increases their dependency on *arotdars*, some of whom send transportation to collect the fish.

Social and gender dimensions: Richer farmers can afford to pay bribes to police during fish transport. Some *arotdars* also provide them with extra benefits, like transportation, because of their large production and reliable supply. Men avail themselves of all kinds of transportation vehicles and distant markets, based on where they can get better prices, but they prefer selling live fish. However, issues around bribes, road conditions and live fish transportation facilities remain a problem. Women usually sell fish to local market retailers because they do not have enough production to warrant transporting them to distant markets with better prices.

6.1.3. Groups/networks

General issue: There appear to be no major groups related to aquaculture. During fieldwork, men reported fish-related groups in one village where membership requires one to be a fish farmer and to be experienced. Other types of social networks, however, do play an important role, such as relationships with officials, market actors and input suppliers to gain access to information, markets and ponds.

Social and gender dimensions: Women have access to groups that NGOs form, either for training on, for example, poultry or for microcredit.

6.1.4. Seed

General issue: Farmers access seed easily through *patilwalahs* and nurseries, if they are nearby. Sometimes, however, there is a lack of hatcheries, which forces farmers to travel longer distances to procure seed. Farmers prefer seed bought from nurseries and hatcheries because they are of better quality and they can choose their seed, unlike seed from *patilwalahs*.

Social and gender dimensions: Men access seed from nurseries whenever possible. For women, *patilwalahs* emerged as the most important source of seed because they come to their door to sell them. Only a few women mentioned they buy from a hatchery or a nursery, which requires support from men.

Intersectionality: For poorer farmers, access to seed is mainly through *patilwalahs*, mostly because they want to avoid transportation costs. For richer households, access to seed was through hatcheries and nurseries.

6.1.5. Feed

General issue: Farmers perceive that feed dealers are providing them with low quality feed at higher prices. They also report that feed dealers do not let them know when the prices go down. Since feed prices are perceived to be high, many farmers use a mixture of homemade and commercial feed in their ponds.

Social and gender dimensions: Most households get feed from local markets near their village. The larger brands are usually consistent in the quality of feed they provide, but poorer farmers cannot always afford these brands. Unlike large farmers, small farmers cannot buy feed on credit, so they usually rely more on homemade feed.

Although both women and men reported that women can access feed if they want to, restricted mobility means that women's access to the market is limited, and it tends to be men who purchase feed. Some women call the feed dealer and get feed delivered to them, while others purchase feed when they go and buy other groceries. As a result, women tend to rely more on homemade feed.

Intersectionality: Women without able men in their household can access the market to buy feed or its related ingredients when necessary, and it is socially accepted.

6.1.6. Credit

General issue: Lack of capital makes it difficult to pay for inputs and other investments required for aquaculture, especially labor and feed costs. As indicated in Section 4.6.6, there are three major types of finance:

1. Chain finance, such as dadon (advance payments) from *arotdars*, and inputs on credit from input suppliers

2. Microfinance loans from NGOs, often targeted at women, which are usually without strict collateral requirements or paperwork but are only for small amounts (BDT 50,000 maximum) and have high interest rates.
3. Commercial bank loans (no aquaculture-specific loans available) provided under strict collateral requirements, but with lower interest rates.

Social and gender dimensions: For poorer households, repaying loans in instalments is an issue since they can only repay them during harvest, which is not as frequent as the repayment requirements. NGOs have more frequent repayment instalments than banks. Poorer households with smaller farms also do not receive the benefits of buying inputs on credit and accessing dadon. Wealthier households usually take large loans from banks, receive inputs on credit and use dadon.

Women often have limited decision-making power over the loans, even ones from NGOs under their names. However, men's dependence on women for loans allows women to be informed and involved in the decision-making about loans, unlike other areas of aquaculture. A lack of knowledge about loans, finances, required investments and access to income to repay the loans limits women in having more decision-making power.

Intersectionality: Both male and female youths feel they require larger loans to become entrepreneurs along the aquaculture value chain, especially as *arotdars*, feed sellers (for men) and nursery operators (for women). But their access is restricted for the same reasons as for poorer farmers.

6.1.7. Market

General issue: Engagement in the market is critical for all farmers. It is where they can purchase feed, other inputs and sell and buy fish and where information on prices is shared. *Arotdars* are an important source of information on species demand and market prices.

Social and gender dimensions: Men of any wealth status can usually engage in the market freely. But for women farmers, there is limited access to markets due to gender norms. This applies both to buying farm inputs and selling fish. Women enlist men to get the services they require, such as selling fish and buying inputs (e.g. fingerlings from *patilwalahs*). In some cases, they were found to circumvent markets, selling fish directly to restaurants.

Intersectionality: Different types of women have more freedom to navigate the market, for example widows or households without an able man present.

6.1.8. Information

General issue: There is varied access to information among farmers. Farmers feel they lack technical information, especially about fish disease and quality input identification. Few farmers mentioned accessing information from the DOF. Instead, they rely on hatchery owners, fish vets, feed sellers, *arotdars*, experienced large farmers and medicine sellers. They get this information directly during transactions or through mobile phones.

Social and gender dimensions: Poorer farmers more frequently reported accessing information on best aquaculture practices and market information from experienced richer farmers, compared to richer farmers who mostly accessed technical information through training and market information from *arotdars*. Generally, men have more opportunities than women to access information through different channels due to women's restricted mobility. Women need permission if they want to attend training and have to balance household responsibilities. They are also restricted from receiving information directly through a mobile phone, since few women have their own phone. The general lack of aquaculture knowledge hinders women's decision-making power in aquaculture (Section 6.3).

6.2. Decision-making at the intrahousehold level

The fourth key dimension of gender relations is decision-making power (Section 3.1). This takes place at two levels: (1) within households and (2) between actors in the value chain. This section focuses on intrahousehold decision-making, particularly at farm level in the chain, drawn from focus groups with women and men farmers.

Women reported that their ability to influence decisions related to aquaculture was constrained by their limited access to information and adequate knowledge, and their limited availability of time due to their reproductive responsibilities. Men have more decision-making power because they are recognized as "the main aquaculture farmer" by both men and women within the household, but also by other actors in the value chain. Men do not see a necessity or purpose to consult women on topics they believe they have no knowledge about. Instead, men discuss these issues with market actors or other farmers. This was not only a perception of men in the focus groups, but also of women, who feel they lack knowledge to enhance farm performance. Women also reported being afraid to make decisions related to aquaculture in case they make the "wrong decision" and face backlash from husbands. An increase in access to knowledge could help address this and increase women's decision-making power in aquaculture.

Generally, therefore, women's ability to decide on how resources are used in aquaculture depends highly on getting permission from their husbands. There were, however, variations depending on the types of decisions and the type of pond (whether women owned it or it was a homestead pond) as further elaborated in Table 14.

With regards to the use of the fish, men make decisions based on profit, species demand and amount of capital they have. They usually prioritize selling fish that have high market value and are large in size. To help them make the decisions of when and what species to sell, men mostly discuss with other farmers and *arotdars*, based on market demand.

While men make decisions about selling fish, women have some decision-making power over how many fish to keep for consumption from homestead ponds. Men prefer if women keep the smaller fish, since larger fish fetch better prices. There are variations by type of pond. For homestead ponds, husbands consult with their wives about how many fish to keep for consumption and for gifting. According to both men and women, husbands do not discuss sales from the homestead pond with women; they just tell them. If women sell fish from their homestead pond, they always have to let their husband know and get their permission if they want to keep the money they earned.

For commercial ponds, men make consumption and sales decisions. According to both women and men, women do not know how much is harvested or sold from the commercial ponds. Rather, men just bring back 2–3 kg of fish for home consumption. According to both men and women, men discuss with *arotdars* and their fathers regarding fish sales. They tell the women now and then, but do not involve them in these decisions. There were, however, examples of women who had increased access to and decision-making power over resources. That occurred when loans were taken in their names to buy aquaculture inputs like feed and seed or even to hire labor. In these loan-related decisions, women were consulted because the loans were in their names.

