USAID
FROM THE AMERICAN PEOPLE

FINAL REPORT

FINAL PERFORMANCE EVALUATION FOR THE FEED THE FUTURE BANGLADESH AQUACULTURE AND NUTRITION ACTIVITY

July 19, 2023

This document was produced by ME&A, Inc. at the request of the United States Agency for International Development. It was prepared independently by the USAID Bangladesh Monitoring, Evaluation, and Learning (BMEL) Activity.

FINAL REPORT

Final Performance Evaluation for the Feed the Future Bangladesh Aquaculture and Nutrition Activity

July 19, 2023

Contract/Order Number: GS-10F-154BA/72038819M00001
USAID Bangladesh Monitoring, Evaluation and Learning Activity (BMEL) Activity

Prepared by

ME&A, Inc.

4350 East-West Highway, Suite 210

Bethesda, MD 20814 USA

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

ACRONYMS

Acronym or Short Form	Definition
AAER	Adopt-Adapt-Expand-Respond
AMP	Aquaculture Medicinal Products
AIN	Aquaculture for Income and Nutrition
Aquaculture Activity	(USAID) Bangladesh Aquaculture and Nutrition Activity
BB	Bangladesh Bank
BDT	Bangladesh Taka
BFDC	Bangladesh Fisheries Development Corporation
BFRI	Bangladesh Fisheries Research Institute
BMEL	Bangladesh Monitoring, Evaluation, and Learning Activity
BMP	Best Management Practices
BMO	Business Management Organization
CC	Coordination Committee
CGIAR	Consortium of International Agricultural Research Centers
CGIP	Carp Genetic Improvement Program
CIB	Credit Information Bureau
CMIL	Classic Melamine Industries Ltd.
CODEC	Community Development Centre
COP	Chief of Party
COVID-19	Coronavirus Disease 2019
CPG	Carp Pituitary Gland
CSISA-BD	Cereal Systems Initiative for South Asia-Bangladesh
CSO	Civil Society Organization
DEC	Development Experience Clearinghouse
DO	Development Objective
DOF	Department of Fisheries
DYD	Department of Youth Development
EG	Economic Growth
EQ	Evaluation Question
ET	Evaluation Team
FAS	Fixed-Amount Subaward
FCR	Feed Conversion Ratio
FGD	Focus Group Discussion
FIAB	Feed Industries Association Bangladesh
FPE	Final Performance Evaluation
FTF	Feed the Future (Program)
FY	Fiscal Year
GAP	Good Aquaculture Practice
GIFT	Genetically Improved Farmed Tilapia

Acronym or Short Form	Definition
GOB	Government of Bangladesh
ICLARM	International Center for Living Aquatic Resources Management
IGA	Income Generating Activity
IP	Implementing Partner
IR	Intermediate Result
KI	Key Informant
KII	Key Informant Interview
LEAF	Local Extension Agents for Fisheries
LGED	Local Government Engineering Department
LSP	Local Service Provider
MEFCC	Ministry of Environment, Forests, and Climate Change
MEL	Monitoring, Evaluation, and Learning
MFI	Micro Finance Institution
MOFL	Ministry of Fisheries and Livestock
MOU	Memorandum of Understanding
MRA	Microcredit Regulatory Authority
MT	Metric Ton
NGO	Non-Governmental Organization
OSSC	One Stop Service Center
PKSF	Palli Karma Sahayak Foundation
RA	Research Associate
RTC	Ready to Cook
RTE	Ready to Eat
SBCC	Social and Behavior Change Communication
SOW	Scope of Work
TBN	Tilapia Breeding Nuclei
TL	Team Leader
TOC	Theory of Change
ToT	Training of Trainers
USAID	United States Agency for International Development
USG	United States Government
WASH	Water, Sanitation, and Hygiene
WBC	Women Business Center
WMF	Women Micro Franchisee
YDO	Youth Development Organization
ZOI	Zone of Influence
ZOR	Zone of Resilience

EXECUTIVE SUMMARY

INTRODUCTION

The United States Agency for International Development (USAID) has supported the Feed the Future (FTF) Bangladesh Aquaculture and Nutrition Activity (Aquaculture Activity) since February 2018 with a no-cost extension through November 2023. The Activity was implemented by WorldFish in the Feed the Future (FTF) Zone of Influence (ZOI) and Zone of Resilience (ZOR). A final performance evaluation was carried out from February through May 2023 to answer the following Evaluation Questions (EQs):

1. To what extent has the Aquaculture Activity achieved its overall goals and objectives sustainably? Specifically, to what extent has the activity been successful in achieving its Intermediate Results (IRs)—increasing productivity and strengthening markets?
2. To what extent has the Activity addressed systemic challenges across the aquaculture sector? How may USAID address the remaining gaps in the aquaculture market systems?
3. How sustainable are the Activity's private and public-sector engagements likely to be at addressing the emerging production, productivity, and market access challenges in the aquaculture sector?
4. How successful has the Activity been in promoting/ commercialization of genetically improved carp (rohu, catla, and silver) and tilapia fish species? Has the Activity made any sustainability plan for the genetic improvement program and, if so, how?
5. How successful has the Activity been in using the sub-grant approach to support Activity objectives?
6. How well were the grants aligned with each other in support of the Aquaculture Activity's objectives?
7. How successful has the Activity been in addressing regulatory and policy issues related to the aquaculture sector?
8. How effectively has the Activity addressed the emerging challenges of host and impacted communities in the ZOR? How may USAID address the existing and emerging challenges of the aquaculture sector in the ZOR?
9. How successful has the Activity been in identifying, implementing, and promoting nutrition-sensitive interventions? How effective has the Social and Behavior Change Communication (SBCC) of the activity been?
10. How successful has the Activity been in effectively integrating gender considerations and ensuring equitable access for women, increasing female engagement and empowerment, and promoting women entrepreneurs?
11. How effective has the Activity's Monitoring, Evaluation, and Learning (MEL) approach and tools been in measuring market system change? What are some of the lessons learned? And based on the lessons learned, what are some scalable interventions?

The Aquaculture Activity's goal of *inclusive aquaculture sector growth through a market system approach* is based on three objectives: 1) to increase aquaculture productivity, 2) to strengthen aquaculture value chains, and 3) to improve nutrition-related behaviors of rural households. Life-of-Activity targets include:[1]

- 400,000 men, women, and youth have improved access to better quality aquaculture inputs, services, and/or market channels.

[1] Aquaculture Activity Year 6 Quarter 1 Progress Report: October–December 2022.

- 30 percent expansion of investment by the private sector in aquaculture production—market-related to inputs and services.
- 30 percent increase in productivity from ponds and *ghers*.
- 20 percent increase in the number of households adopting improved nutritional practices.

The Aquaculture Activity's design and Theory of Change (TOC) focused on a hybrid market systems approach designed to strengthen market system linkages and attract private-sector investment. Priority was also placed on boosted inclusion of women and youth in the aquaculture sector. Much of the Aquaculture Activity's work was undertaken through grantees: a mix of private-sector firms and Non-Governmental Organizations (NGOs) operating in the ZOI and ZOR.

METHODOLOGY

The evaluation adopted a case study approach. Case studies focused on one district selected in each of four different ecological/geographical clusters of the aquaculture sector. Each study traced participating the Aquaculture Activity grantees and the market actors with whom they linked to assess their value chains. Each case study drew on Key Informant Interviews (KIIs) with grantees and other experts; Focus Group Discussions (FGDs) with participating aquaculture farmers or processors; and an analysis of relevant grant documents, the Aquaculture Activity's reports, quantitative data, and other secondary documents.

FINDINGS AND CONCLUSIONS

For the purposes of this summary, evidence has been clustered into the following broad themes: 1) productivity and nutrition; 2) the aquaculture market system; 3) the enabling environment; and 4) the grants' approach and measuring systems change.

Findings: Aquaculture Productivity and Nutrition (EQs 1, 4, 8, 9)

The Aquaculture Activity met its target of a 30 percent increase in productivity from fish culture. Fish farmers gained better access to quality, affordable inputs—in particular, quality seed and information. Efforts to improve access to affordable feed were disappointing, because the major challenge was not availability but affordability, which continued to rise to the point where the cost of fish feed prohibits most smallholder farmers from using fish feed. The large feed suppliers/sub-grantees reported that the input and transport costs (and regional issues like the war in Ukraine) are to blame. One of the Aquaculture Activity's early ideas was for fish feed producers to purchase imported feed inputs together to bring down costs. This did not come to fruition. When asked about working with other sub-grantees, informants said they had not done so.

Fish seed. The Aquaculture Activity engaged 13 hatcheries in the ZOI and ZOR—providing them with quality brood, information about biosecurity, brood management, improved seed production, and safe transportation techniques. The Aquaculture Activity tried to commercialize G3 rohu (WorldFish's [WF] improved variety of carp) by involving more hatcheries (including the Department of Fisheries [DOF] in 2021), but the G3 rohu seed market is still underdeveloped, because brood stock was only recently provided to the DOF. The Aquaculture Activity may have missed an opportunity to extend the reach of the program by including the numerous informal hatcheries and nurseries in the ZOI and ZOR.

Fish feed, medicine, water, and soil testing. Quality feed is available, but remains too expensive for most smallholder farmers, who are largely unbanked. The Aquaculture Activity's efforts have not increased the availability of affordable, quality fish feed. Aquaculture Medicinal Products (AMPs) are available, but largely unused by most (small) farmers. Similarly, while the demand for water and soil testing technology is high among aquaculture farmers, and the Aquaculture Activity grantees were meant to supply water and soil test kits, access to kits fell short because kits were imported and expensive.

Best Management Practices (BMP). Case study and survey data suggest that the Aquaculture Activity contributed to improving farmer adoption of good aquaculture practices. Farmers interviewed in this evaluation said they will continue to use BMP. The Activity adopted a multiple-touch approach

with farmers: introductory meetings, informational meetings with handouts, direct training, and follow-ups. Some grantees introduced farmers to apps.

The Aquaculture Activity's engagement in the dried fish industry in the ZOR benefited the host community from an economic perspective and illustrates how that industry could be made safer, improve processor livelihoods, and increase the availability of Ready-to-Cook and Ready-to-Eat (RTC and RTE) products. The ZOR case study also points to the need to expand pond aquaculture to meet the demand for freshwater fish, which is increasing mostly due to non-resident populations (including refugees and aid workers), especially given the decreasing availability of marine fish.

Market linkages. The Aquaculture Activity improved market linkages but lacked the means to effectively measure the associated changes. This information would likely have helped it to adapt its approach over time. It is unclear how the Aquaculture Activity used its extensive MEL data to support activity adaptation.

Farmers benefited from the improved capacity of dealers and retailers (*e.g.,* One Stop Service Centers [OSSCs], Women Micro Franchisees [WMFs], Women Business Centers [WBCs], and others) to give appropriate and timely advice.

The Aquaculture Activity's engagement of private-sector actors was appropriate, and grantees' cost-share portion (43.5 percent, on average) was good in the Bangladesh context, where private-sector firms expect donor funding for "projects." In retrospect, more effort was needed to acclimatize firms to the market systems approach, shift them away from this expectation, and better leverage donor funding.

Nutrition. The Aquaculture Activity met its targets for adopting good household nutrition practices, small fish consumption and a diversified diet: more than 90 percent of households reported started eating mola with the head; 75 percent of women reported they consumed a diversified diet and more than 18 percent of households reported. Activity contributions included grantee efforts to increase production of carp-mola polyculture and pond dike vegetable cropping, nutrition education, and development and promotion of RTC and RTE fish products.

Enabling environment. The Aquaculture Activity's contributions to the enabling environment were limited. The Aquaculture Activity missed opportunities to engage with the GOB and to address important policy and regulatory issues. Attention to transport and cold chain investment—both critical barriers—were small, especially compared to the Aquaculture Activity's investments in inputs. Initiatives addressing inclusion of women and youth in aquaculture merited more attention.

Conclusion: Performance indicators and evaluation findings confirm that the Aquaculture Activity has achieved many of its targets. Aquaculture productivity has increased because farmers are now using BMP and enjoy greater access to high-quality seed, fry, and fingerlings. Farmers have access to high-quality feed, but most cannot afford it. The Activity has strengthened linkages in the market system for seed, fry and fingerlings, information, AMP and technology, and feed (to a lesser extent) on the input side. The Activity's efforts in nutrition-sensitive aquaculture have contributed to improved nutrition and aquaculture practices. It has also strengthened the capacity of some actors and linkages among them. The Activity's attempts to assess change in the market system have been ineffective, limiting the its ability to adapt its approach during the project cycle.

Findings: Aquaculture market system (EQs 2, 3)

Scaling successful approaches. The Aquaculture Activity worked with 88 grantees, successfully addressing some systemic challenges and generating learning for future market systems development activities. The Activity's successful seed interventions could be multiplied with more district-level hatcheries and nurseries producing the most productive and appropriate species. Experience with knowledge transfer and advisory services suggests that sectoral impact could be achieved by 1) increasing the proportion of existing farmers using BMP, 2) bringing more people into pond culture, and 3) creating more graphic and/or video presentations of BMP to extend the reach of information.

Public sector engagement. The Aquaculture Activity had very limited engagement with GOB agencies. This dampened sustainability, reach (particularly to youth and women) and policy impact. Cooperation and collaboration between the public and private sectors are necessary to 1) ensure and enforce safe handling processes and 2) minimize loss between ponds and end markets (packaging, cold chain, and transportation infrastructure). The Activity missed opportunities for expanded use of G3 rohu by 1) not sharing brood stock earlier with the DOF and 2) not consulting the Bangladesh Fisheries Research Institute (BFRI).

Figure 1. Sustainability scale of the Aquaculture Activity's aquaculture market components

Output market. The Aquaculture Activity's efforts in the output market contributed to some improvements in safe handling, packaging, and transport.

The biggest success was in the dried fish industry in Cox's Bazar, which benefited from increased safety for processors, safer products through better processing and hygienic environment, and productivity of RTE and RTC products.

Cold chain development was successful for one of the Activity's grantees and its clients/consumers but has not been replicated by others.

Sustainability. The Aquaculture Activity's efforts across the sector were valuable but insufficient to produce long-term sustainability in most sub-sectors, as seen in figure 1 above.

***Conclusion*:** As of early 2023, the market system is better placed to address existing and emerging challenges regarding seed quality and availability, information sharing, and meeting the increasing demand for RTC and RTE. More effort is needed to meet the demand for fresh fish—which includes solving the ongoing affordable, quality, feed challenge and access to finance. The Aquaculture Activity missed opportunities across the sector because of lack of public sector engagement. The success in Cox's Bazar suggests that a locally sensitive, market systems approach is possible and spotlights strategic shortfalls in adopting a market systems approach in other localities and value chains. Indeed, the project could have borrowed from more "mature" market systems development initiatives in agriculture and other value chains to advance the aquaculture market systems.

Findings: Enabling environment (EQs 7, 10)

Policy. The Aquaculture Activity worked on updating the National Fisheries Policy and its grantee, the Bangladesh Shrimp and Fish Foundation (BSFF) and worked on policy consolidation and improvement related to aquaculture inputs. The evaluation found several policies and regulatory issues that still need to be addressed for the effective functioning of the aquaculture sector.

Credit. Despite efforts to increase farmers' access to credit, fewer than 6,000 farmers received loans through December 2022. The average loan to male farmers was almost seven times that of the loan size to female farmers.

Gender. The Aquaculture Activity's grantees mostly met their inclusion goals for women and youth participation as described in their grant agreements. Women's participation in aquaculture remains primarily around family pond management and supporting their families/husbands. Youth, especially young men, express interest in aquaculture as an income-generating activity. Nonetheless, patriarchal social norms and norms that see youth as untrustworthy, as well as barriers to credit, continue to marginalize women and youth from participating in the sector.

***Conclusion*:** Aside from work on the National Fisheries Policy, the results of which are not yet known. the Aquaculture Activity did not adequately address policy or regulatory issues in the aquaculture sector. Gender and youth inclusivity were addressed through targets, but a more strategic approach in which women and youth are supported as entrepreneurs, employees, processors, and farmers could be more sustainable.

Findings: Grants approach and measuring systemic change (EQs 5, 6, 11)

The Aquaculture Activity got off to a slow start with significant staff turnover in the first several years. This was then compounded by the global COVID-19 pandemic. The Activity improved its grants management approach over time, which can be seen in fewer criticisms in 2022 closeout reports.

Selection. The sub-grant approach was moderately successful in supporting the Aquaculture Activity's objectives. The Activity selected a wide range of private-sector firms to facilitate market system strengthening across the input, services, and output markets. Most of its sub-grantees were large national or regional firms who could meet the rigorous reporting requirements. Local market stakeholders were engaged through the sub-grantees, *e.g.,* local input sellers and producers. The Activity selected experienced and knowledgeable nutrition-focused NGOs that effectively designed and implemented interventions.

In retrospect, due to large, national commercial firms dominating the fish feed market, the feed sector partners should have been regional and local. Overall, feed sector grantees may not have been adequately aware of market challenges prior to starting their activities, which impeded their efforts. They were focused on expanding their market share and profit. A stronger, more focused market systems approach throughout the Aquaculture Activity may have produced stronger interventions and, also, a different set of grantees.

Timeline. Many grantees in the Aquaculture Activity's early years criticized the grant timelines, which were mostly one year. This changed when the Activity revised its grant procedures to include clear guidance and relatively short and easy processes to extend grant terms. The grants may have been more effective had these procedures been in place earlier. Several grantees have had two to four grants (or years).

MEL System. The Aquaculture Activity sought to assess changes in the market system through the MEL system, the baseline and mid-term evaluations, and an Aquaculture Activity-designed-and-conducted study assessing change in the market system. Nonetheless, the MEL system lacked the necessary data to measure systemic change. The baseline's value chain map is general, lacking necessary detail about local and regional value chains where systems change takes place.

The Aquaculture Activity plans to launch another study assessing systems change which will seek to measure the targeted 30 percent expansion of private-sector investment in aquaculture production. The study will focus on private-sector investment in inputs and services (seed, feed, production market-related information, technology, *etc.*), for which there is currently no data.

***Conclusion*:** The Aquaculture Activity's co-investment with the private sector and hybrid approach are appropriate in the Bangladesh aquaculture sector. Overall, the Activity might have been more effective by focusing on a market systems approach which 1) mapped local and regional value chain actors and linkages among them, 2) identified push-and-pull factors and the actors with the greatest

potential for roles in market strengthening, and 3) based on 1 and 2, focused on specific market challenges in potential-partner proposals.

The Aquaculture Activity's MEL efforts to date have been insufficient to measure market system changes and adapt the Activity accordingly. The Activity needed context-driven local and regional value chain maps at baseline. With that starting point, the Activity could have measured changes in those value chains—which, over time and multiple value chains, could effectively illustrate market system change.

LESSONS LEARNED

Transformations in the aquaculture market system required a greater diversity of expertise, data, and perspectives to meet the ambition of the Aquaculture Activity. WF brought significant technical expertise to the Activity, which contributed to improving seed, farmer skills and nutrition information and outcomes. Market systems transformation required more analytic economic and business expertise. Lessons from more mature market systems in Bangladesh (for instance in agriculture, livestock, commodities) could have informed the Activity's approach as well. The individualized approach to grantmaking and the laser focus on private-sector engagement may not have served the need for building market linkages from the outside. Ongoing multi-stakeholder workshops and a multi-stakeholder campaign might have generated awareness and interest in the Activity, increased private-sector engagement, built public-private partnerships, and strengthened relationships among stakeholders.

Some of the interventions that offer value to the aquaculture sector and potential market sustainability that *could be scaled* include:

- **Hatchery-nursery linkages** that promote access to high-quality seed. Additional training and support for transporters and sellers could continue to extend the availability of high-quality seed outputs (fry/fingerlings) to farmers.
- **Training small farmers especially targeting youth (and young women).**
- **OSSCs** to continue to reach farmers with advice in addition to selling products.
- **Dried fish processing and value-added production** approaches from Cox's Bazar (including use of e-commerce) to other areas of Bangladesh.
- **Integrated carp-mola polyculture** for increasing fish productivity and family nutrition.

RECOMMENDATIONS

Drawing on the findings and conclusions presented above, the following recommendations are put forward to inform future USAID programming:

Activity Design

- When taking a market system approach, pair aquaculture expertise with business development expertise.
- Require stronger coordination between the Implementing Partner (IP) and relevant GOB actors, such as conducting twice-yearly workshops with DOF and BFRI on capacity development, quality assurance, and policy issues.
- Conduct a stronger, more inclusive relationship building and multi-stakeholder Activity launch that includes Civil Society Organizations (CSOs), policy influencers, the GOB, and other market actors to engage stakeholders at the outset, generate interest in the Activity, understand its goals, and develop synergies among stakeholders.
- Develop detailed local and regional value chain maps to support activity design.
- Clearly define the desired systemic market change and when and how to measure it so that change can be tracked and adjustments made throughout the Activity.

- Tailor Activity design to local contexts and priorities to address local challenges and more effectively engage women and youth and climate/environmental factors.

Enabling Environment

- Encourage financial service providers to create aquaculture-friendly loan products that are in line with the local fish culture cycle. The effort requires opening pathways for appropriate loan products through changes in policy and financial institution agreements.
- Address policy issues and encourage effective enforcement such as assessing the Fish and Animal Food Act 2010 to identify issues that need to be revised, dropped, or require new acts. For example, the Act affects partnerships among feed mills and the community feed millers' licensing process that the Activity found problematic.
- Use understanding of impact of climate change and ecological environment of local areas to tailor interventions to local areas, something that The Aquaculture Activity did not prioritize.

Aquaculture Sector

- Expand training for hatcheries on BMP, linking hatcheries to build up nursery BMP. Increase the number of nurseries.
- Promote and commercialize high-yield fish seed.
- Extend training to small aquaculture farmers: consider delivery through NGOs with DOF and aquaculture-focused IP(s).
- Promote group farming to address multi-owner ponds that are otherwise not in use and encourage knowledge sharing.
- Engage the DOF and the private sector to develop and promote water and soil testing.
- Build capacity of community and regional feed mills with a market systems approach to address elite domination of the feed market and reduce the cost of fish feed.
- Build up a fish meal industry to support domestic fish feed production.
- Continue capacity building among fry/fingerling sellers, nurseries, and hatcheries and improve the transportation system. Hatchery associations and the transport service providers can facilitate the seed supply chain.
- Further improve the cold chain between farmers and end markets to limit the loss of fish and fish products, which costs the industry and is a determinant of the food supply.
- Leverage aquaculture product packaging as a distribution channel for nutrition messaging.

1. INTRODUCTION

This report presents the findings, conclusions, and recommendations of the Final Performance Evaluation (FPE) of the Bangladesh Aquaculture and Nutrition Activity (Aquaculture Activity)—funded by the United States Agency for International Development (USAID) in Bangladesh and implemented by WorldFish (WF) (formerly the International Center for Living Aquatic Resources Management [ICLARM]), a public international organization. A four-person Evaluation Team (ET) managed by the USAID/Bangladesh Monitoring, Evaluation, and Learning (BMEL) Activity conducted the evaluation.

1.1. BACKGROUND

The Aquaculture Activity has been implemented by WF for more than five years starting in February 2018 and continuing until November 2023—due to a 10-month, no-cost extension. The Activity has been implemented in three divisions and 21 districts located in the Feed the Future (FTF) Zone of Influence (ZOI) and two southeastern districts in the Chattogram division located in the FTF's Zone of Resilience (ZOR). The Activity has an allocated budget of $24.5 million—26 percent of which is used for grants.[2]

1.2. THE AQUACULTURE ACTIVITY'S OBJECTIVES AND THEORY OF CHANGE (TOC)

The Aquaculture Activity focuses on one goal: inclusive aquaculture sector growth through a market system approach. It has three objectives: 1) increase aquaculture productivity, 2) strengthen aquaculture value chains, and 3) improve nutrition-related behaviors of rural households. The Activity had the following life-of-Activity targets:[3]

- 400,000 men, women, and youth have improved access to better quality aquaculture inputs, services, and/or market channels.
- 30 percent expansion of investment by the private sector in aquaculture production and market-related inputs and services (seed, feed, production market-related information, technology, *etc.*).
- 30 percent increase in productivity from ponds and *ghers*.
- 20 percent increase in the number of households adopting improved nutritional practices (consumption of nutritious food, dietary diversity, and hygiene practices).

By design, most of the Aquaculture Activity's work was through grantees: a mix of private-sector firms and Non-Governmental Organizations (NGOs) that would facilitate a hybrid market system approach with some development interventions. In both zones, the Activity expected to see linkages, inclusivity, and activities within the aquaculture market system grow and attract replication and investment. (See Annex 2: The Aquaculture Activity Theory of Change.)

1.3. EVALUATION PURPOSE, AUDIENCE AND SCOPE

The purpose of this FPE of the Aquaculture Activity is to assess the extent to which the Activity has achieved its overall objectives. The performance evaluation will offer recommendations for strategic and programmatic options for future aquaculture programs and other relevant activities based on findings from desk review and primary data collection with a broad range of Activity stakeholders—including the WF, individual and organizational grantees, and Activity participants such as farmers, input providers, buyers, and others in the aquaculture market system. (See Section 3. Evaluation Questions and Annex I for the Evaluation Scope of Work [SOW]).

The final evaluation report is a source for USAID and others working in the aquaculture market system in Bangladesh. The primary intended audience for the FPE findings and recommendations is the

[2] BANA Year 6 Quarter 1 Progress Report: October-December 2022.

[3] *Ibid.*

Economic Growth (EG) office of USAID/Bangladesh. USAID may distribute the report to other parties involved in identifying, designing, or implementing other FTF initiatives: Government of Bangladesh (GOB) ministries and departments; other donors; and private-sector entities across development sectors. Upon approval by USAID/Bangladesh, ME&A, Inc. (ME&A), will upload the final report on the USAID Development Experience Clearinghouse (DEC), and USAID may share this link widely.

1.4. EVALUATION QUESTIONS (EQS)

This evaluation's SOW (Annex 1) requested that the ET provide answers to 10 EQs, which became the 11 following discussions with USAID (see Table 1-A).

Table 1-A. Evaluation Questions (EQs)

Evaluation Questions
1. To what extent has the Aquaculture Activity achieved its overall goals and objectives sustainably? Specifically, to what extent has the activity been successful in achieving its IRs—increasing productivity and strengthening markets?
2. To what extent has the Aquaculture Activity addressed systemic challenges across the aquaculture sector? How may USAID address the remaining gaps in the aquaculture market systems?
3. How sustainable are the Activity's private and public-sector engagements likely to be at addressing the emerging production, productivity, and market access challenges in the aquaculture sector?
4. How successful has the activity been in promoting/ commercialization of genetically improved carp (rohu, catla, and silver) and tilapia fish species? Has the activity made any sustainability plan for the genetic improvement program? And if so, how?
5. How successful has the Activity been in using the sub-grant approach to support Activity objectives?
6. How well were the grants aligned with each other in support of the Activity's objectives?
7. How successful has the Activity been in addressing regulatory and policy issues related to the aquaculture sector?
8. How effectively has the Activity addressed the emerging challenges of host and impacted communities in ZOR? How may USAID address the existing and emerging challenges of the aquaculture sector in the ZOR?
9. How successful has the Activity been in identifying, implementing, and promoting nutrition-sensitive interventions? How effective has the SBCC of the Activity been?
10. How successful has the Aquaculture Activity been in effectively integrating gender considerations, ensuring equitable access for women, increasing female engagement and empowerment, and promoting women entrepreneurs?
11. How effective have the Activity's MEL approach and tools been in measuring market system change? What are some of the lessons learned? And based on the lessons learned, what are some scalable interventions?

2. METHODS

2.1 APPROACH AND METHODS

The evaluation approach included conducting four case studies—one per ecological/geographical cluster—of the aquaculture sector. The ET purposively selected one district from each cluster based on 1) its aquaculture market from least robust (Faridpur) to most robust (Satkhira) and in between (Barishal and Cox's Bazar) and 2) the Aquaculture Activity's investment in the sub-Intermediate Results (IRs) in the districts, so that the selected districts addressed as many of the grantees and sub-IRs as possible. In each case, the ET sought to trace Activity grantees and the market actors with whom they are linked to assess their value chains. Each case study included Key Informant Interviews (KIIs) and Focus Group Discussions (FGDs). In addition, the ET analyzed grant documents, Activity reports, and Aquaculture Activity quantitative data; and consulted other secondary documents.

Document Review: The ET reviewed documents pertaining to the Aquaculture Activity, its grantees, and aquaculture-related documents; and Activity-provided survey data and indicator data. (See Annex 5: Bibliography.)

KIIs: These semi-structured interviews used discussion guides—allowing the interviewer to explore topics as they emerged. (See Annex 4 for the KII guides.) They also helped experts from the team ensure that technical issues were covered in sites where they were not present.

FGDs: Four FGDs were conducted in each case study district with people (primarily producers) trained by Aquaculture Activity grantees.

Sampling: The ET relied on the following provided lists provided by the Aquaculture Activity: 1) grantees, 2) trained farmers and some processors, 3) dealers and retailers, and 4) loans taken per financial services grantee, The Team Leader (TL) used the grantee list to assess the sub-IRs that would be covered within the selected districts and the number of grantees the FPE would cover (34 of 88 in the selected districts). For FGDs, the TL assessed the number of trainees (from the trainee database) within the selected districts by gender, age, upazila, and grantee.

In most cases, FGD participants in each district were trained by four different grantees. Upazilas with a minimum of 15 potential participants for a FGD (*e.g.,* male youth) were selected with consideration of maximizing representation within the district and potential travel constraints. For each FGD, the Aquaculture Activity supported the ET with a local representative, which was sometimes one of the grantee's dealers. This representative called potential participants using a script provided by the ET and a randomly ordered sampling list—with instructions to start at the top of the list and stop when up to 10 people agreed to participate.

Once the upazilas were selected, the TL used the same methods to select KIIs from the list of dealers and retailers—with a focus on the broadest representation—using the upazilas to narrow the list. In some districts, the ET sought to interview all dealers and retailers associated with the district's city center and selected upazilas, while in others (*e.g.*, Satkhira), the TL randomly sampled when there were two or more grantee dealer/retailers in an upazila or city center. Otherwise, the sampling was done to capture the most diverse participants (across grantees and sub-IRs). The TL also requested information from the Aquaculture Activity on local representatives of grantees (sometimes there were none). The results meant many more KIIs in Satkhira than in the other districts, so two teams worked in Satkhira. (See Annex 4 for KII participants by type of market actor and a list of FGDs by gender and age.)

Table 2-A. Geographic distribution of KIIs and FGDs

District	Ecological Zone	KIIs	FGD Participants (4 FGDs/district)
Cox's Bazar	Disaster prone/ marine coastal/ refugees	18	31
Barishal	Coastal/riverine	18	32
Faridpur	Riverine/flood prone	17	32
Satkhira	Tidal/saline	29	31
Aquaculture Activity grantees	-	24	-
Aquaculture Activity, USAID Each discussion counts as one, although most involved multiple participants.	-	11	-
Total	**-**	**117**	**126**

Tools: The FPE relied heavily on the expertise in aquaculture, market systems, and nutrition of its team members. The KII and FGD guides developed by the ET provided a framework for data collection, while the expertise of the four data collection teams meant they could adapt the guides during the discussions and get the most from the study participants.

Each expert led a team of two (with a notetaker), where the TL teamed up with a Research Associate (RA) with extensive data collection experience who led most of the discussions as the TL lacked the local language. The full ET with notetakers/RAs tested the performance of data collection tool, teams, and processes in Faridpur, because it 1) required the least number of KIIs and was, therefore, a good place for testing and revising tools and processes, and 2) is close to Dhaka and, therefore, permitted efficient transportation to the next districts.

Notes were taken during KIIs and FGDs: Some interviews were recorded with the participants' permission and revised by the team prior to submission to the TL for review. After reviewing the notes, the TL provided feedback to the teams on performance (especially important during the first days of data collection) and requests for clarification or further elaboration where possible. When the TL took notes through an interpreter, the RA reviewed the notes.

2.2 DATA ANALYSIS

Qualitative data analysis involved coding the data using Dedoose software to identify themes in the interview notes and assess their relative importance in answering the EQs. The ET met for iterative discussions of themes and answers to EQs, which then led back to follow-up searches for key terms in notes and documents. The ET requested access to the Aquaculture Activity's quantitative survey data (on March 5), as the Activity had conducted annual surveys since 2020. (Their partners were not fully on board until then.) While the Activity used their results in performance monitoring (*e.g.,* measuring indicators), the ET sought to use data to address EQs and assess the Activity's indicators and targets.

The ET received some of the survey data on April 4 related to aquaculture productivity. The TL requested additional data that addressed nutrition and gender (April 5). Many of the gender indicators

were asked only of NGO-trained farmers, and some first appeared on surveys in 2022. Quantitative data analysis consisted of calculating descriptive statistics and frequencies of survey results. The TL used the trainee and loan databases to assess grantees' inclusion of women and youth in some of their activities.

2.3 METHODOLOGICAL LIMITATIONS

Challenges assessing attribution and contribution: Lack of endline data from which to assess outcomes, combined with the non-linear market system change process with multiple contributors, means that the ET cannot definitively attribute change to the Aquaculture Activity based on survey data. The ET used available evidence from primary and secondary sources to assess the Activity's contribution and reach informed conclusions about the program's *likely* contribution to observed market change outcomes. The ET used the Aquaculture Activity's productivity-related survey data from 2020–2022 to examine change in productivity over time that may be associated with the Activity to mitigate the absence of endline data. According to the Activity, the endline survey will be done before the end of the project. Finally, Activity staff changeover means not being able to answer some of the why's and how's of decisions made in the Activity's first two years.

Non-representative sampling: Sampling was based on the case study approach and is, therefore, not representative of the Aquaculture Activity's activities with 88 partners and more than 100 grants. The case studies focused on 34 grantees and associated grants. The ET did not discount other grantee activities and captured some of them in discussions with the Activity and through analysis of its closeout reports.

Potential response bias: The ET sought to mitigate bias by triangulating the responses from different stakeholder groups such as producers, input dealers, retailers, and buyers (through KIIs and FGDs) and with the documentation and data available.

3. FINDINGS AND CONCLUSIONS

The findings and conclusions of this evaluation incorporate the results of the desk review, results of data collection in February–April 2023, and Aquaculture Activity performance reported through December 2022. For a granular perspective, see the case study reports in Annex 5.

3.1 EXTENT TO WHICH GOALS AND OBJECTIVES ACHIEVED (EQ1)

To what extent has the Aquaculture Activity achieved its overall goals and objectives sustainably? Specifically, to what extent has the activity been successful in achieving its IRs—increasing productivity and strengthening markets?

Overall, the Aquaculture Activity has achieved many of its goals as indicated by its performance indicators and the following findings. Aquaculture productivity has increased through increasing pond aquaculture, farmers using Best Management Practices (BMPs), the introduction of Genetically Improved Farmed Tilapia (GIFT) (WF's genetically improved high-yielding tilapia), raised awareness about the benefits of carp-mola polyculture, and the greater availability of high-quality seed, fry, and fingerlings. Farmers have access to high-quality feed, but most cannot afford it. With the market system, the Activity has strengthened linkages for seed, fry and fingerlings, information, Aquaculture Medicinal Products (AMPs), technology, and feed (to a lesser extent) on the input side.

The Aquaculture Activity has also strengthened some of the actors and linkages in the output market. Its attempts through 2022 to assess change in the market system have been ineffective, which appears to have limited its ability to adapt its approach during the project. The Activity's efforts in nutrition-sensitive aquaculture have contributed to improved nutrition and aquaculture practices, especially through carp-mola polyculture by retaining the naturally growing mola and consuming them.

The Aquaculture Activity used a hybrid market systems facilitation approach (with cost-sharing by private-sector grantees) and a development approach (through NGOs). Through these entities, the Activity sought to increase aquaculture productivity (partially by training 146,167 farmers on BMP through December 2022) and strengthen backward- and forward-market channels. It sought to facilitate aquaculture market system development to improve inputs (seed, feed, and other inputs, *e.g.,* AMPs and equipment), services, and output markets for live fish and value-added products—some of which require cold chain storage and transport.

Finally, the Aquaculture Activity's TOC includes cross-cutting issues: inclusion of women and youth in aquaculture and climate-smart aquaculture and innovation. (Inclusion is addressed below.) Regarding climate issues, the ET found no wide-scale climate-smart initiatives. Notwithstanding this, BANA did produce and distribute materials to raise awareness about aquaculture-related climate issues and supported and encouraged a few hatcheries to use heat protection nets, efficient water recycling and filtration systems and solar. Tailoring interventions based on an understanding of local needs and context was a missed opportunity identified by KIIs. One of those areas that needed attention was the importance of ecology and environmental issues such as the salinity of water in Satkhira and the reduction of marine catch in Cox's Bazar. The ET did not hear any reference to the Activity addressing this issue in Satkhira, but the Activity's approach in Cox's Bazar suggests some sensitivity to the challenges there. The ET finds that more may have been done with more focused and local approaches.

Like most activities, the Aquaculture Activity's outcomes were affected by the pandemic. While the difference between what could have been and what occurred cannot be measured, the ET can confirm the Activity's reporting of challenges around shutdowns, supply chain issues, and increasing cost of inputs. These issues have resulted in higher costs, especially for fish feed.

3.1.1 IR1: Increased aquaculture productivity

Bangladesh's pond aquaculture sector is diverse. Producers grow a variety of species, and farm sizes vary from family-run plots to intensive operations. The main production systems for freshwater aquaculture are extensive and semi-intensive pond polyculture of carps, tilapia, and pangasius catfish. Pond polyculture of Indian, Chinese, and common carp produced 2,416,130 Metric Tons (MTs) in 2021, about 61 percent of the total freshwater aquaculture production in Bangladesh.[4] The main species found in inland fish production are pangasius catfish (18.72 percent), tilapia (15.11 percent) and rohu (14.10 percent).[5]

Fish polyculture is a common pond-based aquaculture system practiced by farmers of all sizes to maximize input efficiency and increase productivity and profit. Polyculture of rohu with tilapia is better than pangasius because pangasius requires more high-protein feed in a culture system. Since tilapia has high growth rates and can be cultured in a wide range of environmental conditions, farmers of all types find it an attractive fish to culture. Moreover, polyculture of carps and tilapia uses natural food availability in the pond ecosystem. So, the Aquaculture Activity's focus on carp, tilapia, and culture methods was a good choice.

The Aquaculture Activity's annual productivity survey data illustrate an increasing production trend (ET analyzed data from 2020–2022). Several factors affect fish productivity and its measurement. For example, the Activity focused on tilapia and carp, while pangasius catfish ranked first in production statistics.[6] For this reason, the average observed production is below the national average (Table 3), likely due to the absence of pangasius. Productivity can vary depending on the culture system and species: Among tilapia species, for example, the ET observed three types: tilapia, GIFT and monosex.