Different women also have different levels of decision-making power. Educated women with their own money, as well as women without guardians, can make their own decisions. Unmarried women have less decision-making power because they have to listen to their

		Men	Do men consult with women?	Women	Do women consult with men?
Homestead pond	Sales	Yes	No	Yes	Yes
	Consumption	Yes	Yes	Yes	Yes
Commercial pond	Sales	Yes	No	No	-
	Consumption	Yes	No	No	-

Source: FGDS and KIIs.

Table 14. Gendered decisions on use of fish.

parents. From the youth focus groups, wealth appeared to be an important factor influencing the degree of autonomy in decision-making. Both young women and young men reported that irrespective of sex, wealth meant some autonomy in decision-making. Yet generally, young men had more decision-making power than young women, particularly when they took over their father's aquaculture business. Young women also reported that their decision-making power lessens once they get married.

6.3. Power relations and structures in the value chain

Here we summarize the main insights around decision-making processes that affect the performance of the value chain. We draw on data from the FGDs with men and women farmers and from the KIIs with other value chain actors.

Across the aquaculture value chain, the *arotdar* is the most powerful actor in terms of controlling the price and buying in bulk. According to farmers, a few *arotdars* often hold a monopoly in specific villages where farmers have limited choice of whom to sell to. To secure supplies, dadon is used, especially by larger *arotdars*, as farmers are forced to sell to them. In some villages, this has led to these larger *arotdars* forcing out smaller ones. Farmers expressed suspicions of collusion between *arotdars*, believing they set the prices together. Furthermore, farmers felt that *arotdars* cheated them with improper weighing of fish being sold.

Issues of trust and transparency seem to be working in both directions. *Arotdars* expressed struggling to secure sufficient supplies of fish, particularly good quality, live fish. In addition, some reported that some farmers take advantage of the dadon system, getting it from multiple sources and supplying to the one giving the highest amount. This is why *arotdars* indicated that, for them, access to more working capital to expand the dadon system and more support to farmers with technical assistance to enhance fish production are two key interventions needed to improve the functioning of the chain.

Formal (laws and policies) and informal institutions play an important role in shaping the performance of the value chain. These include the following:

- A government policy places restrictions on digging ponds, because priority is given to using land for agriculture.
- Political parties interfere in access to benefits, including using equipment required for aquaculture. People with political alliances have more power to influence the police and government—meaning those who are allowed to dig ponds—while those who support the opposition face constraints.
- There is alleged corruption at multiple levels. Respondents in the FGDs said that an alleged system of bribes entrenches the power of certain actors, enforced by police and market owners. Farmers said they pay bribes to use road transportation, dig ponds and use machinery. Richer farmers can afford paying these bribes and avail themselves of the benefits, as opposed to poorer farmers. Within the market, retailers also allegedly pay bribes to police and market owners to set up their market stalls. A retailer or intermediary's ability to set up in the market is determined by how much they are able to pay.
- Farmers also pay "protection money" to *mastaans* on a monthly basis. These payments ensure that the mastaans do not harm the farmer's business and also provide protection from other local goons.

6.4. Distribution of benefits from the value chain

Understanding the dynamics between who has access to key resources, as well as who can decide how to use the resources and the power dynamics around them, is central to understanding who benefits at different nodes of the value chain.

Generally speaking, we observe that the distribution of benefits varies depending on the type of farmers:

- Farmers with strong social links to the ruling political party and the *arotdars* are most able to benefit.
- Richer farmers with access to financial capital are better equipped to navigate the value chain. They have the capital to access quality inputs in bulk and maneuver relationships with *arotdars*, as well as to pay bribes, or use their connections to get their way.

- Small-scale farmers of lower socioeconomic profile with fewer ponds and capital are least able to benefit. Because of their lack of capital, they cannot afford the quality seed, feed, medicine and irrigation. They are more constrained by government policy on digging ponds. They do not always have the necessary connections with *arotdars*.
- Women and men reported that men consistently benefit more from aquaculture. It is the interplay among different dimensions of gender relations that undermines women's ability to participate and benefit. These include the gender division of labor and unpaid care burden, restrictive gender norms that hamper their engagement, gendered constraints in access to key resources (ponds, quality inputs, mobility, markets) and dependency on men and husbands for almost all decision-making, such as getting permission to attend training sessions and to start a business.
- There are, however, exceptions. Women who are single, unmarried, social outcasts, wealthy or educated have more space to maneuver in the value chain under certain conditions. These women reported that they do not face discrimination when it comes to prices or services and that fellow male value chain actors support them. Also, women from homestead ponds have more decision-making power over fish for consumption than women from commercial ponds.

6.5. Summary of resource and power dynamics

The performance of the aquaculture value chain is affected by the access and control of actors over economic and social resources and also by power dynamics between actors. For farmers overall, we observed that the main constraints are access to quality inputs (seed, feed, medicine), dependence on market actors, especially *arotdars*, formal extension services, and accessible and affordable loans. The performance of other value chain actors, such as *arotdars*, relies mainly on the farmers, which is why they maintain good social networks by providing technical advice, transportation and, through dadon, financial relationships. At the same time, *arotdars* are seen as the most powerful actor in the chain because they control the prices in the market. The dadon system, which gives farmers access to the credit they require, is used by *arotdars* to secure their supplies of fish and therefore create a dependency relationship. Power dynamics at different levels of the value chain (household, community) intersect to disadvantage most women and men with a lower wealth status. Generally, women have less decision-making power at all levels of the chain.

Formal structures and informal structures disadvantage poorer farmers. There are official government policy restrictions around digging ponds and using equipment, but wealthier or better-connected farmers are able to circumvent these restrictions through informal structures, such as bribery and nepotism. Aquaculture policies mostly overlook women farmers. Women's differentiated gendered needs and preferences are not represented, because they are not recognized as farmers due to existing gender norms and stereotypes.

Informal institutional structures also influence power relations in other parts of the value chain. First, indications of systematic institutionalized corruption allows individuals and businesses to bypass formal and informal rules and gain benefits through connections and monetary means, such as bribes to set up a market stall, facilitate transport and dig ponds. This can also hinder women and men of lower wealth status and/or with limited social networks from entering the value chain in different functions because they usually lack the financial capital and social networks required to deal with such informal institutions.

At the farm level, the most critical resources to perform successfully are seed, feed, market information, medicine and access to intermediaries. Seed and feed are also the major cost components for farmers. The proximity of these resources differs across villages. Financial constraints and lack of access to good infrastructure (roads/transport) are other perceived constraints to farm performance.

Women farmers specifically experience gender-based constraints that prohibit them in performing optimally in aquaculture. The constraints are due to restrictive gender norms such as mobility, gender division of labor, differences in economic empowerment and legal/institutional issues. Although women

contribute significant levels of unpaid labor at the production level, in all farm types, the general opinion of both women and men is that women are not aquaculture farmers and lack of knowledge about it, which keeps them excluded from decision-making.

Critical areas where these gender dynamics play out to the disadvantage of women include the following:

- **Time**: Due to a high burden of reproductive tasks, women lack the time to invest in aquaculture.
- **Access to ponds**: There are issues for both men and women to pond digging because of restrictive policies. Restrictions around inheritance of land and mobility constraints further affect women, so they are unable to access ponds far from their homes.
- **Seed transactions**: Men appear to have better access to quality seed than women, because they are able to access it directly from nurseries and hatcheries. Women often rely on *patilwalahs*, who are perceived to sell seed of more variable quality. In practice, this might not always be the case, but a lack of transparency in the seed value chain makes it difficult to know the quality of the seed supplied.
- **Access to information**: Men have access to aquaculture information such as aquaculture practices and market prices through different sources, including hatchery owners, fish vets, feed sellers, *arotdars*, experienced large farmers and medicine sellers. Women often rely on husbands or neighbors and *farias* for information, so they have fewer information sources.
- **Fish sales**: Gender norms restrict women in their access to a physical market. Instead, they rely on male household members, local marketing and *farias* who buy at the farm gate. In some locations, the relationship with *arotdars* is critical to getting good prices, and this can be challenging for women, as well as some men.
- **Formal ownership of a resource**: For example, certain types of NGO credit are specifically directed at women. Men rely on their wives to gain access to these loans, so women are consulted more on the use of them, even if the husband often still has the final say.

With regards to consumption, considering the major role women play in providing food for the family, they have more control over how much and what kind of fish are kept for consumption, even when this goes contrary to the man's priority toward profits. Within the market, there are also some women retailers, who are shifting the perception of male retailers positively toward involving women more in the value chain. The study found that male retailers in markets who had exposure to women retailers as colleagues were more positive about women's involvement in the value chain.

7. Value chain upgrading

This section covers the following research questions: How do different value chain actors (men, women, youths) increase the benefits they derive from participating in the aquaculture value chain? What upgrading strategies do different actors in the value chain use and what are the outcomes of those strategies? To what extent are identified strategies successful? For whom and why or why not?

7.1. Introduction to upgrading

For the purpose of this analysis, we define economic upgrading as the process of moving to higher value-added activities, using more sophisticated or more efficient technologies and processes, and increasing the knowledge and skills of actors. The ultimate goal of economic upgrading is to increase the economic benefits derived from value chain activities. It is often about "moving up" in the chain by adding functions or making products of higher value. However, it has also been recognized that for value chain actors it can also be about doing things more efficiently or producing more of a lower value product thereby generating economies of scale (Ponte and Ewert 2009). Social upgrading has been described as "the process of improving the working conditions, benefits and rights of workers in a value chain with the ultimate goal of enhancing the quality of their employment and their wellbeing" (Sen 1999 and 2000; Rossi 2011). We broaden this definition here by including the increase of equity and well-being of value chain actors and making the value chain more inclusive. Economic upgrading can go hand-in-hand with improving equity in the chain when smallholders or vulnerable actors are the ones who are able to upgrade.

We group upgrading strategies in two broad categories:[11]

1. Improve product, process, volume and/or variety in the same value chain node or function: This is about improving practices and/or technologies to do things better or more efficiently. It can be about producing better quality products, reducing costs or a combination of both.
2. Change and/or add functions up or downstream in the chain, or in input and service provision: This can be functional upgrading by adding on higher or lower value roles in other parts of the chain, but it can also be a complete transition to another function.

In section 7.2, we present these strategies separately, for farmers in general, for women farmers and for other value chain actors. This draws on the data from the FGDs with women and men farmers. We summarize the key strategies that different types of farmers already use in their aspirations to upgrade their current roles and function. We also include observations about women who have upgraded to different functions.

7.2. Upgrading within function

7.2.1. Strategies farmers use

Challenges among farmers for improving the quality of production have already been presented in sections 5.3 and 6.2. Here we summarize the key points based on the main hindering factors around producing fish more efficiently.

For all farmers, the main barriers for upgrading efficiently relate to access to quality inputs (fingerlings and feed specifically), overcoming issues related to disease and knowledge of best aquaculture practices.

For farmers of lower socioeconomic profile, access to finance and ponds remains the major barrier. Without money to pay off leases for more ponds and quality inputs, their productivity will never increase. Apart from the general constraints, richer farmers always have the capital to pay off bribes to access more ponds and purchase quality inputs to increase productivity. They also have the capital to sustain relationships with *arotdars* to ensure their fish are always sold.

Men farmers tend to have more opportunities to upgrade due to greater access and control over resources needed for aquaculture and less restrictive gender norms around where they can move freely. Key strategies men use to upgrade

and improve production are maintaining good relationships with wholesalers and value chain actors. Men have networks, mobility and access to knowledge that help them succeed in aquaculture.

Women farmers reported they have limited opportunities to participate in upgrading opportunities for multiple reasons. Their engagement in aquaculture is restricted to the homestead due to norms around women's household care work. This limits their availability of time as well as their mobility to engage in commercial pond production. Norms around mobility also limit their ability to access other quality inputs (fingerlings, seed) and training opportunities, which hinder the production efficiency of the homestead pond. Gender norms around types of work that women can perform and where they can be "visible" also inhibit women from playing any other roles further up the value chain.

Mobility restrictions have consequences for access to quality inputs. Women farmers overcome the mobility constraints in a number of ways. They are highly dependent on different male actors for information on aquaculture practices and how to deal with disease. These include men at farm gate transactions (buying fingerlings, selling fish, buying feed), male neighbors and to some extent husbands. Other sources of information are from feed companies that provide information on feed/medicine and how to deal with disease.

Where finances permit, they outsource tasks to hired male labor, because it is perceived as more socially acceptable for men to do some of the more laborious tasks in pond management, such as those related to stereotypes of strength. Women rely on selling fish near homes to small retailers to avoid transportation costs. They also sell fish by communicating with men who come to their farm gate and buy fingerlings from them. Neighboring farmers also help these women by telling them when the fish are ready for sale. They do not have sufficient quantities to sell to distant markets or large *arotdars* because they are small scale and have small harvests.

According to women respondents, women who do well come from rich families where they own their own ponds or have inherited an aquaculture business from their deceased husbands. Women's positive deviance at the farmer level has been identified as those who can move relatively freely to buy inputs and sell fish because they do not have able men (sick, migrated, widowed) in the household.

The FGDs with farmers also yielded insights into their own perceptions and recommendations of what actions could address their various constraints. Table 15 summarizes suggestions that farmers made to help them upgrade in the value chain.

The recurring issue that emerged was the need for more diverse financing options. This was perceived as a pathway to access better quality inputs, especially fingerlings and feed, attain more ponds and support with addressing gaps in technical knowledge around aquaculture practices. The current loans available to farmers are reportedly too small to afford all the quality inputs. Large loans and more "fish-specific loans" would enable farmers to expand their aquaculture business with more ponds. Farmers also specifically requested more forms of dadon, where they get advance payments for their fish. This is preferable because this form of payment is repaid coinciding with the harvest, as opposed to other times of the year or with more intervals, as is the case for microfinance and commercial loans. Dadon from *arotdars* also guarantees that they are able to sell their fish in bulk. Both smaller farmers, who are unable to access dadon, and smaller *arotdars*, who are unable to provide it, are mostly excluded from this system. Table 15 provides an overview of suggestions farmers gave for upgrading in the same function in the aquaculture value chain.

Table 16 provides recommendations from officials at the DOF during the KIIs to improve the performance of farmers in the aquaculture value chain.

7.2.2. Strategies used by upstream and downstream value chain actors

Upstream and downstream value chain actors also reported constraints and opportunities for upgrading within their current function. Table 17 summarizes the data from the KIIs on the key constraints, opportunities for upgrading, and required support. Overall, there are increased opportunities due to a rising demand for fish, particularly live fish and high quality products. Consistently, all actors expressed a need for improved financing options.

Type	Detail
Ponds	Farmers need more access to ponds, both leased and dug.
Systems	Diversify species by moving to more valuable or cost-effective species, such as koi, pangash, shing, catfish and tengra.
Knowledge	Farmers need more training on best aquaculture practices, particularly how to identify quality inputs (fingerlings and feed) and how to address disease. They also need more training from the DOF specifically, as well as the Ministry of Women and Children Affairs (MOWCA) and NGOs. Currently, there is not much access to training from the DOF, and NGOs do not provide aquaculture training.
Inputs	Improve the quality of fingerlings by, for example, supporting *patilwalahs*, and increase the quality of feed. Improve the quality of medicine available by promoting responsible practices among medicine dealers through prohibiting the sale of expired products. Also, machinery is needed for pond digging and irrigation.
Credit	Provide help with financing. The dadon system should be increased and made accessible to more and different types of farmers. In addition, lower interest on loans, fish-specific loans and larger loans from NGOs are all needed.
Collective action	Form groups to jointly pay for transporting fish to market. Promote smallholder farmers buying feed together in bulk to provide access to feed on credit, like large farmers.
From government	Support farmers with training from the DOF, youth department and the MOWCA. Monitor feed quality, set a cap on leasing ponds and investigate alleged corruption.
Market	More efficient and safe transportation facilities are needed for live fish and to reduce mortality in transit. Farmers want to see fairer fish prices. Improve women's direct links with market actors willing to buy at the farm gate to widen their choice of where to sell. Strengthen fish handling practices to improve food safety.

Source: FGDs and KIIs.

Table 15. Recommendations from farmers to help them upgrade.