Tilapia grow to a marketable size (100–150 g) within a short culture period (two to three months), allowing farmers to produce more than one crop per year. The highest annual production of monosex

[4] Bangladesh Department of Fisheries. (2022) *Yearbook of Fisheries Statistics of Bangladesh*. DOF, Bangladesh, Dhaka.
[5] *Ibid.*
[6] Bangladesh Department of Fisheries. (2022) *Yearbook of Fisheries Statistics of Bangladesh*. DOF, Bangladesh, Dhaka.

tilapia under monoculture is around 10,000 kg/ha.[7] The production of GIFT is 8,028 kg/ha with carp polyculture.[8] Through Aquaculture Activity initiatives, the number of ponds increased over time, which also contributed to productivity (see Table 3-B below).

Table 3-A. Production performances of farmers under the Aquaculture Activity from 2020 to 2022

Farmer type	**Average production in specific ponds** (kg/ha)				**National productivity[9]** (kg/ha)
	2020	*2021*	*2022*	*Average*	
Carp Farmer	3069	3584	3890	3570	
Tilapia Farmer	8338	9865	7916	8681	8028-10000
NGO-trained Farmer	2711	2830	3419	2983	
IP-trained farmer			3586	3586	
Average	3630	4157	4136	4010	5129

Table 3-B. Aquaculture Activity farmers' average number of ponds with pond area by year[10]

Farmer type	**2020**		**2021**		**2022**	
	# ponds	*pond area (ha)*	*# ponds*	*pond area (ha)*	*# ponds*	*pond area (ha)*
Carp farmer	1.6	0.3	1.6	0.3	1.6	0.3
Tilapia farmer	2.1	0.8	2.3	0.3	2.2	0.7
NGO trained	1.3	0.1	1.2	0.1	1.3	0.1
IP trained					1.3	0.3

The Aquaculture Activity's targets include a 30 percent increase in productivity from ponds and *ghers*. Comparing the baseline data (2018) and 2022 productivity data for carp and tilapia, it has achieved the goal with a 42 percent increase for carp (2,629 kg/hectare [ha] to 3,736 kg/ha) and a 34 percent increase for tilapia (4,874 kg/ha to 6,525 kg/ha). Given the comparison of national productivity and the Activity's farmers' statistics, we can infer that its geographic targeting of farmers was appropriate.

[7] Nabi, M., Halim, M.A., Nahar, S. 2017. Study on production performance and economic of mono-sex tilapia culture at marginal farmer's ponds in Gopalgonj Bangladesh. Int. J. Fish. Aquat. Stud., 5: 104–108.

[8] Rana, K.J. and Hassan, M.R. 2013. On-farm feeding and feed management practices for sustainable aquaculture production: an analysis of case studies from selected Asian and African countries. On-farm feeding and feed management in aquaculture. FAO Fisheries and Aquaculture Technical Paper No. 583 No. 583. pp. 21-67. Rome, FAO.

[9] Bangladesh Department of Fisheries. (2022) *Yearbook of Fisheries Statistics of Bangladesh*. DOF, Bangladesh, Dhaka.

[10] The productivity data are derived from the productivity of the respondents' "specific pond/gher" that was selected when the farmer joined the Activity, if s/he was culturing more than one pond/gher. The Activity's 2022 survey, which measured productivity with 1,600 cultured fish households, asked two questions about gher/pond excavation and re-excavation: 1) *How many years ago did you excavate your gher/pond?* and *2) How many years ago did you re-excavate your gher/pond?* Of those 1,600 respondents, 413 (about 25 percent) did not answer those questions. The ET found 90 of 875 respondents (about 10 percent) reported *excavating* in the last four years, *e.g.,* 2018–2022 (and 13 of them re-excavated in the last year). Five-hundred and seventeen (517) respondents (63 percent) reported *re-excavating* in the last four years; of those, 261 did not respond to the first question above. Based on these data, the ET cannot say that total pond area has increased.

Sub-IR 1.1: Increased availability of improved fish seed

For quality seed production, the Aquaculture Activity engaged with 13 hatcheries in the ZOI and ZOR, providing them with quality brood and knowledge of biosecurity, brood management, improved seed production, and safe transportation techniques. WF has improved varieties of carp (G3 rohu) and tilapia (GIFT) that are known to produce a better yield. WF headquarters controls the G3 rohu initiative. Under the Activity, WF provided G3 rohu spawn to 27 hatcheries and 33 nurseries between 2020 and 2023.[11] Two grantees engaged in collecting the raw materials and processing them into the Carp Pituitary Gland (CPG) hormone for seed production.

The Aquaculture Activity's grantee hatcheries effectively trained/developed nursery operators to ensure affordable quality seed to farmers. In some places, it linked existing and new hatcheries and nurseries, strengthening the value chain so that hatcheries would train nurseries in BMP and thereby expand the supply of quality fry and fingerlings. The Activity did not work with informal hatcheries and nurseries—backyard hatcheries and nurseries that may be considered part of the sector's "grey" market system—and which play an important role in the seed and fry/fingerling supply in Bangladesh. These hatcheries may maintain brood stock, produce seed/fry, and supply grow-out farms directly or through nursery operators. Nursery operators play a crucial role in seed distribution to farmers' ponds. These informal aquaculture actors supply seed to informal nurseries, which then supply fry/fingerlings of unknown quality to farmers. Their role was not addressed by the Activity.

Conclusion*:* The Aquaculture Activity expanded the supply of quality fish seed and improved fish seed, especially GIFT. (See response to EQ 4 for details on G3 rohu and GIFT.) The Activity may not have considered the potential of informal hatcheries and nurseries.

Sub-IR 1.2: Increased availability of affordable quality fish feed

The aquafeed industry is well established in Bangladesh, making feed generally available near farmers' homesteads through a strong dealer network of national and regional feed companies. Feed costs typically comprise 40 to 70 percent of production costs in semi-intensive, intensive, and super-intensive aquaculture.[12] The ratio may be higher in some small-scale aquaculture farms, where family labor often is not counted. Most farmers are small-scale farmers. Small- and large-scale farmers face a problem with high feed prices. High fish productivity depends on feed quality, and high-quality feed is the most expensive. Finding good-quality fish feed with a high protein content and vitamins at a reasonable price is challenging.[13] The supply of essential quality ingredients like fish meal for aquafeed production is increasingly challenging, as there are shortages and competition for it with other sectors (*e.g.,* poultry and livestock). By themselves, small-scale farmers are unable to use locally available ingredients to make quality feed sustainably and cost-effectively.

The Aquaculture Activity worked with several feed producers[14] to support an affordable supply chain in the feed sector. However, the Aquaculture Activity's attempt with private-sector companies and local and regional feed mills to develop affordable feed in the value chain was unsuccessful due to 1) pre-existing domination of the market by large commercial feed companies and 2) legal and financial challenges for local and regional feed mills to source ingredients for and consistently produce high-quality feed. The partnership among the feed mills for repackaging, repricing, resizing, *etc.*, is not legally

[11] WorldFish distributed G3 rohu in 2020: Activity zone - 5 hatcheries and 4 nurseries; Out of the Activity zone - 2 hatcheries and 11 nurseries; in 2021: Activity zone - 4 hatcheries and 15 nurseries; Out of Activity zone - 7 nurseries, and in 2023: Activity zone - 13 hatcheries and Out of Activity zone - 10 hatcheries.

[12] Mamun-Ur-Rashid, M., Belton, B., Phillips, M., Rosentrater, K.A. 2013. Improving aquaculture feed in Bangladesh: From feed ingredients to farmer profit to safe consumption. WorldFish, Penang, Malaysia. Working Paper: 2013-34.

[13] Prodhan, M.M.H. and Khan, M.A. 2018. Management practice adoption and productivity of commercial aquaculture farm in selected areas of Bangladesh. J. Bangladesh Agricultural University, 16 (1): 111-116.

[14] Through 2022, BANA worked with the following feed producers at the national and regional levels: National level: Aftab Feed Products Limited, Agro-Industrial Trust, Spectra Hexa Feeds Ltd.; Regional Level: KNB Agro Industries Ltd. and Victor Feeds Ltd., and at the local level, the Activity worked with one community feed center through its grantee Matrix.

approved by the feed laws,[15] and community feed millers are not able to meet the licensing requirements.[16] The Activity continues to support grantees working with feed mills to produce affordable, quality feed in 2023 (*e.g.,* establishing community feed millers with small-scale fish feed-producing machines using locally available feed ingredients) that the ET hopes will be assessed in the endline evaluation.

As fish feed prices rise, farmers tend to reduce their reliance on name-brand feed. Results from the Aquaculture Activity's 2022 farmer productivity survey illustrate how sampled Activity-trained farmers use fish feed:

Table 3-C. Aquaculture Activity farmers' average feed used (2022)

Farmer type	Feed used (Kg/ha)	Calculated Feed Conversion Ratio (FCR)
Carp Farmer	4822	1.35
Tilapia Farmer	7860	1.10
NGO Farmer	1591	1.87
Trained by IPs	2809	1.27
Average	**3686**	**1.09**

The observed FCR values (see Table 5) for tilapia and carp farming are below the standard values of 1.5 to 2.5[17] and 1.52 to 1.73,[18] respectively, in pond environments in 2022 (the only year for which Aquaculture Activity data are available). Besides high feed prices, other reasons for the FCR are that good farming and feed management practices that favor high eco-efficiency and feeding cost-effectiveness may not be widely known to farmers. Some common prevailing practices such as excessive feed input or species-specific protein level may be arrested with more widespread knowledge sharing.

Farmers believe that their preferred commercial company's feed is of high quality, which is true of the large, commercial feed producers. Farmers also use locally available feed ingredients and feed. The local small-feed millers produce feed for their own use and sell to their neighbors. But the quality of this feed does not meet the standard quality of the large companies. Local feed millers tend to lack technical capacity, a license, and sufficient capital to invest in the technology needed for economies of scale in their production. They are potential actors that, under the right conditions, could facilitate less expensive and quality feed to maximize farmers' productivity.

Conclusion*:* The Aquaculture Activity's efforts have not increased the availability of *affordable*, high-quality fish feed.

Sub-IR 1.3: Increased adoption of improved pond management practices

[15] If a policy is specific about an issue, then market actors and authorities have a solid framework in which they make decisions. If policy/regulations are broad or non-existent regarding a particular matter, then authorities may use the space to challenge the market actors—basically offering an opportunity for graft.

[16] After receiving feedback from USAID, the ET asked the Aquaculture Activity staff about its ongoing work with feed mills. The staff then provided a 2022 assessment report (author/entity unidentified in the report), "Ways of increasing profitability of CFC (Community Feed Center): an initiative for development business model." The report examines what happened with CFCs developed under a previous WorldFish project (AIN) under Matrix (an Aquaculture Activity sub-grantee). The report describes the characteristics of CFC still working and those that are not.

[17] Rana, K.J. and Hassan, M.R. 2013. On-farm feeding and feed management practices for sustainable aquaculture production: an analysis of case studies from selected Asian and African countries. On-farm feeding and feed management in aquaculture. FAO Fisheries and Aquaculture Technical Paper No. 583 No. 583. pp. 21–67. Rome, FAO.

[18] Hossain, M.I., Shikha, F.H. and Hoque, A.B.M. A. 2019. Growth performance of Indian major carps at pond system using shrimp industry waste in their diet. J. Environ. Sci. & Natural Resources, 12 (1&2):101–108.

Knowledge and access to advisory services are key to adopting BMPs. The Aquaculture Activity grantees conducted capacity building for farmers, dealers, retailers, Local Service Providers (LSPs), and others to provide them the knowledge they need to improve the use of BMP and therefore productivity. Grantees trained 146,167 farmers (through December 2022) on various aspects of aquaculture, Good Aquaculture Practices (GAPs), BMP, processing, *etc.* (See 3.2 Addressed Systemic Challenges [EQ2] for details on Aquaculture Activity-supported training).

Farmers benefited from training because it broadened their knowledge and encouraged them to adopt improved culture practices. They also benefited from the improved capacity of dealers and retailers (*e.g.*, One Stop Service Centers [OSSCs], Women Micro Franchisees [WMFs], Women Business Centers [WBCs], and others) to give appropriate and timely advice. The adoption of improved management practices is linked to increased productivity.[19] Higher productivity is associated with higher incomes, which may improve the livelihood status of fish farmers in Bangladesh. The Aquaculture Activity's quantified achievements through December 2022 include more than 320,000 individuals applying improved management practices or technologies.[20]

The Aquaculture Activity grantees said they will not continue direct farmer training after grant closeout. Their associates (*e.g.*, level input suppliers), hatchery owners, and nursery operators will continue their businesses, as will the Activity-supported, app-based information sharing (see Table 3-D) briefly described below. The apps are meant to provide ongoing and updated access to information and products; but many farmers, especially women, lack access to smartphones. Even farmers who use apps struggle to make the most out of their functions due to 1) lack of understanding/familiarity/ comfort with using an app and/or 2) illiteracy or low literacy.

Table 3-D. Aquaculture Activity-supported digital apps

Grantee	App Name	Function	Status
ACI Agribusiness	Rupali	Android applications may help farmers and others get aquaculture advice and information. App supports communication between the company, dealers, and retailers.	Functioning.
MarGEn Ltd.	e MarGEn	Forward market linkages—available for Ready to Cook (RTC) and Ready to Eat (RTE) online orders, payments, and home delivery.	App functioning but Facebook is preferred.
The Right Kind	Right Fish	Market platform for stakeholders. App developed and LEAF were trained. Grantee submitted a second proposal, which the Aquaculture Activity rejected.	Not functioning.
M-World	Macher Gari	App supports seed and fish transport (trucks, van, micro, *etc.*). Uses a commission-based business model.	App functioning but slow. Call center active. Still in the development stage.
Parmeeda	Nirapad Khamar	App provides information though video on fish stock and post-harvest management information.	App not functioning.

[19] Prodhan, M.M.H. and Khan, M.A. 2018. Management practice adoption and productivity of commercial aquaculture farm in selected areas of Bangladesh. J. Bangladesh Agricultural University, 16 (1): 111–116.
[20] Aquaculture Activity. 2023. Year 6, Quarter 1 Progress Report (October–December 2022).

Grantee	App Name	Function	Status
KIU	The Bookkeeper	Requires farmer profile development for loan eligibility. Plan to add bank and upload farming data.	App developed. They are trying to onboard company, bank, *etc.*
Coxbazarshop.com	Coxbazarshop.com	Order dry fish and recipes online; order tracking and payment.	App functioning but Facebook is preferred.
Aftab Feed Products Ltd.	Aftab Feed Products	Support to feed supply chain, provide feed use information during production, audio, and video training clips.	Partially functioning with dealer, sub-dealer, and LSP onboarding; and capturing farmer-level data. Call center is running.

Conclusion: Aquaculture Activity-supported interventions have increased the adoption of improved pond management practices. The sustainability of farmers' use of BMPs depends on their continued search for knowledge and their ability to apply what they learn. The apps, advisory services, and direct training are the most likely sources of information that may need to be staged in the same manner as the Activity's interventions: introduction meetings, training that includes helping people become comfortable using apps, and regular touch points. Staging and training so that farmers become comfortable with apps is essential to providing cost-effective access to information and support—especially given the gap between farmers' capacity and the apps' reliance on literacy rather than visual presentations.

3.1.2 IR2: Strengthened aquaculture value chains

The Aquaculture Activity's project targets include having 400,000 men, women, and youth gain improved access to better quality aquaculture inputs, services, and/or market channels. As of the end of 2022, there were 318,657 Activity-associated individuals who had applied improved management practices or technologies.

Sub-IR 2.1: Increased market linkages

Access to inputs, services, and market channels is critical to a healthy market system; access data, however, are insufficient for an assessment of change in the system. A market system change assessment requires, like any change assessment, before-and-after measurements, such as the number of market actors and their roles in a value chain and the strength of linkages between them. Those data are not available, so the ET relied on reports and case studies to assess the Aquaculture Activity's contribution to increased market linkages.

Based on the available data, linkages (rated as being low, medium, or highly effective based on case studies) were strengthened and/or created between:

- Grantees and input providers: Highly effective to ensure input distribution up to the dealer level and moderate among grantees, dealers, and LSPs/WMFs.
- Grantees and WF: High for grant management and report preparation, but low in quality monitoring of grantee activities.
- Hatcheries and nurseries: Highly effective for seed distribution and providing technical advice.
- Farmers and their local dealers/retailers: Highly effective between dealers and farmers, but low for providing technical advice/services to small/marginal farmers.
- Actors in the dried fish industry in Cox's Bazar: Highly effective.

- Output market grantees and their clients: Highly effective between grantees and forward-market clients (super shops/consumers) but low between grantees and backward-market clients (farmers, local traders).

No new or improved linkages were observed between the public sector (GOB entities active in aquaculture) and WF and market actors.

Conclusion: The Aquaculture Activity increased market linkages but missed the means to effectively measure the associated changes. This information would likely have helped the Activity to adapt its approach over time. It is unclear how it used its extensive MEL data to support activity adaptation.

Sub-IR 2.2: Increased engagement of the private sector in aquaculture markets

The Aquaculture Activity worked with 88 organizations through 2022, primarily through sub-grants. Some organizations received two to four grants, while the Activity dropped a few or terminated their grants due to poor performance. Its targets include a 30 percent expansion of investment by the private sector in aquaculture production and market-related to inputs and services (seed, feed, production market-related information, technology, *etc.*). Data are not available to assess this target.

The Aquaculture Activity stated that the necessary data will be collected from grantees and former grantees during the Systemic Change Measurement study, which is expected to start in June 2023. It is unclear why the Aquaculture Activity did not select a target that could be tracked like the FTF standard indicator (EG.3.1-14 Value of new USG commitments and private-sector investment leveraged by the USG to support food security and nutrition).

Table 3-E. Total investment by Activity and the private sector (USD)

-	Aquaculture Activity	Partner
ZOI investment		
IR1	$1,834,989	$1,938,798
IR2	$2,684,493	$2,630,897
IR3	$1,069,439	$487,806
ZOR investment		
IR1	$147,902	$88,227
IR2	$214,417	$266,698
IR3	$1,236,306	$112,099
Total	$7,187,546	$5,524,525

Based on grantees' cost share, investment by firms and NGOs was $5,524,525 through 2022, which is 43.5 percent of the $12,712,071 total of all grants (see Table 3-E). The Aquaculture Activity and grantees invested $10,646,422 in the ZOI and $2,065,649 in the ZOR. This table summarizes the monetary investment by IR in the FTF zones.

The detailed table on which this summary is based (Table 5-J in Annex 10: Investments by the Aquaculture Activity and private-sector entities) illustrates the value of each grant, the grantee's investment, and that investment as a percentage of the total grant budget. Another summary table (Table 5-K) illustrates how the private-sector investment in the ZOR ($467,024) is much smaller than the investment in the ZOI ($5,057,501).

According to the Aquaculture Activity's outreach to its partners, since grant completion, firms have invested an additional $4,048,619 (see Table 5-L). The ET did not analyze these data, as the table was provided as the ET was completing the draft report, but we noticed that most ($3,000,000) of the investment was one grantee's purchase of machinery. The ET member who interviewed that grantee understood that the purchase was made prior to the Activity grant. Upon following up with that key informant, he confirmed that the machine was purchased prior to the Activity grant and that it was not yet in use prior to the initiative with the Activity. The machine was put into use as part of the grantee's intervention under the Activity.

Credit: Access to financial services is critical to growth in any sector. The Aquaculture Activity and its private-sector partners each invested nearly $400,000 in access to credit for a primarily unbanked population of aquaculture farmers—for a total investment of $774,166 (see Table 16). The most important outcomes are:

- Attention to this unbanked population
- Bank Asia's agent outreach in aquaculture and connecting with farmers through input sellers
- Bank Asia and the City Bank's use of digital banking—providing clients with cards
- Grantees' understanding of aquaculture farmers' context and needs
- Tailored loans

Despite these investments, however, the outcome was a small number of loans proportional to the number of farmers wanting loans (the number of loan applicants is unknown), and the tailored loans were mostly too small to effectively support farmers' production needs. This is discussed in more detail under EQ2.

Table 3-F. Access to finance investment by Activity and the private sector (USD)

Grantee	Total budget	Aquaculture Activity	Partner	Partner cost-share
Bank Asia Ltd.	$315,490	$192,672	$122,818	39%
The City Bank Ltd.	$317,030	$105,794	$211,236	67%
Shushilan	$100,246	$73,963	$26,283	26%
Mukti Cox's Bazar	$41,400	$20,313	$21,087	51%

Conclusion: The Aquaculture Activity's engagement of private-sector actors was appropriate, and grantees' cost-share portion was good in the Bangladesh context. Private-sector firms expected donor funding for "projects." They need to be acclimatized to the market systems approach with cost sharing.

Sub-IR 2.3: Improved enabling environment for inclusive growth in aquaculture

Per the Aquaculture Activity's categorization of Activity and grantee activities, the enabling environment consists of policy/regulatory issues, transport and cold chain sector issues, and inclusion of women and youth in aquaculture.

***Policy/regulations*:** The Aquaculture Activity worked on updating the National Fisheries Policy; and its grantee, the Bangladesh Shrimp and Fish Foundation (BSFF), worked on policy consolidation and improvement in licensing, the management process, and effective use of aqua inputs. (See EQ 7 for more on this.) It did not work on policy issues related to two of its major sub-IRs under increased aquaculture productivity. Specifically, seed- and feed-related policy issues—like the Hatchery Act 2010 and Rules 2011, which include sustainable hatchery development to ensure quality fish and shrimp seed; and the Fish and Animal Food Act 2010, which includes safe fish and animal feed production, processing, quality control, import, export, marketing, and transportation—received little attention.

The evaluation found several policies and regulatory issues that need to be addressed for the effective functioning of the aquaculture sector. In addition to the hatchery laws and licensing and the feed law mentioned above, pending policy issues include:

- Licensing of feed mills
- Certification of dried fish
- GOB mandate for feed companies to use jute bags
- Disconnect between banks and the GOB requirement that banks' clients have guarantors/documents if the loan is over a certain value. (See EQ 2 for more on this.)

Transport and cold chain: The Aquaculture Activity's investment in improving the transport system and cold chain were small and so were the outcomes, *e.g.,* M-World's Macher Gari and MarGEn's cold van. The interventions affected the individual grantee engaged but need replication to affect the system. Given that cold transportation is expensive and—according to the grantee—clients are unwilling to pay 100 percent of the cost the firm incurs, replication without another intervention is unlikely. (See EQ 2 for more details.)

***Women and youth in the sector*:** More women and youth are engaged in aquaculture due to the Aquaculture Activity. Grantees largely met their inclusion goals for women and youth. As in many countries, youth are perceived as uninterested in agriculture/aquaculture; but as in those countries, youth are interested in the sector, just not as traditional farmers but as their primary Income Generating Activity (IGA). Youth, especially young men said they were interested in an IGA in aquaculture in service provision, as buyers or suppliers, or in value-added products. Women in aquaculture mostly support their family's pond culture. Their roles rarely represent an IGA or an opportunity for significant financial contribution to the family (dried fish processors are the exception to this norm). The Activity has included success stories from some of their supported youth entrepreneurs and farmers in its Activity Outcome Journal.

USAID sees inclusion as an underlying principle to closing the economic gender gap and reducing the poverty rate by strengthening agriculture (and aquaculture) value chains. Overall, the ET finds that with a few exceptions, most of the women associated with BANA who are newly or better engaged in aquaculture are small fish farmers and processors (some). Inclusivity needs to be driven by seeing women in all aspects of aquaculture—including women entrepreneurs, employees, processors, and farmers. The Aquaculture Activity's success is mostly with women as small farmers and some entrepreneurs (WBCs and WMFs).

Conclusion: The Aquaculture Activity's enabling environment improvements appear to be drops in a bucket: Attitudes toward women working in aquaculture continue to be based on patriarchal social norms; and youth face severe access to credit challenges, as well as norms that see youth as untrustworthy. The Activity missed opportunities to engage with the GOB to address important policy and regulatory issues. Its transport and cold chain investment and achievements were small compared to its investment in inputs.

3.1.3 IR3: Improved nutrition-related behaviors of rural households

The Aquaculture Activity began supporting nutrition-sensitive aquaculture in Activity Year 2. For more detail on Its nutrition-focused interventions and performance, please see the response to EQ9.

Sub-IR 3.1: Improved nutrition awareness and practices

Per the Aquaculture Activity's annual survey data, the percentage of households adopting good nutrition practices (measured in terms of eating mola fish with head) improved by 42 percentage points, and the percentage of households adopting good hygiene practices improved by 40 percent—both of which are well above the Activity's target (Figure 2). These results support those found in the case studies.

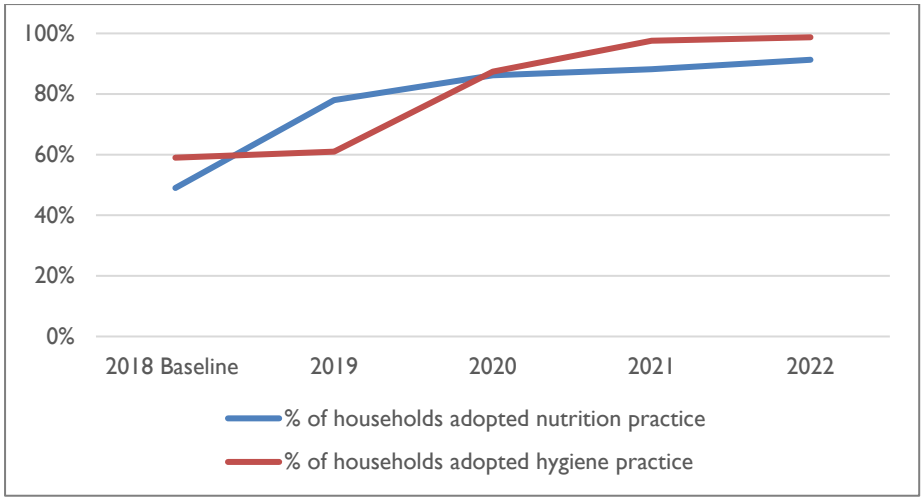


Figure 2. Nutrition and hygiene practice by the *Aquaculture Activity's annual surveys*

Sub-IR 3.2: Improved access to diverse and nutritious foods

To improve access to diverse and nutritious foods, the Aquaculture Activity adopted two approaches: 1) increase production and household consumption of mola fish and vegetables by promoting carp-mola polyculture and pond dike vegetable cropping, and 2) develop and promote RTC and RTE fish products. The Activity's annual surveys show that household consumption of small fish increased by 4 percent from the baseline. The percent of female participants consuming a diversified diet improved by 15 percent points (Table 3-G).

Table 3-G. Household consumption of fish and dietary diversity by the *annual surveys*

-	2018 Baseline	2019	2020	2021	2022
% of households increased consuming small fish	14.0%	15.0%	9.3%	16.9%	18.51%
% of female participants consuming a diet of minimum diversity	59.7%	59.7%	47.0%	54.0%	75.0%

The Aquaculture Activity contributed to an increase in the availability of RTC and RTE. The downturn in 2020 appears to be an anomaly and may have been related to COVID-19. The Activity noted in its reports that productivity dropped as people were unable to access inputs during the pandemic-related shutdown. Data are not available to measure change or improvement in the consumption of RTC or RTE.

Conclusion: Based on data gathered in this evaluation, the Aquaculture Activity successfully supported grantees' facilitation of nutrition-sensitive aquaculture—especially the promotion of carp-mola polyculture and corresponding nutrition practices.

3.2 ADDRESSED SYSTEMIC CHALLENGES (EQ2)

To what extent has the Aquaculture Activity addressed systemic challenges across the aquaculture sector? How may USAID address the remaining gaps in the aquaculture market systems?

Systemic challenges that the Aquaculture Activity identified at baseline and that it addressed are *availability* and *access* to consistent/good *quality*:

- Seed, fry, and fingerlings.
- Affordable feed, AMPs, and technology.
- Knowledge and advisory services.

- Output market—including safe handling, transport, cold chain, storage, and value-added products.
- Credit.

Below are findings for the Aquaculture Activity's efforts for each of these challenges.

Seed, fry, and fingerlings: The Aquaculture Activity's efforts (described in 3.1.1) were largely successful in addressing the availability and quality of seed, fry, and fingerings. Access remains uneven across districts; farmers in some districts have easier access, while those in others (*e.g.,* accessing carp seed and/or fry/fingerlings in Barishal and Cox's Bazar) have less access and, therefore, pay more due to transport costs.

Way forward: Develop more district-level hatcheries and nurseries with the most productive and appropriate species.

Feed, AMPs, and technology: The Aquaculture Activity supported linkages between market actors to extend the distribution channels for feed, AMPs, and technology, thereby increasing the availability of these inputs to farmers. Its efforts in the feed value chain, as noted in 3.1.2, have not generated affordable, quality feed for farmers. In 2023 the Activity continues to work in this area with grantees. Most farmers, especially small-scale farmers, access AMPs and technology, *e.g.,* water test services/kits, when they experience a problem. The Activity made AMPs and technology more available to farmers through grantees and their associated dealers and retailers, but some grantees did not provide the promised test kits.[21] As with all inputs, when there is a cost, most farmers—because they are small farmers—will only purchase these inputs and services when their fish are at risk.

Way forward: Local and regional feed millers are the most likely market actors that, under the right conditions, could facilitate less expensive and quality feed to maximize farmers' productivity. See "*Credit*" below for recommendations regarding financial services, as access to affordable credit on terms that meet the needs of aquaculture sector actors remains the leading challenge for most actors. The most used and desired technology is water and soil testing, which could be expanded through a combination of public and private efforts (as described in Recommendations).

Market system challenges

The Aquaculture Activity supported grantees that sought to buy fresh fish directly, which could then be quickly packed and safely sent to markets in urban areas. One of the grantees described the following challenges it encountered, which are typical in the aquaculture sector. Parmeeda seeks to improve consumer confidence in the fish it provides by tracing inputs, *e.g.,* what, when, how, and how much farmers feed the fish and use other inputs, test the water, *etc.* Farmers were trained on how to input these data into an app, but this was difficult for farmers.

At the same time, Parmeeda encountered two additional challenges: 1) building trust with farmers required significant relationship building and local contact, and 2) farmers could net sell them the expected quantity of fish. Farmers are often beholden to local retailers/dealers, from whom they take inputs on credit and agree to sell their fish to them at a lower rate than they can get from other buyers. Thus, Parmeeda was unable to purchase the bulk quantity needed from farmers despite the resources deployed to build trusting relationships.

Knowledge and advisory services: Most of the Aquaculture Activity's grantees implemented activities on a cost-share basis. Small grantees' core staff primarily implemented activities, while large grantees' line staff mostly worked on grant activities. The Activity grantees worked across aquaculture market actors in the input and output markets, increasing their capacity and strengthening supply chains. The Activity and the grantees jointly organized Training of Trainers (ToT) for developing core trainers and conducting training for market actors. The core trainers then organized and conducted training for

[21] The ET heard from KIIs that some grantees did not provide any or enough test kits. Grantee reports indicate that test kits were supplied, except in a few cases that do not match the case study locations. In at least one case, the Aquaculture Activity said that the grantee was not expected to supply test kits, while their dealer/retailers the ET spoke with said they were promised the kits.

farmers and other stakeholders. The Activity assessed training through annual surveys, and an Activity representative sometimes attended training sessions and other grantee outreach activities.

The Aquaculture Activity successfully facilitated capacity-building of grantees, their associated dealers and retailers, and farmers. Consistent availability of skills and services in the local market is a sign of sustainability. The Activity strengthened the linkages between farmers and input providers and in upskilling input providers, improving their capacity to provide good advice.

The Aquaculture Activity supported the creation of many apps and is in the process of testing its own app which will serve as a tool to access knowledge and advice for all actors. But most farmers lack the smartphones needed to use most apps, and many farmers lack either the technological literacy or adequate literacy to access and use the apps. One grantee's closeout report stated that while a few farmers have accessed the app, they use very few of its features due to lack of knowledge, comfort, skill, and literacy.

Way forward: Expand training in FTF zones and other areas to 1) increase the proportion of existing farmers using BMPs, 2) bring more people into pond culture, and 3) create more graphic and/or video presentations of BMPs to make knowledge easily accessible. Work with the DOF, local governments, and local associations to sustain interventions and support farmers' continued search for knowledge and its applications. (See Recommendations for more details.)

Output market: The Aquaculture Activity worked with a handful of grantees to strengthen post-production—including safe handling, transport, cold chain, storage, and the development of value-added products. Activity grantees in Cox's Bazar were particularly successful in improving the safe (*e.g.*, hygienic) handling and processing of fish and dried fish value-added products. Cold chain efforts by MarGEn (grantee) were also successful for MarGEn, though MarGEn noted in its closeout report that customers remain unwilling to pay 100 percent of the extra cost. Nonetheless, the outreach of these output market efforts was small: few farmers were connected, few output market actors were adequately trained, and transportation and cold chain management was mostly neglected within the system. These longstanding issues continue to plague the sector and need to be solved to reduce waste between pond and market and support the creation and marketing of value-added products.

The Aquaculture Activity gave grants to 11 companies to implement activities to strengthen the output market such as fish post-harvest management, packaging, dry fish processing, and marketing. RTE products through physical and online marketing, *etc.* The Activity's grantees supported dried fish producers and entrepreneurs and created employment within that industry in Cox's Bazar.

Way forward: Engage the private sector and government to 1) commit to safe handling processes, such as hygienic wholesale points and markets and its enforcement, and 2) develop cold chains so that fewer fish/fish products are lost between ponds and end markets. The RTE and RTC market is growing but needs further strengthening in post-harvest management, packaging, and the transportation of wet fish.

Credit: Lack of access to finance hinders aquaculture sector growth. The Aquaculture Activity worked with financial institutions like banks and Microfinance Institutions (MFIs) to increase farmers' access to financial services. Generally, large commercial farmers have relatively easy access to financial services from banks or other sources, but marginal (mostly unbanked) farmers struggle to access bank credit due to unfavorable policies, attitudes, lack of trust, bank personnel practices, complex processes, *etc.* Also, the small loan sizes, high interest rates offered by MFIs, and the lack of aquaculture-specific loan products discourage farmers. The biggest challenge for banks is farmers' lack of collateral and documented credit history.

The Aquaculture Activity's annual survey data for 2022 provide insight into farmers' credit sources (see Table 10). Among its grantees, products included individual loans: Bank Asia's interest rate ranges from 4 to 8 percent with a six-month grace period, City Bank Ltd.'s (CBL) ranges from 6 to 9 percent with nine to 36 months prior to payback, while Shushilan's (NGO) rate is 12.5 percent with a two-month grace period. Prottyashi plans to develop a loan product for aquaculture with installment payments to start two to three months after farmers start harvesting fish. Mukti Cox's Bazar created

a dedicated loan package for dried fish producers that offers Bangladesh Taka (BDT) 20,000 to 100,000 to small dry-fish producers, who are mostly women without bank accounts and business documents.

Table 3-H. The Aquaculture Activity's farmers' loans: number of loans and average value by source (BDT)

Farmer type	NGO		Banks		Family & friends		Local associations		Other	
-	#	*avg. amount*	#	*avg. amount*	#	*avg. amount*	#	*avg. amount*	#	*avg. amount*
Carp farmer	4	85,000	4	97,500	-	-	-	-	-	-
Tilapia farmer	3	49,600	16	978,125	-	-	-	-	1	40,000
NGO trained	5	49,600	3	26,667	3	9,333	1	10,000	2	51,000
IP trained	1	59,091	4	168,750			1	30,000	1	50,000

Despite efforts to increase farmers' access to credit, few farmers received loans through December 2022 (seeTable 3-H).[22] Women were far more likely to be served by MFIs than by banks. The average loan to male farmers was almost seven times larger than loans made to female farmers. Some financial service providers received multiple grants from the Aquaculture Activity, as seen in Table 3-I, where in Bank Asia, Mukti and Shushilan have a "phase 2." Bank Asia's average loan size increased over time, while those from NGOs remained relatively stable.

Table 3-I. Loans from grantees by gender

-	*Female*		*Male*	
Loan Source	# loans	Average loan (BDT)	# loans	Average loan (BDT)
Bank Asia	12	34,583	433	36,732
Bank Asia-2	64	46,250	537	51,844
City Bank	15	643,333	215	1,353,907
KiU	320	32,800	59	35,661
KMSS	1907	28,958	103	58,612
Mukti	711	47,693	19	251,579
Mukti-2	340	47,147	26	72,115
Prottyashi	3	66,667	-	-
Shushilan	1059	27,711	36	66,944
Shushilan-2	52	30,077	4	33,250
Grand Total	*4483*	*35,644*	*1432*	*245,932*

While CBL has one agent banking office per district, Bank Asia uses point-of-service agents at existing shops—making access to financial services closer and more convenient to farmers. Bank Asia facilitated loans through input sellers who connected the bank with farmers. Resulting loans required farmers to

[22] The Aquaculture Activity's loan database provided data through December 2022. Bank Asia, Mukti, and Shushilan had multiple grants from the Activity.

use 50 percent of the loan to buy inputs from the referral input seller. Bank Asia also introduced a "fish card" to access the digital system. The model worked, but the coverage was very low.

Regarding farmers' lack of documented credit history, Bank Asia sought to document farmers' histories, which required a time-intensive process of collecting each farmer's history from retailers. Bank Asia prepared each farmer's profile by collecting data, processing the loan application, appraising the potential for a loan and, if successful, delivering the loan to the farmer's account.

The Bangladesh Bank (BB) implements the Agricultural and Rural Credit policy and program meant to facilitate rural farmers' access to credit. BB requires banks and financial institutions to upload information of all loans with an outstanding balance of one Taka or more to the Credit Information Bureau (CIB) database. The policy does not require a CIB data check for fresh loans below BDT 250,000, but banks must ensure that they do not disburse a loan to an existing defaulter (clause 5.09, Agricultural and Rural Credit Policy, 2021–2022, BB).

Bank Asia, however, requires collateral and a CIB data check for loans over BDT 40,000. The BB's policy also permits credit for crop/fish cultivation of up to two hectares against the mortgage of crops, without any collateral. Collateral is required for credit for cultivation of crops exceeding two hectares, although it may be considered under existing terms and conditions of the bank and based on banker-customer relationship (clause 5.10, Agricultural and Rural Credit Policy, 2021–2022, BB). As noted above, most of the farmers associated with the Aquaculture Activity have ponds under two hectares.

Way forward: Facilitate consultative workshop(s) with key stakeholders such as BB, the Microcredit Regulatory Authority (MRA), private banks (*e.g.,* Bank Asia), the Palli Karma Sahayak Foundation (PKSF), and the Insurance Development and Regulatory Authority (IDRA) to 1) review the policy, 2) identify loan product qualities that fit aquaculture needs, and 3) identify ways to bundle loans with insurance to strengthen loan distribution channels and expand access to credit.

3.3 SUSTAINABILITY OF PRIVATE AND PUBLIC SECTOR ENGAGEMENT (EQ 3)

How sustainable are the Activity's private- and public-sector engagements likely to be at addressing the emerging production, productivity, and market access challenges in the aquaculture sector?