Type	Detail
Improving productivity	More training is needed, as well as more cultivation of native species. Make use of unused ponds, and enhance tengra and catfish production. Using new technologies is necessary.
Inputs	Develop feed mills and increase the proximity of feed shops. Raise awareness about new feed, and improve the quality of fingerlings. The government must investigate feed quality regularly.
Infrastructure	A better communication system is needed, as is a reliable and consistent electricity supply.
Finance	Loans with low interest rates are needed, as is financial support from the government.
For women	Get women involved in feed preparation and fish drying. Raise awareness about the importance of women's involvement.
For youths	Get youths involved in input selling businesses, including medicine and hatcheries. Youths could lease ponds by forming cooperatives.
Institutional	Government administration should not stop farmers from digging ponds. Market regulations are needed to ensure fair prices in markets. Stop illegal transportation bribes to police.
Market	Increase fish exports and the number of private sector aquaculture entrepreneurs. Market regulations are needed to ensure fair prices in markets, because syndicates control fish prices.

Source: FGDs and KIIs.

Table 16. Suggestions from the DOF.

Barriers and gaps	Opportunities for upgrading	Support needed
Seed suppliers		
Hatcheries • Space for fingerling production is insufficient. • Broodstock is of poor quality. • Finance to invest in production is limited. • There are financial constraints due to increasing input costs, rising wages and demand for quality fingerlings. • The lack of a required license to operate a hatchery results in issues with government officials. • The drainage system is poor due to limited space. • There are no women in hatchery businesses because of constraining gender norms about their ability to perform this role.	Opportunities are available to expand production and increase profit due to the following: • Demand is growing for quality fingerlings from farmers with expanding pond areas and improved practices. • Competition is limited, as there are few hatcheries. • Better technologies, such as using oxygen to extend longevity, are needed to transport fingerlings.	• Provide better broodstock support. • Develop magur fish farming. • Provide financial support to nurseries and producers to ensure the demand for seed from hatcheries is sustained.
Nurseries • Low quality feed is hampering the quality of fingerlings. • Training and knowledge on nursery management are lacking. • There is a lack of finance. • Ability to expand is limited for enhancing fingerling production and adding more varieties of fish. • Competition is growing among nurseries in some locations, as numbers have increased. • Costs of running a business are rising. • A lack of finance for farmers leads to reduced ability to purchase fingerlings.	• Demand is growing among farmers as more ponds are operated. • Demand for larger fingerlings has increased. • Farmers pay more attention to the quality of fingerlings before purchasing, which means quality improvements are recognized in higher prices for fingerlings. • Increase interest among women farmers to become nursery operators since they can do it near their home.	• Financing is needed to lease more ponds to allow diversification of fingerling production of pabda and tengra. • Improve access to quality feed to grow quality fingerlings in larger sizes. • Improve the quality of seed as well as the transparency about quality and the origin. • Offer technical support to women to set up nurseries.
Patilwalahs • The costs of doing business have increased significantly, making running a business less profitable than before. • There is a lack of capital to provide seed to farmers on credit. • Payments from farmers are delayed because of floods. • Competition with nurseries is growing. • Access to quality fingerlings is lacking, as nurseries sell mixed and/or poor quality fingerlings to *patilwalahs*. • When quality is inconsistent, this negatively affects their reputation compared to fingerlings supplied by nurseries.	• No opportunities observed.	• Provide support for *patilwalahs* to access ponds to upgrade to nursery operators.

Barriers and gaps	Opportunities for upgrading	Support needed
Market actors		
Arotdars • Fish supply is insufficient. • There are not enough *farias* to supply fish. • There is a lack of finance at low interest rates. • Competition and rivalry exists between *arotdars* due to low supply. *Arotdars* who are able to provide most dadon are most successful in securing supplies. • There are issues related to higher costs from increasing staff salaries, compliance with quality requirements and higher production, as well as losses related to selling live fish dying in transit and nonrepayment of dadon due to floods. • There is no support from the government and no training opportunities. • Markets are unstable due to police checks and political tensions, which disrupt business. • Syndicates control fish markets. • High taxes to pay at the market. • Women cannot become *arotdars* because of constraining gender norms.	• Fish demand is growing and the number of buyers is increasing. Demand is higher for live fish and larger fish, which has led to rising fish prices and profits. • Transporting fish needs improvement. • More young men are motivated to become *arotdars*.	• Enhance the supply of fish through improved finance for farmers to increase productivity and the number of *farias* and/or the quantities they trade. Enhancing the dadon system, among others, is one way to do so. • Train young men who aspire to the role of *arotdars* on how to run the business. • Provide information and training on modern methods for fish preservation. • Set up permanent (legitimate) markets with stability and no disruptions.
Farias • The supply of live fish is insufficient. • The supply of higher quality fish is also insufficient. • Competition among *farias* is growing, with about eight to 50 similar operations in the area.	• Growing demand for live fish and high quality product, especially catla and shing, means there are opportunities to expand their role.	• Improve access to finance, such as Grameen Bank and other NGOs, to enhance buying capital.
Retailers • There is a lack of sheltered and permanent stalls, which is particularly an issue during the rainy season. • Corruption and tensions exist in the marketplace as some markets are occasionally broken down. • There are few women retailers due to gender norms.	• Women are present in some locations, and this appears to have a positive effect on men's attitudes toward women's involvement.	• Improve technologies to preserve fish. • Provide finance and training. • Create stability in the marketplace and tackle corruption. • Offer special corners for women retailers to create an enabling environment for them in this role.

Barriers and gaps	Opportunities for upgrading	Support needed
Feed suppliers		
Feed mills • There is competition with other feed mills in some areas. • The requirements for feed quality have increased, but there is a lack of access to quality ingredients. • Finance is lacking. • Women are unable to run mills due to constraining gender norms.	• Demand is growing among farmers for quality feed due to changing practices. • There are opportunities for women to be involved in office work rather than field work. • More networks are needed with producers and nurseries.	• Improve access to inputs, such as protein, to make quality feed. • Improve access to finance. • Enhance links between feed mills and their buyers.
Feed traders • There is competition among feed traders, with 10 traders located in the same area and 40-45 when considering a wider geographical range, though it has declined. • The financial crisis has caused many feed traders to drop out. A lack of finance required to set up a business has constrained growth. • Flooding has impacted production and sales, and some profits have decreased. • Business is down in winter.	• There is growing demand from farmers and reduced competition due to the closure of some feed traders. • NGO loans have created many opportunities for feed traders to develop a business and create their own brand. • Advice and knowledge are available from feed companies and experienced farmers. • A good reputation is important to maintain clients, so feed traders provide technical advice to farmers they serve to maintain strong social networks with them.	• Nothing reported.

Source: KIIs.

Table 17. Barriers and upgrading opportunities observed by other value chain actors.

7.3. Upgrading to new value chain functions

Derived from data from the FGDs, this section presents aspirations for farmers to upgrade to new functions. Table 17 shows that only *patilwalahs* had upgrading ambitions that went beyond their function in the chain, so this is not presented separately. This section also presents some examples of positive deviance, where women were seen in roles in which few women are active.

7.3.1. Strategies aspired by farmers

Table 18 provides a summary of upgrading aspirations into new functions in the chain of men and women farmers and youths in farming communities. Overall, men farmers are most interested in becoming feed dealers and nursery or hatchery operators, alongside their aquaculture farm. These are seen as lucrative businesses and an opportunity to improve their wealth status and the productivity of their farms.

Women farmers were seen to have limited opportunities to upgrade into new functions. Nevertheless, they expressed an interest, particularly in functions that can be done close to the home, which would accommodate their mobility constraints. These opportunities include selling feed from their home and setting up a nursery business. Having a nursery business could help them overcome challenges they have related to accessing good quality fingerlings for their own farm and for other women farmers in the village.

Both young men and women had few aspirations to get involved in aquaculture farming, but it was seen as possible if options in the cities fail, such as paid service jobs at companies, electrical works and grocery shops. Young men reported that they aspire for higher social status aquaculture positions, such as feed sellers, hatchery managers and *arotdars*, because they perceive these are lucrative and have high earning potential.

Function	Men	Women	Youths
Farming	-	-	Youths aspire to engage only if other alternatives fail or when inheriting a farm.
Feed dealers	This is perceived as a lucrative business. Men expressed interest to set it up in addition to their farm.	• Women can sell feed from their homes. • There are challenges to sell at competing prices.	• Young men aspire to this role because it is seen as lucrative. • Access to finance is a challenge.
Hatchery operators	This is perceived as a lucrative business.	-	-
Nursery operators	This is perceived as a lucrative business.	• It can be done near their homes. • It gives them access to better quality fingerlings. • There are challenges related to technical know-how.	Young women express very few aspirations to be involved in aquaculture at all, but nursery operator is one role they would consider.
Arotdars	-	-	• Young men aspire to this role because it is seen as lucrative. • Access to finance is a challenge.

Source: focus groups with men, women and youths.

Table 18. Aspirations for upgrading in new functions expressed by men, women and youths.

Young women appeared even less interested in aquaculture overall. Instead, they were more interested in further studies to get a job in the police force, NGOs, large companies or to become doctors. The only role they might consider was that of a nursery operator, because it can be done from home. Getting permission for other business roles from their husbands was seen as a major limitation. A major fear of young women was to be married off, because this would restrict their opportunities to work or even finish their studies. Richer younger women are seen to have more choices and decision-making to choose what types of work they engage in compared to women in lower class groups.

Aspirations of young women change with major life events. They reported that marriage could mean that their aspirations focus more toward raising their children rather than productive work. Young men, on the other hand, did not mention the influence of marriage in their productive life activities. For them, it was the life event of inheriting an aquaculture business that could influence their interest to engage in aquaculture.

Suggestions from respondents for supporting women and youths to upgrade into new functions include the following:

- Support women to set up nurseries, especially where there are none or few. This could also be promoted among young women.
- Support women to sell feed from their homes, especially where access to inputs is limited.
- Create an enabling, safe and secure environment in the market where women can make transactions with ease, such as activities by CARE.
- Encourage youths with training and credit support to engage in the value chain as *arotdars* or feed sellers.
- Help groups of youths (both men and women) to lease government land so that they can conduct aquaculture together as a cooperative.

7.3.2. Strategies used by women (positive deviance)

From the FGDs with farmers and KIIs with different value chain actors, we probed for evidence of positive deviance of women in other functions of the value chain. It should be noted that because of the nature of these strategies, this information is often based on only one respondent or a group of respondents. These are exceptions of women acting in a role that most women are restricted from.

Women as retailers

The study reported three women retailers in two markets in Rajshahi Division: two in Mohishal Rail Bazar in Godagari Upazila and one in Singra Bazar of Singra Upazila in Natore District. One woman's husband was too sick to carry on his business, and the other two are widows who continued their husband's business after they passed away. The men retailers reported that these women were able to succeed by establishing good relationships with market actors who support them. Interestingly, in the markets where women retailers were present and operating, the male retailers were positive about women's involvement in the aquaculture value chain and expressed their belief that more women could get involved in the future. These male retailers highlighted that a women's corner would be of value to help women reach more customers. This was unlike retailers in markets where no women retailers operate. Here, key informant retailers reported that it was not possible for women to do business in an open market space due to gender norms about where women can operate and that they would never get permission from their husband.

Women as *farias*

A woman faria was reported in Bagatipara Upazila of Natore District in Rajshahi Division by a male faria key informant. This woman took up her husband's business after his death and competes with 24–30 male *farias* in that area. However, she is currently restricted from expanding her business because of a lack of finance. The informant reported that this could be another constraint preventing more women from entering this function. He does not hire women because he feels they do not understand the business, unless directly involved, and that women are better hired as cooks and cleaners in the restaurant business. He did not mention any social norms that constrain women from entering this function. This was in contrast to other *farias* who reported women cannot do this role, because they cannot travel far or do business at night.

Women as feed suppliers
One men's focus group reported a woman feed seller in Badarganj Upazila, Rangpur Division. Men reported that they sometimes buy their feed business in their wife's name so that she can run it in case they pass away. Some feed mills said they have women employees, mainly working in desk jobs.

Women as value chain supporters
Women were also present as NGO credit officers. NGOs see this as a good career path for women. Women in the DOF were reported in Mithapukur Upazila, Rangpur District and Gaibanda District, and the woman in Mithapukur is the main fisheries officer. However, none of the women farmers reported knowing about any women extension officers.

7.4. Summary of value chain upgrading

For farmers, their socioeconomic status impacts their ability to upgrade. Finance is considered a key constraint to upgrading, which more well-off farmers have better access to. Access to quality inputs and training were barriers to upgrading for all farmers. However, overall, male farmers have the networks, access to knowledge and the control over resources that give them a better opportunity to upgrade than women. Farmers and male youths seek opportunities to upgrade along the value chain with feed, seed (hatchery) and *arotdar* businesses. Female youths only see opportunities within the confines of their homes by selling feed or selling fingerlings via nurseries.

Other value chain actors and input suppliers (such as *arotdars*, retailers, hatcheries, nurseries, feed dealers and other input dealers) see value in helping farmers obtain the technical and financial support needed to improve production. In turn, this will benefit them through increased fish supplies for their business (intermediaries and retailers) or increased demand for inputs (feed, seed and other input dealers).

Gender relations play an important role in determining opportunities to upgrade. In this context, it is important to consider the four dimensions of gender relations: gender division of labor, access and control over resources, decision-making power, and social and gender norms. These are all interlinked and interlocked. Taken together, they explain how different value chain actors can upgrade. Women farmers, in many cases, are unable to produce significant quantities because they have limited decision-making power, limited access to resources and are constrained by norms related to their mobility. The low supply of fish means they are unable to supply *arotdars*, who deal in larger volumes and often do not recognize women as potential suppliers. In addition, because of their lack of mobility, women depend on actors such as *patilwalahs*, who might provide poorer quality inputs, which in turn affects the productivity of their farm and therefore their economic performance. In addition, because they are not recognized as aquaculture farmers, women have less access than men with respect to all kinds of resources, including assets, inputs, technology and information/knowledge. This is a major constraint to performance, limiting the choices around what inputs they can access. Their choice is limited to what comes to their farm gate, and these are usually subpar quality, which shows how the different levels of the value chain interlock. Norms and gender division of labor within households dictates that women can only take care of children, cook food and fetch water, while men grow fish, sell them in the market and build or repair the house. These play an important role in influencing aspirations for both women and men to engage in aquaculture in the first place, and which function they engage in.

8. Recommendations

The findings in this report (sections 4, 5 and 6) identify a range of value chain limitations and barriers that this project can address. The full set of barriers and corresponding recommendations for action within the project activities and through project partnerships are presented in Annex 2. Here we present key recommendations relating to economic performance and to social and gender performance, respectively.

8.1. Economic performance

Key recommendations to enhance economic performance:

1. **Reduce policy barriers**: Leverage partnerships with government to streamline and make permission easier to dig ponds, at least for lower socioeconomic households.
2. **Address economic losses of extensive farmers**: Investigate the root causes of losses, and either bring in partners to work with extensive farmers or work with farmers directly to upgrade their systems.
3. **Bridge inputs gaps**: Invest in fit-for-context strategies to get the combination of required inputs, such as small quantity sales by local service providers (LSPs), at affordable prices, and/or develop targeted financial support for women and men farmers, including youths. In particular, pilot "last mile client"[12] models that get inputs to the villages with low access.
4. **Address knowledge and information gaps:** Ensure improved access to technical information and training for all actors, particularly poorer farmers, women and youths, to improve efficiency, productivity and reduce costs. A possible model includes the LSP model already mentioned. This could also be targeted at women specifically as clients and as LSPs.
5. **Promote innovative financing options:** Experiment with different financing options that are fit-for-purpose for the cycle in the aquaculture value chain. This could include using digital tools to enhance bookkeeping of different value chain actors that could be used as a credit history to gain access to formal finance.
6. **Address issues of collusion and monopsony:** Promote better links in the chain, such as between smaller farmers and smaller *arotdars*.
7. **Investigate reports of alleged corruption and support addressing it:** For long-term transformation of the sector, it is necessary to address norms around the acceptability of corruption and bribes, the lack of transparency, the amount of political influence and the influence of mastaans. While this is beyond the reach of the project, it can engage with officials on the subject and promote good practices among value chain actors.