The Aquaculture Activity is one of the largest investments in the development of Bangladesh's aquaculture market system. Keeping in mind the dynamic nature of the aquaculture market system, the Activity's contribution improved some sector areas (see EQs 1 and 2). More market system strengthening is necessary to increase productivity and assure the country's food supply.

As noted in responses to EQs 1, 2, and 7, the Aquaculture Activity's engagement of the public sector was limited to sharing G3 rohu brood stock with DOF hatcheries in 2022, updating the National Fisheries Policy of 1998, and developing an AMP inventory. Such inventories must be regularly monitored and updated. The policy revision is much needed and is expected to be launched in May 2023. Its sustainability is unknown as the text has not been shared. The Activity's provision of G3 rohu brood stock to DOF hatcheries extends testing of G3 and facilitates the expansion of G3 seed throughout government hatcheries once available (in 2023). As stated in response to EQ4, however, the long-term sustainability of the carp genetic improvement program and its benefits in Bangladesh remain to be seen.

Another GOB entity with which the Aquaculture Activity might have effectively engaged is the Youth Development Organization (YDO) under the Department of Youth Development (DYD) in the Ministry of Youth and Sport. The DYD has an office in every district with fishery specialists. It provides training on behalf of the GOB from computers to livestock, fisheries, aquaculture, sewing, *etc.*—basically youth workforce development. DYD is based at the district, not upazila, level. It also provides e-learning courses on YouTube on pond polyculture. Figure 3 provides a snapshot of the anticipated sustainability of various Activity initiatives based on findings from this evaluation.

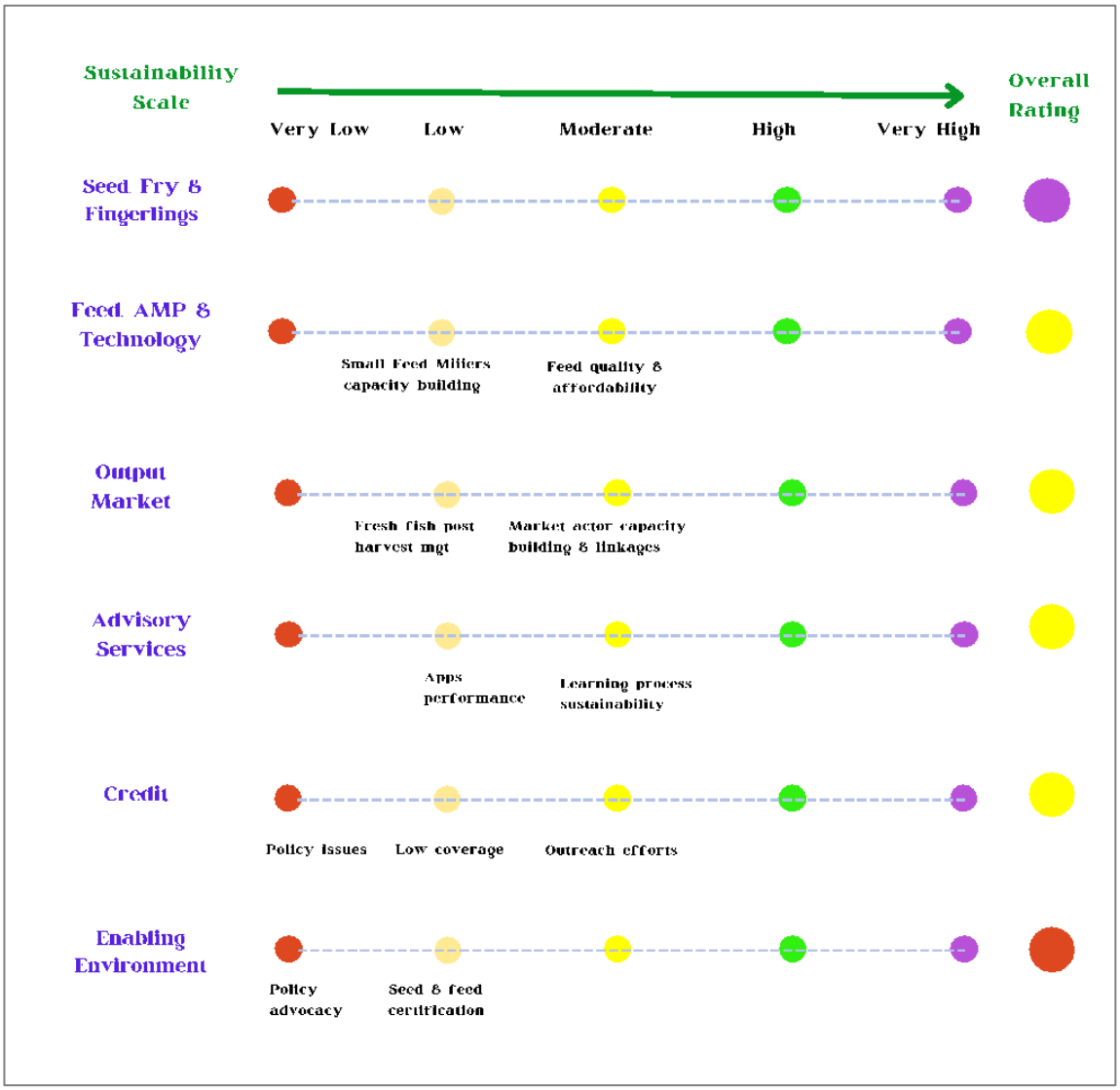


Figure 3. Sustainability scale of the Aquaculture Activity's aquaculture market components

Through December 2022, the Aquaculture Activity engaged approximately 67 firms and 18 NGOs. It facilitated aquaculture sector development most effectively and with sustainable results in increasing access to quality seed, best aquaculture management practices (knowledge), and advisory services. Its work in the dried fish sector in Cox's Bazar—resulting in increased safety for processors and more quality products, combined with e-commerce—improved the sector significantly and sustainably.

There was some modest improvement in access to capital through banks and MFIs. The innovative loan products and loan appraisal process has had some positive effects on fish farmers, but the loan coverage is low. To expand outreach, existing loan processes require policy changes for collateral and loan ceiling amounts. Thus, the sustainability and scale of the loan process is subject to future support.

Feed and aqua medicine are the most expensive ingredients for fish production. The Aquaculture Activity supported eight national and regionally based feed companies in strengthening the feed distribution channel with local-level market actors such as LSPs and WMFs. Their addition made feed available (but not affordable) at the farm level along with advisory services and, to a lesser extent, water and soil testing through established OSSCs.

Affordable, high-quality feed is still a major challenge. Opportunities to develop the feed sector and make quality feed affordable include 1) engaging with the DOF and Feed Industries Association Bangladesh (FIAB) to enforce existing feed-quality monitoring protocols and 2) facilitating feed formulation with local ingredients and effective business model for local small-feed millers to make

good quality feed available at a competitive price. As noted in EQ1, Aquaculture Activity grantees provided some dealers/retailers with water and soil testing kits, but some case study and reporting participants disagree about their availability.

The processed fish market is growing, and the Aquaculture Activity successfully facilitated some grantees to process fresh fish and prepare RTE and RTC food and marketing through physical and online platforms. These companies adopted the interventions and increased investment, and they added human resources and infrastructure for continuation of the business. In the very large live and fresh fish markets, Activity grantees (Parmeeda and MarGEn) sought to source fish from the farmers/markets based in project locations. They trained farmers, wholesale market laborers, and local fish buyers to ensure cleaning, grading, icing, packaging, and transportation of the fresh fish. Both grantees marketed the products through online and super shop outlets in Dhaka.

However, due to the short intervention duration, the impact was low. There is an opportunity to add value by strengthening the post-harvest management, storage, packaging, icing, and transportation/cool chain management of fresh fish. This is possible with capacity building of farmers and output market actors; and attracting private-sector investment for infrastructure development using an incentive-based business model.

The Aquaculture Activity facilitated eight digital services (apps) to connect input and output market actors, service providers, farmers, and consumers. Three apps are functioning (Rupali, Aftab Agro Care, and CoxsBazarShop.com) on a limited scale. Some of the apps are not being used at present and some are under development.

Conclusions: Given the fragmented nature of the aquaculture market and the shutdowns and supply chain challenges experienced during the height of the global pandemic, the market system is better situated now to address existing and emerging challenges regarding seed quality and availability, information sharing, and meeting the increasing demand for RTC and RTE. More effort is needed to meet the demand for fresh fish—which includes solving the ongoing affordable, quality feed challenge and access to finance. The Aquaculture Activity missed opportunities to expand youth engagement through the DYD.

3.4 PROMOTION AND COMMERCIALIZATION OF GENETICALLY IMPROVED CARP AND TILAPIA (EQ 4)

How successful has the Activity been in promoting/commercializing genetically improved carp (rohu, catla, and silver) and tilapia fish species? Has the Activity made any sustainability plan for the genetic improvement program? And, if so, how?

Carp are the most important fish species in Bangladesh. Those most widely cultured are rohu, catla, and silver carp, which account for about 32 percent of the total production of fish from ponds. These fish are commonly grown in a polyculture system. However, commercial hatcheries in Bangladesh rely on wild brood stock to produce the seed of rohu for aquaculture, which often results in low productivity. Hatcheries use their own brood stock for a few generations until they start to have problems: low viability, deformities, and poor growth—which are associated with high inbreeding levels.

To address these issues, the WF carp genetics program developed a fast-growing strain of rohu, the "WF Generation 3 Rohu" (G3 rohu) in 2020–2021, after three generations of selective breeding. The journey started in 2012 with the collection of spawn from the Halda, Padma, and Jamuna rivers. The program aims to improve the productivity and profitability of carp aquaculture systems in the country by developing and disseminating fast-growing strains of the three species. In 2020, a multiplier population comprised of highly ranked WF G3 rohu families was released to hatcheries in Bangladesh for development into brood stock. The G3-multiplier brood stock were spawned in commercial hatcheries for the first time in mid-2022.

At the end of the trial, in June 2022, the G3 multiplier ranked first in all 19 farms and, on average, weighed 37 percent more than fish from the second-ranked strain, the control line, across all farms (Hamilton *et al.*, 2022). This result supported WF's expectation of around 10 percent improvement in

growth in every generation (*i.e.,* 30 percent improvement after three generations). Currently, the G3 rohu brood stock is held by 29 hatcheries across the country. Eight of them produced spawn in 2022. In January 2023, WF gave G3 rohu brood stock to six DOF hatcheries for seed production.

The Aquaculture Activity claimed the presence of G3 rohu in the markets of the southwest region. Hatcheries at Satkhira, Barishal, and Bandarban held G3 rohu brood and are supposed to breed them this breeding season. But G3 rohu is little known among farmers. During the ET's field visits, farmers did not recognize the presence of G3 rohu.

Carp Genetic Improvement Program (CGIP) Sustainability: WF initiated the CGIP in 2012 with financial support from USAID through the Aquaculture for Income and Nutrition (AIN) activity. Based in Jashore, the program started with the collection of rohu and catla spawn from the Halda, Jamuna, and Padma rivers in 2012. Subsequently, silver carp stock was sourced from 17 Bangladeshi private and public hatcheries in 2015. The program uses a pedigree-based (or family-based) selective breeding method. After the completion of the AIN project in 2017, the program was sustained by additional support from USAID through the Aquaculture Activity and, later, the Fish Innovation Lab, Bill & Melinda Gates Foundation, International Fund for Agricultural Development (IFAD), EU Commission, Consortium of International Agricultural Research Centers (CGIAR), *etc.* The WF carp genetics program aims to implement a commercially oriented dissemination model for the next generations of improved rohu (*e.g.,* G4, G5, *etc.*) and other genetically improved carp in the future, to reduce dependency on donor funding. It intends to provide the G3 rohu spawn or fry to selected private hatcheries.

The main drawback of G3 rohu development is the isolation from relevant government research and extension agencies. The proposed model is undergoing careful revision with the engagement of DOF hatcheries and potential private hatcheries. However, the responsibility for the base population—now kept in leased ponds under BANA at Jashore—remains unclear as the Aquaculture Activity does not appear to have consulted the BFRI.

In contrast, BFRI developed a new variety of the fourth generation of rohu fish (called Subarna Ruhi) in 2021 through genetic research which has up to 20.12 percent faster growth potential than that of the base population. The broods of Subarna Ruhi are in DOF and private hatcheries, and some of them are producing seed. There are no strong linkages between WF and the GOB agencies working in aquaculture, primarily BFRI and DOF. BFRI is not involved in or formally informed by WF about G3 rohu. Further development of G3 rohu needs strong collaboration between WF, BFRI, and DOF.

Tilapia culture plays a vital role in fish production, distribution, marketing, and consumption, as well as a significant role in increasing food supply in the country. The GIFT strain (which is monosex) showed significantly better performance compared to other tilapia in many ways. Monosex tilapia is much demanded and valued in the local market.

As a result, the farming rate of monosex tilapia is growing. Farmers can produce monosex tilapia in their ponds twice a year. In practice, monosex tilapia dominates the culture system, and seeds are readily available to interested farmers. However, GIFT is the only source of monosex tilapia seed production; without GIFT, monosex tilapia could not be sustained. In the market, GIFT and monosex tilapia are distinguished through body color differences. Some consumers have reservations about monosex tilapia due to the use of synthetic hormones in their production.

Large feed companies also have tilapia hatcheries. They do a seed business along their feed products. The Aquaculture Activity strengthened the capacity of certain tilapia hatcheries in the ZOI and ZOR by supplying brood from their breeding nuclei and training hatcheries on BMPs. Tilapia is now the second-ranked species in pond aquaculture in Bangladesh. WF/the Aquaculture Activity deserve credit for this. Moreover, tilapia farming is one of the potential strategies for adaptation to climate change due to its adaptability to the impact of climate change on aquaculture. Tilapia can tolerate low water levels and poor water quality with rainfall variation, temperature fluctuation, and changes in salinity.

GIFT sustainability: The improved breeding and farming practices of tilapia in Bangladesh has resulted in the development of GIFT: a strain of Nile tilapia (*Oreochromis niloticus*). This GIFT strain was introduced

to Bangladesh in 1994 by WF. Research efforts focused on the development and continuous improvement of strains by genetic selection at the BFRI when the GIFT strain was reintroduced in 2005 from Malaysia. Between 2012 to 2016, WF established "Tilapia Breeding Nuclei" (TBN) under a DOF project and WF (AIN and Cereal Systems Initiative for South Asia–Bangladesh [CSISA-BD] projects). Thus, GIFT development is sustainable through the continued collaboration of BFRI, private hatcheries, and WF.

Conclusion: Like GIFT, G3 rohu could be a suitable high-yielding species for Bangladesh aquaculture if hatchery owners maintained the brood stock properly and if it were readily available and well marketed. BANA tried to commercialize G3 rohu by involving more hatcheries (including DOF), but the G3 rohu seed market is still underdeveloped. At present, it is very difficult to differentiate between native Rohu and G3 rohu at the seed, fry, fingerling, and even grow-out stages. Only hatchery operators can identify the G3 rohu in their stock.

According to the Aquaculture Activity, WF scientists are working on this issue. Given the variety of rohu (native, BFRI's Suburna rohu [G4], and WF's G3), farmers may have mixed rohu, which negatively affects their productivity. Therefore, WF, BFRI, and DOF should work together to coordinate the marketing of these varieties. Regarding tilapia, the current GIFT is from generations 13 to 17. It is continually improving based on research at BFRI and WF. To maximize productivity from GIFT, hatcheries must replace their brood stock with their newest strains.

3.5 SUB-GRANT APPROACH (EQS 5 AND 6)

How successful has the Activity been in using the sub-grant approach to support Activity objectives?

The Aquaculture Activity's hybrid approach—blending development and market system approaches—was necessary and appropriate. Grants, as an agreement type, were presumably necessary because the Activity is managed by an international, nonprofit, research organization under a public international organization agreement.[23] The sub-grant approach was moderately successful in supporting the Activity's objectives. The Activity selected experienced and knowledgeable nutrition-focused NGOs that effectively designed and implemented interventions. It also selected a wide range of private-sector firms to facilitate market system strengthening across the input, services, and outward markets.

The selected grantees were mostly medium- and large-sized regional and national firms. Eligibility criteria across all grants included verification that the firm could meet the cost share (set at 50 percent in the 2022 manual; no mention of a minimum in the 2019 manual); meeting criteria found in the published Terms of Reference (TOR) and meeting the Aquaculture Activity's partner pre-award risk assessment eligibility. During the first two years, the Activity held meetings with stakeholder groups covering the potential for stakeholder involvement and published TORs called "Aquaculture Business Proposal Announcements (ABPAs)" in Bdjobs and local newspapers. It received hundreds of proposals for each TOR. In 2019, the Activity formalized the process in a grants manual and revised the process from "TOR-full proposal" to "ToR-concept note-invited full proposal." The process reduced receipt of proposals from ineligible entities.

In the feed sector, most of the selected sub-grantees were large commercial firms. In retrospect, having had the experience, seen the challenges in the feed sector, and recognizing the elite capture of the fish feed market (described under EQ 2), Aquaculture Activity staff believe that a regional and local approach would be more effective. This evaluation's findings concur with that conclusion (see recommendations). The Activity and its grantees may not have been adequately aware of the market challenges (suggested by the descriptions of challenges described in closeout reports), although such challenges should have been predictable by both the Activity and its grantees. A stronger, more focused market systems approach throughout the Activity may have produced stronger interventions and/or a different set of grantees.

Much was said by key informants and learned through reading closeout reports about the timing of sub-grants. In the early part of the Aquaculture Activity, subgrants were no more than one year. None of the staff from the early years remain are with the Activity to explain why grant terms were set that

[23] See WorldFish entry in this USAID document: https://2017-2020.usaid.gov/sites/default/files/documents/308maa.pdf.

way. The Activity changed its grants management (as documented in the BANA Grants Management Manual) following concerns expressed by USAID and grantees/IPs). The revised procedures include a streamlined, no-cost, extension request (at least one month prior to the end of the subgrant).

The process includes a formal letter followed by submission of a workplan and budget of revised activities with reviews by the Activity's point of contact. A for-cost extension process can take the same amount of time; but due to the potential for review/discussion/revision, the sub-grantee's request is required two months before the end of the current grant. Thus, grant modifications for extending the agreement can take as little as two weeks but not more than two months, giving grantees a well-known timeframe.

Over time, the Aquaculture Activity worked with 88 partners. Several grantees held between two and four grants. If the Activity had started with the current procedures, it is likely there would have been fewer total grants and complaints. It is likely that longer-term grants or just a better understanding of the flexibility of grant extensions would have better supported the Activity's objectives.

The current staff believe that the approach taken in the last two years—wherein grants are scheduled for one year with options for extension, modification, and/or an additional grant should the grantee's direction shift and still meet the needs of the Aquaculture Activity—has been more effective. Based on a review of almost half of the grants (through December 2022) and KIIs with grantees, it seems that the Activity has improved its sub-grant management. Regarding partner selection, the Activity might have chosen differently had it developed local and regional value chain maps that identified actors with the potential to foment market systems change.

How well were the grants aligned with each other in support of the Aquaculture Activity's objectives?

With grant alignment, the ET found evidence of alignment with a market systems approach in several areas:

- Selection of hatcheries, BANA-supported connections between hatcheries and nurseries, and development of new nurseries.
- Selection of multiple grantees in the dried fish sector in Cox's Bazar.
- Facilitation of formal contracts between a commercial feed company and 10 local feed mills.
- Facilitation of one commercial feed company's work with an AMP company.

As noted in previous sections, these activities strengthened the aquaculture market system in the geographic areas in which the activities were undertaken, as well as specific value chains (seed, dried fish, feed, improved access to feed, and AMPs, respectively). The market development results are found in the continuation by market actors in their relationships (market linkages) and willingness to develop further linkages outside of the FTF zones and/or without additional support (grant funds).

Most actors the ET talked with said that they did not collaborate with other Aquaculture Activity grantees, although some were aware of what others were doing.

A full picture would not be complete without understanding that some market system efforts failed. Failures are common to the market system approach, as partners' ideas may not develop as planned. For example, the Aquaculture Activity's efforts in the feed sector included some false starts (*e.g.,* Victor Feeds' business model did not work once it was piloted). Another subgrantee's (Matrix) work with local feed mills was ineffective due to the inability of the feed mills to access credit to purchase necessary machinery and locally sourced ingredients—which required cash, although the grantee facilitated a meeting with the bank and bank agent.

Conclusion: The Aquaculture Activity's co-investment with the private sector and hybrid approach are appropriate in the Bangladesh aquaculture sector. It got off to a slow start, which was then compounded by the global COVID-19 pandemic. The Activity improved its grants management over time, which can be seen in fewer criticisms in 2022 closeout reports. Some grantees lacked an adequate understanding of the stakeholders, context, and challenges, which meant to be effective, the sub-

grantee had to start by learning and then building trust within the community. Some sub-grantees' efforts were more effective than others.

Overall, the Activity might have been more effective by focusing on a market systems approach with 1) mapping local and regional value chain actors and linkages among them, 2) identifying push-and-pull factors and the actors with the greatest potential for roles in market strengthening, 3) focusing on market challenges in potential-partner proposals, and 4) taking a more local, systemic approach by engaging appropriate local stakeholders. This is reflected in other EQs around women and youth and climate-sensitive aquaculture.

3.6 REGULATORY AND POLICY ISSUES (EQ 7)

How successful has the Activity been in addressing regulatory and policy issues related to the aquaculture sector?

The Ministry of Fisheries and Livestock (MOFL), through DOF, has overall responsibility for fisheries and aquaculture development, management, and conservation. The Aquaculture Activity had no formal Memorandum of Understanding (MOU) with government entities for collaboration. Its collaboration with DOF appears to have been informal.

A total of 27 acts, laws, and regulations exist in Bangladesh, 11 of which have been executed in the aquaculture sector.[24] Most of the rules and laws were created in the last two decades following the adoption of the National Fisheries Policy in 1998. WF worked jointly with DOF starting in 2021 to revise the National Fisheries Policy of 1998. The aim of the policy is to strengthen the fisheries and aquaculture sector and ensure food, nutritional, and livelihood security. The revision will be completed in a formal national workshop in May 2023.

The Aquaculture Activity also supported the BSFF in working on "policy consolidation and improvement in licensing, management process and effective use of aqua inputs." BSFF made an inventory of aqua inputs, including existing rules and regulations on aqua inputs and listed national-level testing facilities and capacity on AMP. The Activity did not work on two of its major sub-IRs under increased aquaculture productivity: seed- and feed-related policy issues like the Hatchery Act 2010 and Rules 2011, which include sustainable hatchery development to ensure quality fish and shrimp seed; and the Fish and Animal Food Act 2010, which includes safe fish and animal feed production, processing, quality control, import, export, marketing, and transportation.

Other current policy issues identified by the ET which would have benefited from Aquaculture Activity attention are listed under EQ1.

Conclusion: WF and the Aquaculture Activity worked only on revising the National Fisheries Policy, the results of which are not yet known. The Activity did not adequately address policy or regulatory issues in the aquaculture sector.

3.7 HOST AND IMPACTED COMMUNITIES IN ZOR (EQ 8)

How effectively has the Activity addressed the emerging challenges of host and impacted communities in the ZOR?

The country's largest influx of Rohingya refugees occurred in 2017 following the military aggression in the Rakhine State, Myanmar. Most of the refugees reside in camps located in Ukhiya and Teknaf in Cox's Bazar district. The influx has increased the overall market price of all commodities due to increased demand. The income of the host communities did not increase in contrast, although some of them are engaged as support staff for aid workers. Some host community laborers cannot find work at fair wage rates, because day laborers (men) from the Rohingya community will work for much lower rates than the standard wage of host community laborers. For example, per FGD participants, if a man from the host community does a job for BDT 500, a Rohingya will do the same for BDT 300.

[24] Shamsuzzaman, M.M., Islam, M.M., Begum, A., Schneider, P. and Mozumder, M.M.H. 2022. Assessing fisheries policies of Bangladesh: Need for consistency or transformation? Water,14, 3414. https://doi.org/10.3390/w14213414.

On the supply side, however, dried fish producers are benefiting from the increased demand of Rohingya and aid workers. About 28 percent of total employment in Cox's Bazar comes from fishing and related activities, including shrimp farming, hatcheries, and dried fish production.[25] Marine resources are now depleting at a faster rate than the replacement rate, owing to overfishing and destructive fishing practices. Rohingya refugees consume fresh fish (affecting the supply of raw fish) and dry fish, the production of which requires wet fish. The increased demand and consumption has resulted in higher fish prices (more than BDT 10/kg).

Dried fish or dried fish powder producers at Cox's Bazar supply fish products to refugee camps, although sometimes they cannot meet the demand due to a shortage of production capacity. So, the regional dry fish market has expanded. By contrast, big fish traders at Chattogram import dried fish from neighboring countries to fill the gap in Cox's Bazar, which makes the market very competitive. The quality of imported fish is not as good as the local products according to local dried fish producers. To feed the Rohingya people, wet fish are also imported from outside Cox's Bazar, which are then marketed in the camps.

In addition to aquaculture-specific issues, the presence of the refugees has led to deforestation in the hilly areas of Ukhia, Teknaf, to meet their accommodation needs. This is a noticeable environmental issue. The ET also found that the fishing community at Teknaf needs alternate livelihood options as they are unable to fish on the Naf River due to security reasons.

Conclusion: The Aquaculture Activity's engagement in the dried fish industry benefits the host community from an economic perspective. Demand for freshwater fish, however, is increasing—mostly due to non-resident populations (including refugees and aid workers) and a trend of decreasing marine fishes. The result is an opportunity for the expansion of aquaculture in this region.

Cox's Bazar lacks carp hatcheries and sufficient nursery operators, so the supply chain from the hatcheries of Potia, Chattogram, and nursery operators needs to be linked with the natural carp spawning source of River Halda, Chattogram.

How may USAID address the existing and emerging challenges of the aquaculture sector in the ZOR?

Though the seed supply chain is functioning well with 13 hatcheries in BANA's project locations, there are approximately 1,000 hatcheries functioning across the country. Thus, strengthening the seed market in the ZOR and nation requires engaging:

- Hatchery associations to 1) ensure quality seed production across the country (Jeshore, Bogura, Mymensingh, and Comilla hubs), 2) support collaboration among the hatcheries, and 3) foment a competitive spirit among hatcheries.
- Public and private-sector hatcheries and actors to support quality brood production.
- Public and private hatcheries to replace their existing rohu brood stock with G3 rohu to increase the availability of seed, fry, and fingerlings of this high-yielding variety for farmers.

To increase productivity:

- Instilling good management practices (as opposed to traditional practices) for the large bodies of water of Chakoria (Cox's Bazar), which are also used for shrimp culture and salt production. This can be accomplished by combining training with a cluster farming approach to help farmers learn and use BMPs.
- Increasing productivity requires a combination of: 1) empowering relevant local actors (*e.g.,* men, women, and youths) across multiple entry points (*e.g.,* household and community levels; local formal and informal institutions) to 2) learn and practice aquaculture BMPs, and 3) ensure access to affordable quality seed and feed.
- Strengthening the output market supply chain and improving processing to minimize post-harvest losses with improved cleaning, packaging, transportation, and cold chain management.

[25] BBS, 2018. Statistical Year Book of Bangladesh. Bangladesh Statistical Bureau, Dhaka, Bangladesh.

This requires private sector-led interventions and experienced institutions/NGOs to organize farmers and educate them on GAP and post-harvest management. Private-sector firms could ensure good packaging, transportation, storage, processing, and marketing of the fish.

- Designing customized digital technical training materials, including Bangla language videos demonstrating BMPs; using mobile apps and social media to disseminate materials; negotiating with market actors to display learning materials in their shops/stations; and implementing a survey to test their effectiveness—revising the materials to maximize effectiveness and to sustain learning and dissemination.
- Facilitating discussions with BB to review the existing Agriculture and Rural Credit policy to improve the loan appraisal and disbursement processes.
- Addressing regulatory issues to improve the sector's business enabling environment. The major aquaculture inputs like seed and feed are regulated by existing policies (Hatchery Act 2010, Rules 2011, and Fish and Animal Food Act 2010). Regulations need to address seed and feed certification to ensure quality, elaborate partnership business rules between and among feed millers, and set rules for licensing community feed millers.

3.8 NUTRITION (EQ 9)

How successful has the Activity been in identifying, implementing, and promoting nutrition-sensitive interventions? How effective has the SBCC of the Activity been?

The GOB endorses a lifecycle approach for improving maternal and child undernutrition with a combination of nutrition-specific and nutrition-sensitive interventions.[26] Small indigenous species such as mola fish are a rich source of vitamin A, iron, zinc, calcium, and vitamin B_{12} and are uniquely positioned to contribute to reducing undernutrition. The Aquaculture Activity aimed to address the household-level causes of undernutrition through a nutrition-sensitive approach, specifically focusing in the first 1,000 days (pregnant women and young children). It used nutrition-sensitive aquaculture and market-systems-led nutrition interventions to achieve its targets.

How well did the Activity identify nutrition-sensitive interventions?

The Aquaculture Activity conducted two stakeholder workshops in its first year to identify platforms and interventions to improve access to diverse and nutritious foods and to understand effective SBCC strategies for nutrition that worked well in Bangladesh. In the workshops, various nutrition-focused organizations from the GOB, United Nations, NGO sector, a few seed companies (vegetable seeds), and research organizations (nutrition research) were present.

None of the consultations included public aquaculture-focused agencies like representatives from the MOFL, DOF, or BFRI to identify appropriate aquaculture system platforms for nutrition-sensitive aquaculture promotion. Nutrition-sensitive aquaculture is a new concept in Bangladesh, and a sectoral integration of nutrition-sensitive aquaculture is unlikely to be successful and sustainable without a systems approach and adequately involving public-sector aquaculture actors.

How well did the Activity implement and promote nutrition-sensitive aquaculture interventions?

3.8.1 Improve nutrition awareness and practice (IR 3.1)

To improve nutrition awareness and practice, the Aquaculture Activity adopted two modalities: 1) direct nutrition and Water, Sanitation, and Hygiene (WASH) interventions through NGOs, 2) nutrition message dissemination through non-nutrition actors, and 3) awareness building through advocacy and media. The Activity partnered with NGOs to provide fish farmers with knowledge and support for carp-mola polyculture, integrated farming techniques, and vegetable production on pond dikes and in homesteads. The intervention was designed to increase nutrition-related awareness and

[26] Second National Plan of Action for Nutrition 2016–2025 (2017). Ministry of Health and Family Welfare. Government of the People's Republic of Bangladesh.

behavior of rural households and was aimed at increasing farmers' access to quality input supplies and embedded information services.

Seven NGOs delivered nutrition interventions, while almost all non-nutrition grantees (private companies) were involved in nutrition SBCC activities. The NGOs trained farmers on nutrition and carp-mola polyculture. The training topics varied slightly by NGO, but most covered carp-mola polyculture, pre-stocking management, disease management, homestead gardening and dike cropping, basic nutrition, gender and youth, water and sanitation (including tippy taps), distribution of vegetable seed, mola brood and carp fingerlings, demonstration fish farms, demonstration of vermicompost, *etc.* Some NGOs facilitated market linkages.

Figure 4. Brochure on small fish nutrition

The ET interviewed beneficiaries of the Community Development Centre (CODEC), Shushilan; and Prottayashi in Barishal, Satkhira and Cox's Bazar districts, respectively. In addition to NGO partners, the Aquaculture Activity disseminated nutrition messages—particularly the importance of mola fish and vegetables for human nutrition, promotion of carp-mola polyculture, and pond dike cropping through non-nutrition grantees like seed, feed, and AMP suppliers.

The Aquaculture Activity developed nutrition training materials on balanced diet, nutrition of women and children, importance of small fish and vegetables to ensure protein and micronutrients, hygiene and hand washing, mola culture, dike cropping, and homestead gardening. The Activity also developed several SBCC materials like brochures (*e.g.,* Figure 4), pamphlets, billboards, and festoons to promote mola fish and vegetable production and consumption at the household levels. These materials were used by NGOs and non-nutrition actors in farmer trainings. In addition to using Activity materials, grantees developed their own nutrition-sensitive aquaculture SBCC materials specific to their interventions.

Evidence of change: Aquaculture Activity nutrition interventions through NGOs and private companies have increased mola culture among the beneficiaries. Before this, the farmers removed mola from the pond before releasing carp or other fish species. With the right knowledge of mola culture, the beneficiaries produce mola for household consumption and to sell in the market. Similarly, vegetable production on pond dikes and in homesteads has increased. Activity beneficiaries confirmed that the training they received from Activity grantees has improved their knowledge and skill to grow vegetables. The farmers were also linked with input sellers.

> *"Mola fish has 100% vitamin. Head contains 53%, tail 1%, part after the head is 39% and then 7%. Banana flower has 70% iron. Eating fish and vegetable[s] improves our immunity against diseases."* – Female farmer, Barishal

The participants in FGDs and KIIs had specific knowledge on the nutritional value of mola, how to process and cook mola (mola needs to be eaten with the head), how to process vegetables to retain micronutrients, critical times for handwashing, and the importance of handwashing with soap.

In Bangladesh, rural households are already exposed to nutrition messages through health system platforms and mass and electronic media. The Aquaculture Activity's interventions specifically improved beneficiaries' knowledge of mola fish culture and its nutritional importance, as reflected in the case studies and the Activity's survey data.

As described in 3.1.3, the Aquaculture Activity's survey data show that it exceeded its target of increasing good nutrition and hygiene practice by 20 percent in beneficiary households. Nutrition SBCC through private companies showed mixed findings. Within the grant period, almost all private companies included nutrition sessions in the farmers' training. However, after their contract ended, only a few incorporated nutrition SBCC into their routine business activities.

Interviews with key informants and ET's observations revealed that it is not always practical to routinely discuss nutrition topics with customers seeking agriculture, poultry, and aquaculture

products. Input sellers' shops are potential platforms to disseminate messages on nutrition. Putting a poster on the wall inside the shop, providing takeaway materials like leaflets, and putting nutrition messages on product packs are alternatives to direct message dissemination.

Build awareness through advocacy, media, and other activities.

1. The Aquaculture Activity promoted the importance of fish nutrition through health system actors and platforms. It conducted a workshop in collaboration with the Bangladesh National Nutrition Council, GOB's high-level coordination and policy formulation body, to promote fish consumption through nutrition stakeholders. It also observed National Nutrition Week each year at the national and upazila levels.

2. To remove misconception about tilapia fish consumption, the Aquaculture Activity collaborated with GORAI films and developed different digital awareness content like video shows, advertisements, and social media campaigns along with celebrity endorsements. "Tilapedia"—a dedicated e-social platform—was developed to convey the brand value of this fish. To date, 201,982 people have visited the page.

3. Aiming to improve fish consumption among children, Duronto TV—in partnership with the Aquaculture Activity—aired 26 episodes of the animated show *Mecho Tota Gecho Bhut* (Fish-loving Tota and the Tree Ghost) during 2019–2020. The series followed Tota, a boy who loves to eat fish.

4. In partnership with the publishing house *Shomoy Prokashon*, the Aquaculture Activity published a fish-based cookbook called *Machbhog* (relishing fish) containing 120 fish recipes. So far, 223 copies of the cookbook have been sold, and 1,000 pamphlets on fish recipes have been distributed.

5. The Nutri-champ teams organized 45 community-based events—including cooking demonstrations, school- and university-based awareness programs, and fish market events. Collectively, the team distributed 400 festoons, 3,000 leaflets and brochures, and 2,000 recipe pamphlets to 2,353 participants.

6. To promote dietary diversity and hygiene practices, the Aquaculture Activity partnered with Classic Melamine Industries Ltd. (CMIL), to inscribe a set of nutrition messages on melamine plates and bowls. CMIL sold 4,520 plates and 4,420 bowls in different districts in the ZOI and ZOR.

Evidence of change: No data were provided to measure changes in nutrition awareness and practices for fish consumption based on Aquaculture Activity-supported advocacy, media, and campaigns. Although the Activity used various channels to promote fish consumption, it missed the opportunity to engage government aquaculture sector actors like the MOFL, DOF, and their associated entities to further extend the reach of nutrition information.

3.8.2 Improved access to diverse and nutritious foods (IR 3.2)

To improve access to diverse and nutritious foods, the Aquaculture Activity adopted two approaches: 1) increase production and household consumption of mola fish and vegetables by promoting carp-mola polyculture and pond dike vegetable cropping, and 2) develop and promote RTC and RTE fish products.

Increase production and household consumption of mola fish and vegetables.

To promote mola culture and vegetable production, NGOs provided mola brood and vegetable seeds and seedlings to farmers. Farmers, particularly women, grew vegetables like sweet pumpkin, lemon, gourds, leafy vegetables, *etc.*, for household consumption. In the FGDs, farmers mentioned that they consume their produce on a regular basis, and any surplus is sold in the market. As the children do not like to eat small fish, some women reported that they prepare foods with mola paste for young children.

Promote RTE and RTC fish products.

The Aquaculture Activity partnered with big fish processing companies like CHHIP Food BD, MarGEn, and Roja to develop and promote RTC and RTE fish products aimed at increasing fish consumption by the younger generation. MarGen developed seven RTC/RTE products like shrimp tempura, shrimp

popcorn, fish balls, and fish nuggets. CHHIP Food BD did not develop new products; rather, they promoted their existing 17 fish-based RTE/RTC products through fish fairs, awareness sessions, promotional still pictures, leaflets, posters, stickers, festoons, and X-banners. CHHIP Food BD reached approximately 62,565 customers, including 83 percent men and 17 percent women. Shushilan promoted RTC and RTE fish products through women entrepreneurs and in schools with students in grades 9 and 10 in the Barishal, Satkhira, and Khulna regions.

Evidence of change.

As described under 3.1.3, the Aquaculture Activity's survey data show that 1) households were more likely to consume small fish in 2022 compared to 2018, and 2) women are increasingly consuming a more diverse diet. Data were not available, however, to measure change or improvement in the consumption of RTC or RTE.

3.8.3 Conclusions

The Aquaculture Activity's NGO-led direct nutrition intervention achieved its target of improving knowledge, practice, and dietary diversity. It facilitated improved knowledge and practice of good nutrition and hygiene behavior, especially in household fish consumption—although the increase was not large. Nutrition SBCC through private companies is unlikely to be sustained beyond project support. The Activity missed the opportunity of engaging with government aquaculture sector actors, primarily engaging with health systems actors instead.

3.9 GENDER (EQ 10)

How successful has the Aquaculture Activity been in effectively integrating gender considerations, ensuring equitable access for women, increasing female engagement and empowerment, and promoting women entrepreneurs?

The Aquaculture Activity's Gender Strategy describes a gender-transformative approach to changing the attitudes and roles of women in the aquaculture sector. This includes its partner (grantee) selection and the partners' attention to:

- Equal opportunity employment
- Gendered budgets
- Maintaining diversity and equality in staffing procedures and attendance/participation in events
- Gender-related targets
- Sex-disaggregated monitoring
- Zero tolerance for sexual harassment and gender-based violence

Also, the Activity sought to increase capacity building and the sensitization of Activity and partners' staff, apply a gender lens in communications, and conduct gender analysis of research and MEL data—reporting gender-related results to USAID "fortnightly, quarterly, and annually."

The Aquaculture Activity grantees mostly met their inclusion targets for women and youths' participation as described in their grant agreements, although not all grantees had such targets, *e.g.,* banks did not agree to provide a minimum percent of their aquaculture loans to women.

Most of the NGOs focused on women (see Table 3-J below). United Purpose, for example, trained 100 women entrepreneurs and 9,500 women producers on business skills through its WBC model, which included training entrepreneurs from the WBC in ToT sessions, who then trained thousands of others. In addition, United Purpose disseminated messages about women in aquaculture use of gillnets to support women's aquaculture independence, and nutrition to more than 200,000 recipients.

Table 3-J. Percentage of the *Aquaculture Activity trainees who are women or youth*[27]

-	**Women**	**Youth**
NGO trainees	-	-
Banchte Shekha	100%	37%
BNKS	87%	13%
COAST Trust	39%	14%
CODEC	88%	17%
GRAUS	55%	18%
Mukti	81%	16%
Prottyashi	61%	20%
Shushilan	100%	47%
Tahzingdong	88%	21%
United Purpose	100%	11%
Firm trainees	-	-
Afil Aqua	1%	15%
Aftab Feed Products Ltd.	22%	21%
AIT	12%	21%
Bank Asia	6%	13%
Cox's Bazar Shop	96%	36%
Harun Motshay Hatchery	33%	20%
KAAS Trade	29%	15%
KMSS	80%	34%
M World	2%	3%
M/S Shah Amanth Traders	28%	29%
Ma Motsho Hatchery	28%	37%
MarGEn Ltd.	4%	19%
MATRIX	19%	15%
Motshay Bangla Hatchery	38%	28%
Nabolok Parishad	46%	25%
Petrochem Ltd.	26%	16%
Rabeya Motshay Hatchery	26%	20%
Sarder Agro	11%	22%
Satota Poultry	35%	17%
Shushilan (MFI)	90%	41%
The City Bank	5%	20%
The Right Kind's	6%	25%
KNB Agro Industries Ltd.	43%	27%

[27] Analysis done with the Aquaculture Activity participants database through December 2022.

Women's participation in aquaculture has increased due to training through Aquaculture Activity grantees and WMFs. While those the ET interviewed worked in pre-existing shops/family businesses, Activity staff said that many of the WMFs were women entrepreneurs. Women that the ET met with described feeling empowered by what they learned about aquaculture and nutrition, dried fish processing, value-added products, business (for the WMFs), and their ability to support their family's nutrition and income. Income is derived from: 1) selling fish (for women farmers in homestead ponds); 2) processing dried fish, creating RTE products, and making sales for dried fish producers; 3) attracting customers with newly stocked aquaculture products; sharing knowledge; advising fish farmers; and having more business knowledge and skills (for WMFs).

Despite these results, women's participation in aquaculture remains primarily focused on family pond management and supporting their families/husbands. Assuming an estimated two million homestead ponds,[28] ample opportunity exists to improve efficiency and productivity among the millions of women who support their families' fishponds, consumption, and sales. Beyond those socially accepted efforts, though, is a sector dominated by men and mostly patriarchal social norms that limit women's mobility, decision-making, and control of assets. Of the 17.8 million jobs in aquaculture in Bangladesh, women are estimated to hold less than 8 percent.[29] Survey data from female farmers trained by the Aquaculture Activity's NGO grantees said they agree with the statement that women can go to the market when no male household member is available (43 percent).[30]

When women were asked who makes decisions about them going to the marketplace, 23 percent said their husband does (9 percent said themselves, and more than 46 percent said the decision is made jointly). They said that decisions about their mobility (going to a relative's house, hospital, cinema, NGO training, and marketplace) are mostly made by themselves with their spouses. Likewise, the same respondents indicated that most spending decisions were made together with their husbands (about 67 percent of the time, except regarding land sale/lease, where husbands are more likely to make the decision alone).[31] As noted in EQ2, the average loan to men was more than seven times that of the average loan to women over the Aquaculture Activity through 2022.

The ET found that attitudes differed by age and sex, where older men and women thought that women's aquaculture roles are limited to homestead ponds, except for the women involved in the dried fish industry, Hindu women, and tribal women in Bandarban. Women provide necessary labor in the dried fish industry, as the men are typically fishing (marine fishing, something women do not traditionally do). Hindu and tribal women do not suffer the same restrictive social norms as their Muslim peers. Young men in Faridpur said they believe women should be involved in aquaculture (and agriculture), but young men in Satkhira expressed the more commonly held attitude that women should support the pond at home.

Youth and Aquaculture Activity grantees acknowledge challenges of "older" women to exercise their rights and economic empowerment. Challenges include:

- Illiteracy or low literacy.
- Lack of mobility.
- Household responsibilities.
- Lack of awareness, knowledge, skills, and independent decision-making.

The Aquaculture Activity's quarterly report ending December 2022 describes constraints for women in aquaculture in the ZOR, noting that the Activity has supported engaging women:

> "*The participants* [in a gender-focused workshop] *identified some key constraints, which can be listed but not limited to the restriction on women's mobility, ownership, and access to pond[s],*

[28] Ahmed, B.N., Waibel, H. The role of homestead fish ponds for household nutrition security in Bangladesh. Food Sec. 11, 835–854 (2019). https://doi.org/10.1007/s12571-019-00947-6.
[29] World Bank blog post (February 2, 2022). https://blogs.worldbank.org/endpovertyinsouthasia/supporting-women-fish-farmers-bangladesh-recover-pandemic-losses.
[30] BANA 2022 Productivity Survey Data. Most gender-focused questions were asked of NGO-trained farmers only.
[31] *Ibid.*

approval, and support from the family that would facilitate women in getting involved in the aquaculture sub-sector at ZOR. There exist some other set of challenges like slow growth rate in fish production by the smallholders, uneven wages for women aquaculture workers, access to technical knowledge and information that … are not complementary for women taking up homestead pond aquaculture as business. However, having discussed the aforesaid points, the participants commented that women's involvement in aquaculture at ZOR has begun increasing because of the Activity. They added [that] the Activity is facilitating women['s] empowerment at ZOR through implementing some interventions like providing specialized trainings, extending financial supports, getting better access to quality inputs, arranging women-friendly and affordable transportation options, creating collection/aggregating points at the community level, etc. *Participants commented that [the] continuous and sustainable participation of women in [the] aquaculture sub-sector require[s] strategic support from government agencies as well as from respective private sectors.*"

A discussion with the Aquaculture Activity staff about the Activity's inclusion activities included a recommendation for taking the family approach (described above), as a means of making activities more inclusive. The approach acknowledges that most women's decision-making requires the input of a male family member. In having women and male family members present at initial Activity meetings, decisions about women's continued participation can be immediately made, or so logic suggests. Activity staff noted that there is a cost element to the family approach. The real question might be: What is the cost of failing to include women's participation in aquaculture?

Conclusion: USAID sees inclusion as an underlying principle to closing the economic gender gap and reducing the poverty rate by strengthening agriculture (and aquaculture) value chains (CDCS p.10). Overall, the ET finds that with a few exceptions, most of the women associated with the Aquaculture Activity who are newly or better engaged in aquaculture are small fish farmers and some processors. Inclusivity needs to be driven by supporting women's participation in all aspects of aquaculture including as entrepreneurs, employees, processors, and farmers. The Activity's success is mostly with women as small farmers and some entrepreneurs (WBC and WMF).

3.10 MONITORING, EVALUATION, AND LEARNING (MEL) (EQ 11)

How effective have the Activity's MEL approach and tools been in measuring market system change?

3.10.1 Measuring market system change

MEL system: The Activity's TOC, which guides the MEL plan, focuses on assessing the capacity of aquaculture actors. To effectively measure market system change, the Aquaculture Activity needed to identify actors and assess changes in their behavior, the strength of their relationships, and the number of linkages between them (*i.e.,* who is connected to whom to do what). This is challenging, because: 1) markets are dynamic, and 2) they tend to include a variety of hyper-local, local, regional, national, and international actors.

While the TOC adequately describes the areas, means, and outcomes the Aquaculture Activity expected to see, and the MEL system collects a tremendous amount of data, there is a disconnect between them because the data needed to assess market systems change—and changes in private-sector investment are missing, particularly at the sub-local, local and regional levels where systems change mostly takes place. In addition to the absence of data to measure these aspects of system change, the ET found that the Activity's annual and quarterly reports bury the reader in detail but say little about change over time, which suggests that MEL data may not have been used to adapt its approach and activities.

The Aquaculture Activity's MEL plan describes the Adopt, Adapt, Expand, Respond (AAER) framework—commonly used in development programs taking a market system approach, which suggests that systemic change will occur through market actors crowding in and copying the successful behavior of other actors. A recent technical paper criticizes the way the AAER framework is generally presented—indicating that its two-by-two matrix has led many market system-based interventions to miss many of the framework's parameters, *e.g.,* "[the] nature of the actor's relationship to the programme; who the actor is; the nature of the behaviour change; the cause of behaviour change; and

the 'phase.'"[32] These aspects are the same or similar to those needed to understand system change. The author describes ways to maximize the analytical potential of the AAER framework.

The Aquaculture Activity assessed changes in the market system through the MEL system, the baseline and midterm evaluations, and with an Activity-designed and conducted study measuring change in the market system.

Baseline: The Aquaculture Activity's baseline report included a fish value chain diagram and explanatory narrative that was based on data collected from 141 informants across 17 aquaculture roles. The resulting detailed market analysis resulted in a generic value chain diagram that fits most areas. Yet, as found in this evaluation and in the midterm evaluation, the Activity needed activities tailored by context, and that context consists of local determinants that were not captured at baseline.

Midterm evaluation: The midterm evaluation found that "Adaptive management and systemic change measurement level data collection from partners and their distribution network actors was much less than what is necessary to effectively identify market level constraints and problems." Further, the midterm report recommended that the TOC be revised to include "behavior level changes of different market stakeholders (system and development outcomes)."

Measuring changes in the market system report: The Aquaculture Activity's 2022 special report, "Measuring Changes in the Market System: A Qualitative Assessment,"[33] provides the perspectives of interviewed partners (43 grantees), market actors (1,240), and consumers and direct Activity participants (917). While many people were consulted, the report does not provide a description of the design and methods (*e.g.,* sampling design and assumptions, data gathering design, analysis methods, *etc.*)—thereby giving the reader no means to assess the study's validity. The ET requested and received sampling tables, but without an accompanying narrative.

The market system report presents findings based on their relation to evidence of change; innovation; sustainability, and replication from the three sets of participants. From their partners, the Activity's concluding summary states that "systemic change is indeed taking place in the market systems that [the Aquaculture Activity] has intervened in," and that partners are "highly likely to continue with interventions without further support from [the Aquaculture Activity]." Other conclusions include increased participation of women and youth in aquaculture and increased the Activity grantees' profit/revenue. Other actors are also described as having "personally benefit[ted] from [the Aquaculture Activity]'s interventions in some capacity: either financially, socially, or through increase in knowledge." The conclusion further suggests that the study did not provide enough evidence of replication at the farmer level, so the Activity recommends a quantitative study.

The Aquaculture Activity plans to start another study assessing systems change and to measure one of their targets for which it needs data as described under 3.1.2. After publishing a TOR in 2022, the Activity selected the same organization that did the midterm evaluation to conduct an "Impact Assessment for Measuring Systemic Changes and Capture Learning in the Aquaculture Activity." The work is expected to begin in June 2023.

Conclusion: Overall, the Aquaculture Activity's efforts to date were insufficient to measure market system changes and adapt the Activity accordingly. It needed context-driven local and regional value chain maps at baseline. With that starting point, the Activity could have measured changes in those value chains—which, over time and multiple value chains—should effectively illustrate market system change.

3.10.2 Lessons learned

What are some of the lessons learned? And based on the lessons learned, what are some scalable interventions?

Transformations in the aquaculture market system required a greater diversity of expertise, data, and perspectives to meet the ambition of the Aquaculture Activity. WF brought significant technical

[32] Lomax, Jake (2020). "AAER Revisited: from systemic change narrative to systemic change analysis." DOI: 10.13140/RG.2.2.32996.81288.
[33] BANA (2022). Measuring Changes in the Market System: A Qualitative Assessment.

expertise to the Activity, which contributed to improving the availability of quality seed, farmer skills and nutrition information and outcomes. Market system transformation required more ongoing, practical, analytic, economic, and business expertise. Lessons from more mature market systems in Bangladesh (*e.g.,* in agriculture, livestock, commodities) could have informed the Activity's approach as well.

The individualized approach to grantmaking may not have served the need for building market linkages from the outside. Neither did the laser focus on private-sector engagement—which, while important, missed opportunities for engaging with government on policy, monitoring, infrastructure and extension issues and initiatives. A more holistic, joined-up approach was necessary. Ongoing multi-stakeholder workshops and a multi-stakeholder campaign, as well as other intentional efforts to forge synergies and linkages among players, might have generated awareness and interest in the Activity, increased private-sector engagement, built public-private partnerships, and strengthened relationships among stakeholders.

The following are some of the interventions that could be scaled given their sustainability and value in the sector and market.

- **Hatchery-nursery linkages.** BMP and biosecurity training to hatcheries and nurseries and Activity-facilitated linkages between hatcheries and nurseries effectively improved the seed value chain. The approach is effective. Additional training and support of transporters and sellers would extend the outreach of high-quality seed outputs (fry/fingerlings) to farmers.
- **Training small farmers, especially youth,** was well received, and additional avenues could be explored for reaching more participants.
- **OSSCs.** The Aquaculture Activity's capacity building of (mostly) existing businesses to become OSSCs strengthened the aquaculture market by facilitating the OSSCs' ability to provide advice in addition to selling products.
- **Dried fish processing and value-added products**. The Aquaculture Activity's capacity building and market expansion of dried fish processing, safer and more efficient processes, improving the safety and variety of value-added products, using e-commerce, and local mobile unit sales in Cox's Bazar were successful interventions and are scalable to other areas of Bangladesh where dried fish processing is common.
- **Integrated carp-mola polyculture.** The Aquaculture Activity's expansion of carp-mola polyculture in the FTF zones and training farmers and others on the value of mola fish have succeeded at both increasing fish productivity and family nutrition. Successful and scalable efforts include a campaign with recipes and cooking demonstrations with a focus on women.

4. RECOMMENDATIONS

4.1 ACTIVITY DESIGN

When taking a market system approach, pair aquaculture expertise with a business development firm.

Market systems development experience and capacity should be part of any future aquaculture sector development scope of work. The Aquaculture Activity's market sector approach would have been better served by pairing WF with a business development firm—one with the necessary market systems expertise to help WF tailor activities with consideration for local and regional context and value chains. The business development firm's expertise is needed to facilitate: 1) financial assessment and mapping of commercial enterprises, 2) private-sector firms' business plans *vis-à-vis* the Activity, 3) open space for increasing investment, and 4) business expansion or deepening in the sector.

Require stronger coordination between IPs and relevant GOB actors.

GOB has a few institutions that could have supported the Aquaculture Activity had WF reached out to them—especially DOF, BFRI, and DYD, which may have created more interest, innovative approaches, and sustainability in the long term. The engagement should strengthen: 1) the take-up of technology and the Activity, 2) capacity development process, and 3) quality assurance and policy support for a business-enabling environment.

***Conduct a stronger, more inclusive relationship building and multi-stakeholder Activity launch: include CSOs, policy influencers, GOB,* and other stakeholders.**

The findings illustrate that while the Aquaculture Activity included many actors, the grantees mostly worked in silos. Its approach and interventions may have been more effective had it engaged stakeholders with different perspectives in a "whole system in the room" workshop. Engaging with people at the outset and throughout the project to own the activity, agree to its goals, and have a common vision of its purpose can create powerful synergies among stakeholders.

Develop detailed value chain maps to support Activity design.

As explained in the findings, the lack of local and regional value chain maps that identify the actors, their roles, their numbers, and relationships created a big gap in the Activity's ability to: 1) tailor approaches and interventions to local and regional context and challenges, 2) know what changes were occurring and which were not, where change was (and was not) happening as envisioned, and 3) benchmark and continue to adapt its approach over time.

Clearly define the desired systemic market change and when and how to measure it so that adjustments can be made throughout the Activity.

Identifying the changes desired and their respective indicators and then measuring them throughout the Aquaculture Activity would have given it much more direction and insight into its approach throughout its five- (and now six)-year activity. The most important indicators for a market systems approach include the number of market actors (by type, location, size), their connections with others in their value chain, and the strength of those connections.

Tailor Activity design to local context and priorities.

Major findings are common across geographic areas such as how prohibitively expensive fish feed is and how difficult it is for most farmers to access credit. Any aquaculture program that takes a market systems approach is likely to yield positive results by focusing on access to essential inputs and improving BMPs. Changing the system itself, however, requires wholistically addressing local and regional value chains. For example, an Aquaculture Activity grantee sought to buy fish directly from farmers, so the farmers were trained on BMPs and how to use the grantee's app to record their use of inputs to establish the data needed to trace fish. Doing this would fill a gap in the market by providing customers with information about the inputs used in the fish they eat, as customers increasingly want to know that what their families consume does not contain pesticides and medicines.

The grantee struggled, however, to get farmers to agree to sell their fish to the company, because farmers received inputs from local dealers/retailers with the agreement that they would sell their fish to them at a pre-specified (non-market) price. This is a systemic challenge that the Aquaculture Activity did not address that is highly localized, because the actors are not national or regional but hyper-local. So, farmers complain that they do not get a fair price for their fish, while simultaneously acknowledging that their purchase of inputs on credit is the source of the issue. Unraveling that conundrum requires a sensitive, localized, systemic approach.

The same can be said for engaging women in aquaculture. The case studies illustrated the many ways in which women are involved—although regarding numbers, most women in Bangladesh are involved in their homestead pond only. Yet some women entrepreneurs, dried fish producers, and RTC/RTE value-added product producers are successfully working in the sector. They appear to be more likely to work as part of a group/collective or as part of their family business. A tailored, local approach could also be used to address the effects of climate change and ecological environment issues.

A holistic, market systems approach designs interventions with local stakeholders, obtaining buy-in, which is something that the Aquaculture Activity and its grantees did to some extent throughout their efforts. However, many grantee closeout reports refer to challenges based in local contexts, where more time and labor is required to be in person—building relationships and trust and sharing knowledge. These are predictable challenges, so the fact that they are described as challenges by many grantees suggests that the grantees' approaches were not as tailored to local contexts as needed.

Wholistic and systemic way forward addressing common and local challenges.

The Aquaculture Activity should have a Coordination Committee (CC) that helps it to meet local and context-specific challenges—including those related to engaging women and youth, addressing the effects of climate change and climate-smart initiatives, and unraveling local and/or market system conundrums. The CC would include the IP and donor, representatives of essential GOB agencies (DOF, BFRI, ministries of environment, women, and youth development) and a local government authority (who knows the local context). Added to these are upazila-level representatives, minimally from the market system (*e.g.*, from the Business Management Organization, farmers' organization) and women and youth, but it may also include representatives related to a local-identified issue (*e.g.*, village organization representative). These people would be identified during upazila-level consultation workshops that might be called local Activity launch meetings.

USAID's IP would organize quarterly meetings of the CC to provide a brief update on activities since the previous meeting (also provided in writing in advance in a clear, readable format) followed by thematic queries (carefully composed questions that help the members think about each issue area, *e.g.*, women, youth, climate/environment, finance). During the meetings, the CC will discuss how to better address identified challenges that are common across local contexts. Their ideas will be presented at local quarterly meetings with local CC members (who may also attend the Aquaculture Activity-level CC meetings) and community stakeholders. The local representative of each issue area can lead the query process on local challenges by providing a summation of the ideas the CC generated.

Grounding the CC would be MOUs between the IP and CC membership organizations. For the MOUs to be meaningful, stakeholders need to understand the Activity's approach (TOC) and goals. The Aquaculture Activity should host Activity Launch Events at the national, regional, and local levels with a USAID and GOB presence at each event—during which stakeholders would gain an understanding and appreciation of the Activity. If the Activity is co-designed, then these events may be a culmination of a series of workshops. If not, then these events may be workshops in which stakeholders can express their perspectives on the Activity's design, which will then be considered in revising the Activity's approach, if necessary (at any level: local, regional, and national; and on any theme). Through these engagements, stakeholders can buy into the Activity and, therefore, be prepared to act, including being part of an MOU and CC.

Assumptions: The Aquaculture Activity will take a market system/development hybrid approach and attracts local, regional, and national market stakeholders (*e.g.,* businesses) with a focus on local and regional stakeholders. Local CC representatives are selected in an equitable manner based on existing or nascent community structures such as farmers' and village organizations, Business Management Organizations (BMOs), and the like. In the local Activity launch event, the IP will introduce the Activity and the purpose and structure of the CC, with a USAID representative as witness. This witnessing is important: 1) to ensure that the IP faithfully presents the information and 2) for the community to begin having faith in the IP, the Activity, and relevant stakeholders. Launch events are likely to expose challenges that must then be taken up early in the Activity or any early faith building will be lost.

Encourage financial service providers to create aquaculture-friendly loan products.

Access to finance is a common challenge for fish farmers. The Aquaculture Activity partnered with MFIs and private banks to pilot financial service products and processes. Although MFIs and bank experiences are encouraging, the availability of and access to aquaculture-friendly loan products remain challenges for small and marginal farmers.

Barriers to accessing credit include: 1) loans that are too small to meet credit needs and 2) needing collateral, guarantor, and CIB reports to get a loan. The priority focus should be 1) reviewing the Agricultural and Rural Credit Policy and Program for Fiscal Year (FY) 2021–2022 of BB and the PKSF[34] credit product—particularly for agriculture, and 2) holding a series of dialogues with BB, the MRA,[35] PKSF, and private banks to improve the loan product and implementation pathways, and 3) assess Bank Asia's merchant referral agent banking for the potential for scaleup and how this model might be used by other financial service providers.

Address policy issues and encourage effective enforcement.

The effects of the Aquaculture Activity's work on revising the National Fisheries Policy 1998 and consolidating and improving licensing, management processes, and effective use of aqua inputs are not yet known. Moreover, it missed opportunities to address other policy issues described in response to EQs 1 and 2.

To address these issues and improve this growing sector's enabling environment, attention is needed on 1) the applicability of the Fish and Animal Food Act 2010 to address the partnership business model among feed millers, the community feed millers' licensing process, and feed packaging using jute bags; and 2) assessing the Fish and Animal Food Act 2010 and identifying issues that need to be revised, dropped, or require new acts. These activities require a series of discussions with the MOFL in association with FIAB to carry forward the agenda to improve the aquaculture sector's growth opportunities.

4.2 AQUACULTURE SECTOR

Expand training of hatcheries on BMP, linking hatcheries to build up nursery BMPs, and increase the number of nurseries.

BMP use in hatcheries combined with high-yielding fish species increases hatchery productivity and produces highly vigorous and uniform fry that are free from diseases and malformations. In this way, the hatchery will be in a better position to meet nursery and fish farmers' demand for high-quality seed. Hatchery workers should be given adequate initial training, as well as regular refresher training, on safety in all areas of hatchery operation.

As of FY 2021–2022, Bangladesh has a total of 1,056 registered hatcheries—of which 103 are government-owned hatcheries and 953 are private sector-owned (DOF 2022). Feed companies like Mega (Spectra), Nourish, Quality, and Aftab are the leading players in seed production—specifically tilapia. BMPs must emphasize the optimal use of production inputs such as:

Figure 5. Fish nursery and owner

- Good brood stock
- Appropriate feeds for each specific age and stage
- Adoption of on-farm quarantine and biosecurity measures
- Compliance with hatchery registration law
- Stocking only healthy fry and fingerlings/seedlings
- Using genetically improved fish species for stocking sourced from government or accredited non-government hatcheries, *etc.*

[34] PKSF is an apex organization established by the GOB. It is a specialized institution for alleviating poverty and improving the quality of life of the poor by providing resources for creating employment and enhancing economic conditions.
[35] MRA is the central body for monitoring and supervising microfinance operations of NGOs of the Republic of Bangladesh.

The Fish Hatchery Act 2010 and Rules 2011 need to be updated with BMPs, and there should be a national plan of action for quality seed production with the fish production target of 2025 under the GOB's eighth Five-Year Plan. Emphasis should be given to quality brood production and strengthening the supply chain. For example, hatcheries must focus on issues like the possibility of inbreeding—where female and male breeders are chosen from a finite population for mating. One solution to this challenge is to use the natural carp breeding ground—the Halda River—for carp hatchery development in the ZOR.

Fish nursery management is dedicated to rearing fry and fingerlings. Nursery operations have a long chain from hatchery to *patilwala*, where maintaining BMPs is a crucial factor. Nursery BMPs cover practices in pond preparation, cleaning, liming, filling, fertilization, stocking, and water quality management. Moreover, nurseries should be constructed in a way or in areas with easy access to local farmers to limit transport time and challenges. Transport time between the hatchery and grow-out site should be less than three hours (otherwise, transport must include oxygenation).

Fish seed quality and profit are correlated, so another sector improvement would be tracing—being able to identify the hatchery, zone/collection site, and brood stock for fry/fingerlings at the time of purchase or transfer to the farmer. Finally, as in agriculture, good businesses (such as hatcheries) need branding and spaces where business owners (hatcheries and nursery owners) can effectively address compliance and other issues, *e.g.,* a nationwide hatchery association. There is an existing association (https://www.facebook.com/bfhca/photos/), but it appears to have very few active members.

Promote and commercialize high-yield fish seed.

One of the challenges to sustainable aquaculture development is the lack of improved fish strains. In Bangladesh, aquaculture is still largely based on unimproved fish strains—which results in poor growth rates, high mortality, and high production costs. Genetically improved fish seed and a high-functioning seed system are crucial for increasing productivity and improving socioeconomic performance. To date, only a few species like GIFT, silver barb, rohu, and climbing perch are available in the country—and rohu (G3 and Suburno Ruhi) was only very recently introduced.

The Aquaculture Activity did not coordinate with DOF (until the end of 2022) or BFRI about G3 rohu, which likely constrained the production of high-yielding fish seed like G3 rohu. Dedicated hatcheries by DOF and the private sector are necessary to produce G3 rohu, and registered hatcheries must replace brood stock with G3 rohu. Certification of hatcheries and fish seed quality are crucial to promoting high-yielding seed dissemination, as is farmers' willingness to pay for quality-certified seed. The latter requires an SBCC campaign to motivate farmers and nurseries.

Social networks will play an important role in the diffusion of innovations like high-yielding fish varieties. Leveraging social networks for technology diffusion can be an effective approach to achieving wide-scale adoption of improved fish varieties. Organizing farmers into clusters can foster interactions and shape aqua-related risk perceptions—and, subsequently, increase adoption of innovations and promote sustainable intensification. Further, the Activity should leverage relationships between input providers and farmers.

Large feed companies with the capability of producing high-yielding fish seed may be encouraged to shift to high-yielding species with economic incentives. In addition, sector development requires strengthening aquaculture labor and equipment use and other logistics to facilitate hatchery production and delivery of high-yielding seed to farmers. Finally, research and training programs should focus on the development of high-yielding fish strains.

Extend BMP training to small farmers: consider delivery through NGOs with DOF and aquaculture-focused IP(s).

Extend BMP training to more farmers and other market actors and consider including topics such as new species, water management, fish diseases, and the market system. Use a ToT approach with practical and hands-on training techniques to develop a cadre of resource people who could be deployed to work with their own organizations or with other organizations who are looking to expand their work in the sector. The ToT should include DOF, BFRI, and DYD training facilities.

Figure 6. SBCC visual (Arabic)

Given the need for practical training tools, train LSPs on user-friendly video production. LSPs could produce videos and share them with other market actors and online, *e.g.,* in social media and through associations. Engage private-sector firms to invest in providing training and Information Communication Technology (ICT) tools to aqua retailers so that they can use the tools when advising farmers. Encourage more women OSSC agents through flexible educational and work environments. Explore sustainable business models with private-sector companies and/or local associations and LSPs so that LSPs can expand their reach to women farmers in their communities.

Promote group farming to address multi-owner ponds and encourage knowledge sharing.

Small-scale aquaculture producers in the rural areas of Bangladesh are facing challenges related to multiple people owning ponds, as described in the findings. Collective action through participation in Farmers' Organizations (FOs) can provide an effective mechanism to assist small-scale producers to overcome these challenges and contribute to fish productivity. FOs exist in some places, as do village organizations, which have the potential to succeed in aquaculture through cluster management. Cluster management refers to a group of aquaculture farmers or FOs that collectively implement certain production standards.

Field experience from other Asian countries (*e.g.*, India) shows that cluster management used to implement appropriate BMPs can be an effective tool for improving aquaculture governance and management in small-scale aquaculture farming—enabling farmers to work together, share knowledge, improve production, and develop sufficient economies of scale. In Bangladesh, DOF works with cluster farming (shrimp culture) in the southwestern region, where Cluster-Based Farm Management (CBFM) is successful. Group farming also encourages equality between genders for salary and remuneration.

Group farming, catalyzed by external interventions, has provided women farmers with an important alternative to being unpaid workers on family farms. This approach is especially suitable where women are relatively less subject to the social norms that restrict women's mobility and social interaction in southeastern Bangladesh.

Engage DOF and the private sector to develop and promote water and soil testing.

Soil quality is an important factor in fishpond productivity as it controls pond bottom stability, pH and salinity of overlying water, and concentrations of plant nutrients required for the growth of phytoplankton—which is the basis of food for fish. Soil and water testing is an indispensable tool for advisory services and formulation of fertilizer and feed recommendations. By applying BMP, water and soil quality testing, and use of aqua medicine, the Aquaculture Activity worked on disease diagnosis and prevention. Testing facilities for water and soil need to be established close at hand for farmers to prevent disease outbreaks. These analytical services should be closely linked to the extension and advisory services and should maintain functional and technical relationships with test laboratories, universities, and research institutions.

Water analysis is becoming common in production aquaculture. The Aquaculture Activity tried to support testing facilities through its grantees (LSPs and OSSCs), but there were problems with the supply of testing equipment/kits. Water quality variables such as water temperature, salinity, dissolved oxygen, alkalinity, hardness, total ammonia nitrogen, and nitrite testing require meters or testing kits—which are not manufactured in Bangladesh and are expensive.

Increasing attention to conditions in culture systems is an indication of a greater awareness of the importance of water quality in aquaculture and of a desire to improve management. In rural Bangladesh, there are no water quality testing laboratories or individuals trained in water analysis. Upazila-level DOF offices have some testing facilities, but they are not for pond site measurement. Soil testing facilities are more readily available due to the presence of village-level agriculture workers (Block Supervisor), and soil testing facilities are available in every district headquarters (HQ).

For ready-to-use water quality tests (water pH through litmus paper), DOF should introduce such facilities or feed and AMP producers could produce water testing kits/equipment in the country to meet market demand and reduce dependency on expensive, imported test kits.

Use understanding of impact of climate change and ecological environment of local areas to tailor interventions to local areas.

Aquaculture in Bangladesh is susceptible to a variety of climatic factors—including global warming, rainfall variation, salinity change, and temperature fluctuation. The Bangladesh National Adaptation Program of Action and Bangladesh Climate Change Strategies and Action Plans (BCCSAP) have recognized areas affected by the climate and recommended urgent and immediate actions, but there has been a lack of initiative at the primary level to address this issue. Under the climate action plan during and after disasters, the government, NGOs, and communities are supposed to take adaptation initiatives. The adaptation approaches include early warning systems, saline-tolerant agriculture, rainwater harvesting, secured drinking water adaptation, raising homestead and plinth, salt-tolerant fish farming, heightening pond boundaries, structural adaptation, and increasing community resilience.

In Cox's Bazar, for instance, the marine fish catch is less than it used to be due to climate change and over-fishing, which hinders dried fish production and the livelihood of producers. Moreover, the intensity of natural calamities has increased in recent years, which affects dried fish as well as the aquaculture infrastructure. Considering the aquaculture sector's susceptibility to the impacts of environmental change, tilapia farming is one of the potential strategies for adaptation to climate change. Compared to other fish, tilapia can adapt to low water quality caused by rainfall variation, low water volume, changes in salinity and temperature, and flood and drought conditions. In addition, integrated rice-tilapia farming is also adaptive to changes in water level and temperatures.

Build capacity of community and regional feed mills with a market systems approach to address elite capture of feed market and reduce fish feed costs.

Based on the Aquaculture Activity's efforts to create *affordable* fish feed, future activities should focus on sourcing local ingredients and addressing the enabling environment to expand the potential for community and regional feed mills to make affordable, quality feed (see enabling environment recommendations) and increase competition among the feed manufacturing companies. Thus, this recommendation should be considered in combination with the enabling environment (policy and regulatory issues) recommendations.

Strengthening the collaboration and accountability between DOF and the FIAB[36] to address feed prices may also help achieve this goal. Favorable feed laws and collaboration and partnership among feed millers could open the scope for joint procurement of feed ingredients, lower production costs, and improve their competitive advantage with commercial feed. Simultaneously, feed mill owners/managers need assistance in licensing, business management capacity, and attracting venture capital or accessing

[36] The FIAB was established in 2008. It is the only body for animal feed manufacturers in Bangladesh which include poultry, aqua, and cattle feed. FIAB is a member of the Federation of the Chamber of Commerce and Industry (FBCCI).

banks for infrastructure development and working capital. It is important for these businesses to assess their expected Return on Investment (ROI) and prepare a business case for investment.

Additional support mechanisms for making affordable, quality feed are that DOF could: 1) more frequently test feed quality and address low-quality feed, and 2) reduce import taxes on fish meal and other feed ingredients to lower feed cost.

Build up fish meal industry to support domestic fish feed production.

The Aquaculture Activity has good initiatives in the dried fish industry development. In fish-drying areas of Cox's Bazar and elsewhere, the ingredients for fish meal production are available; but due to the lack of technical knowledge and investment, fish meal is not produced by local producers. Scaling up the Activity's interventions in small-scale fish meal production in coastal regions (Cox's Bazar and Dubla Island, Khulna) may support the above recommendations for affordable fish feed, as fish meal is one of the ingredients.

Continue capacity building among fry/fingerling sellers, nurseries, and hatcheries to improve transportation.

The Aquaculture Activity grantee facilitated "Macher Gari[37]" to ensure the quality and timely delivery of seed from hatcheries to nurseries and nurseries to farmers (see 3.1.2). The pilot should be assessed to understand how well it met demand, competitive advantages with current practices, van/vehicle operating systems (*e.g.,* physical, call center, apps-based structure, *etc.*), and market actors' motivations. If the service meets demand, is affordable, and is perceived positively by users, then the business model could be expanded and copied. Actors include hatchery associations (to facilitate the capacity building and motivation events for the stakeholders) and firms that provide the transport services and processes (call centers/apps).

Market actors should also develop digital/video training in Bangla about the safe transportation of spawn, fry, and fingerlings. Videos, banners, and leaflets should be available on social media and apps, and at nurseries, hatcheries, and other input suppliers.

Further improve the cold chain between farmers and end markets.

The success of the Aquaculture Activity's efforts to improve post-harvesting BMPs is encouraging and needs to be scaled up with additional private-sector investment to reduce post-harvest loss, which is a major issue. Based on the lessons learned, capacity development of farmers and wholesale market actors should be focused on fish grading, cleaning, icing, and packaging; developing digital training materials on postharvest management practices and displays in the marketplace; and strengthening collaboration and networking among input services providers and those in the output market.

Private-sector investment to increase access to cold storage and freezer vans, thereby reducing waste in the system, needs to be explored. The Horticulture Export Development Foundation (HF),[38] the Local Government Engineering Department (LGED),[39] and the Bangladesh Fisheries Development Corporation (BFDC)[40] are potential public partners to facilitate the cold chain infrastructure development activities. Since DOF has established some landing cum storage facilities for culture fishery at the upazila level, it too has the potential to support cold chain development efforts.

To meet consumer demand, aquaculture actors need to focus on the profitable activities of fresh fish marketing and developing value-added products such as RTE and RTC. These activities have great potential for inclusion of women and youth and generating employment. At the same time, special care

[37] Macher Gari is a mobile phone application used for fish seed delivery.
[38] Hortex Foundation was established in 1993 with the patronage of the Ministry of Agriculture, GOB, as a nonprofit organization. It is registered as a Company Limited.
[39] LGED is an organ of GOB created for providing transport infrastructures and technical support to improve communication and transport network, job creation, and poverty reduction.
[40] BFDC is responsible for fish landing, storage, and transportation in the country—although their activity is only limited to riverine and coastal districts—mainly for capture fishery.

needs to be taken to ensure that every woman's participation is consistent with her choice and time availability, and that employment results in enhanced decision-making related to income generated.

Leverage aquaculture product packaging and distribution channels for nutrition messaging.

Engage aquaculture product manufacturers (of fish feed, medicine, and seed) and sellers to instill in them the value of nutrition messaging, especially regarding the nutritional value of fish. Discuss how they can facilitate messaging, which benefits the health and wellbeing of families and children and, ultimately, their businesses through increasing the demand for fish (and therefore their products). Collaborate with them to design platforms to disseminate nutrition messages. Possibilities include putting a poster on a wall inside businesses (shops), providing takeaway materials like leaflets, and putting nutrition messages on product packaging.

Build the next generation of aquaculture actors by engaging youth.

Integrate aquaculture training with science and health classes in schools and/or after-school clubs. Use the Positive Youth Development Framework to design interventions in co-creation events involving youth and community members. Work with communities, schools, DYD, families, and youth with a focus on engaging adolescents.

Engage young adolescents (10 to 14 years) in school demonstration ponds with dike vegetable farming or plain land vegetable gardens:

- Train them in BMP.
- Integrate health, nutrition, aquaculture BMP, science, and soft skills in the curriculum (such as cooperation and self-awareness).

Figure 7. Young women participating in an FGD

Engage older adolescents (15 to 19) in the above and:

- Add age-relevant soft skills training and market skills appropriate for young entrepreneurs.
- Provide opportunities for youth to engage in season-long leadership of a homestead pond with family approval.
- Ensure that adolescents and young women can access training, skills building, networks, and other opportunities to enter and thrive in the aquaculture value chain. This could include earmarked training spaces, gender awareness-raising efforts, and subsidized and bundled loans.

5. ANNEXES

ANNEX 1: SCOPE OF WORK

USAID/Bangladesh

Date of Request: October 20, 2022

Type of Task: Final Performance Evaluation for the Feed the Future Bangladesh Aquaculture and Nutrition Activity

Description of Activity: (*Guidance – please provide a short summary of the activity that will receive service/s; it should contain at minimum the objectives of the activity, anticipated results (or results if available) major challenges to implementation, and major successes); (Guidance – if this an assessment or special study, please provide topic, necessary explanation, and rationale for undertaking*)

The overarching goal of the Feed the Future Bangladesh Aquaculture and Nutrition Activity is to achieve inclusive aquaculture sector growth through a market system approach. Specific objectives are:

- Increased productivity of aquaculture production systems.
- Strengthened aquaculture market systems, with particular attention to expanding opportunities for women and youth.
- Increased awareness and adoption of nutrition-related behaviours, with a particular focus on women and youth.