8.2. Social and gender performance

Key recommendations to enhance social and gender performance are as follows:

1. **Close the gender recognition gap:**
    - Use project data and evidence to increase recognition of women's paid and unpaid sector contributions.
    - Ensure gender inclusion and balance in all areas of project interventions.
    - Conduct honest checks on potential accidental and subtle bias in the project, partner language, practices and so forth, and develop clear alternatives.
    - Identify and collaborate with women who already show examples of positive deviance, such as existing women entrepreneurs, to amplify the visibility of these women and learn from what has made them successful in their position to apply elsewhere.
    - Leverage the power of the *arotdar* to influence positive gender messages and technical extension information. This requires engaging *arotdars* through gender-sensitive and/or gender-transformative training.

2. **Address time burdens as a gender barrier:**
    - Accommodate women through project design, such as timing and location of project activities and training.
    - Reduce these burdens using labor-saving innovations built into the interventions.
    - Transform gender relations via meaningfully incorporating gender-transformative strategies into household to market scale that ensure domestic, nonpaid work is more equally divided between family members (see gender-transformative approaches mentioned under point 8).

3. **Increase women's access to ponds:**
    - Long-term individual access: Confirm if the local barrier is inheritance-related. Partner to address as a long-term strategy.
    - Short-term individual or collective access: Identify nontraditional and new pond access for women, either individual (unused ponds) or collective community ponds or tanks). Draw on existing insights from India, for example, regarding lessons to inform the latter.

4. **Enhance women's access to information (farming, market):**
    - Accommodate women by working around normative barriers to technical information by engaging and testing LSP models in which women are the LSPs.
    - Innovate within the digital component of the project by assessing the specific digital needs and constraints of women. Pilot test, with effective monitoring and evaluation (M&E), the best bet two to three digital strategies to overcome them.
    - Work with formal and informal extension actors to build incentive and capacity to both reach and benefit women farmers. If one or more actors have sufficient capacity, develop gender-transformative modules that they can incorporate, and invest in building their capacity to deliver. Partner with them on M&E, including rapid feedback and improvement.
    - Make sure project training partners engage family support before involving women in aquaculture training.
    - Be sure to accommodate women's time burdens in timing and location of training.

5. **Catalyze more gender-equitable control (decision-making over ponds):**
    - Apply tailored gender-transformative approaches, such as those used in other WorldFish work (see point 8), within polyculture trainings and in farmers groups using robust M&E.
    - Investigate outcomes of asset-transfer initiatives in Bangladesh. If they have potential, then pilot with ponds and/or credit in combination with a gender-transformative approach to ensure that such control is sustainable in the long run (see point 8).

6. **Work from a recognition of aspirations as the basis for upward mobility in chains for lower socioeconomic women and men:**
    - Men, including youths, of lower socioeconomic status identified aspirations to move into higher value positions. Unpack the specific barriers and opportunities to that movement.
    - Confirm women's aspirations within the sector, including youths, and identify key opportunities. The WorldFish-Bopinc Niches tool can be applied (Bopinc and FISH, forthcoming).

7. **Commit to enabling more women to engage, stay and succeed along chains:**
    - Take stock of project progress and limits to date as well as associated lessons, such as how criteria influences the gender balance of project participants (entrepreneurs).
    - Linking to the above, work with women who show positive deviance and male champions to identify entry points to expand and build on existing momentum of "only women without 'able' men."
    - Support men and women from lower wealth groups using a combined approach that targets several dimensions or skills—technical, financial and business skills—so that they can move up into the higher nodes of the value chain.

- Keep the investment in an informed and well-bounded set of work on women's entrepreneurship:
    - Identify and "bound" (i.e. clearly define and limit) two to three key questions and innovations that will be piloted via action research in relation to women's entrepreneurship and enterprise (as per the following bullets).
    - Ensure that M&E and research around these speaks to the project M&E framework (dimensions of empowerment of particular interest, including economic empowerment).
    - Given the extent to which this is a hot topic, ensure there is a well-documented foundation of current knowledge in place, for example through a literature review on women's entrepreneurship.
- Leverage the shift to digital and virtual marketing. Within a Niches assessment, using the WorldFish-Bobinc Niches tool, critically assess opportunities for digitally based entrepreneurship and enterprises that are working around traditional mobility constraints, expanding markets and profits.
- Build on existing niches and momentum where they converge with interest—women as nursery operators. Set up virtual and, if possible, face-to-face mentorships for emerging women professionals with successful women and men operators.
- Galvanize the freedom that poorer women have by including them in the project activities in roles uncommon for women. Invest in building their capacity for fish production, providing them with the needed capital, technical and business skills to start aquaculture, making them a role model for other women.
- Contribute to the collective and individual agency of women to navigate sector barriers like via women's business groups. (Note: The project will have to navigate issues of potential competition versus support among members). For example, the approach can be used as applied by WorldFish and CARE with women retailers in Egypt.[13]
- To address constraining norms that undermine the sustainability of outcomes, incorporate gender-transformative strategies within the economic empowerment-related components of the project. For example, adapt the Gender Action Learning System (GALS) methodology (Oxfam Novib 2014a and 2014b), combined with previous WorldFish methodologies for gender-transformative approaches, which drew on several resources from other organizations.[14] This would reduce normative barriers within households, at communities and in markets.

8. Proactively address the key underlying informal barrier to points 1 through 7—constraining gender norms and stereotypes:

- Within the project teams and practices, assess and address potential subtle bias and gender-reinforcing practices by the project, such as around targeting and associated messaging. This requires raising staff awareness about nutrition-programming that targets women only as reinforcing gender norms and stereotypes. In addition, check for and address potential subtle bias in project communications, specifically stereotypical images of men as fishers, women as cooks and caregivers.
- In the project interventions, use priority leverage points to shift norms and stereotypes, especially regarding women as fish farmers and women in paid work in value chains. These would be, for example, at household scale within polyculture training sessions, within farmer groups, and at community and market scale. Draw on best practice WorldFish and other models (CARE, GALS) to refine one or two bespoke and fit-for-purpose gender-transformative approaches. Ensure that these are informed by the specific issues, challenges and opportunities identified in the project's Gender Scoping Study (reference 2019). Dedicate ample training and coaching for facilitators and invest in quality M&E design. To help with this, plan the output at the outset.

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Notes

[1] Rangpur Division: Dinajpur, Gaibandha, Kurigram, Lalmonirhat, Nilphamari, Panchagarh, Rangpur, Thakurgaon. Raishahi Division: Bogra, C. Nawabganj, Joypurhat, Naogaon, Natore, Pabna, Rajshahi, Sirajganj.

[2] https://www.citypopulation.de/Bangladesh-Mun.html, which takes its data from the Bangladesh Bureau of Statistics.

[3] The protocol for this study is available upon request.

[4] Of the European Commission/DEVCO: https://ec.europa.eu/knowledge4policy/publication/value-chain-analysis-development-vca4d-methodological-brief_en

[5] The protocol for this study is available upon request.

[6] Disaggregated analysis is beyond the scope of this research. In general, there was very little variation in fish species.

[7] See https://app.powerbi.com/view?r=eyJrIjoiNGEwMTU2NWQtYjg4Zi00M2NiLTkxODYtYzE4ZGNjZjFmMDg1IiwidCI6IjI2MDI1NGRiLWRjNDEtNGY3ZC04OGI0LTMxODExZjA3MGJmNyIsImMiOjN9.

[8] These include BRAC, Grameen, Uddipon, SKS, TMSS, ASHA, Asroy, Shanti, Kormoshongstan Committee, Disha, Jagoroni Chakra Foundation, Gono Unnoyon, GUK, Juno Unnoyon (Youth Improvement), Swanirvar, Daridro, Gram Bikash, Bij Shamiti (Seed Association), Buro, Rural Foundation, Asroy, Konthoshor, Padakkep, Caritas, Shatafu, 1DF, Proshika, Ekti Bari ekti Khamar.

[9] Grameen, ASHA, GUK and Gak; at Konthoshor's (an NGO) the president, vice-president and members are all women.