The activity has the following targets during its implementation period:

1. 400,000 men, women and youth in the FTF ZOI have improved access to better quality aquaculture inputs, services, and/or market channels

2. 30 percent expansion of investment by the private sector in the FTF ZOI in aquaculture production and market related to inputs and services (e.g., seed, feed, production/ market related information, technology, etc.)

3. 30 percent increase in productivity from ponds and ghers7 in the FTF ZOI

4. 20 percent increase in the number of households adopting improved nutritional practices

(consumption of nutritious food, dietary diversity and hygiene practices)

Please see attached the activity Program Description for more details.

The total estimated cost (TEC) for Bangladesh Aquaculture and Nutrition Activity is $28,458,192 and the duration is February 6, 2018 to February 5, 2023.

Research Question: (*Guidance – If an evaluation, please provide at least 3 research questions the evaluation team will consider*)

1. To what extent the Aquaculture Activity has achieved its overall goals and objectives sustainably? Specifically, to what extent has the activity been successful in achieving its IRs—increasing productivity and strengthening markets?
2. To what extent the Aquaculture Activity addressed the systemic challenges across the aquaculture sector? How may USAID address the remaining gaps in the aquaculture market systems?
3. How sustainable are the activity's private-sector engagements to continuously address the emerging production, productivity, and market access challenges in the aquaculture sector?

4. How successful has the activity been in promoting/commercialization of genetically improved carp (rohu, catla, and silver) and tilapia fish species? Has the activity made any sustainability plan for the genetic improvement program and if so, how?
5. How successful has the activity been in using the sub-grant approach to support the activity's objectives and address targeted market system constraints?

   - Are these bringing the desired changes?

   - Was the sub grant period conducive to the objectives?

   - Has there been any changes to any sub sectors and if yes, what is the collective impact on the overall system?
6. How successful has the activity been in addressing regulatory and policy issues related to the aquaculture sector?
7. How effectively the activity contributed to address the emerging challenges of host and impacted communities in Zone of Resilience (ZOR)? How may USAID address the existing and emerging challenges of the aquaculture sector in the ZOR?
8. How successful has the Activity been in identifying, implementing and promoting nutrition-sensitive interventions? How effective has the SBCC of the activity been?
9. How successful has the Aquaculture Activity been in effectively integrating gender considerations and ensuring equitable access for women, increasing female engagement and empowerment, and promoting women entrepreneurs?
10. How effective has the activity's MEL approach and tools been in measuring market system change? What are some of the lessons learned and based on lessons learned, what are some scalable interventions?

Team composition:

Team Leader/Evaluation Specialist (National/International)

The Team Leader will:

1. Have a master's degree or higher degree in a relevant discipline such as Agriculture, International Development, Economics, Business Administration

2. Have at least 15 years of experience in evaluating projects with focus on agribusiness, aquaculture, market systems development, public-private partnerships, for USAID or other international development or donor agencies.

3. Have significant experience in designing quantitative and qualitative surveys/studies/evaluations

4. Have strong knowledge and experience of aquaculture, value chains, support markets, finance etc.

5. Have knowledge of USAID Feed the Future (FTF) program, USAID regulations and systems, performance monitoring and evaluation guidance, evaluation policy, gender policy, annual reporting etc.

The team leader will provide overall leadership for the team, and s/he will finalize the evaluation design, coordinate activities, arrange periodic meetings, consolidate individual input from team members, and coordinate the process of assembling the findings and recommendations into a high-quality document. The team leader will possess good organizational and team building skills. S/he must demonstrate cultural sensitiveness,

particularly when interacting with a range of stakeholders. S/he will lead the preparation and presentation of the key evaluation findings and recommendations to the USAID/Bangladesh team and the major stakeholders. S/he will have excellent communications and writing skills in English.

Aquaculture Specialist:

The Aquaculture Specialist will:

1. Have a minimum of a master's degree in aquaculture, fisheries, limnology or any other related areas

2. Have 10+ years of experience in aquaculture production and marketing, including private-sector engagement. Field experience is strongly desired.

3. Have experience of basic research, extension and improved management practices in aquaculture sector in Bangladesh

4. Have significant knowledge and experience in evaluations and/or assessments of projects with similar scopes

5. Have strong analytical skills

6. Have strong oral communications and writing skills in English

The Aquaculture specialist will provide technical assistance in the evaluation of the aquaculture productivity, policy areas, and private-sector engagement interventions of the activity, among others. S/he will actively participate in the desk review of materials and assist the team leader in developing methodologies, work plans and report outlines. S/he will assist the team leader in setting and conducting interviews with relevant stakeholders and actively take part in these. S/he will participate in team meetings, site visits, and draft the report of the evaluation. S/he will also participate in presenting the report to USAID or other stakeholders and be responsible for addressing pertinent comments provided by USAID/Bangladesh or other stakeholders.

Markets System/Business Development Specialist

The Markets System/Business Development Specialist will:

1. Have a minimum of a master's degree in agriculture, aquaculture, fisheries, marketing, business, finance, and economics

2. Have 10+ years of experience in aquaculture business development, extension services, market systems approach, and private-sector engagement

3. Have strong knowledge of aquaculture market segmentation in Bangladesh, including demand and supply situations

4. Have significant knowledge and experience in evaluations and/or assessments of projects with similar scopes

5. Have strong analytical skills

6. Have strong oral communications and writing skills in English

The Markets System/Business Development Specialist will provide technical assistance in the evaluation of the overall market system development, and private-sector engagement interventions of the Activity, among others. S/he will actively participate in the desk review of materials and assist the team leader in developing methodologies, work plans and report outlines. S/he will assist the team leader in setting and conducting interviews with relevant

stakeholders and actively take part in these. S/he will participate in team meetings, site visits, and draft the report of the evaluation. S/he will also participate in presenting the report to USAID or other stakeholders and be responsible for addressing pertinent comments provided by USAID/Bangladesh or other stakeholders.

Nutrition Specialist:

The Nutrition Specialist will:

1. Have a minimum of a master's degree in nutrition science, sociology, agriculture and any other relevant subjects

2. Have 10+ years of experience in nutrition sector, specifically with nutrition sensitive agriculture with demonstrated experience in SBCC design, implementation and assessment

3. Have strong knowledge of nutritional issues, *e.g.,* balanced diets, consumption, hygiene etc.

4. Have significant knowledge and experience in evaluations and/or assessments of projects with similar scopes

5. Have strong analytical skills

6. Have strong oral communications and writing skills in English

The Nutrition Specialist will actively participate in the desk review of materials and assist the team leader in developing methodologies, work plans and report outlines. S/he will assist the team leader in setting and conducting interviews with relevant stakeholders and actively take part in these. S/he will participate in team meetings, site visits, and draft the report of the evaluation. S/he will also participate in presenting the report to USAID or other stakeholders and be responsible for addressing pertinent comments provided by USAID/Bangladesh or other stakeholders.

Deliverables: (*Guidance – In a bullet format, please provide a list of anticipated deliverables (e.g. Design proposal; Draft questionnaires, protocols and other data collection instruments; Updated SOW, if applicable; Draft Report; Mission Presentation; Final Report in electronic version that incorporates comments, statements of difference (if applicable) and appendices; Data sets; etc***))**.

The evaluation team will provide deliverables as per the USAID Bangladesh standard evaluation requirements.

Note: Any firms and individuals who have previously worked with the Aquaculture activity for implementing any interventions and/or for any evaluations/assessments, will not be considered for this evaluation. All possible conflict of interest issues needs to be disclosed.

ANNEX 2: THE AQUACULTURE ACTIVITY THEORY OF CHANGE

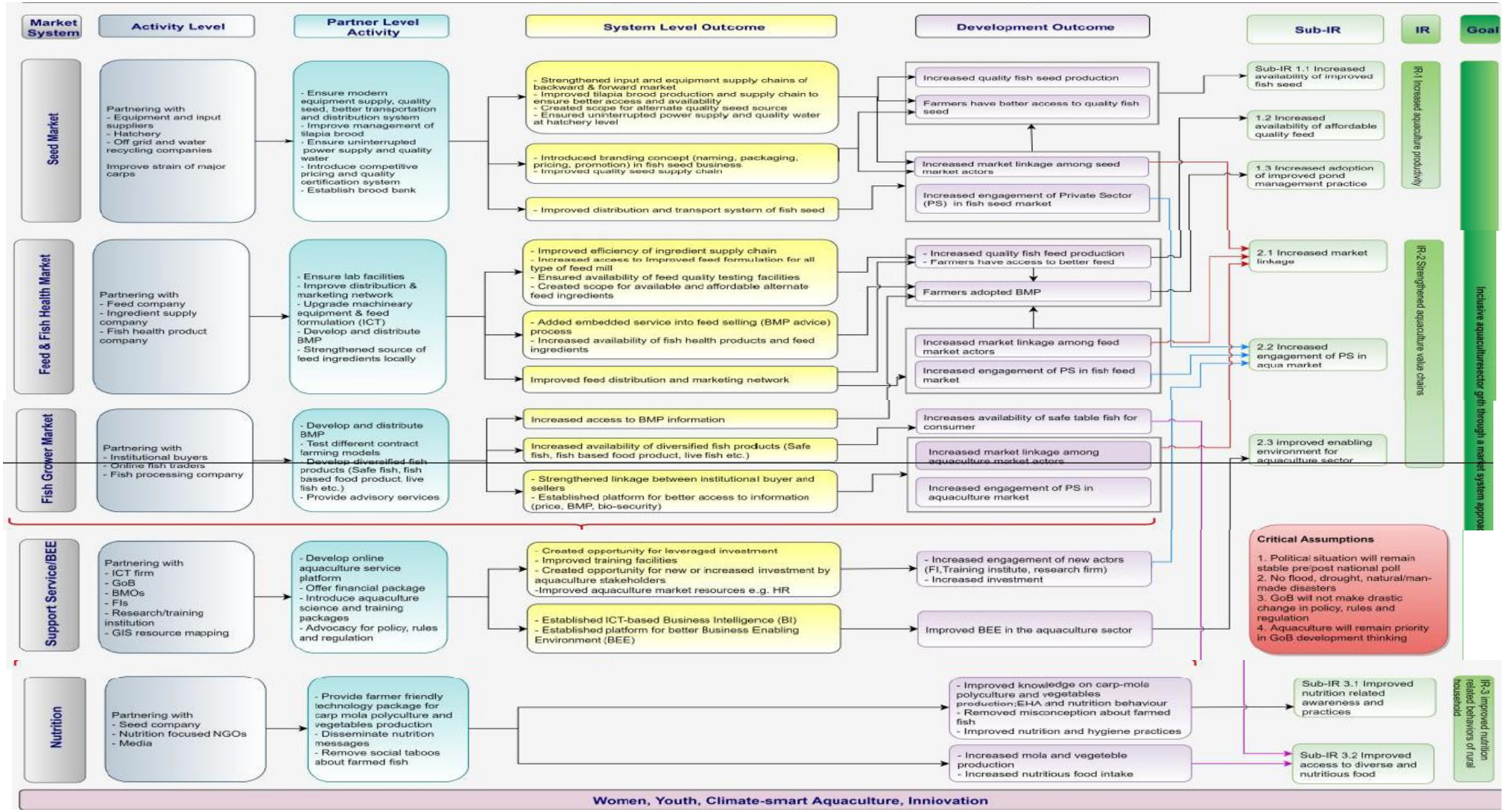


Figure 8. The Aquaculture Activity Theory of Change (TOC)

ANNEX 3: KII AND FGD GUIDES

Focus Group Discussion (FGD)

Instructions

Thank you for taking the time to talk to us today. My name is _____ and my colleague's name is _____. We work for BMEL on behalf of USAID and are conducting an evaluation of the USAID-funded Feed the Future Bangladesh Aquaculture and Nutrition Activity implemented by WorldFish. This Activity has been implemented in 23 districts in Bangladesh over the past five years. As farmers, you are important in the aquaculture sector in this district. You also had some training with one of the Activity's grantees. You have been recommended to us as one of the key stakeholders able to provide expert insights into the aquaculture sector in this district. Your participation is voluntary. I would like to ask you some questions regarding market actors in this district, about fish farming in your area and in your experience, and about the training you were in. Your views will inform our recommendations about future USAID programming in Bangladesh. We encourage you to be as candid as possible. There are no right or wrong answers to the questions. Whatever you say will be helpful to us. It will take about one hour.

I'd like to go over a few things that you discussed with *name of BMEL organizer* when you spoke. What is said in this group discussion stays here. We will not use your name when talking about what we learn. We will not use your name in our report. *Name of notetaker* will take notes without using your names.

Fish Farmers – FGD

Question: Farmers' FGD	**Time (min)**
1. Warm up Question: How important is fish farming to your family?	3
Exercise 1: Mapping linkages We'd like to understand the aquaculture sector that you are part of. We have some names of seed, feed, medicine, financing and other providers. When I say a name, would you please raise your hand if you have bought from or worked with them? We'll start with input providers. This can include financial services. *Facilitator posts the actor "cards" that are active with at least one of the participants on a board.* The next category is buyers. Is there anyone we haven't mentioned that you interact with? *If yes*: Who? What is their role? Facilitator *makes cards with names and roles of other actors and posts them.* Besides the MFI/Banks you mentioned, do you get financing from any others? Could be family and friends or moneylender. Are you still cooperating with *name*? (continuing, discontinued). *Facilitator notes on board/sticky notes responses for each actor.* *For existing relationships ask:* What do you think about the future of the relationship with [*name]?* What about buyers and other output markets? *Repeats exercise above.*	10-12
2. Let's talk about fish seed. Are you able to get what you want from the suppliers you talked about? *Probe:* Amount? Quality? Price? Timeliness? How has the price changed in the last 2 years?	3
3. Let's talk about fish feed. Are you able to get what you want from the suppliers you talked about? *Probe:* Amount? Quality? Price? Timeliness? How has the price changed in the last 2 years? 3a. What feed management practices do you follow? Probe for how often and how much they feed per unit? Do you know what the feed conversion ratio is for the feed you use to get maximum growth?	3

Question: Farmers' FGD	**Time (min)**
4. Have you had any improvements in your fish farming activities in the last 5 years? ● *If yes:* What changed? ● How did *[name of improvement]* change? *Probe:* what other market actors were involved? How satisfied are you with those actors?	5
5. Are you aware of these services: fish buyers purchasing directly from farms, contract growing, improved transportation, aquaculture loans, etc. in the area? ● *If yes:* Did you use those services? ● Was it convenient and cost effective to you? Did the fish buyers provide advice on fish harvesting as well?	3
6. How do you take care of your pond? ● *Probe*: Testing soil? Testing water? Access to testing? Cost of testing? ● *If they are not doing it,* why?	3
If not already discussed, ask: 7. Are you doing carp-mola polyculture and pond dyke vegetable growing? ● Are your getting any support, if so, from whom? 8. Will you continue carp-mola polyculture and pond dyke vegetable production? *If yes*: Why?	5
9. Do women and children consume fish and vegetables daily? ● *Probe for:* What are the health benefits of eating fish and vegetables? ● *Probe for:* How often do the children in your home eat fish? How often do they eat vegetables? How often do the women in your home eat fish? And vegetables? 10. Do you have tippy taps in your households for handwashing? ● When are the most important times during the day to wash your hands with soap?	5
11. Have you seen any change in how women work in aquaculture in last 3 years? *Probe*: how did the change(s) come about? *11a. For women's FGD:* How do you address the challenges of being a woman working in aquaculture? ● *Probe*: What people or organizations do you work with? How do they support your work?	4
12. How have younger people in their teens and twenties participated in aquaculture in recent years? ● How is their participation affecting the sector? *12a. For youth FGD:* How do you address the challenges of being a young person working in aquaculture? ● *Probe*: What people or organizations do you work with? How do they support your work?	4
13. Will you expand or improve your fish farming in future? *Probe*: why/why not?	4

Question: Farmers' FGD	**Time (min)**
14. What more should be done to address new challenges or ones you already have in the aquaculture sector? *Probe:* policies/regulations hindering or helping? Specifically for host communities? To address climate challenges?	5-7

Key Informant Interview (KII)

Instructions

Thank you for taking the time to talk to us today. My name is _____ and my colleague's name is _____. As name of BMEL organizer explained, we work for BMEL on behalf of USAID and are conducting an evaluation of the USAID-funded Feed the Future Bangladesh Aquaculture and Nutrition Activity implemented by WorldFish. This Activity has been implemented in 23 districts in Bangladesh over the past five years. You have been recommended to us as one of the key stakeholders able to provide expert insights into the aquaculture sector in this district. Your participation is voluntary. I would like to ask you some questions about your collaboration with BANA and the aquaculture value chain you are in. Your views will inform our recommendations about future USAID programming in Bangladesh. We encourage you to be as candid as possible. There are no right or wrong answers to the questions. Whatever you say will be helpful to us. It will take about a half hour. We will not use your name when talking about what we learn. We will not use your name in our report. Name of notetaker will take notes. Do you have any questions before we begin?

Hatcheries/ Nurseries – KII

Question: Hatcheries/Nurseries KII	**Time (min)**
1. Why did you collaborate with the Aquaculture and Nutrition Activity? What challenges were you trying to solve through your initiative? 2. Was this effort different from what you'd done before? Please briefly describe the changes.	3
3. How well did it work? How did the collaboration impact your business (PROBE: brood stock development, capacity/ facility/ linkage development, new products/ customers, sales, etc.)?	2-3
If outreach is part of their initiative, then ask: 4. How did you reach or provide services to nurseries/ fingerling traders/farmers? 5. Was this different from what you did before BANA? *Probe*: How well did that work? 5b. Have you seen any change in competition for high quality seed in the last 4 years? PROBE: What is BANA's role in competition to produce/have high-quality seed?	2-3
6. If the informant's initiative was about carp PG or synthetic hormones: Did you experience any challenges handling carp PG or synthetic hormones? 7. Do you prefer one of them? Why?	3
8. What safety measures did you learn from *grantee name/BANA*? 9. How well did they work in your hatchery/nursery? 10. Do you continue to follow them? Why? *Probe:* How often does BANA/grantee check in with you? 10b. Are you aware of any seed quality certification? Probe: what do you think about the government having such a certification?	2-3
11a. How do you deliver seed to buyers? Is there a minimum weight for delivery? What is the price of different seed per unit (what unit)? [*be sure to ask for each species: focus on G3 rohu, GIFT, carp, mola]* 11b. What is the availability of seed in your area? Probe: by species? Any shortfalls where farmers can't get what they need or want? Why is that? 12. Are you familiar with "Macher Gari"? *If yes:* Did you avail the facilities to transport your fry/fingerlings? How accessible is the Macher Gari?	1-2

Question: Hatcheries/Nurseries KII	**Time (min)**
If the informant was involved in G-3 rohu and GIFT tilapia production, then ask: 13. What were the benefits in G-3 rohu and GIFT tilapia production? 14. What were the challenges? 14b. Are there enterprises that can control GIFT gender trait? Probe: What are they?	2
15. How do the nurseries, fry traders and farmers feel about G-3 rohu and GIFT tilapia fish species? ● Are there challenges in availability? *If yes:* Why is that?	2
16. If the informant's initiative included mola breeding: What support did you get from the Aquaculture and Nutrition Activity for production and commercialization of mola seed? *Probes:* What are the benefits of mola breeding? Is it more profitable than carp hatchlings? Did you face any challenges selling mola spawn/ fry? 16b. Does your business have any challenges with power supply? 16c. How about quality water supply? 16d. Have you any recent technology upgrades for your business? If so, what are they? How are they working?	3
17. If the respondent availed loans: How accessible and useful was the aquaculture loan for your business?	2-3
18. How many women work in your business? How has it changed in the last 5 years? 19. How many female fish farmers do you service (or what %)? How has it changed in the last 5 years? *Probe:* What special expertise or skills do they bring? Do they face challenges to participate? How did you help their participation in the sector?	
20. Were there any nutrition focused activities in your initiative?	
21. Did you incorporate any nutrition focused information in your dealings with your customers? *If yes:* How did this initiative affect your business?	2
22. Did you collaborate with other grantees? *If yes:* How? 23. Are you aware of any other initiatives (engaging public and private sector) of the activity? *If yes:* Who?	2
24. Have other Hatcheries/ Nurseries adopted similar initiatives? *Probe*: Why/why not? What type of support do they need?	1-2
25. Are there any regulatory and policy issues that impact your business with aquaculture market actors? 26. Are you aware of the Aquaculture and Nutrition Activity's work on these issues? *If yes:* Please describe.	1-2

Question: Hatcheries/Nurseries KII	Time (min)
27. What are the existing/emerging challenges you faced? What more should be done to address existing/ emerging challenges in the aquaculture market system? *Probe:* specifically for host communities? To address climate challenges?	2

National Fish AMP/ Equipment/ Technology Suppliers – KII

Question: National Fish AMP/ Equipment/ Technology Suppliers KII	Time (min)
1. Why did you collaborate with the BANA activity? What challenges were you trying to solve through your initiative (introducing new products, facility, distribution, promotion/ advisory)? 2. Was this effort different from what you'd done before? 3. How well did it work?	4
4. Have you heard of local service providers? *If yes:* Who are they? Were they helpful to get access to aqua-medicines and other farm essentials? *If yes:* How? 5. What other service providers are you connected with in the backward market? What other service providers are you connected with in the forward market?	1-2
6. Do you participate in any one stop service centers in this area? Is the OSSC helping to extend your business? If yes: How?	2
If informant provided equipment: 7. Is the equipment new in the region for pond fish farming? 8. How confident are the farmers in using the equipment? 9. Is the equipment locally made or imported?	0-2
If the informant was involved in G-3 rohu and GIFT tilapia production, then ask: 10. What were the benefits in G-3 rohu and GIFT tilapia production? 11. What were the challenges? 12. How do the hatchery, nurseries, fry traders and farmers feel about G-3 rohu and GIFT tilapia fish species? *Probe:* Have you observed any challenges?	0-3
13. Did you get support from BANA/WorldFish to measure progress of your initiative and impact on your business and your customers? *If yes:* How did /BANA initiative impact your business and customers?	3
14. How might this initiative impacted your business going forward? *Probe:* continue activities in the initiative; expand business; and why	2

Question: National Fish AMP/ Equipment/ Technology Suppliers KII	Time (min)
15. Are you aware of any other entities working with BANA? *If yes:* Did you collaborate with any of them? *16.If yes:* What were the benefits of collaborating? Challenges? Would you do it again?	3
17. Do you know if any other Fish AMP/ Equipment/ Technology Suppliers adopted similar initiatives? *Probe*: Why/why not? What type of support do they need?	2
18. Are there any regulatory and policy issues that impact your business with aquaculture market actors? 19. Are you aware of the Aquaculture and Nutrition Activity's work on these issues? *If yes:* Please describe. Did you consult with BANA? What happened?	3
20. What are the existing/emerging challenges you faced? What more should be done to address existing/ emerging challenges in the aquaculture market system? *Probe*: specifically for host communities? To address climate challenges?	2
21. Were there any nutrition focused activities in your initiative? (*Probe*: technology support for promoting mola polyculture or pond dyke vegetable production?) 22. Did you incorporate any of that nutrition focused information in your dealings with your customers? 23. What were the benefits of that? Challenges? 24. Are you continuing the nutrition focused activity? If yes: Why so?	3
25. How many women work in your business? How has this changed in the last 5 years? 26. How many female fish farmers do you service (or what %)? How has this changed in the last 5 years? *27. Probe:* What special expertise or skills do they bring? Do they face challenges to participate? How did you help their participation in the sector?	1

Local Fish Feed Suppliers (Companies/ Dealers) – KII

Question: Fish Feed Suppliers KII	Time (min)
1. Why did you collaborate with the Aquaculture and Nutrition activity? 2. Was this effort different from what you'd done before? 3. How well did it work?	3
4. If the informant's involved in genetically improved (G3 rohu) fish: What were the benefits with G-3 rohu and GIFT tilapia fish species? What were the challenges?	0-3

Question: Fish Feed Suppliers KII	Time (min)
5. How many female fish farmers you served (or what %)? How has it changed in the last 5 years? *6.Probe:* Do they face challenges to participate? How did you help their participation in the sector?	2
7. Do you incorporate any nutrition focused information in your dealings with your customers? 8. What were the benefits of that? What were the challenges? 9. Are you continuing the nutrition focused activity?	3
10. How does this initiative affect your business going forward? *Probe:* continue activities in the initiative; expand business; and why	3
11. Are you aware of any other entities working with BANA? *If yes:* Did you collaborate with any of them? *12. If yes:* What were the benefits of collaborating? Challenges? Would you do it again? 13. Who do you compete with for customers as a feed supplier? 14. How would you rate the quality of your feed (the feed you sell) against your closest competitor? 15a. What are you doing to provide good customer service? 15b. What is the price of your feed (per unit)?	2
16. Who are your customers? (Probe: hatchery, Nursery, dealers, farmers) 17. From whom do you buy product? (Probe: Company/dealer/depo) 18. How are you doing business with them? PROBE: credit, 19. Do you have access to adequate feed supplies for your customers? Discuss 20. What is your view of your customers (farmers) feed management practices? Discuss	1
21. Are there any regulatory and policy issues that impact your business with aquaculture market actors?	2
22. What more should be done to address existing/ emerging challenges in the fish feed market? *Probe*: specifically for host communities? To address climate challenges?	3

Financial Services Providers (Banks/ MFIs) – KII

Question: Financial Services Providers KII	Time (min)
1. Why did you collaborate with the Aquaculture and Nutrition Activity? 2. Was this effort different from what you'd done before? 3. How well did it work?	3

Question: Financial Services Providers KII	Time (min)
4. How does this initiative affect your business going forward? *Probe:* continue activities in the initiative; expand business; and why	3
5. Are you aware of any other entities working with BANA? *If yes:* Did you collaborate with any of them? *6. If yes:* What were the benefits of collaborating? Challenges? Would you do it again?	1
7. Do you know whether other financial institutions adopted similar initiatives? *Probe*: Why/why not?	1
8. Are there any regulatory and policy issues that impact your business with aquaculture market actors? *If yes:* Please describe.	2
9. What more should be done to address existing/ emerging challenges in the aquaculture market actors? *Probe*: specifically for host communities? To address climate challenges?	3
10. About how many women working in aquaculture sector have applied for finance? 11. How has this changed in the last 5 years? 12. Do they face particular challenges to get loans? 13. How did you help their participation in the sector?	3
14. Did you incorporate any nutrition focused information in your dealings with your customers? 15. What were the challenges of that? 16. Are you continuing the activity? *If yes*: Why so?	1-2

Fish Buyers (Online Traders/ Inst. Buyers/ Processors) – KII

Question: Fish Buyers KII	Time (min)
1. Why did you collaborate with the Aquaculture and Nutrition Activity? 2. Was this effort different from what you'd done before? 3. How well did it work?	4
If the informant's initiative included genetically improved fish: 4. What were the benefits with G-3 rohu and GIFT tilapia fish species? 5. What were the challenges?	0-3

Question: Fish Buyers KII	Time (min)
6. How does this initiative affect your business going forward? *Probe:* continue activities in the initiative; expand business; and why	3
7. How many female fish farmers do you serve (or what %)? How has this changed in the last 5 years? *8.* Do they face challenges to participate? How did you help their participation in the sector?	1-3
9. Was there any nutrition focused activity in your initiative (prob: buying of mola)? *10. If yes:* What were those?	3
11. Are you aware of any other buyer working with BANA? *If yes:* Did you collaborate with any of them? *12. If yes:* What were the benefits of collaborating? Challenges? Would you do it again?	2
13.What type of support do you need? 14. Who are your customers? (Probe: paikar, retailer, processor) 15. From whom do you buy your product? (Probe: farmer, paiker, ice supplier) 16. How are you doing your business with them?	1
17. Are there any regulatory and policy issues that impact your business with aquaculture market actors?	2
18. What more should be done to address existing/ emerging challenges in the aquaculture actors? *Probe*: specifically for host communities? To address climate challenges?	3

Nutrition Actors (Companies/ NGOs/ Media, Nutrition Ambassador) KII

Question: Nutrition Actors KII	Time (min)
1. Why did you collaborate with the Aquaculture and Nutrition Activity? What nutrition focused interventions were you involved with? 2. What nutrition related challenges/gaps your initiative addressed? 3. Who were the target groups for your intervention?	5
4. What nutrition and WASH related practices changed due to your initiative? *Probe:* for who?	3
5. Did you collaborate with other partners to implement the nutrition focused activities? *If yes:* What partners? For which activities did you collaborate?	2

Question: Nutrition Actors KII	Time (min)
6. Did you have any activity related to misconception on farmed fish? *If yes:* What are the activities? Please briefly describe (*prob*: who were the target groups, how the activity was performed?) 7. How effective were they?	1-3
8. Have you replicated similar activities in your other projects? how did your initiative impact people?	1
9. How many women work in your initiative? How did it change in the last 5 years? 10. How many female fish farmers/women did you serve (or what %)? How did it change in the last 5 years? *11.* Do they face challenges to participate? How did you help their participation in the sector?	4
12. Are you continuing the initiative? How likely are you to continue the nutrition focused activities after BANA ends?	2
13. What more should be done to address existing/ emerging challenges of nutrition focused aquaculture in Bangladesh?	3

Local Fish AMP/ Equipment/ Technology Suppliers KII

Question: Local Fish AMP/ Equipment/Technology Suppliers KII	Time (min)
1. Why did you collaborate with the BANA activity? 2. Was this effort different from what you'd done before?	4
3. Who are the local service providers supporting fish farmers in your area? Specifically, aqua-medicines, equipment, technology, and knowledges on how to use them. Were they helpful and how? 4. Who are the people you provide service to? (Prob: hatchery, Nursery, buyer, 5. From whom you get service from? (Pob: DOF, NGO, company)	1-2
6. Do you participate in any one stop service centers in this area? Is the OSSC helping to extend your business? *If yes:* How?	2
If informant provided equipment: 7. Is the equipment new in the region for pond fish farming? 8. How confident are the farmers in using the equipment?	0-2
If the informant was involved in G-3 rohu and GIFT tilapia production, then ask: 9. What were the benefits in G-3 rohu and GIFT tilapia production? 10. What were the challenges? 11. How do the hatchery, nurseries, fry traders and farmers feel about G-3 rohu and GIFT tilapia fish species? *Probe:* Have you observed any challenges?	0-3

Question: Local Fish AMP/ Equipment/Technology Suppliers KII	Time (min)
12. How this initiative has impacted your business going forward? *Probe:* continue activities in the initiative; expand business; and why?	2
13. Are you aware of any other entities working with BANA? *If yes:* Did you collaborate with any of them? *14. If yes:* What were the benefits of collaborating? Challenges? Would you do it again?	3
15. Are there any regulatory and policy issues that impact your business with aquaculture market actors?	3
16. What are the existing/emerging challenges you faced? What more should be done to address existing/ emerging challenges in your business? *Probe*: specifically for host communities? To address climate challenges?	2
17. Is there any nutrition focused activities in your initiative? (*Probe*: technology support for promoting carp-mola polyculture or pond dyke vegetable production?) 18. Do you incorporate any of that nutrition focused information in your dealings with your customers? 19. Are you continuing the nutrition focused activity?	3
20. How many female fish farmers do you serve (or what %)? How has this changed in the last 5 years? *21*. Do they face challenges to participate? How did you help their participation in the sector?	1

Department of Fisheries KII

Questions for DOF
1.What do you know about BANA activities in your area?
2.What do you know about G-3 rohu and GIFT tilapia production? 2a. What were the benefits in G-3 rohu and GIFT tilapia production? 2b. What were the challenges?
3. What is the present status of carp seed availability in your area? 3a. What about quality of the seed? 3b. What is the price of carp seed in your area?
4. What is the present status of fish feed availability, quality and price in your area? 4a. What about quality of feed? 4b. What is the price of feed in your area?
5. What are the existing/ emerging challenges in the aquaculture development? 5a. To address climate challenges?

Value Chain Market Actors Mentioned by Informants/Farmers

Questions for value chain actors (Snowball KIIs)
1. What is your role in the aquaculture sector in this area?
2. How do you go about it? (What is your business model?)
3. What is your service area? Or where do you work? 4. Do you advise your customers on fish farming techniques? Or do you have water testing kit to test pond water quality?

Additional Questions for some Local IP Contacts (For Additional KIIs)

Question: Local Fish AMP/ Equipment/Technology Suppliers KII
1. Is your company cooperating with other feed mills to import feed ingredients? Why/why not?
2. How has your company been doing with sourcing ingredients locally for feed?
3a. What companies is [name of the IP] working with to formulate feed? 3b. To test it? 3c. Have you a least cost feed formulation? What is the cost of it (per unit)?
4. Has your company upgraded equipment for the purpose of formulating feed? 5. What about for feed production?

Table 5-A. Preliminary Discussions with USAID and WorldFish

GD #	Date	District	Gender	Organization	*Name*	Role/Position
1	2/9/2023	Remote	Male	WorldFish	*PII*	BANA Chief of Party
	2/9/2023	Remote	Male	WorldFish	*PII*	BANA Senior MEL Specialist
	2/9/2023	Remote	Female	WorldFish	*PII*	BANA Finance & Grants Manager
	2/9/2023	Remote	Male	WorldFish	*PII*	Sr. Program Manager
	2/9/2023	Remote	Male	WorldFish	*PII*	DcOP
2	2/14/2023	Remote	Female	USAID Bangladesh	*PII*	Program Management Specialist, Economic Growth Office
	2/14/2023	Remote	Male	USAID Bangladesh	*PII*	Former AOR
	2/14/2023	Remote	Male	USAID Bangladesh	*PII*	Former Alternate AOR
3	2/16/2023	Remote	Male	USAID Bangladesh	*PII*	AOR
	2/16/2023	Remote	Male	USAID Bangladesh	*PII*	Alternate AOR

Table 5-B. KIIs with WorldFish

KII #	Date	Meeting Platform	Gender	Organization	Role	Name and Designation
1	20-Feb-23	Virtual	Male	WorldFish	Activity	*PII*
2	22-Feb-23	Virtual	Male	WorldFish	Activity	*PII*
3	23-Feb-23	Virtual	Male	WorldFish	Activity	*PII*
4	26-Feb-23	Virtual	Male	WorldFish	Activity	*PII*
5	1-Mar-23	In-person	Both	WorldFish	Activity	*PII*
6	5-Mar-23	In person	Male	WorldFish	Activity	*PII*
7	30-Mar-23	Virtual	Male	WorldFish	Activity	*PII*
8	16-Apr-23	In-person	Male	WorldFish	Activity	*PII*

Table 5-C. KII with IPs and VC Actors

KII #	Date	Meeting Platform	District	Gender	Organization	Role
1	1-Mar-23	Virtual	National	Male	City Bank	IP
2	3-Mar-23	Virtual	National	Male	Parmeeda	IP
3	5-Mar-23	Virtual	National	-	Bank Asia	IP
4	5-Mar-23	Virtual	National	Male	GORAI	IP
5	6-Mar-23	Virtual	National	Male	Petrochem Bangladesh Ltd.	IP
6	6-Mar-23	Virtual	National	Female	Shushilan	IP
7	6-Mar-23	Virtual	National	Male	ACI Limited	IP
8	7-Mar-23	Virtual	National	Male	Spectra Hexa Feeds Ltd	IP
9	7-Mar-23	Virtual	National	Male	Agro Industrial Ltd (AIT)	IP
10	7-Mar-23	Virtual	National	Male	MarGen Limited	IP
11	7-Mar-23	Virtual	National	Male	Classic Melamine Industries Ltd	IP
12	7-Mar-23	Virtual	National	Male	Coast Trust	IP
13	12-Mar-23	In Person	National	Male	Modhumoti Motsho Utpadon Kendro	IP
14	14-Mar-23	In Person	National	Male	Organization for Development of Society & Economy (ODSE)	IP
15	17-Mar-23	Virtual	National	Male	CODEC	IP
16	18-Mar-23	Virtual	National	Male	M-World	IP
17	21-Mar-23	Virtual	National	Male	Aftab Feed Products Ltd	IP
18	1-Mar-23	Virtual	National	Male	Mukti	IP
19	8-Apr-23	Virtual	National	Male	Matrix Business Development Ltd	IP
20	8-Apr-23	Virtual	National	Male	Alim industries Ltd.	IP
21	8-Apr-23	Virtual	National	Male	Green Dale	IP
22	8-Apr-23	Virtual	National	Male	Imexpro (BD)	IP
23	19-Mar-23	Online	National	Male	Chittagong Meridian Agro Industries Ltd.	IP
24	8-Apr-23	Virtual	National	Male	KNB (former employee)	IP
25	8-Mar-23	In Person	Faridpur	Male	-	Dealer, Fish Feed Supplier

KII #	Date	Meeting Platform	District	Gender	Organization	Role
26	8-Mar-23	In Person	Faridpur	Male	-	Dealer, Fish Feed Supplier
27	8-Mar-23	In Person	Faridpur	Male	-	Dealer, Fish Feed Supplier
28	8-Mar-23	In Person	Faridpur	Male	-	Local service provider
29	8-Mar-23	In Person	Faridpur	Male	-	IP
30	8-Mar-23	In Person	Faridpur	Female	-	Fish AMP/Equipment/Technology Suppliers
31	8-Mar-23	In Person	Faridpur	Female	-	Fish AMP/Equipment/Technology Suppliers
32	9-Mar-23	In Person	Faridpur	Female	-	Fish AMP/Equipment/Technology Suppliers
33	9-Mar-23	In Person	Faridpur	Female	-	Fish AMP/Equipment/Technology Suppliers
34	9-Mar-23	In Person	Faridpur	Male	DOF	GOB Extension
35	9-Mar-23	In Person	Faridpur	Male	Noboganga Motsho Arot	Fish buyer
36	9-Mar-23	In Person	Faridpur	Male	-	Fish Trader & Retailer
37	9-Mar-23	In Person	Faridpur	Male	-	Fingerling Seller
38	9-Mar-23	In Person	Faridpur	Male	-	Commission Agent
39	11-Mar-23	In Person	Faridpur	Male	Faridpur Feed Association	Association leader
40	11-Mar-23	Virtual	Faridpur	Male	-	Local Buyers
41	11-Mar-23	In Person	Faridpur	Female	Commission agent	Arotder (Wholesaler)
42	13-Mar-23	In Person	Satkhira	Male	-	Aqua machineries
43	13-Mar-23	In Person	Satkhira	Male	-	Sales Point (Feed and medicines)
44	13-Mar-23	In Person	Satkhira	Male	-	Dealer
45	13-Mar-23	In Person	Satkhira	Male	-	Dealer
46	13-Mar-23	In Person	Satkhira	Male	-	Commission Agent
47	13-Mar-23	In Person	Satkhira	Male	-	Fingerling Seller
48	14-Mar-23	In Person	Satkhira	Female	-	Women Micro Franchise
49	14-Mar-23	In Person	Satkhira	Male	-	Seller/Dealer

KII #	Date	Meeting Platform	District	Gender	Organization	Role
50	14-Mar-23	In Person	Satkhira	Male	-	Trader
51	14-Mar-23	In Person	Satkhira	Male	-	Feed trader
52	15-Mar-23	In Person	Satkhira	Male	Aftab Feed Products Ltd.	IP
53	15-Mar-23	In Person	Satkhira	Male	Spectra Hexa Feeds Ltd.	IP
54	15-Mar-23	In Person	Satkhira	Male	Imexpro (BD)	IP
55	15-Mar-23	In Person	Satkhira	Male	Bank Asia	IP
56	15-Mar-23	In Person	Satkhira	Male	-	Sales Point (Medicine)
57	15-Mar-23	In Person	Satkhira	Male	Shushilan	IP
58	16-Mar-23	In Person	Satkhira	Male	-	Buyer
59	16-Mar-23	In Person	Satkhira	Male	-	IP local contact
60	16-Mar-23	In Person	Satkhira	Male	Bithi Scientific Hatchery and Fisheries	Hatchery
61	16-Mar-23	In Person	Satkhira	Male	Petrochem (Bangladesh) Limited	IP
62	18-Mar-23	In Person	Satkhira	Female	-	Women Micro-Franchise
63	18-Mar-23	In Person	Satkhira	Male	-	Sales point
64	18-Mar-23	In Person	Satkhira	Male	DOF	GoB Extension
65	19-Mar-23	In Person	Satkhira	Male	-	Sub dealer (Sales point)
66	19-Mar-23	In Person	Satkhira	Male	-	Sub dealer (Sales point)
67	19-Mar-23	In Person	Satkhira	Male	Upazila Level DOF	GOB Extension
68	20-Mar-23	In Person	Satkhira	Male	Upazila Level DOF	GOB Extension
69	20-Mar-23	In Person	Satkhira	Male	-	Fish Farmer
70	20-Mar-23	In Person	Satkhira	Male	-	Fish Farmer
71	13-Mar-23	In Person	Cox Bazar	Male	Cox's Bazar Shop	IP
72	13-Mar-23	In Person	Cox Bazar	Male	M/S Shah Amanth Traders	IP
73	14-Mar-23	In Person	Cox Bazar	Male	Aftab Feed Products LTD	IP
74	14-Mar-23	In Person	Cox Bazar	Male	-	Fish meal producer
75	15-Mar-23	In Person	Cox Bazar	Male	-	Boat operator cum seller
76	15-Mar-23	In Person	Cox Bazar	Male	DOF	GOB Extension

KII #	Date	Meeting Platform	District	Gender	Organization	Role
77	16-Mar-23	In Person	Cox Bazar	Male	Prottyashi	IP
78	16-Mar-23	In Person	Cox Bazar	Male	-	Seed nurturer
79	18-Mar-23	In Person	Cox Bazar	Male	-	Dealer
80	18-Mar-23	In Person	Cox Bazar	Male	Bank Asia	IP
81	18-Mar-23	In Person	Cox Bazar	Male	-	LSP/Mach Bandhu
82	19-Mar-23	In Person	Cox Bazar	Female	-	IP (Nutrition Ambassador)
83	19-Mar-23	In Person	Cox Bazar	Male	WorldFish, BANA	IP
84	20-Mar-23	In Person	Cox Bazar	Male	Ma Mostsho Hatchery	Hatchery
85	20-Mar-23	In Person	Cox Bazar	Male	-	Large farmer
86	21-Mar-23	In Person	Cox Bazar	Male	Niribili Hatchery	Hatchery
87	21-Mar-23	In Person	Cox Bazar	Male	Mukti	IP
88	5-Apr-23	Online	Cox Bazar	Male	-	Youth enterprise
89	13-Mar-23	In Person	Barishal	Male	-	Fish Meat Seller
90	13-Mar-23	In Person	Barishal	Male	-	Nursery
91	14-Mar-23	In Person	Barishal	Male	-	Dealer
92	14-Mar-23	In Person	Barishal	Male	Bank Asia	IP
93	15-Mar-23	In Person	Barishal	Male	-	Fish Feed Seller
94	15-Mar-23	In Person	Barishal	Male	-	Feed supplier
95	16-Mar-23	In Person	Barishal	Male	DOF	GOB Extension
96	16-Mar-23	In Person	Barishal	Male	-	Feed supplier
97	17-Mar-23	In Person	Barishal	Male	Shushilan	IP
98	18-Mar-23	In Person	Barishal	Male	-	Trader
99	18-Mar-23	In Person	Barishal	Male	-	Trader
100	18-Mar-23	In Person	Barishal	Female	Bank Asia	IP
101	18-Mar-23	In Person	Barishal	Male	-	Feed supplier
102	19-Mar-23	In Person	Barishal	Male	Petrochem	IP
103	19-Mar-23	In Person	Barishal	Male	-	Large farmer
104	20-Mar-23	In Person	Barishal	Male	-	Large farmer

KII #	Date	Meeting Platform	District	Gender	Organization	Role
105	20-Mar-23	In Person	Barishal	Male	-	Larger Farmer
106	14-Mar-23	In Person	Barishal	Male	Rabeya Mathsya Uthpaden Kendra	IP

Table 5-D. Focus Group Discussions

FGD #	Date	District	Sex	Type of FGD/Farmer	Number of Participant
1	9-Mar-23	Faridpur	Women	Adult Farmers	8
2	9-Mar-23	Faridpur	Women	Youth Farmers	8
3	9-Mar-23	Faridpur	Male	Adult Farmers	8
4	9-Mar-23	Faridpur	Male	Youth Farmers	7
5	13-Mar-23	Satkhira	Women	Adult Farmers	8
6	14-Mar-23	Satkhira	Women	Youth Farmers	8
7	14-Mar-23	Satkhira	Male	Adult Farmers	8
8	13-Mar-23	Satkhira	Male	Youth Processors	8
9	15-Mar-23	Cox's Bazar	Women	Adult Farmers	8
10	16-Mar-23	Cox's Bazar	Women	Youth Farmers	8
11	14-Mar-23	Cox's Bazar	Male	Adult Farmers	8
12	18-Mar-23	Cox's Bazar	Male	Youth Farmers	7
13	13-Mar-23	Barisal	Women	Adult Farmers	8
14	15-Mar-23	Barisal	Women	Youth Farmers	8
15	18-Mar-23	Barisal	Male	Adult Farmers	8
16	16-Mar-23	Barisal	Male	Youth Farmers	8
TOTAL					**126**

ANNEX 5: BARISHAL CASE STUDY

Barishal Case Study Summary

Several grantees were active in Barishal. The evaluation assessed activities of seven grantees:

Aftab Feed	Promotion of quality fish feed and advisory services for farmers through dealers, local service providers (LSP) and One Stop Service Centers (OSSC). *LSP and OSSC are new business models.*
Spectra Hexa Mega Feed	Promotion of quality fish feed and advisory services through dealers and capacity building of farmers through Mega Feed Schools (MFS). *MFS is new for the grantee.*
Petrochem	Promotion of quality aqua medicines and advisory services offered through dealers and OSSC. *OSSC is a new model for Petrochem.*
Bank Asia Limited	Access to credit, financial literacy and fish farming training to farmers. *Reaching out to fish farmers through agent banking is new for Bank Asia.*
CODEC	Delivery of direct nutrition and WASH messages, promotion of carp-mole polyculture and dike vegetable gardening.
Shushilan	Delivery of direct nutrition and WASH messages, promotion of carp-mole polyculture and promotion of ready to eat (RTE) and ready to cook (RTC) fish products. *Promotion of RTC/RTE is new for Shushilan.*
Rabeya Matsho Utpadon Kendra	Promotion of hatchery biosecurity, best management practices improved carp seed production and capacity building of nursery operators and farmers on best management practices. *Hatchery biosecurity was new for the grantee.*

- 1 sales executive, 2 dealers and 8 adult male farmers trained by Aftab Feed
- 8 adult female farmers trained by CODEC
- 8 young women trained by Rabeya Matsho Utpadon Kendra
- 8 young men trained by Bank Asia
- 4 large farmers
- 1 Petrochem marketing executive, 1Petrochem dealer
- 1 DOF officer
- 1 Bank Asia local representative, 1 Bank Asia local agent
- 1 representative from Shushilan
- 4 additional actors mentioned during FGDs: nursery operator, feed and AMP sellers

The Evaluation Team (ET) interviewed market actors and farmers related to the grantees. ET spoke with 49 people:

Findings

The case study suggests that due to its geo-ecological position, Barishal is not a big grower of carps. The farmers mentioned that access to credit and information/knowledge on fish farming are two major constraints for fish farming. Access to seed is not a big problem, but there is concern about the quality of seeds obtained from fingerling traders and seeds brought from neighboring districts. Large national companies as well as local feed companies are selling their products. There is availability of quality feeds, but the price has increased by up to 50 percent over the last two years due to the high price of raw materials. Farmers sometimes prefer homemade feed over commercially available feed due to its high cost. There is also concern about the quality of feed produced by some local companies. The grantees provided training on fish farming techniques and best management practices which the farmers appreciate. The training helped them perform their farm activities better. AMP, technology and advisory services are available to farmers through grantee's dealers and sub-dealers. All the grantees are appreciative of BANA collaboration as it has given them publicity and their business has grown by multiple folds. The financial institution gave credits, but the amount and timing appeared inadequate to the larger farmers. Women's participation in fish farming has increased due to the BANA intervention. Nevertheless, women are primarily involved in family pond management helping their husbands or the male members of the family. Youth are interested in aquaculture as a source of income to support their education and families. However, except for engaging youth through training, BANA did not have any activities for young people. BANA's nutrition intervention resulted in awareness of the nutritional importance of mola fish and vegetables. Carp-mola polyculture and household consumption of mola fish has increased. In Barishal, there is no policy or regulatory issues hindering the aquaculture sectors.

1. Productivity (IR1)

Barisal is a south-central district of Bangladesh and lies in the delta of the Padma (Ganges) and Jamuna (Brahmaputra) rivers. Various types of fish are found in Barishal from pond culture and also from river catch. According to female fish farmers, many of them became solvent by farming fish in Barishal. The most commonly cultured fish in Barishal include various types of carp such as rohu, katla, kalibaush, mrigel, grass carp, silver carp, puti, pangas and tilapia. According to a large farmer in Barishal, tilapia and prangus have the highest demands in the market and are available. However, according to the Department of Fisheries (DOF) official, Barishal is not a big grower of carp, due to the unavailability of good quality seeds. Instead, the Jessore, Mymenshingh and Bogra belts are better for carp farming.

Two types of fish farmers are seen in Barishal as in other parts of the country. This includes large farmers who culture fish as their main earning source, and smallholder farmers who culture fish seasonally mostly in their own ponds or ponds shared by multiple farmers. Some of the large farmers follow a four-month cycle and harvest fish three times a year. Some large farmers follow a three-year cycle from fry/fingerling to table size fish. They harvest fish multiple times, but timing varies depending on the size of the fish. Seasonal farmers culture fish during the wet season in the same land after harvesting crops like paddy, pulses, wheat and so forth. From key informants and also from ET observation, it was revealed that rural households in Barishal usually have a homestead pond. There they culture fish for household consumption and for selling in the market. Also common is leasing ponds for multiple years by oneself or a group of farmers.

According to the DOF representative and a group of small holder fish farmers, Barishal is not good for fish farming due to its geo-ecological position. A literature review describes several rivers flowing across Barisal including the Kirtankhola, Arial Khan, Khoyrabad, Kalijira and Sandha Rivers. This region also represents a tidal wetland with areas that are affected by daily tidal fluctuations and monsoon tide. According to small holder fish farmers, during tidal surges fish from the pond drain out.

Study respondents mentioned the following factors affecting Barishal pond fish culture:

i. Knowledge and awareness on proper fish farming techniques
ii. Access to inputs like quality seed and feed
iii. Access to finance

1.1. Seed

Access to good quality seed is limited in Barishal as there are not many big hatcheries and nurseries available according to a DOF official. Seed produced in Barishal is limited and cannot meet the demand. However, according to him, seed quality from government owned hatcheries is good compared to the private sector hatcheries. Some farmers reported buying seed from the government hatchery. The farmers source fry/fingerling either from neighboring districts like Jessore, kushtia, Satkhira and Khulna or procure locally from fingerling traders (*patilwalas*). During the fish farming season, seed is sold from hatcheries at BDT 8000/kg while in the off season, the price drops to BDT 3000/kg. Some large farmers possess nursery ponds and produce fry/fingerling for their own use and also sell it to other farmers and fingerling traders. There is concern about the quality of fry/fingerling if not procured from a trusted source. Nevertheless, the farmers mentioned that they can produce quality fry/fingerling by observing physical characteristics like bright, shiny and slimy skin, no external sign of infection like redness or spots, and fast and anti-current movement in water.

> *"We know the technique of identifying good quality fingerlings. We need to rotate the water and keep an eye on the fish…….. The good quality fish swims in the opposite direction of the current." - Fish Farmer FGD, March 18*

BANA collaborated with 'Rabeya Matshya Uthpadan Kendra' (hereafter referred as Rabeya Hatchery) in Barishal to promote quality carp seed production by ensuring hatchery biosecurity, best hatchery management practices and quality brood management. The Rabeye Hatchery benefited from the collaboration with BANA as they trained them on proper hatchery management and hatchery biosecurity. *"We received training on hatchery biosecurity and fish farming, and financial support from BANA to bio-secure our hatchery. ….Now we put in proper fencing/wall around the hatchery, we maintain proper hygiene while going inside like disinfecting hand and feet, we dispose the dead fish in an isolated and dedicated place…. Now fish have better immunity, and disease outbreak is less."* The female youth FGD respondents mentioned that the quality of the carp seed from Rabeya Hatchery is good, and they prefer to procure fry/fingerling from Rabeya Hatchery. Rabeya Hatchery did capacity building of two other hatcheries named 'Harun Matshya Hatchery' and 'Matshya Bangla Hatchery' on brood management and commercial carp seed production. They also involved officials from DOF in hatchery training.

G-3 rohu was not well-known to most of the farmers. The DOF official mentioned that G-3 is a superior variant as they grow quickly but need to be kept in separate pond to avoid cross-breeding. He also confirmed that G-3 is not commonly cultured in Barishal. The DOF received some G-3 brood from World Fish, but due to operational limitations like the absence of separate ponds, the broods were kept with the local variety and cross-bred. Petrochem mentioned that World Fish provided training on G-3 to their enlisted farmers. A few farmers started culturing G-3 but eventually stopped as it required a separate pond and management system. Monosex/GIFT tilapia cultivation is common. Farmers expressed dissatisfaction about seed quality as sometimes the seeds are sold as monosex yet the fish multiply.

Findings: *There was concern about the quality of seed among farmers. BANA worked with hatcheries to improve quality carp seed production by ensuring hatchery biosecurity and best hatchery management practices. Non-BANA hatcheries and farmers were linked with BANA grantee hatcheries for obtaining quality seed and hatchery management capacity building. BANA did provide training on G-3 rohu to selected farmers, but the culture of G-3 was not sustained.*

1.2. Feed

Farmers use two types of feeds: commercially available feed and homemade feed. Smallholder farmers prefer commercial feed, but when it is no longer affordable, they rely on homemade feed. Homemade

feed is made of mustard cake, husk, cooked rice, vegetable waste, salt, cow litter, paddy cheata *(unfilled grain)*, molasses, baking soda among other fillers. After decomposing, the mixture is used as fish feed. One of the large farmers mentioned that the homemade feed makes the fish tastier than the commercial feed fed fish. Several national company feeds are available in the market through dealers, sub-dealers and retailers including Aftab feed, Spectra Hexa Mega Feed, ACI, Nourish, Quality, Kazi, Aman, SMS and ACMI. Of these Aftab, Spectra Hexa Mega, and ACI are BANA grantees. The DOF official mentioned that feed primarily comes from outside of this zone which is why the price is high. The feed quality of the national companies is good as confirmed by the farmers and the DOF official. Feed price varies by company and prices have increased over the years. There are different types of feeds for different types of fish. The female farmers mentioned that they pay BDT 20/kg more than before. The Aftab feed company representative stated that their feed prices have increased by 40-50 percent depending on the type of feed. The farmers mentioned that for mixed fish feed of Aftab, they pay BDT 55/kg which is BDT 48 more than what they paid six to seven months before. For pangus/tilapia feed price is even higher. One of the large farmers mentioned that in a pond of 30,000 pieces of pangus, feed of BDT 30,00,000 is required in three-four months to make the fish weigh 1.5 kg each. Aftab feed prices range from BDT 50-70/kg and for Megafeed the price ranges from BDT 63-70/kg.

> *"Many different varieties of feed are available in the market. Some of them are good but some do not match the nutrition composition mentioned on the pack. The farmers are deceived by buying the low-quality feed. There should be some routine monitoring from the government fisheries department to check the quality of feed on a regular basis." - Aftab Feed Dealer*

The respondents stated market availability of feed was not an issue. However, a dealer mentioned that a few months earlier there was a shortfall of Aftab feed. It took nearly 10 days after placing an order to obtain the products. Nevertheless, there is concern about feed quality as different varieties of feeds are available in the market. Farmers mentioned that with some feed varieties fish do not grow at the same rate. One of the dealers expressed concern that for some feed produced by local companies and available in the market *(name was not mentioned)*, the nutrient composition does not match with what is mentioned on the pack. This results in the farmer being deceived and actually buying low-quality feed. He expressed the importance of the government fisheries department regularly monitoring to check feed inputs and quality. The DOF official did mention that their department does routine feed quality monitoring on a sample basis. However, their testing only checks for key ingredients like protein. Detailed nutrient composition analysis is not feasible on a routine basis. BANA started working with a local feed mill to promote local quality feed production in the Barishal region. However, at the time of this assessment, the activity had just started, and the grantee could not be included in the evaluation.

Findings: Farmers use two feed types– commercially available and homemade feeds. Commercially available feeds by national feed companies are expensive but are of good quality. Feed price varies by company and prices have increased up to 40-50 percent over last two years. BANA primarily worked with national feed companies to reach out to farmers through their dealer networks. Market availability of feed was not an issue, however, there is concern about the quality of feed produced by local companies. BANA has started working with a local feed company to promote quality feed production. However, this grantee was not included in this evaluation as the activity had just started at the time of the assessment.

1.3. **Other inputs** e.g., training, AMP, equipment, technologies, advisory services, credit

All the respondents expressed appreciation to the training they received from BANA grantees[41]:

- Aftab Feed (fish farming, feed management, dike vegetable gardening, OSSC[42])
- Petrochem (fish farming, OSSC). Petrochem developed two booklets – one on fish farming and dike vegetable gardening and the second on fish diseases. The booklets were shared with the farmers during training.

[41] The evaluation team could not interview representative of Parmeeda worked in Barishal due to unavoidable situation.
[42] OSSC: One Stop Service Centre

- Spectra Hexa Feed (fish farming, feed management)
- Rabeya Motsho Utpadon Kendra (fish farming, brood management, hatchery biosecurity nutrition)
- Bank Asia (fish farming, financial literacy)
- CODEC (fish farming, nutrition, WASH, dike vegetable gardening, hand washing station, tippy taps)
- Shushilan (fish farming, nutrition, WASH, dike vegetable gardening, hand washing station, tippy taps, RTE[43] products)

"I learnt a lot of important points of fish farming like how to prepare the pond for fish farming, when and why to apply lime, how to test water with kit, what to apply to improve water quality, what to do if fish dies (what medicines to apply). They also provided water quality testing kit free of cost." - Spectra Hexa Mega Feed Dealer

Rabeya Hatchery reached out to 38 fish seed agents/lead farmers and 1015 smallholder farmers through printed materials like posters, festoons and leaflets offering training. Aftab Feed reached out to 1397 farmers through courtyard meetings (trainings sessions), of which 16 percent were women farmers. Spectra Hexa Mega Feed trained 1861 farmers of which six percent were women. In contrary, Petrochem trained only 195 males and no female fish farmers. Bank Asia trained 237 farmers of which four percent were female. CODEC reached out to 1560 famers including 84 percent of whom were women.

Besides BANA grantees, some respondents mentioned government and non-BANA actors like the DOF, Sonar Bangla Hatchery and BRAC for training on fish farming. One of the non-BANA feed suppliers mentioned that he had attended a training on fish farming techniques in Thailand organized by the DOF.

AMP, equipment, technology support and advisory services are available to farmers through company dealers and sub-dealers/retailers. All farmers mentioned that they have access to AMP and advisory services on fish farming and feed management practices. Alongside fish farming advice, technological support like water quality testing kit is available provided by Aftab Feed, Petrochem, and Spectra Hexa Feed, although some farmers mentioned that services on water quality testing are limited. AMP products are available from several companies like Petrochem, ACI, and EON (EON is not a BANA grantee.) Nevertheless, advisory service is also provided by the non-BANA dealers/retailers and nursery owners, and Upazila Fisheries Officers as mentioned by FGD respondents.

"Petrochem provided kit to examine oxygen, pH and ammonia levels in water. After receiving training and technology (kit), I can do the things better than before. I am now helping people in their fish farming. The farmers bring water in a small botte, I help them by checking the quality of water. I give them free advice and suggest the right medicine that I have." - Petrochem AMP Sub-Dealer

In areas where BANA supported limited water testing service, farmers mentioned that they rely on their past experiences, color of the water, and fish behavior, and apply appropriate medicines. One of the large farmers mentioned that farmers in his area get water quality testing support from the Upazila Fisheries Office by bringing in a sample of the pond water. They also get relevant advice from the Upazila Fisheries Officer.

Besides AMP and technology support, during COVID-19, BANA collaborated with an NGO to improve the sanitary and hygienic conditions of two local fish markets in Barishal City. The NGO trained fish sellers, cutters and leaseholders on the importance of keeping the market clean and hygienic. Along with market cleanliness and hygiene, messages were promoted on employing COVID-19 safety measures, like hand sanitation, mask wearing and social distancing. However, the BANA contract was only for three months. When the contract ended so did the activities, and market cleanliness or hygiene practices were not sustained.

[43] RTE: Ready to Eat

Farmers mentioned access to credit was the most important input for aquaculture. They mentioned that access to credit from banks is difficult while NGO credit, while easier to obtain, has high interest rates. Bank Asia, in collaboration with BANA, invested in aquaculture credit in Barishal. Bank Asia worked in Barishal in two phases: Phase I (October 2019-September 2020) and Phase II (August 2021-July 2022). During Phase I, Bank Asia gave credit to 110 farmers while in Phase II they gave credit to 97 farmers. Credit recovery was 100 percent for Bank Asia. However, most of the farmers mentioned that they did not receive credit from Bank Asia. The youth farmer group, trained by Bank Asia, informed us that they did not receive credit even after the training. The Bank Asia retailer mentioned that although his target was to arrange credit for six to eight people, only three people received the credit that he recommended. The Bank Asia representative and the farmers mentioned that sometimes despite eligibility, credits cannot be approved due to lack of adequate paper documentation of pond ownership.

Bank Asia primarily disbursed small credits of up to BDT 50,000 for a period of six months with an interest rate of four to eight percent. One of the large farmers who received a credit of BDT 40,000 from Bank Asia mentioned that the credit amount and duration was not favorable for him as he had to repay the credit during the harvest season in his area. This caused him to sell his fish at low prices and he therefore incurred a loss. Another large farmer receiving similar credit stated that he took a credit of BDT 50,000 at a four percent interest rate, but the credit was not useful. Given the size of his business, he required more funds. In addition, the credit processing time took nearly six months, and he did not receive the money in time to buy fish seed or feed.

Findings: The grantees provided training on fish farming and feed management techniques which the farmers appreciated. AMP, technology support for water quality testing and advisory services are available to the farmers through grantee's dealers, sub-dealers and retailers. Water testing services are available and provided by Aftab Feed, Petrochem, and Spectra Hexa Feed. Nevertheless, water testing services are limited, and farmers rely on their past experience to assess water quality and apply appropriate medicine. The BANA intervention to ensure market hygiene and cleanliness was not sustained as the contract duration was too low to make any sustainable practice changes. Access to credit was facilitated by Bank Asia at a low interest rate, although the credit amount and duration was not favorable for fish farmers.

Market system (IR2)

The fish value chain in Barishal is not complex and is similar to other districts in Bangladesh. Actors are usually divided into two segments: production and marketing. In the production part of the fish value chain, fish farmers are the main actors with auxiliary support from input suppliers, i.e., seed, feed, AMP and technology providers. Fish commission agents (*arotdars*), wholesalers and retailers are the key actors in the marketing segment. Figure 1 represents a simplified fish value chain in Barishal as described by the farmers. BANA interventions to farmers were primarily through input sellers like hatchery, nursery, feed sellers, and AMP/technology supplies. In Barishal BANA did not work with forward market actors such as fish buyers, processors or commission agents.

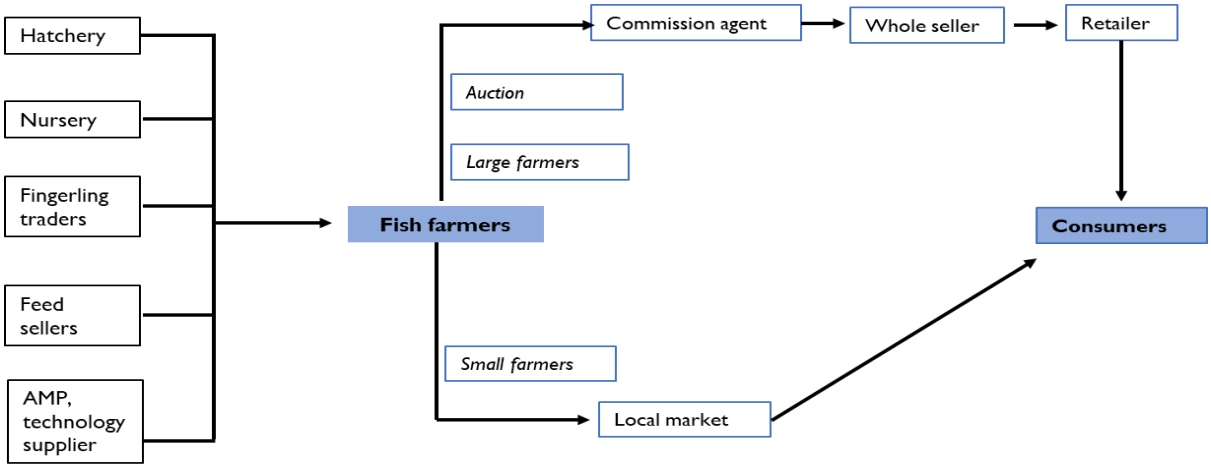


Figure 9. Fish value chain in Barishal

2.1 Market linkages

The large farmers mentioned that they bring fry/fingerling from Jessore, Kushtia, Satkhira and Khulna. Sometimes hatchery people from other districts, like Khulna, lease ponds in Barishal and sell their fry/fingerling from there. Other sources of seed come from Patilwala or fingerling traders obtaining seeds from within Barishal. Some of the large farmers have nursery ponds where they grow fry/fingerlings for their own use or sell them to other farmers. It appeared that all the sources mentioned are not BANA grantees. Farmers also obtain seed/fry from Rabeya Hatchey —a BANA grantee. CODEC after training, provide fish seed and vegetable seed/seedling to their beneficiaries. Small holder farmers sometime get fry/fingerling from large farmers of the same locality. One of the large farmers mentioned that during June and July, the Upazila Fisheries Officer provides free seeds in certain *upazilas*.

Carp Pituitary Gland (CPG) is used as a natural stimulant for the induced breeding of carp and is a mandatory hatchery input. There is no local production of CPG in Barishal. In Jessore, some CPG is collected from fish cutters in the wet market. Hatcheries in Barishal primarily rely on CPG from India arriving through illegal channels, which is both expensive and comes with administrative issues due to its illegality. The Rabeye Hatchery mentioned that there was an opportunity to train fish cutters in local markets on how to collect CPG for local production. The hatchery owner initiated a discussion with BANA on this, however, BANA did not have any intervention related to CPG in Barishal.

The other inputs like feed, medicine, equipment distribution to farmers is through company to dealer to sub-dealers or retailer of either BANA grantee or non-BANA actors. The ET did not find sub-dealers or retailers regularly in Barishal. BANA grantees like Aftab Feed, Petrochem, Spectra Hexa Mega Feed, and ACI promoted their products and reached out to the farmers through their dealers and sub-dealers. As mentioned in earlier sections, all the grantees organized training sessions for the farmers on fish farming best management practices. Most of the dealers or sub-dealers of the grantees were already connected with the grantees before the BANA collaboration started and were in the business for more than 10 to 15 years. All dealers and sub-dealers are also connected with other input suppliers like agriculture and poultry feed, fertilizer and medicines. Nevertheless, there was no collaboration between BANA grantees at the dealer or sub-dealer levels.

"One Stop Service Centre (OSSC)" is being operated by Aftab Feed and Petrochem from where the customers get all services like feed, information, fertilizer, medicine, water quality testing and so forth from one single service point. Aftab has 11 OSSC in Barishal region while Petrochem runs two centers. The OSSC is called "Mach Bondhu Shebakendra" ("Fish Friendly Service Center").

Similar service centers were also operated by Greendale, the AMP company working in collaboration with BANA, during the period of 2019-2020 under. They operated 20 Greendale Service Centre (GSC) in five districts in Barishal, Khulna and Dhaka divisions by turning selected dealer's shop into GSC. They provided water and soil testing kits, and printed materials like posters, leaflets on fish farming and AMP. Manuals on BMP with the Greendale products list were also available in GSC. Greendale conducted training for farmers, hatcheries, nurseries, fingerling traders and arotdars.

Petrochem has **fish doctors** who are graduates in fisheries. When the retailer or OSSC service provider cannot solve a problem, fish doctors go to the spot and provide a solution. A similar service is also provided by Spectra Hexa Mega Feed, Aftab Feed and ACI. Nevertheless, fish doctor services are not new under the BANA collaboration. The grantees had provided this service before they collaborated with BANA. SKF, the medicine company and sub-contractor of Aftab Feed, also provides similar service as mentioned by Petrochem representative.

An Aftab feed representative mentioned developing a mobile application (app) called **'Aftab Agro Care'.** At the time of the assessment, the app had not yet been launched with the farmers but was available in the Google Play Store. The app is expected to support feed supply chain more efficiently between dealer, sub-dealer and farmers. In the app the farmer can also access technical information on fish farming, feed management and so forth.

Petrochem runs a call center called **"Number EK, Krishi Shomadhan Onek"** ("One number, many agricultural solutions"). This call center is not a part of the BANA project, but Petrochem incorporated fisheries related information after collaborating with BANA.

BANA grantee dealer/sub-dealers or company representatives appreciated the advisory services that they are providing to farmers alongside selling their products. The BANA collaboration has provided publicity, a platform to promote their products and this has resulted in increased sales and business. Aftab feed sales have increased by at least 15 percent.

> *It helped us grow our business. Through the farmer's training we have promoted our products. Our sales have increased by at least 15% - Fish Feed Supplier KII, 15 March*

Access to credit is important for fish farming. The farmers mentioned that access to credit from Banks, particularly Bank Asia, was limited. The female farmers also mentioned obtaining credit from CODEC for fish farming and other purposes. They stated that for fish farming CODEC gave them a two-month grace period *(usually NGOs start collecting installments following the month of loan disbursement).* The farmers also mentioned BRAC microfinance, Grameen Bank and Asha for credits for various agribusinesses including fish farming. Nevertheless, these credit lenders are not BANA grantees.

Findings: BANA did not significantly influence Barishal's market linkages through its grantees. BANA did reach out to farmers primarily through input sellers like hatcheries, nurseries, feed sellers, and AMP/technology supplies. BANA grantee Rabeya Hatchery produced good quality carp seeds; however, the farmers predominantly rely on seeds brought from neighboring districts like Jessore, Kushtia, Satkhira and Khulna and primarily from non-BANA actors. There is no local source of CPG in Barishal and hatcheries rely on illegally sourced CPG coming from India. Other inputs like feed, medicine, equipment distribution channels to farmers is through company to dealer to sub-dealers or retailer either through BANA grantees or non-BANA actors. Most of the dealers or sub-dealers of the grantees were already connected with the grantees before the BANA collaboration started. All dealers and sub-dealers of BANA-grantees are also connected with other input suppliers like agriculture and poultry feed, fertilizer and medicines. OSSCs implemented by Aftab Feed and Petrochem are potentially a sustainable model as they increased the grantees businesses. 'Fish Doctor' services are not new and are provided by both BANA and non-BANA actors. In Barishal, BANA did not work with forward market actors like fish buyers, processors, or commission agents.

1.5. Private sector engagement

Fish seed: BANA collaborated with the Rabeya Hatchery and the Matshya Bangla Hatchery in Barishal for improving hatchery biosecurity and best management practices, and to ensure quality carp seed production. Beside these hatcheries, there are other non-BANA hatcheries in Barishal who are actively doing business including Sonar Bangla Hatchery, Harun Motsho Hatchery, Mamun Motsho Hatchery, Gouronodi Motsho Hatchery and Ma Motsho Hatchery. The Rabeya Hatchery mentioned that after the BANA collaboration their productivity increased, and their business grew by 10 percent. Besides these local level hatcheries, national companies like Aftab supply tigar tilapia (monosex) seed to farmers. If the order is for 100,000 pieces, they deliver the seed to the farmer's pond sites.

Non-BANA nursery operators are also active in Barishal. The ET interviewed a non-BANA nursery owner. He is the sole provider of fish fry/fingerling in this locality/union. CODEC, during their intervention, took mola fish from the nursery and distributed it among its beneficiaries.

Fish feed: National feed companies such as Aftab Feed, Spectra Hexa Mega Feed, Nourish and ACI, and regional companies such Amrito, Chartara sell fish feed in Barishal. Aftab is running OSSCs which has sustainability potential as the farmers receive the required aquaculture products and advisory services from a single sales point. The feed price of Mega feed is little higher than Aftab feed per kg depending on the feed types. Nevertheless, feed prices have increased over the last two years by up to 50 percent due to the high cost of raw materials.

> *"BANA collaboration helped us grow our business. Through the farmer's training we have promoted our products. Our sales have increased by at least 15%."* - Aftab Feed Representative

Aqua medicine products: Different types of AMP are used by the fish farmer. Petrochem and Greendale collaborated with BANA and invested in Barishal. While the Greendale contract ended in 2020, they are continuing their GSC business model, but not under the brand name of "Greendale Service Centre" as before. They are continuing training for farmers and hatchery and nursery owner's and providing test kits and signboards. Petrochem is operating two OSSCs in Barishal. One of the OSSC service providers of Petrochem mentioned that *"It helped to build relationships as well as the expansion of my customer base and increase income. I also know how to clean the water and medicine for various diseases of fish. … My business improved significantly after the training… it grew about 100%".*

Other companies selling AMP in Barishal include ACI, SKF, EON, etc., through their dealer network. Although ACI is a BANA grantee, their intervention was not covered in Barishal region.

Findings: the BANA collaboration with hatcheries has improved production of quality carp seed, and this is likely to sustain as the grantees benefitted from adopting improved hatchery biosecurity and best management practices. The OSSC business model is likely to sustain as the farmers obtain the required products and advisory services from a single sales point which has helped increase the grantees' customer base leading to business growth.

1.6. Enabling environment for inclusive growth

It is mentioned in previous sections that access to credit is an important input for fish farming. With support from BANA, Bank Asia processed credits to 207 farmers. However, there are policy and regulatory issues that limit access to credit by last mile farmers. In collaboration with BANA, Bank Asia primarily targeted last mile farmers with a credit of up to BDT 50,000 for a duration of six months. Bank Asia's national level representative informed us that a major delay in loan disbursement happened in the end of 2021 due to the CIB and related to a policy of Bangladesh Bank. The CIB necessitates National ID, photo, property documents and signature of the credit borrower. Previously there was no CIB related obligation for small holder farmers with a credit size of BDT 50,000 and no collateral was required—making loan processing easy. With CIB, the main challenge was the property documents which are not traditionally updated for small holder farmers. For example, a farmer may have applied for credit, but his land ownership (land of the pond) belongs to his father. Hence, credits cannot be processed. In these cases, sometimes Bank Asia approved the credit on a case-by-case basis. For example, credits were approved for those who were very well known to the Bank/agents and the Bank was confident about loan repayment. Nonetheless, CIB's policy is formulated by Bangladesh Bank, the central Bank of Bangladesh. BANA, during its project timeline, had little or no scope to do any high-level advocacy to modify the policy to make the loan processing favorable for last mile farmers.

Most of the respondents stated faced no policy-related challenges in their fish farming business. However, the Rabeya Hatchery mentioned the use of oxygen bags for transportation of seed and fry/fingerlings. The oxygen bags are made of polythene, but polythene bags are banned in Bangladesh in all sectors due to its negative environmental impact. The hatchery operator identified lack of modern transportation system as a big predicament for aquaculture in Barishal. Large farmers also mentioned the importance of having improved post-harvest processing and modern transportation systems. BANA grantees, like MarGen, had activities around post-harvest processing and improved transportation in Satkhira and Jessore. But grantees in Barishal did not have similar activities.

Findings: BANA facilitated credits to last mile farmers through Bank Asia. However, Bangladesh Bank's CIB related policy caused a delay and stagnation in credit disbursement process in the end of 2021. The CIB policy is of the central bank of Bangladesh and there seems little or no scope of high-level advocacy to modify the policy by BANA. A lack of post-harvest processing and modern transportation systems also challenges aquaculture in Barishal. Though BANA did not have any activities around this, other BANA grantees working in Satkhira and Jessore had interventions for post-harvest processing and fish transportation.

2. Nutrition and hygiene (IR3)

BANA nutrition intervention included 1) nutrition specific message dissemination including WASH primarily through NGOs, and 2) integration of nutrition messages in activities of non-nutrition partners like private sector actors, hatcheries and feed retailers. Nutrition focused activities were

aimed at farmer groups producing fish, ensuring their fish have the required nutrition, and increasing consumption. Farmers who produce big fish sell them at particular time intervals. BANA promoted polyculture of small fish like mola with big fish like carp (carp-mola polyculture) and dike cropping to spread sales and income over time. BANA promoted mola consumption by not discarding mola heads. In Barishal two NGOs: CODEC and Shushilan implemented BANA nutrition interventions.

2.5. Nutrition awareness and practice

Nutrition intervention by NGOs

> *"Mola fish has 100% vitamin. Head contain 53%, Tail 1%, part after head is 39% and then 7%. Banana flower has 70% iron. Eating fish and vegetable improves our immunity against diseases"* - Female farmer FGD

All the respondents who were beneficiaries of COEDC knew about the benefits of eating fish and vegetables, the nutritional importance of mola fish, how to process mola fish (eat mola with heads), and how to cut and wash vegetables. The respondents also mentioned receiving training from CODEC on tippy taps for hand washing. However, at the time of evaluation, those taps were not in use as other sources of water for hand washing were available. The respondents were able to state the critical times for hand washing and the importance of using soap in hand washing.