[10] A table with detailed data on input use is presented in the Appendix of this report.

[11] See Bolwig et al. 2010 for general a discussion and Ponte et al. 2014 for an application in aquaculture.

[12] The term "last mile" here refers to the movement of goods and services from a market, center or hub to a final destination. The term comes from the telecommunications industry, which faced difficulty connecting individual homes to the main telecommunications network. In the value chain context, challenges of last mile delivery include costs, ensuring transparency, increasing efficiency, and improving infrastructure. Last mile client models in this case are therefore models that seek innovative ways to reach remote farmers with inputs and services.

[13] See https://www.worldfishcenter.org/pages/tackling-problems-poor-women-fish-retailers-egypt/.

[14] These were adapted activities from Promundo's curriculum for promoting gender-transformative change with men and boys (The ACQUIRE Project and Promundo 2008; Promundo-US and CGIAR Research on Aquatic Agricultural Systems 2016), Helen Keller International's Nurturing Connections aimed at transforming intra-household family dynamics that disempower women (Helen Keller International Bangladesh, no date) and UNDP's Gender Awareness and Development manual (MOWA and UNDP 2007), UNESCO's Gender Sensitivity training manual (UNESCO 2004), and BRAC's Gender Analyses and Awareness course.

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Annex 1. Input use in fish production

	Homestead pond	Extensive pond	Improved extensive pond	Commercial pond
Commercial feed (kg/ha)	3.2	0	348	2306
Fertilizer (kg/ha)	170	275	198	377
Homemade feed (kg/ha)	905	1233	843	1547
Fingerlings (kg/ha)	1366	1235	3385	2940
Lime for pond (kg/ha)	140	164	116	253
Drugs, antibiotics (BDT/ha)	591	307	1001	3405
Hormones (BDT/ha)	7	0	0	0
Vaccines (BDT/ha)	23	0	0	0
Disinfectants (BDT/ha)	436	448	1550	1924

Source: farm survey.

Table 19. Annual input use, per producer type.

Annex 2. Value chain barriers and recommendations

	Value chain barriers and opportunities	Recommendations	
		Within the project	**Via project partnerships**
Economic performance			
i)	Almost 60% of total production remains in rural areas, which emphasizes the major role that aquaculture plays in local food and nutrition security in Rajshahi and Rangpur.	Include ongoing rapid assessments with local women and men to accomplish the following: • Track COVID-19 pressures on local fish supplies for nutrition, and adapt project and partnerships as needed to address threats. • Identify factors that support this local use of fish and resilience in local systems and adapt project strategies to support them.	Communicate this and related evidence to policy and program actors to sustain investment in aquaculture for food and nutrition security in the areas.
ii)	Perceived policy barrier to production: Permission required to dig ponds, in particular, limits lower income households.	----	Engage policy partners regarding the influence of the current digging policy, or the perceptions thereof, and potential avenues to reduce its effects, especially for poorer households.
iii)	Extensive farmers appear to operate at a loss, even when the value of what is used for home consumption is included.	Prioritize investing in extensive farmers: Identify specific causes of economic losses in extensive systems, and invest in addressing these. Or identify how fish farmers can move out of extensive and into more profitable systems (see iv).	As extensive systems owners overlap with lower socioeconomic groups, identify partners and programs from the private sector and NGOs that invest in small farmer system upgrading and transitions (see iv).
iv)	At the farm level, the most critical resources to perform successfully are seed, feed, market information, medicine and access to intermediaries. Seed and feed are also major cost components for farmers. Financial constraints and lack of good roads and transportation are other perceived constraints to performance. The proximity of these resources differs across villages.	Project interventions should focus on an integrated package of interventions that combines the priority inputs as well as financial support or credit. Assess the needs of and target women and men farmers, particularly in lower income groups. Input supply models that bring information and inputs to farmers could have potential, such as the LSP model. Also, the project could explore which communities are most burdened by the remoteness of required inputs and target those with interventions, such as nurseries, local feed mills and input suppliers that are also trained to provide technical information.	These models require engagement with local businesses, DOF fisheries officers, microfinance institutions and other stakeholders. Regarding inputs for homestead and extensive ponds (see iii), identify partners and models that can bundle small quantities of inputs, such as LSPs breaking feeds into smaller portions. If possible, invest in connecting these input actors to farmer groups (both the groups that already exist and potentially those established by the project, ensuring these are inclusive to women).

	Value chain barriers and opportunities	Recommendations	
		Within the project	**Via project partnerships**
Social performance			
i)	While women engage and contribute in all aquaculture chain roles, especially at the producer level, their unpaid and paid work is weakly or not at all recognized within households, communities and by extension officers. An additional risk is that women's role might not be well recognized by project and partner staff in design and implementation.	Address the invisibility of women's unpaid and paid labor in and through the project: • Fill gender data gaps in the sector and divisions using new evidence of women's paid and unpaid contributions (data needs to be generated, shared and normalized). • Directly engage both women and men as fish farmers and value chain actors in project activities, and ensure capacity and asset opportunities reach women directly. • Check for and address potential subtle bias, or reinforce language and practices by project staff. For example, examine language used by staff, such as "fish farmer and his wife" and directing attention only to men in households. • Check for and address potential subtle bias in project communications, especially in stereotypical images of men as fish farmers and women as cooks and caregivers. • With their permission, amplify the visibility of women in the sector, such as case examples. • Develop strategies to use the space created by women who are exceptions. Work with them and next generation positive deviators and male champions to identify entry points and strategies.	Address the invisibility of women's unpaid and paid labor: • Catalyze or contribute to policy and guidance on gender-balanced and inclusive extension best (and worst) practices by the public and private sectors as well as NGOs. • Communicate and offer support to the DOF regarding gender-inclusive statistics (including a data gap analysis, and a strategy to fill this gap) and gender capacity in the DOF (by refining and sharing WorldFish gender capacity indicators, and supporting their use by the DOF).
ii)	Time burdens associated with gender division of labor limit women's ability to engage more fully in aquaculture chains, especially outside the home.	• Accommodate this gender barrier by designing the timing and place of all project opportunities to work around women's time burdens. • Reduce women's time burdens through the project's technical and social innovations, such as processing technologies. • Transform by fully incorporating gender-transformative strategies into key interventions, such as polyculture training, particularly at the household level.	Encourage partners to pick up and continue with WorldFish digital messages regarding sharing domestic work during COVID-19, and monitor and evaluate their influence on sharing work.

	Value chain barriers and opportunities	Recommendations	
		Within the project	**Via project partnerships**
iii)	Women's access to ponds is restricted because of barriers to ownership, such as inheritance practices.	• Identify and apply relevant lessons regarding ways around access to pond issues for the project from other contexts, such as India. Draw on the WorldFish project Gender Dynamics along Fish Value Chains in India: Testing Assumptions about the Influence of Women's Self-Help Groups which is assessing outcomes of women's aquaculture groups.	Share insights about barriers to women's equitable land and pond access and ownership with government and civil society partners: • Support and convene strategizing to reduce barriers, such as inheritance practices. • Engage with public, private and civil actors regarding ways around household barriers to ponds. For example, pilot and assess the outcomes of community ponds or tanks operated by women's groups.
iv)	There is gender-imbalanced control over ponds and other aquaculture resources, so women have relatively little decision-making power over household productive assets. Decision-making power appears to be more equitable when women have some form of ownership over an asset.	• Apply gender-transformative approach strategies within polyculture training for farmers. Include a robust M&E framework. • Investigate asset transfers or other means of securing women's assets to increase more equitable decision-making, combined with gender-transformative approaches, to ensure it does not rebound.	Catalyze or contribute to the momentum around asset transfers in the sector to increase more equitable decision-making. Scale existing gender-transformative approach strategies (WorldFish 2016) into microcredit programs in the divisions to increase the foundation for equitable decision-making.
v)	Mobility and aspirations: Only men of higher socioeconomic status are involved in high value positions, such as feed sellers, *arotdars* and hatchery owners. Male youths said that they aspire to roles of higher socioeconomic status. A main barrier is the capital to invest in such larger businesses.	Unpack barriers to identified higher value positions of interest to men of lower status, including youths. Technically and financially support men and women from lower wealth groups, and build their business skills so that they can move up into the higher nodes of the value chain.	---