The CODEC national level representative stated that CODEC conducted nutrition awareness raising campaigns for the community -- particularly for women and children, training for farmers on mola culture and fish farming, a school awareness program, and hand washing awareness campaigns including use of tippy taps. They organized farmer field schools and conducted training programs on carp-mola polyculture, vegetable cultivation, preparation of vermicompost, life skills, gill net making (used to catch mola fish), and food safety, etc. After training, they provided carp seed (rohu, katla etc., one kg for each beneficiary) and mola fish to their beneficiaries. For vegetable production they provided seed and seedlings (young plants) of lemon, sweet potato, mango and other vegetables to each beneficiary family.

Shushilan's nutrition intervention was running in Barishal at the time of evaluation and the activities to improve awareness included:

1. **Nutrition awareness.** This focused particularly on the nutrition of women (what to eat during pregnancy, care during pregnancy) and young children (breastfeeding, complementary feeding). It also included the benefits of eating fish, nutritional importance of mola fish, how to process mola, and the nutritional benefits of vegetables.

2. **Promotion of carp-mola poly culture and vegetable gardening**. Promoted mola culture with carp. Mola fish is naturally available in ponds and in natural water bodies like canals. Shushilan brough mola fish from other ponds *(where mola was available)* and provided them to their beneficiaries to grow in their ponds. They also trained the farmers on homestead and pond dyke vegetable gardening. After training they provided vegetable seeds and seedlings.

3. **WASH:** Shushilan's current activity does not have any intervention on tippy taps but they are collaborating with Unilever to create community awareness on hand washing. This activity had not yet started at the time of evaluation.

Nutrition message dissemination by non-nutrition actors

Most of the non-nutrition grantees incorporated nutrition messages in their training. However, that message was limited to mola culture, benefits of mola fish, hand washing and dike/homestead vegetable production. When asked if grantees convey nutrition messages to their customers, some of them responded positively while others, primarily dealers, stated that it is not always feasible. ET's observations at dealer shops suggests that shops are busy serving multiple customers at a time and therefore don't have the time to discuss nutrition issues with customers.

> *"From training I have come to know about the nutritional value of fish and vegetables. When we conducted the training of the farmers, we discussed about benefits of eating fish and vegetables, how to grow dike vegetable etc. In our dealing with customers, we still try to disseminate nutrition messages. When I go to visit ponds, I advise them on dike vegetable production and its nutritional importance."* - Hatchery Owner KII

The Rabeya Hatchery mentioned incorporating nutrition messages in their business activities. They employed a female facilitator to discuss nutrition topics with the farmers during a training they conducted using their own resources and outside of their BANA agreement. They suggested continuing nutrition message dissemination, particularly on dike vegetable production and its nutritional relevance.

Findings: the BANA nutrition intervention resulted in improved knowledge and practice of nutrition for women related to the nutritional importance of mola fish and vegetables. Non-nutrition grantees, although they incorporated nutrition messages (i.e., benefits of mola fish and pond dike cropping) in their training, most of them are not continuing nutrition SBC as it is not practical to discuss nutrition issues with customers coming in to purchase various agriculture, poultry and aquaculture products.

2.6. Access to diverse and nutritious foods

The BANA intervention promoted carp-mola polyculture and pond dike vegetable cropping to increase production and household consumption of mola fish and vegetables. Fish and vegetables are commonly eaten items in the daily menu of Bangladeshi people. According to the Household Income and Expenditure Survey 2022, on average Bangladeshi people consume 68 gm fish/day[44]. The dietary habits in Barishal are similar as reported by the farmers – male, female and the youth. The female farmers (adult and youth) mentioned that they consume their produce on a regular basis, and any surplus is sold in the market. Although fish and vegetables were commonly eaten, after the BANA intervention, the women also became knowledgable about the nutritional importance of small fish like mola and vegetables, and how to cook them to retain most of their nutritional value. As children do not prefer to eat small fish, some women reported that they prepare foods with mola paste to ensure young children get the nutrition needed. Nevertheless, children prefer fish with less bones like pangus.

All farmers mentioned that mola fish naturally occur in the ponds. Some respondents mentioned that before the BANA intervention they used to remove mola from the ponds. After the BANA training, they understood the importance and technique of carp-mola polyculture and are practicing it. Because mola fish is sold at a high rate in the market, farmers grow mola for both purposes – household consumption and sale in the market.

Vegetable growing in homesteads and pond dikes was not new in Barishal. However, BANA grantees provided training on vegetable production which improved their knowledge and skill. CODEC and Shushilan provided seeds and seedlings to the beneficiaries. All farmers, and in particular females (adult and youth) grow vegetables like sweet pumpkins, lemon, guards, leafy vegetables etc., for household consumption. Some larger farmers mentioned they also grow fruit like mangos and lychee on the pond dikes. And similar to their fish production, fruit is used for household consumption with any surplus sold in the market.

Shushilan is promoting **ready to eat fish products** through women entrepreneurs who sell snack items like *singara, samosa (savory snacks)* in food vans *(street food)*. They have a target to work with 10

[44] Household Income and Expenditure Survey 2022. Key Findings. Bangladesh Bureau of Statistics. Statistics and Informatics Division. Ministry of Planning.

women entrepreneurs, although so far, they have worked with only one who is selling RTE fish items like fish fingers and fish cakes. They have provided her with a display box, a hotel stove *(a big stove which can be used outdoors)*, and a big wok, and training on how to prepare RTE fish products and do so hygienically *(covering the food using clean utensils, etc.)*.

To encourage children and youth to eat fish, in three schools in Barishal, Shushilan has started working with ninth and tenth grade students and showing them how to prepare ready-to-cook fish products like fish balls and fish fingers. This includes cooking demonstrations in schools and feeding the students the cooked items. World Fish also provides ready-to-cooked fish products.

Findings: the BANA intervention popularized carp-mola polyculture among the farmers. The intervention intensified production of vegetables on pond dikes and in homesteads. The beneficiaries consume their produce on a regular basis and any surplus is sold in the market.

Cross-cutting themes

BANA grantees committed to include a percentage of women and youth as their beneficiaries. The percentage inclusion of women and youth in grantee activities in Barishal is presented in Table 5-E.

Table 5-E. Inclusion of women and youth in farmer training by grantee

.	**Women**		**Men**		**Inclusion rates**		
.	*Adult*	*Youth*	*Adult*	*Youth*	*% women*	*% youth*	*% women & youth*
Aftab Feed	71	26	984	230	8%	20%	26%
CODEC	1084	221	217	38	84%	38%	86%
Petrochem	0	0	163	32	0%	16%	16%
Bank Asia	66	11	611	78	4%	37%	37%
Spectra Hexa Mega Feed	10	5	142	16	6%	12%	18%
Rabeya Hatchery	153	24	323	90	26%	19%	18%

Except for Petrochem, all grantees included a certain percentage of women and youth in their activities. However, it was not possible to reconcile whether they were able to meet the target in Barishal as set out in the project proposals, because the grant documents do not segregate the targets by geographical locations. CODEC being the nutrition focused grantee, trained 84 percent women, and 38 percent youth beneficiaries.

4.1. Women's roles in aquaculture

Female participation in aquaculture is at homestead ponds, mostly owned by male members of the households. Several studies from Bangladesh indicate women's participation in fish culture is predominantly in feeding, fertilizing, manure and feeding the ponds[45,46]. While these activities are critical and important for fish growth and must be performed daily—they are considered household activities.[47]. While women's economic participation in fish farming is increasing, there is no female large farmer or female fish farm entrepreneur in Barishal. Female farmers were primarily involved in

[45] Barman, B.K. 2001. Women in small-scale aquaculture in North-West Bangladesh. *Gender, Technology and Development* 5(2):267–287

[46] ADB(Asian Development Bank). 2004. *An evaluation of small-scale freshwater rural aquaculture development for poverty reduction*. Manila, the Philippines: Asian Development Bank

[47] Belton, B., Karim, M., Thilsted, S., Murshed-E-Jahan, K., Collis, W. and Phillips, M. 2011. *Review of aquaculture and fish consumption in Bangladesh*. Studies and Reviews 2011–53. Penang, Bangladesh: The WorldFish Center

family pond management supporting their families/husbands in fish farming. The female FGD respondents mentioned that although they were engaged in family fish farming activities before, training by BANA grantees improved their knowledge and skill. Women's participation in fish farming has increased from the previous four years. The respondents stated that behind this change, are contributing factors like training on fish farming and nutrition, particularly from BANA grantees like CODEC and Rabeya Hatchery. The female farmers mentioned that they do not face much challenge in aquaculture activities, as they are supported by their husbands in all aspects of getting inputs like seed or feed and selling the fish in the markets.

However, the Bank Asia representative mentioned that there are challenges in working with female farmers, such as financial decisions are made by husbands, often female farmers do not have their own phones numbers and need to use their husband's phone, and women do not attend meetings regularly called by the grantees.

Findings: Women's participation in aquaculture has increased due to the availability of training on fish farming through BANA grantees. Nevertheless, women's participation in fish farming is primarily around family pond management and in supporting their families/husbands in fish farming. There was no big challenge mentioned by women to be involved in family fish farming activities as they are supported by their husbands or other male family members.

4.2. Role of youth in aquaculture

> *Fish farming is very important to us. We did it because we get benefits in many ways. We can eat fish without buying from the market, get nutrition from it. We can sell the fish in the market and earn money from it. We can pay for our education, our own expense, also support our families. We can grow fish even in a small pond in our homestead."* - Female Youth FGD

Two FDGs were conducted with female and male youth involved in aquaculture. Female youth showed interest in fish farming as it can support both their education and contribute to family expenses. ET observed that almost all respondents had access to smart phones which is a comparative advantage for them to have easy access to information and be involved in fish farming. The young males that the ET interviewed received training from Bank Asia. After the training they expected credit from the Bank which they did not receive. Most of the youths were involved in other businesses alongside fish farming. They showed interest in fish farming given that they have access to inputs like credit, quality seed, feed and required training on fish farming.

Findings: Except for training, ET found no other engagement of youth through BANA grantees.

4.3. Environmental issues affecting aquaculture

Barisal district lies in the delta of the Padma (Ganges) and Jamuna (Brahmaputra) Rivers. Several rivers flow across Barisal including the Kirtankhola, Arial Khan, Khoyrabad, Kalijira and Sandha. The presence of several rivers puts Barishal in a unique situation for aquaculture. The farmers and the DOF official mentioned that due to its geo-ecological position, Barishal is not a very good place for pond fish farming. Barishal being a coastal district and crisscrossed by a number of rivers, tidal fluctuations are significant, and this impacts fish farming. The DOF official mentioned that fish farming techniques that take into account the tidal fluctuations should be considered in Barishal. In addition, and similar to other coastal districts, Barishal is flood prone. Every year the area suffers from flooding causing loss of fish and vegetation. Nevertheless, BANA did not have any activities around environmental issues affecting aquaculture in Barishal.

Findings: BANA did not have any activities to address the issues mentioned above.

ANNEX 6: COX'S BAZAR CASE STUDY

Summary

In Cox's Bazar and Bandarban districts (Zone of Resilience [ZOR]), the Evaluation Team (ET) traced market actors in six upazilas related to the following BANA grantees in Table 5-F.

Table 5-F. BANA grantees and their focus areas

BANA's Grantees	Focus area
Ms. Shah Amanath Traders	Produces safe dried fish through better management practiced. Develops the market channel of the dry-fish products and develops dry-fish producer businesses.
Cox's Bazar Shop	
Chittagong Meridian Agro Industries Ltd.	Increases the growth of tilapia fry and fish production at a low cost and achieves maximum sales revenue through exclusive wholesale services.
Maa Mothsha Hatchery & Nursery	Produces quality fingerlings and supplies them at affordable prices in hard-to-reach areas.
Aftab Feed Products Ltd.	Promotes quality fish feed and ensures advisory services for aquaculture farmers through dealers, retailers, and LSPs.
Prottayshi	Promotes aquaculture activities in the Cox's Bazar district and increases safe fish consumption to fill up nutritional gaps for the poor.
Mukti	Disburses microfinance credit to dry fish actors around the Cox's Bazar district.
Bank Asia	Distributes low interest, short-duration, collateral-free loans for fish farmers and ensures that their investment is recouped from farmers.
Palongki konna	Produces dry fish powder and organizes campaign activities for promoting fish powder.
Nutrition Ambassador	Motivates and creates awareness of good cooking practices among students and the community and increases fish consumption through nutrition education and cooking demonstrations.

The scale of aquaculture productivity in Cox's Bazar region is limited due to the lack of quality carp seeds, sufficient nursery operators, high-priced feed, and farmers' perceptions of aquaculture practices. Tilapia seeds are available from local hatcheries or from large feed companies with supply chains to farmers' ponds. BANA assisted Maa Mothsha Hatchery and Nursery with becoming a hatchery operator from a nursery operator in the Hilly district of Bandarban, and it resulted in developing 32 nursery operators and fish farmers in Bandarban—including women farmers (150 out of 600 farmers). The use of feed in small-scale aquaculture is not well practiced in the region, although national feed companies have good market linkages with their feed and tilapia seed. Due to increased feed prices, a few farmers left aquaculture practices. Through BANA's grantees (Meridian Agri Industry Ltd., Prottyashi), farmers are adopting improved culture practices through training and motivation. Young

9 KIIs with BANA sub-grantees, the DOF officer, and market actors.
4 FGDs with adults (2 FGDs) and youth (2 FGDs)—consisting of 15 male and 16 female participants, respectively.
6 snowballing KIIs with other value chain actors traced from the KIIs.

people of both sexes are interested in fish culture, although they need financial and technical support to get started.

The market linkages in aquaculture and fish processing are mostly driven by Chattogram market actors. Increased demand of freshwater fish due to less availability of marine catch and Rohingya influx resulted in a new market for seed, feed, and other aquaculture inputs in the region. After BANA's intervention through its grantees, 200 dried fish producers had improved production infrastructure, safer work environment, better quality products including RTE products, and more sales. BANA strengthened the e-commerce business of dried fish through developing a web-based online platform and consumer acceptance during the post-COVID-19 situation—which created a strong market linkage for the dried-fish industry.

The dried-fish industry lacks formal credit; however, through Mukti 111 women processors received credit for the first time in Naziratek's dried fish production site in Cox's Bazar. On the other hand, fish meal (*gura sutki*), which is a by-product of the dried fish industry, did not get support for product improvement and marketing. Yet fish meal is a key ingredient in fish food that is imported and could be a profitable sub-sector in aquaculture. Credit initiatives through BANA's grantees to fish farmers and dried fish producers are encouraging.

The nutrition benefits of mola fish are well understood in the region due to training and knowledge sharing of BANA's grantees. In addition, the culture of mola in ponds is practiced by the local communities. Women are actively involved in the dried fish industry—specifically, in grading, dressing, and packing fish. As a matriarchal society, tribal women are now active in aquaculture activity in Bandarban. The effects of climate change, such as rising temperatures and cyclones in the coastal district, are well understood in the fisheries sector. The marine fish ban has a positive effect on fish abundance, although the dried fish industry suffers due to the fish catch ban. The impact of the Rohingya on the local community has impacted food prices, food competition, decreased labor wages, social tension, environmental loss, etc. In contrast, the refugee issue has enhanced economic activity, employment and, in some cases, women's empowerment, e.g., safer work conditions for dried fish processors with better infrastructure and more income resulting from increased productivity and product diversity sold in the community and through e-commerce.

This case study report is organized according to BANA's IRs and sub-IRs as follows:

1. Increased Aquaculture Productivity (IR1)

Aquaculture practices in Cox's Bazar region are growing in part due to BANA's interventions. This is coupled with a decreased demand for freshwater fish due to consumer preferences and the declining marine capture fishery. Marine dried fish production is the major fishery activity in Cox's Bazar, although the shrimp hatchery also has a good market chain. Major aquaculture activities are concentrated in Chokaria Upazila in large bodies of water, and tilapia is the preferred fish species due to salinity tolerance and the presence of several hatcheries.

1.1. Seed

The rapid development of inland aquaculture in Bangladesh is based on the ready availability of fish seed to farmers. Although seed of the major cultured species is now produced in large quantities in hatcheries, poor quality is increasingly perceived as a major constraint on the success of aquaculture, especially for new entrant farmers and poorer smallholders.

- There is a lack of carp seed availability in the Cox's Bazar region as mentioned by the District Fisheries Officer (DFO), nursery operators, and farmers during KIIs. The existing 13 fish hatcheries mostly produce tilapia seed and fish nursery operations are not common in this region. *Patilwala* (a fish fry/fingerling hawker) has an important role in carp fish seed distribution, although the quality of seed at the farmer's level is not always high. It was observed that the carp seed supply in Cox's Bazar mostly depends on fish hatcheries at Potia

Upazila, Chattrogram. The degree to which nursery operators and *Patilwala* work for the carp fry supply business is limited—and farmers do not trust them about fish fry quality.

- Previously, fish farmers in this region were unaware about seed quality, and they did not reach their desired production outcomes. Through BANA's activities, they are now concerned about seed quality. However, due to the lack of regular road communication/transportation system, quality seeds are still not available to rural farmers. When a hatchery owner (Maa Mothsha Hatchery & Nursery) was interviewed, they called for more technical assistance to develop nursery rearing for carp and tilapia, a fry transportation system, etc.
- The price of carp seeds is very high in Cox's Bazar—about 500 BDT/kg compared to 120 to 200 BDT in Jashore. (The DFO noted that *"the shrimp seed now produced in Cox's Bazar [are] air freighted to southwestern region through Jashore, returning empty to Cox's Bazar. So, there is a possibility [of] bring[ing] carp seeds from Jashore to Cox's Bazar, which may help expansion of carp aquaculture in this region"*).
- The DFO of Cox's Bazar has knowledge of G3 rohu from his previous job posting at Lashore and believes that the production of performance G3 rohu is good. BANA provided technical assistance and a carp broods supply to a self-motivated nursery operator to establish a small carp hatchery in Bandarban. The hatchery developed about 32 carp nursery operators through training and advice in the region and maintained a strong relationship with the nursery operators. Maa Mothsha Hatchery collected G3 rohu fingerlings from Jashore18 months ago and plans to breed them this year. As stated by the hatchery owner, the Carp Pituitary Gland (CPG) is the most preferred inducing agent for fish breeding, although synthetic hormones are cheaper. However, it is difficult to get enough CPG from local markets, e.g., Chattogram. Most CPG is imported from neighboring countries, as collecting CPG from wet fish is easy due to the method of fish marketing and consumer preferences; fish are sold beheaded and in cut pieces.
- Genetically Improved Farmed Tilapia (GIFT)(in field observation, monosex tilapia) is the most preferred cultured fish species in the ZOR due to the availability of seasonal ponds, a short culture period, and the presence of tilapia hatcheries. As BANA's grantee, Meridian Agro Industry Ltd.—based in Chattogram and Feni Districts, supply quality tilapia seed to 880 trained farmers and created demand for a market of 10 million tilapia seeds in nine Upazilas of Cox's Bazar and Bandarban as per the KII. Another BANA grantee, Aftab Feed Products Ltd., also supplies tilapia seed (known as tiger tilapia brand) to this region in addition to its main business of fish and poultry feeds. There are other feed companies like CP and Mega, which also supply tilapia seed in the Cox's Bazar region along with their feeds and marketing channels.
- Niribily Tilapia Hatchery is the age-old tilapia hatchery in this region with a production capacity of 40 million monosex tilapia fry in a season. The hatchery ensures a steady supply of quality seed and maintains quality using regular brood stock replacement from abroad and progeny testing. BANA has a linkage with Niribily through Prottayshi and received improved tilapia brood from the WorldFish (WF) cohort stock at Bhola to produce quality tilapia seed and distribute it to beneficiaries of Prottayshi. As informed by a BANA representative, a carp hatchery at a fish farm of the Niribily group (Eidgha, Cox's Bazar) will be established soon.
- The nursery operator or *Patilwala* sometimes mixes normal tilapia seed with monosex tilapia seed due to the high prices of monosex seed, which can only be recognized during culture practice or harvesting (normally, tilapia breed in ponds) as described by nursery and hatchery operators interviewed. Such practices cause farmers desertification and productivity losses. BANA tries to address this constraint by developing more nursery operators to ensure the tilapia seed supply chain.
- Mola fish are abundant in ponds of this region. Previously, farmers removed mola from their ponds, treating them as weed fish. Now they know that fish culture can be done with mola, which they learned from training, awareness building, and nutrition knowledge provided by

the hatchery owner, Prottyashi and Nutrition Ambassador. Interested farmers usually collect mola seed from neighboring ponds free of cost. Prottyashi also supplied mola along with vegetable seeds to its group of beneficiaries.

Conclusion: BANA's intervention in increased carp seed availability is at the primary stage by establishing a small carp hatchery at Bandarban and a carp hatchery with the Niribili group at Eidgha, Cox's Bazar, through Prottayshi. The establishment of the Maa Mothsha Hatchery has developed nursery operators in Bandarban, where carp culture was limited due to the shortage of perennial ponds, although some creeks are available for investing in carp culture. Tilapia is the preferred species due to the short-cycle culture method. The tilapia seed price is high at both the hatchery and nursery levels in the Cox's Bazar region as compared to other parts of the country. Although there are many tilapia seed suppliers in this region, the value chain of tilapia seed is not well organized. BANA contributed to capacity building and quality seed production of tilapia; however, the supply chain to small-scale farmers did not ensure quality.

1.2. Feed

One of the major constraints on the aquaculture sector is the reduction in feed costs and production of quality feed. The main component of fish feed is fish meal. However, the increasing exchange rate, instability in the production of fishmeal around the world, and a price hike led to the rise in the cost of fishmeal.

- Fish feed demand is not at a high level in Cox's Bazar region due to the presence of a limited number of commercial fish farmers, as observed from FGDs. There are some national feed companies like Nourish, CP, Aftab, AIT, Mega, Tong Way, and Paragon in the region, and some local (Chattogram-based) feed companies like Nahar and Telapokado a good business due to comparatively low-priced feed and relationships between feed dealers and farmers. Aftab established 10 OSSCs (Mach Bondu) in Ramu Upazila and claimed to develop some LSPs for expanding aquaculture along with its feed business.
- The commercial farmers buy feed directly from company factories, saving money by buying in bulk. Based on demand, feed companies transport feed to dealers. The feed business mainly depends on farmers' relationships with dealers (trust) and the proximity of farms to feed dealers.
- Generally, small farmers are reluctant to feed their fish regularly. They typically use rice bran, oil cake, and cooked rice as fish feed in their ponds. Occasionally, they apply commercial feed. Small farmers purchase small amounts of feed from local feed dealers. Feeds are available in the market, but they are not affordable for small farmers due to the hike in prices. Also, the testing of feed by the DOF is limited, although a nursery operator claimed that one feed company was punished after a feed test.
- There is a common trend of increased feed prices and lowering fish farming in the region. Larger scale farmers said that feed production costs at the farm level could be lowered 20 to 30 percent if the availability of a major feed ingredient—fish meal—was ensured. They are not interested in producing farm-made feed due to problems with stable raw materials and power supply, and technical knowledge for feed mill operations.

Conclusion: As observed, the national feed companies like BANA grantees Aftab, AIT, and Mega are not popular in this region. Recently, only Aftab has had limited access to farmers through its dealers—like OSSCs. BANA has no visible contribution to the feed sector in this region. However, there is scope to develop local, ingredient-based, farm-made feeds or community feed millers due to the availability of fish meal (*gura sutki*) at dried fish production sites in Cox's Bazar.

1.3. Best Management Practices (BMPs)

BMPs include, but are not limited to, pond selection, feed management, fish health, water quality monitoring, AMP management, and harvesting—including biosecurity. *Prospects for increasing fish productivity through aquaculture can be enhanced through BMPs.* One of the milestones of BANA's

increased aquaculture productivity is BMAs. Through knowledge dissemination and quality inputs, BANA—through its grantees—provides BMPs to fish farmers in this region.

- Maa Mothsha Hatchery acquired knowledge of biosecurity measures, i.e., foot soaking platforms at the entry points of hatcheries, nursing in *hapa* nets, draining out hatchery wastewater, and mixing underground and surface water—all from the training/advice provided by WF/BANA. A representative from the WF regularly visited the hatchery and provided suggestions. This hatchery is now able to produce carp seed for the first time in this area and is supposed to breed G3 rohu next month. The hatchery owner also gathered knowledge about improved fish seed and the brood fish transportation system. Previously, there was a 50 percent mortality rate during fish seed transportation; now it is minimal according to the hatchery owner.

  Through this hatchery, BANA provided training to 600 farmers—including 150 women—in the Bandarban Hilly district. Previously, the tribal people were not interested in doing fish farming. However, when they learned nursery techniques, they got involved in aquaculture practices. Thirty-two nursery operators have been trained,and through them, about 20 *Patilwala* were also developed in the Bandarban district.

- Prottyashi trained 820 fish farmers on improved fish culture techniques. By adopting improved culture practices and BMPs, the beneficiary farmers increased their productivity from seven to eight- kg/dec. to 16-17 kg/dec. (1 dec= 40m^2), as claimed by Prottyashi.

- Large farmers—particularly in Chakoria—culture pangas, tilapia, rohu, catla, and mrigel in ponds using natural surface and underground water. One of them, who has credit from Bank Asia, maintained pond water quality as per the soil and water testing results from the Department of Agricultural Extension (DAE) and DOF. Large farmers in Pakua and Chakoria who were interviewed, also followed BMP knowledge through BANA training and benefited in their fish production.

- The use of AMP in fish culture is low in this region. The large feed companies have a "fish doctor" who provides on-call services, i.e., fish disease diagnoses to fish farmers through their feed dealers. Water testing or feed testing by DOF is scarce in this region, as shared by youth, male FGD participant in Pakua.

- Social media, YouTube and apps like "Rupali" (*developed by ACI under BANA*), are the main sources of knowledge sharing on improved fish culture, as shared by the youth FGD participants.

Conclusion: The nursery operator and *Patilwalas* developed through BANA's intervention will play an important role in aquaculture expansion in this region. Again, the BMPs followed by tilapia hatcheries (Meridian and Niribili) will ensure quality seed supply to farmers in this region. The trained farmers under Prottyashi increased their production level twofold, which is encouraging. All unused ponds need to be brought under fish culture through awareness building, as stated by the fish farmers interviewed in the Ukhia and Chakoria Upazilas. In addition, more farmers need to be trained on basic aquaculture and BMPs in this region.

1.4. Other Inputs

- BANA grantees (Bank Asia, Prottayshi, and Mukti) provide loans to fish farmers or beneficiaries and dried fish producers. Prottayshi provides a micro-finance service in this area and provided loans to 41 aquaculture farmers. The loan product is not different for the fish farmer; however, Prottayshi has a plan to develop a special product for the aquaculture farmer so that installment payments will start two to three months after they start harvesting fish. Mukti created a dedicated loan package for dried fish producers, especially for women, for the first time in this region.

- Bank Asia disburses loans ranging from BDT 50,000 to BDT 500,000, but it does not have designated loan products for the fish farmers. For the first time, they brought fish farmers into

the existing loan product coverage through BANA's initiatives and distributed loans to 64 fish farmers totaling BDT 4 million.

2. Market System (IR2)

2.1. Market Linkages

- National feed companies also have tilapia hatcheries, and they have strong market channels (feed dealers and marketing personnel). They link with feed dealers/commission agents to distribute monosex tilapia seed to the farmers in this region. Hatchery owners/companies provide transport services if the demand for seed quantity is high. However, it is difficult to ensure quality seed supply at the small-scale farmer's level due to adulteration at the intermediary's level. Meridian trained 24 of its own staff for its hatchery operation and market development, and another 2,296 people. These included training for fish seed agents, and lead-, demonstration- and small-scale farmers—10 percent of whom were women.
- As per the comments of the nursery operators interviewed, the fish nursery business is more profitable than table fish production because culture duration is only one to 1.5 months and requires less feed for nursing. The fish seed prices vary according to the source and size differences, as follows:

Fish seed types	Hatchery	Nursery	Advance nursery
Tilapia spawn	0.60–0.70/piece	- - -	- - -
Tilapia fry	- - -	1.00 – 2.00/piece	2.5-3.00/piece
Carp spawn	500/kg (500 pieces)	- - -	- - -
Carp fry	- - -	250/kg (30–40 pieces)	
Table carp	200–300 per kg		
Table mola	300–400 per kg (mola seed is free, as it grows naturally)		

- At the retailer level, farmers cannot buy feed on credit, because the feed companies do not sell feed on credit to retailers. On the other hand, any dealer (wholesaler) will sell feed to farmers on credit because they buy feed from the company directly—and the dealer gets a commission/incentive from the feed company.
- Aftab employed some LSPs for their fish feed and tilapia seed marketing in the Cox's Bazar region. The LSPs served at the village level for aquaculture expansion, and they are linked with feed dealers and marketing personnel. Aftab is in the final stage launching its mobile app (Aftab Agro Care), which is supposed to link farmers to LSPs to marketing personnel to dealers to factories—informed by Aftab representatives at Ramu Upazila.
- The table fish from farmers' ponds are supplied to the market through two channels. In most cases, large farmers call *Shawdagors* (fish buyers/*paiker*) to their pond site, where fish is sold through an auction and the *Shawdagors* transport the fish to *Arot* (wholesale market) or the regular market using their own transportation system. On the other hand, small farmers—or large farmers with smaller harvests—sell their fish directly to the *Arot.*

Conclusion: The market linkage for seed distribution from hatcheries to farmers is a multi-step activity involving many actors. For tilapia seed, a good market linkage was developed through Meridian and Niribily through Prottayshi. More nursery operators need to be developed for tilapia seed due to the availability of seasonal household ponds in the Cox's Bazar region. Also, there is a lack of initiatives by BANA for market linkage development for the small-scale fish farmers who sometimes are not getting support from the *Arotder* (wholesale market actor) and are paid lower prices for fish.

2.2. Private-Sector Engagement

Quality seed supply

Tilapia hatcheries like Meridian and Niribily replace their brood stock every two years through selective breeding, and the broods are reared separately to ensure brood quality. They import improved tilapia broods from Thailand with their own investment, and they will continue to do the same in the future to ensure production of quality tilapia seed.

Dried fish production

The dry fish industry in Cox's Bazar is fully a private sector venture involving more than 30,000 workers, two-thirds of them women, engaged in work with 1,040 dried fish processing units at Naziratek. It is estimated that about 20 percent of the total marine catch is dried year-round with most of the production is from October to April. The market of dry fish is about BDT 3,000 million—where 85 percent comprised of marine fish species, including 15 percent as fish meal, and the rest freshwater fish (Hossain *et. al.*, 2015). During 2010 to 2018 the production of dry fish trended upward. Since COVID-19, the production of dry fish has decreased 60 to 70 percent because the number of fishing vessels has decreased (USAID 2019)—possibly due to the lack of investment.

- M/S Shah Amanath Traders (SAT) is a large-scale dried fish producer in Naziratek, Cox's Bazar. It acquired technical knowledge, BMPs for dry fish production, and market linkage development through BANA. By introducing improved fish handling, use of cement platforms for processing raw fish, and use of turmeric and chili powder as preservatives, compartment fish dryers, vacuum packaging machines, etc., SAT is now able to produce safe, quality, dried products—including the RTE product "Balachao" (very small, dried fish with some spices). Through these initiatives, SAT increased its sales in 2022 by about 59 percent over the previous year. It trained around 380 dry fish producer workers in different aspects of dried fish production—including cleaning, sorting-grading, dressing, hygiene management. Dry fish producers are now able to produce chemical-free or organic dried fish and sell their product to SAT.

  SAT also developed an online platform (www.organicadryfish.com) for dried fish in addition to local outlets for tourists at Nazirartek. About 20 women entrepreneurs were also trained to produce the RTE product Balachao. With BANA's help, SAT has developed a strong collaboration with other e-commerce platforms like CoxsbazarShop.com (CBSC), and Palongki konna who buy dried fish from them. SAT coordinates 320 members in a cooperative society to expand the dried fish market by establishing showrooms, and vacuum packing and branding of organic dried fish. SAT is also trying to establish, with their own investment, an outlet at Dhaka (PKSF market premises)/ Chittagong city for branding their products.

- CBSC is the brainchild of a self-motivated entrepreneur who has had an online business of mainly handicrafts with some dried fish since 2014. During COVID-19 there was a problem with dried fish marketing. With the help of BANA, CBSC developed 57 (20 male, 37 female) small-scale, safe, dried fish and RTE–Balachao producers. The company, based in a call center, introduced smart vacuum packaging for dried fish, which are marketed from its online platform. As a promotional activity, it conducted regular campaigns through social media, a YouTube channel, leaflets, and stickers behind transport vehicles, even at the capital of Dhaka city. On Facebook, Coxsbazarshop.com has 300,000 followers. They also trained local women, who are already engaged in RTE–Balachao production to improve Balachao quality and packaging.

  CBSC organized a youth entrepreneurship club (CYEC) with 500 youth and trained them in safe dry fish production and e-commerce. Some national newspapers, along with the overseas "India Times," published news about CBSC's innovative ideas about the e-commerce of dried fish. CBSC made an agreement with SMART B for developing an Android app (at the Google Play Store on November 26, 2021). Now the entrepreneur has expanded his business by

introducing machinery like an electric dryer and a mechanical fish dresser, and establishing a dried fish production site in Khuruskul, Cox's Bazar.

- Palongki konna—a youth entrepreneur of Kolatilo, Cox's Bazar, has expanded her dried fish powder products business with BANA's support (machinery, website development, etc.). Now she maintains a showroom for her products in addition to her online business.
- Mukti is working with BANA to access finance for the dried fish producers for the first time at Nazirartek, Cox's Bazar. They provided loans to 730 (711 women and 19 men) dried fish producers, raw fish buyers, and dried fish retailers. The loans ranged from BDT 20,000–100,000 and the loan payback has been 100 percent, according to a Mukti representative. The dried fish producer community in Nazirartek is efficient in managing their credit, and this will give Mukti further scope to disburse additional loans in the future in other areas of Cox's Bazar.

Conclusion: BANA successfully intervened in the dried fish industry with technical and financial support from its grantees like SAT, CBSC, and Mukti. With this support, the dried fish industry of Nazirartek, Cox's Bazar, turned around after the COVID-19 pandemic and created an e-commerce platform for quality dried fish products. Also, BANA's grantees developed a healthy environment for the workers and RTE products like Balachao.

2.3. Enabling Environment for Inclusive Growth

- Dried fish production quality in Cox's Bazar has improved. Producers have reduced the use of chemicals or pesticides as found from the FGDs. The DoF monitored the quality of dried fishes under its "Fish Inspection and Quality Control Act2020." The DoF is now working on preparing rules under that Act and to then be able to give quality certificates to dried fish producers. In the dried fish industry, the main challenge is the availability of targeted fish for drying, along with the availability of storage facilities (cold storage) for wet and dried fish, particularly during the off-season.
- The government-enforced 65-day marine fishing ban for the conservation of brood fish resulted in increased availability of fish in our seas as stated by the DFO. He also pointed out that post-harvest losses need to be reduced through the introduction of appropriate techniques, knowledge, and skills. The enforcement of the ban is difficult for poor fishers due to their socioeconomic condition. Registered fishermen get food (typically rice, called Vulnerable Group Food) from DOF as an incentive—according to a fishing boat operator who was interviewed. Most of the small dry fish producers are women who have livelihood challenges during fish banning periods (*Hilsa* and the 65-day marine fish banning period). Fishermen get 30 kg rice during the banned period, but the dried fish workers do not get anything. As a result, they go to other jobs in Chattogram or other areas as ready-made garment workers—as revealed by the adult women in one FGD.
- The fish meal *(gura sutki*) produced at Naziratek does not maintain its quality during its preparation—as observed during field visits and discussed in KIIs. Unused fish for drying, the wastage of wet fish from fishing boats/trawlers, fish carcasses dried on muddy floors, and sometimes mud mixed with the *gura sutki* to increase its weight—were all observed during field visits by the ET. The national-level feed companies lacked faith in fish meal produced in Naziratek and, therefore, use imported fish meal, as revealed in an interview with an Aftab representative. The Secretary of the Naziratek Gura Sutki Producer Cooperative Society (NGSPCS) asked for skills development training along with access to finance for improving this sector. There are about 120 fish meal producers under NGSPCS and its members buy the unused portion of raw fish from landing sites and local dried fish producers. After outdoor sun drying, they sell it to local retailers, fish farmers, distance regional buyers, and divisional wholesalers. In one season, the fish meal producers sold approximately 70 MT fish meal/day to different buyers.

- The fish meal producers are dissatisfied with the regional traders of Chattogram, who buy big chunks of fish meal from them and do not pay fairly in cash. The traders pay 20 to 30 percent in cash and handover two to three bank checks for the remaining amount. However, in many cases, checks are not honored by the bank according to the Secretary of NGSPCS. This is also true for normal dried fish traders, as recorded by an adult male FGD. Nowadays, commercial feed companies import fish meal from neighboring countries or other countries. The fish meal producers try to link and sell product to some of the feed companies as per "Request for Quotation". However, marketing employees of those companies prefer to buy fish meal from importers because they receive a bigger commission from them—as stated by the Secretary of NGSPCS.
- There are about 100 fishing boats that deliver fish to the Naziratek fish landing center. In general fishing is carried out based on *Joo* and *Dala* (full moon and new moon). On average, a fishing boat sells BDT 200,000 to 10,000,000 per trip based on fish availability, fish species, and fish size. The profit margin is 10 to 20 percent. When a fishing boat anchors at Naziratek, typically between 7 and 11 a.m., two to three *Tokai* (intermediate fish buyers) go aboard to take part in an auction. The highest bidder gets the lot and pays in cash. There is no provision of credit in such selling practices. From the boat, the *Tokai* takes the fish to a nearby place, where another auction is held. Here, the dried and wet fish traders participate. As a result of this process, the fish cross hands twice before being dried at the dried fish production sites.
- Formal bank loans are not available to fish farmers and dried fish producers in this region, as noted in FGDs. Banks are not interested in providing loans to dried fish producers due to their lack of fixed assets—as fish drying activities are carried out on government-owned lands.

Conclusion: The fish meal (*gura sutki*) production could be an alternate source of the demand-driven fish feed industry in the country, if some improvements were made. Although BANA did a lot with the dried fish industry, the by-products of the dried fish industry were neglected. Moreover, an alternate livelihood for the dried fish workers during the fish banning period needs proper policy intervention.

3. **Nutrition and Hygiene (IR3)**

3.1. Nutrition Awareness and Practices

There is a lack of knowledge of healthy practices of fish consumption (the hygienic preparation of food) in Cox's Bazar, as well as evidence of the nutritional status of overlooked populations. In dried fish-producing establishments, residents have limited access to health and livelihood services. Fish and vegetables are abundant, and communities are made aware of food preparation and hygienic issues by BANA's grantees.