	Value chain barriers and opportunities	Recommendations	
		Within the project	**Via project partnerships**
vi)	Women's participation in and returns from the chains are hindered by their more limited access (compared to men) to quality inputs (seed, feed), services and technical knowledge about aquaculture. This stems from various factors, including their lack of mobility. For example, women do not have access to the same quality fingerlings as men do, so they need to cope with the information and services they are able to get close to home.	• Develop private sector partnerships that explicitly recognize women, youths and lower-income farmers as clients. Co-develop and test business models that prioritize increasing access to seed, feed, market info and medicine for women and marginalized fish farmers. • Test and compare accommodative strategies that build on existing farm gate networks and practices that women draw upon, including information or inputs from neighbors, *patilwalahs*, etc. In addition, test and compare transformative strategies that bring women into "mainstream" channels to access inputs and information. To set up for that, avoid reinventing the wheel by consolidating (a) best bet business models for inclusive sector growth and (b) relevant WorldFish social and technical innovations that are ready to scale. • As a part of the above, sharpen and clarify what LSP model is being used within the project. Ensure that it is applying learning from the two prior LSP tests (and outside learning) in terms of engaging women and also reaching women farmers, and make explicit its theory of change in terms of gender. Will it—and how will it—reach, benefit and empower women or transform underlying barriers?	Work with partners to identify which villages/geographies in the divisions have challenges to access inputs. Partner to ensure enhancing access in those nonproject areas, including scaling project and WorldFish innovations.

	Value chain barriers and opportunities	Recommendations	
		Within the project	**Via project partnerships**
vi)	Women's paid labor contribution declines along the chain. For example, it drops from 14% at the intermediary level to 3% at the retail level. Most women who are engaged in markets or as input providers are poor or vulnerable or from households without "able" men, so they represent norm-bending based on need. Regarding aspirations, young women indicated that they were more interested in pursuing higher education and blue-collar jobs, but they are afraid they will be married off and not able to complete their dreams. Some female youths did see opportunities in being nursery operators.	Identify risks within the project operationalization and address them: • For example, generate lessons and improved strategies from early project initiatives to work with and develop entrepreneurs as well as small and medium enterprises. • For example, how have criteria set by the project affected the numbers of women, and which ones are selected for project opportunities in the value chain? Develop strategies to address diminishing engagement in paid labor along the chain from intermediaries to retailers. There are multiple aspects and entry points: • Work with positive deviators and male champions to identify entry points to expand and build on existing momentum of "only women without 'able' men" that already operate in roles that other women could also aspire to. • Confirm women's aspirations within the sector, including youths, and identify key opportunities. When this includes entrepreneurship, apply the Niches tool. • Leverage the shift to digital and virtual marketing brought on by COVID-19. Within the WorldFish-Bopinc Niches assessment, critically assess opportunities for digitally based enterprises, working around traditional mobility constraints, expanding markets and profits. • Build on existing niches, especially where it converges with interest—women as nursery operators. Set up virtual and, if possible, face-to-face mentorships for emerging women professionals with successful women and men operators.	Link to project strategies to build opportunities: • Confirm women's aspirations within the sector, including youths, and identify key opportunities. If accurate, for those interested in "blue-collar" jobs (as per this study), then identify opportunities via partnerships (see also vii). Build on existing initiatives and momentum to enhance women's economic empowerment: • For example, catalyze government and NGO/INGO programs for investing in women's businesses around nursery businesses and other priority areas, following assessment of viability/ saturation. • Draw on lessons and build momentum by connecting women and women's groups in the project (e.g. business groups) with wider collective action regarding gender-equitable sector and economies in Bangladesh beyond the divisions. Reduce underlying barriers that undermine success, sustainability and scaling of the above: • Reduce the need for women to negotiate, including regarding early marriage. This requires addressing norms regarding gender division of labor in the household and women's dreams to obtain blue-collar jobs.

	Value chain barriers and opportunities	Recommendations	
		Within the project	**Via project partnerships**
		Contribute to the collective and individual agency of women to navigate sector barriers: • For example, integrate with or establish women's business groups. (The project will have to navigate issues of potential competition versus support.) Reduce underlying barriers that undermine the success, sustainability and scaling of the above: • To address constraining norms that underpin the above, incorporate gender-transformative strategies within the economic empowerment-related components of the project. For example, adapt GALS methodology, combined with previous WorldFish gender-transformative methodologies (Feed the Future Bangladesh Aquaculture and Nutrition Activity) to reduce normative barriers within households, at communities and within markets.	
vii)	In paid work, women rarely have positions of leadership.	Within, for and through the project: • Assess the project's role-modeling of gender-balanced leadership (e.g. anonymous survey, staff and ex-staff feedback) and use learning to enhance meaningful and visible gender-balanced leadership. Set both quantitative and qualitative indicators. • Ensure the project is investing in career-building opportunities for women from Bangladesh, not only lower-role employment. Secure and, if possible, expand PhD and postdoctoral opportunities for Bangladeshi women through the project.	Identify two to five private sector partners interested in exploring more gender-balanced corporate leadership and develop pilot innovations with them (e.g. along the lines of International Financial Corp/World Bank case studies). As an entry point, consolidate evidence for rationale and strategies. Ensure a monitoring plan is in place.

	Value chain barriers and opportunities	Recommendations	
		Within the project	**Via project partnerships**
viii)	Constraining gender norms underlie and reinforce the gender barriers of social performance points i to vii and inequitable dynamics—specifically what behavior and types of work and freedoms are perceived as appropriate for men and women. This includes norms that influence which resources women and men can access or control, where and how they can engage in the chain, and what decisions they can make and to what extent. Key constraining norms in this context include those that (a) limit women's mobility into public spaces and interactions outside of family, and (b) position women as caretakers and supporters and men as head of households and farmers. Norms are enforced via social repercussions at multiple scales, such as humiliation by neighbors, loss of reputation, harassment, etc. Situations where it is socially acceptable for women to deviate from the norm often relate to necessity (poverty, loss of an able man due to death/divorce) or higher wealth status.	Avoid reinforcing the following: • Address potential subtle bias and gender-reinforcing practices by the project, such as those around targeting and associated messaging. Raise staff awareness about nutrition-programming that targets women only as reinforcing gender norms and stereotypes. • Check for and address potential subtle bias in project communications, especially stereotypical images of men as fishers and women as cooks and caregivers. Enable transformation of constraining norms, with gender-transformative approaches tailored to needs and scales.	---
ix)	Power dynamics at different levels of the value chain (household, community) intersect to disadvantage women, including that women have less decision-making power at all levels. This affects not only how many women are part of the chain (reach) but also the gendered distribution of benefits and other outcomes of investments in value chains.	The project can take a multiscale view of its interventions, particularly in relation to gender barriers. Identify lessons from elsewhere to address these across scales. Revisit the project's theory of change through a gender lens, unpacking assumptions about what interventions will lead to and about the context in which they are taking place, and identifying which types of gender outcomes are plausible via each pathway (reach, benefit, empower or transform).	---

Table 20. Economic, social and gender performance issues and recommendations.

WorldFish

About WorldFish

WorldFish is a nonprofit research and innovation institution that creates, advances and translates scientific research on aquatic food systems into scalable solutions with transformational impact on human well-being and the environment. Our research data, evidence and insights shape better practices, policies and investment decisions for sustainable development in low- and middle-income countries.

We have a global presence across 20 countries in Asia, Africa and the Pacific with 460 staff of 30 nationalities deployed where the greatest sustainable development challenges can be addressed through holistic aquatic food systems solutions.

Our research and innovation work spans climate change, food security and nutrition, sustainable fisheries and aquaculture, the blue economy and ocean governance, One Health, genetics and AgriTech, and it integrates evidence and perspectives on gender, youth and social inclusion. Our approach empowers people for change over the long term: research excellence and engagement with national and international partners are at the heart of our efforts to set new agendas, build capacities and support better decision-making on the critical issues of our times.

WorldFish is part of One CGIAR, the world's largest agricultural innovation network.

For more information, please visit www.worldfishcenter.org