- Prottyashi produced social behavior change and communication (SBCC) materials that were used during field awareness events/trainings. They covered hygiene, sanitation, mola fish, dietary practices, and also introduced the "tippy tap" as a hand washing device in rural communities. Courtyard meetings with local people (including pregnant and lactating women) were conducted in the Ukhyia, Chakaria, and Ramu Upazilas for increasing community awareness of nutrition and hygiene. Messages on hygiene practices and their importance were given to students so that they could convey them to their families and neighbors.
- Farmers previously removed mola and/or other unexpected varieties of fish before releasing carp or tilapia in their ponds. However, the mola fish culture practice has increased in recent years. Consumers now know the benefit of eating mola fish. The farmers are now aware of mola culture practices. Although mola grow naturally, Prottyashi provided mola seed with carp seed as inputs to local farmers/beneficiaries. Consumers know how to eat mola fish and the benefit of consuming it, as noted by a female youth in a FGD. Farmers also get vegetable seeds of bottle gourd, sweet gourd, bitter melon, red amaranth, malabar spinach, and water spinach after the completion of the training session for dike cropping and homestead gardening.

- The Nutrition Ambassador is building awareness among students and peri-urban women on how to cook and consume mola fish, good dietary practices for pregnant women, and hand washing, etc. The adolescent girls were curious to know and learn about cooking fish and its health benefits. The Nutrition Ambassador tried to explain misconceptions about the cooking process. She also collaborated with Classic Melamine (also a BANA grantee) to produce melamine plates and bowls with nutrition messages and distribute them to women participants so that they could read the messages and practice them. She developed a demonstration book of cooking recipes and delivered it to beneficiaries. One of their documents, entitled "Mach Voj", was published by the "Somoy Prokashoni" with WF/BANA support. Palongki konna also creates awareness on the nutritional aspects of powdered dried fish among the women's community of Cox's Bazar and the customers of her products.
- The dried fish producers provided hand gloves to women workers at the beginning, and currently the women buy and use them to protect their hands and nails from infection. Also, shades are being built for the women to protect them, as well as the fish, from sunlight—as noted by SAT.
- In most cases, household pond dikes have trees and therefore a pond-dike system is not popular in the Cox's Bazar region.

3.2. Access to Diverse and Nutritious Foods

- The host community prefers dried fish which is readily available. The Nutrition Ambassador produced some videos on recipes for *Lottiya* dried fish curry, which is a local tradition but not available in other parts of the country. She also selected four food recipes to be promoted among the local women including: 1) *kichuri* (a mixture of rice and pulses) with mola fish, 2) *churi* (dried fish and brinjal), 3) p*olao* with small fish, and 4) vegetables with fish curry. All the recipes were selected based on their nutritional value.
- There are many women-led catering businesses in Cox's Bazar. The Nutrition Ambassador stated that dried fish-based recipes could be promoted by involving the women-led catering businesses. With the support of BANA, Palongki konna introduced powdered dried fish with lemon flavoring as a nutritional supplement for children, which became popular in various parts of the country through her online sales.
- In cooperation with local women, CoxsBazarShop.com produced video clips on how to cook dried fish, keeping it tasty and nutritious. On a regular basis, CoxsBazarShop.com also promoted nutritional messages during trainings for dried fish and RTE–Balachao producers.
- Prottyashi conducted awareness and discussion sessions among students in the three Upazilas of Ramu, Ukhyia and Chakaria to increase their knowledge of a hygienic lifestyle and nutritious food consumption. A total of 2,400 participants, 62 percent of them women, attended these in 20 school sessions.

Conclusion: Although dried fish workers have adopted hand washing, use of hand gloves, and other sanitation practices, the hygiene messages need to be expanded to other communities in this region.

4. Cross-cutting themes

4.1. Attitude Toward Women Working in Aquaculture and Women's Role in Aquaculture

- Women are now more engaged in aquaculture as a household activity, but in some area of Cox's Bazar, women are not interested in being involved in fish culture due to barriers, such as limited mobility due to social norms. Women mostly help in homestead fish farming by feeding the fish.
- In the Cox's Bazar area, due to the Rohingya influx, the participation of women as aid workers has increased. This scenario encouraged local women in Ukhia to participate in aquaculture, as mentioned by a KI of Prottyashi.

> *"Good seeds of fish move in [the] opposite direction of [the] clock, bad seed[s] move towards [the] clock direction."* – a female youth FGD participant
>
> "*Inserting my hand below [the] pond surface, we understand how much natural feed [is] present in a pond."* – a female youth FGD participant
>
> *"We did not know the importance and doses of lime, now we use lime at 1kg/dec for pond productivity and [to] prevent fish diseases."*– a male youth FGD participant

- As a matriarchal society, tribal women are now more involved in aquaculture in Bandarban. There are about 50 tribal women and 10 plainlands' women who are now culturing fish in Lama Upazila and the surrounding area due to training conducted by a hatchery owner under BANA.
- As a family business, women are actively involved in the dried fish industry—specifically, in grading, dressing, and fish packing. Also, due to a lack of any other opportunities around their community, women are involved in the dried fish sector. Women also are working with their spouses' small dry fish businesses. In general, women's participation is 70:30 in the dried fish industry. In the RTE–Balachao product development, their participation is 100 percent. They also make RTE products and sell them to CoxsBazarShop.com or the city market. In the small-scale, dry fish producer group under CoxsBazarShop.com, 37 of the 100 dried fish producers are women—and 40 women are now involved in Balachao production. In Kolatoli, Cox's Bazar, the fishermen's wives are involved with small-scale dried fish powder production with the help of Panolgki konna.
- Women are more skilled at cleaning and sorting wet fish than males. In general, male workers get higher salaries. However, some women workers get more than men due to their skill sets—like processing large fish (removal of fish guts, filleting etc.).

4.2. Role of Youth in Aquaculture

- Youth are interested in fish culture, although they need support and training in technical aspects. The youth female community has been well trained in aquaculture by Prottyashi and they do well in small-scale fish farming practices at Ukhia Upazila. Among the trained beneficiaries of BANA in the aquaculture sector in the Cox's Bazar region, 20 percent are youth. Youth entrepreneurs like Palongki konna have been empowered in the powdered dried fish trade through improved technical and IT support by BANA.

4.3. Environmental Issues Affecting Aquaculture

- The previous abundance of fish in the marine catch has gradually decreased due to overfishing, fishing undersized fish, and destructive fishing practices by fishing trawlers. Capture fish (along with Bombay duck fish) has also decreased in recent years. This might be due to climate change. The temperature has increased in recent years, due to climate change, resulting in frequent cyclones. These natural calamities destroy the dried fish infrastructure, causing product and financial losses. These insights are drawn from comments by an adult male in a FGD.
- Late rains and high temperatures seem to be effects of climate change, which somehow has affected fish hatchery operations, as observed by hatchery owners. One large farmer noticed that the water temperature is higher now, more ammonia gas is generated in ponds, and fish are not growing well even after proper feeding.

4.4. Social/Economic/Contextual Issues Affecting Aquaculture

- The influx of the Rohingya population (1.3 million) is a regional crisis. This has put additional pressure on the country's economy and local communities as per the DFO. The influx of Rohingya did not affect artisanal fishermen's profession as the artisanal boats are under the

government's registration according to a fishing boat operator. As per Mukti's observation, deforestation has been growing due to habitat destruction, and the use of trees as cooking fuel has impacted the natural environment. Again, the Rohingya people affect labor wages in the region. They work at a low rate (BDT 300/day), which frustrates the local labor pool. Social insecurity, as created by the Rohingya, is another issue local people voiced. Due to their presence, law and order have deteriorated, which has affected the host community according to a nursery operator in Ukhia. There are a lot of fish from outside of Cox's Bazar that are brought in daily to fed Rohingya people, but the price of fish is going up.

- Rohingya refugees consume dry and fresh fish, which has resulted in an increase in fish prices of more than BDT 10/kg. Rohingya refugees consume fresh fish, which affects the supply of raw fish, while they also consume a lot of dry fish. As a result, the dry fish market has been expanded. Currently, big buyers at Chattogram import dried fish from neighboring countries, which makes the market very competitive. The quality of imported fish is unknown and might cause health problems—according to an adult male in a FGD.

References

Hossain, M.AR.; Belton, B.; Thilsted, S.H. 2015. Dried Fish Value Chain in Bangladesh; World Fish, Bangladesh and South Asia Office: Dhaka, Bangladesh, 122p.

USAID. 2019. From https://pdf.usaid.gov/pdf_docs/PA00TWMH.pdf.

ANNEX 7: FARIDPUR CASE STUDY

Faridpur Case Study Summary

Bangladesh Aquaculture and Nutrition Activity's (BANA) investment in Faridpur was limited. It included activities by four grantees:

Aftab: Promoted quality fish feed and ensuring advisory services for aquaculture farmers through dealers, retailers, and LSPs. *Reaching farmers through LSP is a new business model.*

Agro Industrial Trust (AIT): Promoted quality fish feed and ensuring advisory services for aquaculture farmers through dealers, sub-dealers, retailers, and LSPs. Producing and promoting quality feed for fish farmers by using local ingredients and feed formulation. *Reaching farmers through LSPs and using local ingredients are new to AIT.*

City Bank Limited (CBL): Provided financial management training for hatcheries, nurseries, and farmers; and providing access to loans. *Outreach to fish farmers is new to CBL.*

Parmeeda Enterprise: Trained fish farmers on best practices, provided access to information and resources, and ensured traceability through its online e-commerce platform (Nirapad Khamar) for RTC fish between pond and the point of sales. Parmeeda is extending its e-commerce platform to sell fish directly to consumers and businesses. *Parmeeda is attempting to expand its fish suppliers through outreach in Faridpur.*

Petrochem: Promoted quality aqua inputs and providing advisory services for aquaculture farmers through dealers and Women Micro-Franchises (WMFs). *WMF is a new model for Petrochem.*

The evaluation team traced market actors related to grantees (except City Bank) by speaking with the following 49 people:

- 16 female farmers trained by Petrochem
- Eight adult male farmers trained by Aftab
- Eight young men trained by AIT
- Three (of four on the BANA list) AIT dealers and the local AIT representative
- One (of one) Aftab dealer
- Four (of four) WMF owners
- One Department of Fisheries (DOF) officer
- President and Secretary of the Faridpur Feed Association
- Six additional actors mentioned during FGDs: commission agents, nursery operators, and trader/retailers.

Findings: Overall, the case study suggests that Faridpur's fish productivity is slowly changing at the smallholder farmer level, but without the direct farmer training and access to capital, there is little space for growth. Changing traditional pond culture practices and putting dormant ponds into culture requires direct intervention with farmers or would-be farmers. In addition to financial services, increasing productivity in Faridpur's aquaculture sector requires greater inclusion of women and youth in homestead aquaculture practices. Youth are interested in aquaculture as an income-generating activity. When young women get involved, they have the capacity to bring older women—who may need more assistance in understanding the training than younger women, who may have more education. When women see other women benefiting from an activity, they too become interested.

Since the case study focuses on BANA-supported grantees and market actors, the study is not representative of the Faridpur aquaculture system. The slice of the Faridpur aquaculture market that the evaluation team saw consists of short chains consisting of input provider–producer–buyer (collector or wholesale). Some chains are longer, but in terms of people, they are often still short, as many people have multiple roles in the market.

The grantees reported increased business/sales due to their BANA-supported activities. All report that they will continue their work with the established market actors. Some will continue with the distribution models they tested, while others will switch out LSPs for retailers.

The case study report is organized according to BANA's Intermediate Results (IRs) and sub-IRs.

5. Productivity (IR1)

There are many fish (cultured and natural) in Faridpur—including indigenous and Chinese carps, tilapia, hilsa, catfish, shrimp, small fish like mola, dhela, etc. Fish farming has increased according to study participants in Faridpur, with the potential for further expansion as ponds often lie dormant or are used for jute processing, which pollutes the water. Rivers also supply fish, but due to the high price of fish, they have been over-fished. According to a fish commission agent, Faridpur meets about 60 percent of the district's demand for fish and imports 40 percent from:

- Dhaka, Barisal, Gopalgonj, Shariatpur, Mymensingh (carp, tilapia, catfish, *etc.*)
- Kushtia, Jashore & Meherpur (Pangash)
- Patuakhjali, Barguna (Hilsa)
- Chittagong (marine fish)
- Satkhira (shrimp)
- Bhoirob (small indigenous fish)

Demand and high price for fish likely incentivized local people's interest in participating in fish culture. Based on primary data, Faridpur households either have a homestead pond in which they culture fish for their own use, selling only the excess, or they lease ponds from the village and start aquaculture as some of the BANA-trained farmers did.

Constraints on increasing cultured fish productivity in Faridpur expressed by study participants include access to:

- Affordable inputs
- Capital

According to a few informants and confirmed with BANA, in practice multiple ownership of ponds hinders aquaculture. One informant said that "*40% of ponds in this area become fallow due to shared ownership*." When a household is inherited from parents, for example, the children may leave a pond dormant rather than determine who uses it, or they may come to another arrangement. Some fish farmers lease ponds from the village or from others with more ponds than they can use.

5.1. Seed

BANA grantees did not directly engage in the seed market in Faridpur. According to the Faridpur DOF officer and other informants, including farmers, access to quality, affordable seed in Faridpur is limited due to the increasing cost of seed in the area (this is not a countrywide challenge) and lack of nurseries. One feed supplier noted that it would be a "*bigger crisis during Ramadan*" due to increasing demand for fish. An adult female farmer trained by Petrochem said that the price of some fish fingerlings has increased from BDT 70–100/kg to 150–180/kg.

Some farmers get their seed from within their communities (through trade/sharing of seed), while others collect seed from a government hatchery in another district for their own use and to sell to neighbors. They noted that the price of fry/fingerlings has increased 25 to 30 percent compared to previous years.

G3 rohu is little known in Faridpur among study participants, though some recognize it, especially the DoF officer who expressed a need for a hatchery trial under DoF for G3 rohu. Others may know something about it but may also be confusing it with normal rohu. Those who know of it mention that it is known to grow well. Genetically improved farmed tilapia (GIFT) is also little known among study participants, but seed is available from private and DoF hatcheries.

Findings: BANA did not directly engage in the seed market in Faridpur with hatcheries and nurseries, or by connecting farmers to genetically improved fry/fingerlings.

5.2. Feed

The Faridpur feed market is fairly crowded with 13 producers seeking to increase their market share in a district with limited demand for fish feed. Farmers in FGDs could name at least three of the major brands that they can readily access. The local feed association representative said that over the last three to four years, the feed companies have sought to remove retailers (local traders), who are the key to reaching rural smallholder farmers. This contradicts BANA's grantees' business model, where Aftab and AIT sought to reach into the "untapped" rural market through LSPs. These are mobile individuals with no fixed sales point who are typically linked to a dealer (who has a fixed sales point). The idea is that dealers grow their businesses by expanding through retailers (existing, standard practice) and through LSPs (new model being tested). Each link in the input chain (dealer, retailer, LSP) gets a piece of the action as an incentive to sell a company's feed product(s).

Among the many national, commercial, feed producers competing in the feed market are BANA grantees, Aftab and AIT, both of whom say that their sales increased due to their market expansion with BANA support. Yet AIT's LSPs are no longer active according to the two local AIT retailers interviewed. According to BANA representatives, except for Aftab, none of the LSPs were sustained, "*because the incentive model/profit-sharing model was not effective*." According to informants, dealers are not interested in what they think is sharing their profits with LSPs. It is unclear how dealers feel about the LSP model.

Now that the cost of feed has increased by at least 30 percent according to some farmers—and three-fold according to others, farmers cannot afford it. A couple said they make their own feed consisting of rice bran, mustard oil cakes, rice, vegetables peels, and compost. The cost of feed has increased across the country due to increasing costs of importing some of the necessary ingredients.

In terms of buying on credit, retailers can give feed on credit in smaller amounts compared to dealers and be repaid after fish are sold, though the credit price is higher than the cash price according to farmers FGDs. The feed association representative said that dealers can also extend credit for feed, mostly on trust, but sometimes require papers (e.g., land deed). The representative said that credit is a normal part of poultry and livestock feed sales, but mostly absent in aquaculture. While large commercial aquaculture farmers can readily purchase from dealers or direct from depots and get feed delivered, smallholder farmers are beholden to local retailers, who mostly stock fish feed as a means of increasing sales in their existing shops (e.g., for poultry/livestock farmers or other goods).

Farmers and others in Faridpur's aquaculture sector continue to be concerned about the quality and price of feed. Regarding quality, one farmer recommended having a testing facility in the area. The recommendation is supported by the feed association representative who said that testing labs are needed countrywide to reduce corrupt practices of feed production using poor ingredients and to increase feed quality so that farmers do not bear the cost of the malfeasance.

Related to the need for testing is the potential for local feed mills to produce lower-cost feed with local ingredients. According to BANA staff, community feed can cost as much as 10 to 15 percent less than commercial feed. One farmer in Faridpur said, "*Small-scale feed mills can be established to reduce dependence on commercial feed*" (FGD with adult male farmers). To that end, BANA developed a mobile app to formulate feed using locally available ingredients. This was not mentioned by those interviewed. Driving down the cost is essential to the aquaculture sector, as "*40% of farmers withdrew from regular feeding practices*" according to BANA. Again, a farmer noted that feed ingredients like maize and dried fish/sutki/fish meal, are easy to collect, but they do not currently do it (FGD with adult male farmers). One farmer said, "*We know feed cost[s] could be reduced if we produce it ourselves.*"

Findings: BANA grantees did not affect the feed market in Faridpur, as there were already many quality feed brands available. BANA grantees sought to increase their outreach and market share by testing an LSP outreach model (see Section 2 for market system findings). BANA's recently developed app to help fish farmers create an evidence-based formula for feed with the ingredients they have at hand will

need to be heavily marketed and demonstrated for farmers to be aware of it, download it (assuming they have phones; the women do not), and learn how to use it. If used, the app could improve the production of small fish farmers.

5.3. Best management practices

Farmers, retailers, and dealers universally appreciated the training from BANA grantees (Aftab, AIT, and Petrochem) and others (the Department of Agriculture Extension [DAE] officer). See Table 1 for the number of farmers trained by grantees in Faridpur. Training content included:

- Aftab: pond and pond water management (adult male FGD)
- AIT: pre-stock farming management, AIT feed, and health information (youth male FGD)
- Petrochem: aquaculture and vegetable cultivation (adult and youth female FGDs)
- CBL: financial literacy
- DAE officer: vegetable gardening
- School: nutrition training

Table 5-G. Number of farmers trained by BANA grantees

-	**Male**		**Female**		-
-	*Adult*	*Youth*	*Adult*	*Youth*	*Total*
Aftab Feed Products Ltd.	265	42	8		315
Agro Industrial Trust (AIT)	195	107	26	7	335
Petrochem (Bangladesh) Limited	766	74	49	27	916
The City Bank	45	18	8	2	73
Grand Total	1271	241	91	36	1639

Farmers also receive advice from other farmers ("*locally experienced fish farmer*[s]"), dealers, retailers, and the upazila DoF officer. A male youth said, "*If the fish farmers face any difficulties regarding fish production, the upazila fish office* (UFO) *always responds to any situation when we call them or inform them.*" While the farmers did not mention them, buyers—who often have their own ponds—also give advice. An AIT retailer said that AIT distributed a phone number to farmers from which they can receive advice and information (not mentioned by the FGD participants).

> *"I didn't know about fish farming too much earlier. After getting involved with this project they provided … 3 trainings. They also held 2 meetings at home, taught how to treat fish, improve fish farming, water treatment, fish diseases management/treatment, and nutritional issues like dike farming, how to raise fingerlings to adult fish, level of water to maintain – how to measure it, based on water level the volume of fish seeds to be provided to a pond … Now we clean pond, clear weeds, and apply pesticide to kill snakes, frogs and other insects. We use lime to clean the water. We did not know all this before we received training from Petrochem."* – Women adult farmers FGD

Similarly, AMP/technology supplier associated with Aftab mentioned Aftab's call center as being an effective communication tool (not mentioned in FGDs). He also said that Aftab has a mobile app called *Safal Songi* in operation, but that "*farmers are not aware of the service.*"

Like the farmers who received training, WMFs and retailers valued the training as: 1) an opportunity to grow their business, 2) better serve their community/existing customers, and 3) an opportunity to start or improve their own fishponds. One female retailer said, "*I came to know about growing pond dike vegetables and also started this initiative* [with BANA grantee] … *[the] training from*

Petrochem was useful." There were no negative comments about training, only that direct training is valuable yet there is a lack of it. One fish farmer said that they need knowledge on fish diseases as "*we can understand disease only when the fish are dead.*"

Regarding testing of pond water, women FGD participants said that they use test kits but that the cost has "*almost doubled from a few months back*." Male youth, however, said they use observation, and male adult participants said test kits are not available locally. The AMP/technology supplier, whose business serves as an OSSC, also said that there were insufficient numbers of water quality tests, but that farmers in the region come to him for water testing and consultation.

Findings: Farmers, WMF/retailers, and dealers universally appreciated training from BANA grantees. Farmers felt that training increased their fish production and therefore their income. Women farmers were successfully linked through training to BANA grantees' dealers/WMF/retailers. Men farmers were not successfully linked through training—they purchase inputs and get advice through personal and community-based relationships.

> *"Different problems occur during the fish production like scarcity of oxygen, excessive ammonia and muddy condition, and pest and disease infestation—and mortality of fish increases. In the case of commercial farmers, disease or pest attacks [decrease] as they monitor and supervise their ponds on a regular basis. We do water testing by observations and experience."* – Male youth farmers FGD

Dealers/WMF/retailers said their businesses grew and, therefore, their income rose due to their connection with BANA grantees. For those linked through feed companies Aftab and AIT, however, sales have slowed due to the rising cost of feed. Overall, the BANA-supported trainings successfully resulted in better practices and increased fish production. They were successful in motivating linkages, some of which are continuing.

6. Market system (IR2)

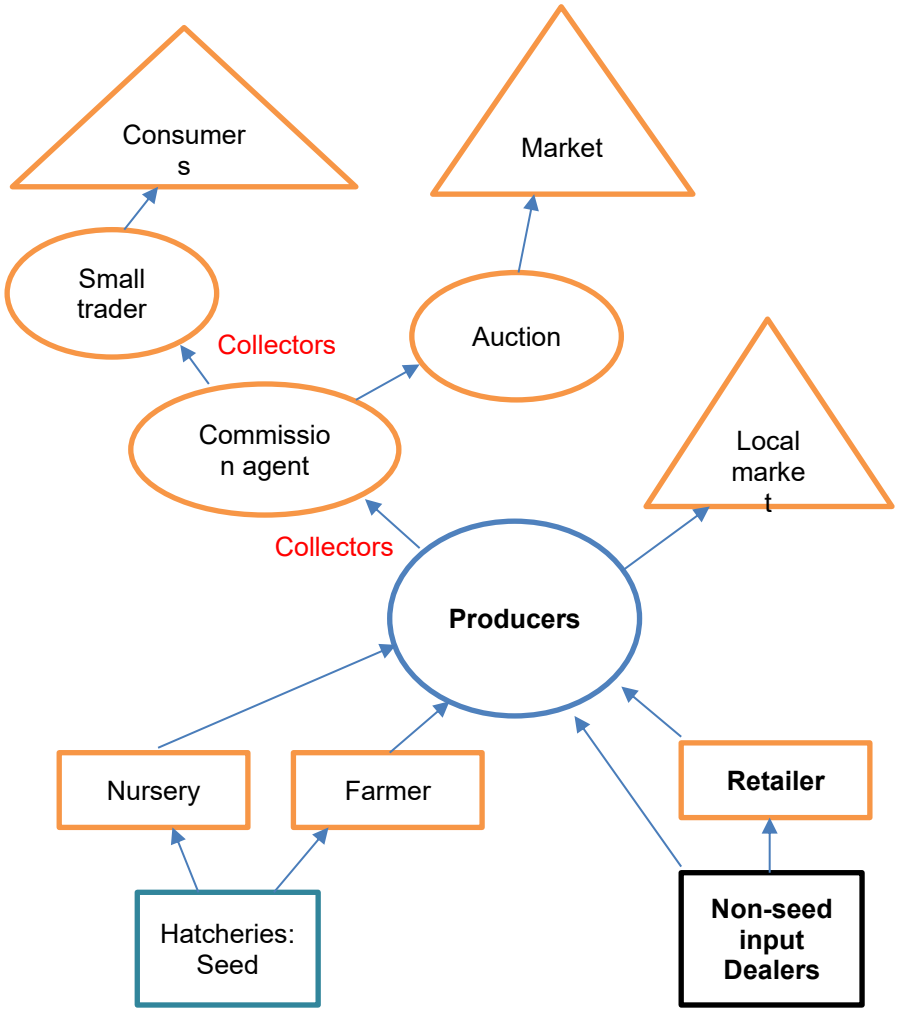
The market system described by study participants in Faridpur includes many short chains and people who serve multiple roles, *e.g.*, a farmer may also collect seed from a hatchery and "nurse" them until they are fry or fingerlings, then farm some, and sell the remainder to other farmers. A commission agent or retailer or dealer may buy fish from farmers and be a creditor to them, requiring that the farmer sells his/her fish back to the agent/retailer/dealer who made the loan (see more on credit under 2.3 below). Figure 1 illustrates the Faridpur aquaculture market from the perspective of BANA-related market actors (in **bold)** and a few non-BANA actors such as the Faridpur Feed Association, DOF, and fish buyers. Figure 7 below illustrates the flow of goods, services, and information.

Most smallholder producers farm in their homestead or leased ponds. They consume the fish and sell the remainder to neighbors and at the local wet market. If they have a large amount, a local buyer or collector may come to their pond to collect the fish. None of the actors mentioned post-harvest processing or value-added products.

6.1. Market linkages

The linkages made in Faridpur between grantee-linked retailers and trained female farmers appear healthy, as the women (adult and youth) said they value the inputs and advice of the local retailers, who are also members of their communities. The adults and young men recognized some of the grantee-related input providers, but they do not purchase from them. They described relationships as personal, built on trust and confidence and mostly made through family connections and local community members.

Less-known market actors in the area, like Aftab, can be developed over time through personal contact, as described by the adult male FGD participants, who included an Aftab retailer/farmer. Their description of feed sellers suggests that upon the first market entrant, if the product is perceived as high quality, it is likely to remain the strongest, unless a new product is introduced and supported by a known and trusted person (as was done with the Aftab floating feed). The lack of Aftab retailers in Faridpur (there was only one on the BANA-provided list) suggests that the company's investment was too small and short to have a strong effect on long-term commitment to the brand.



Aftab and AIT sought to extend their reach and increase their market share by adding LSPs, who are mobile and can deliver products and services directly to farmers. Two of the three (out of four on the BANA-supplied list) Faridpur-based AIT dealers/retailers interviewed said the LSPs are no longer active—and now that the Activity has ended, their sales are less than what they were during the Activity. When asked about his awareness of LSPs, the Aftab retailer interviewed was only aware of DOF's local extension agents for fisheries (LEAFs).

In addition, two of the three AIT dealers interviewed said that AIT planned to decorate their sales points as "Information Dissemination Centers" (*Tottho Kendro*) by providing a table and two chairs and a signboard, as well as water-testing kits. Both said they never received the promised testing kits, which to them meant that the center was not operational. According to BANA, the Aftab dealer has one test kit, which the dealer also mentioned, and Petrochem has not yet supplied them to WMF.

Petrochem sought to extend their network with WMF, including four in the upazilas in which the evaluation team worked. All are married and their shops are family businesses (with their husbands, though the women are licensed, which makes it easier for them to access loans and be eligible for Activities like Petrochem's). One of the four never served as a WMF as her family objected to her attending training after two days. She is not selling Petrochem products. The other three are active and are input providers to local farmers and serve as advisors.

In the output market, Parmeeda sought to expand its access to quality fish for its RTC outlets. Parmeeda trained 137 farmers in Faridpur in 2019 (and more in other districts in the Zone of Influence (ZOI)—including 12 youth and 38 women on best practices and how to use their mobile app (Niripad

Khamar) to report when and how many inputs they use in their ponds.[48] These farmers were potential producers from whom Parmeeda would purchase RTC fish. In the ZOI, Parmeeda sought to improve its brand and expand outreach via mobile, school, and other social media about food safety—with a focus on safely farmed fish.

In addition to accessing support through the mobile app, in 2021 Parmeeda launched a dedicated call center for fish farmers that was available through the app and through the number provided during training. It notes that even farmers registered on the app use only a few of the app's functions, and most farmers lack access to smartphones. As of this writing, the app is offline for several months while it is being updated. Parmeeda's 2021 closeout report notes that farmers need support, easy-to-access features, and "continuous reinforcement" for users to experience the app's value. Also, Parmeeda finds that direct procurement from fish farmers requires linkages (familiarity) within their communities. Given these combined challenges, it started buying fish through local agents familiar to farmers, which helped it build trust with farmers. Local agents are sometimes lead farmers.

Findings: As previously stated, the linkages between BANA grantees and women farmers are strong and are expected to continue. The linkages between BANA grantees and dealers, WMFs, and retailers likely depends on continued communication, which had dwindled during the off-season when the ET was conducting the case study. If BANA grantees continue their outreach to these businesses, then the linkage may continue; without that communication, unless farmers demand the products, the businesses may drop the connection or maintain it only with a dealer from whom they can purchase products demanded by the farmers in their catchment areas.

6.2. Private-sector engagement

As noted in the introduction, BANA's investment and, therefore, the grantees' investment, in Faridpur was small compared with other districts in Feed the Future's (FTF) ZOI and Zone Of Resilience (ZOR). Grantees' funds were not disaggregated by where they worked, so no district-level investment figure is available.

The BANA team noted that Aftab Feed is expanding its feed distribution channel to remote areas with their multiple partner engagement in OSSCs and Aftab's investment ratio increased gradually across grants. An Aftab representative expressed appreciation for the cost sharing as it allowed Aftab to directly reach thousands of farmers through promotional events and training. He said that the BANA-associated "*sales growth … was 5-10%*." The Faridpur Aftab AMP/technology retailer's business also expanded due to his relationship with Aftab's BANA-supported efforts, as did the businesses of the three Petrochem-trained WMFs interviewed. All said they would continue working with the farmers with whom they are newly connected.

Aftab is currently continuing with another BANA grant, focusing on 1) completing the app development started during the first grant, 2) OSSCs, and 3) increasing fish feed dealers in the ZOR. Aftab's 2022 closeout report describes challenges in developing the LSP model but found that it was ultimately beneficial to the company's outreach efforts to farmers and increasing sales.

While AIT noted success through its direct sales program ("… *the tea stall meeting program … ultimately helps to increase sales and is continuing even outside of the FTF zone*," said an AIT representative), the AIT local representative did not believe the company would replicate the LSP model but, rather, it would encourage dealers to add retailers to the distribution channel and thereby increase their sales and customers. AIT's 2022 closeout report states that AIT achieved its target of establishing 50 LSPs, and these LSPs served just over 3,000 farmers. However, the report also notes that significant monitoring, training, and follow-up are required to establish the LSP model, and dealer/retailers—who are supposed to support the LSPs as they are their "extra hands"—are "more focused on their own businesses and making profit."

[48] At the time of the field work, the ET did not have a list of Parmeeda-trained farmers. The area where Parmeeda engaged farmers in Faridpur appears to be on the border with a neighboring district (Gopalganj). As Parmeeda's report is not disaggregated at the district level, the ET cannot assess the effects of Parmeeda's training in Faridpur.

When asked if he will continue activities under the AIT initiative, an AIT dealer said, "*Not exactly. When the project stopped work with AIT, no activities were organized in this area, which resulted in a reduction of AIT feed sales compared with the project period. My future target to increase the fish farmers is to establish my own farm and increase my investment.*" The other AIT dealer said that his business geographically expanded to "*where this feed was not available*," and "*sales increased 25-30%.*" The BANA-supported initiative increased his connections with 50 retailers, two mobile feed sellers, and customers. He maintains relationships with his retailers but does no other activities to increase outreach since AIT is no longer active with BANA.

Petrochem expressed similar concerns about needing to support OSSCs and WMFs as AIT and Aftab expressed LSPs have singular trainings and short-term interventions which are insufficient to drive continued used of BMP and incentivize actors to seek out information through offered resources. Petrochem's 2022 closeout report notes that the new distribution network "increased sales volume significantly." After establishing 59 WMFs, Petrochem promoted 18 of them to OSSCs and added another 17 OSSCs to build its distribution network for AMP.

One key informant noted that outside of Faridpur and unrelated to BANA, Petrochem is building a network of retailers rather than WMFs. When asked about the future of their activities under BANA, a Petrochem representative said, "*When the project closes, the company will continue the activities as they have already invested in the sector and if these activities will continue at least one to two years, the optimum outcome could be possible. The company should work/focus at the farmers level and service provider level. This business model demonstrated a positive sign for increasing pesticides, seeds, micronutrients sales along with fish medicine. The model will not be changed but some activities may be customized,* e.g., *the pond demonstration number could be minimized or reduced, or implement a cost share basis."*

Parmeeda plans to further strengthen its relationships with agents developed during their two years with BANA. The company continues to invest in its e-commerce platform through registering producers (backward linkage) and forward linkages (consumers and businesses) in its RTC supply chain. In addition, Parmeeda plans to continue its efforts to reach consumers who are not served through the e-commerce platform, as they are not comfortable ordering through a mobile app with mobile fish vendors. Parmeeda developed one mobile unit with BANA out of the three planned, and rather than renting fish vans, the company procured a van with the Parmeeda logo as a long-term asset. In its final closeout report and when interviewed, Parmeeda stressed the need for cold transport and storage facilities in the value chain.

Regarding innovation, Aftab, AIT, and Parmeeda had a call center or mobile number that they provided to farmers. While none of the farmer FGD participants mentioned these (and the women did not have mobile phones), the Aftab and AIT retailers interviewed said they were successful in communicating with farmers and supporting their needs, and that farmers were using the services. Parmeeda's closeout report suggests that their call center was needed due to farmers' discomfort using, or their inability to use the mobile app. The interviewed Aftab retailer mentioned that Aftab's mobile app "*Safal Songi*" is in operation, but farmers are unaware of the service (it was not mentioned by any farmers).

City Bank Ltd. (CBL) cited a 100 percent increase in its aquaculture business. The City Bank national-level informant said he would like to continue expanding *"if the program continued."* He provided the same recommendations as found in City Bank's closeout report (2022) about introducing a one-stop service model with fintech services for aquaculture stakeholders.

Findings: Overall, grantees and the sales actors linked with them said that sales and profits increased. Results suggest that some market linkages are sustainable, while others are dependent on input availability (water test kits) and input demand (e.g., if fish feed is too expensive, then farmers won't purchase it, which means that WMFs and retailers likely will stop carrying it).

6.3. Enabling environment for inclusive growth

Access to credit was the strongest identified impediment to productivity in the Faridpur aquaculture sector that BANA invested in across the FTF zones. The Faridpur Feed Association representative said that credit sales are rare in fish production, though they are very common in the poultry sector.

While some buyers/dealers/retailers provide credit, most people said that getting access to credit is either 1) too expensive from Micro Finance Institutions (MFIs)/NGOs) or 2) too difficult from banks. Some farmers specifically expressed a desire for formal financial services. They described challenges such as documentation and bureaucracy and banks preferring to give loans to large farmers.

> *"The first challenge for the younger people is access to capital and high prices of fish feed. There is a government initiative to get credit from the bank at lower interest for fish farming and agriculture, but due to the bureaucratic process the challenge for them is to access the credit, bank officials are likely to provide credit to the large farmers. Even NGO[s] don't permit loans for fish, so the farmers hide the fish cultivation purpose and take it as a business loan."* – Faridpur male youth farmers

Young male farmers trained under BANA, talked about a Government of Bangladesh (GOB) initiative to promote aquaculture. Some of the adult women farmers trained by Petrochem had—at some time during the project period, but not known to be related to BANA—obtained loans from the Bangladesh Rural Advancement Committee (BRAC) and a youth development organization under a GOB initiative with the Department of Youth.

BANA's grantee, CBL, agreed to provide financial literacy training to 1,000 hatcheries, nurseries, and farmers with targeted loans of BDT 120, 300, and 1,100, respectively. CBL's grant and closeout report targets differ significantly. The bank trained 120 hatcheries, 200 nurseries, and 600 farmers, thereby nearly achieving the goal of 1,100 trained. The loan target in the closeout report is 300 compared with 1,520 in the grant agreement. In addition, the closeout report indicated that CBL provided 250 loans, while the BANA database indicates 230 loans across four territories, including Faridpur.

Other challenges in the aquaculture sector enabling environment include establishing a licensing system for hatcheries and feed mills, the use of jute bags for feed, and inadequate execution of existing regulations, as voiced by male youth (see quote). Most informants said they faced no policy-related challenges in the aquaculture sector. While no one specifically mentioned transport as a challenge, one non-BANA buyer (snowball interview) identified two major issues: fish preservation and lack of storage facilities.

> *"In Bangladesh there are enough policies, laws, and regulations but execution is very poor. Like quality control of fish feed, DOF support to the farmer, access to credit, etc. are not properly monitored by the authorit[ies]. There is no association of fish farmers in our village to raise voice, motivate the new generation and retention of existing farmers in this sector to ensure the availability of services."* – Faridpur male youth farmers

Findings: BANA-supported grantees like CBL sought to increase access to and use of formal financial services to fish farmers. As seen in CBL's numbers, only a few loans were provided to fish farmers—confirming what farmers convey, that affordable credit on terms tailored to aquaculture cycles is mostly unavailable.

7. Nutrition and hygiene (IR3)

BANA sought to integrate nutrition awareness in its grantees' activities to improve family nutrition practices. Those practices include good hygiene (when and how to wash hands) and preparation of fish and (a few) vegetables in addition to producing fish and vegetables. Some of the grantees' local actors said they shared nutrition messages with customers, while a few did not.

7.1. Nutrition awareness and practices

Most informants and FGD participants know about the nutritional value of fish, and some know about the importance of eating vegetables. They learned in school and from a cartoon (South Asian children's television series created by the United Nations Children's Fund (UNICEF) with Meena, a nine-year-old girl) that was broadcast for several years. Fish farmer (FGD participants) also learned about the value of consuming fish and vegetables from training, though the dealers and retailers did not indicate they had training on this as part of BANA.

Specifically, FGD participants (all farmers) knew about how to eat the mola head rather than cutting it off and to give fish and vegetables to all family members, including children. A couple of them mentioned washing vegetables.

Regarding hygiene, no one had tippy taps (running water for handwashing), but they know when to wash, and adults from FGDs mentioned using soap and water when handwashing. The ET found that it is not possible to separate the effects of BANA-supported training and COVID-19 effects, as many people changed their handwashing habits during the pandemic.

7.2. Access to diverse and nutritious foods

In Faridpur, participants eat the fish they produce in their homestead ponds. Some grow vegetables also, though they say vegetables are abundant in the market. They mentioned no issues regarding access to diverse and nutritious food.

Findings: BANA's nutrition-focused activities were well understood by farmer trainees. They especially appreciated the carp-mola polyculture training. It is not possible to distinguish hygiene and nutrition knowledge learned from BANA and non-BANA sources such as schools and other public information campaigns, especially those related to handwashing during COVID-19.

8. Cross-cutting themes

BANA's theory of change identifies the following cross-cutting themes: the inclusion of women and youth in aquaculture and environmental issues. Each is addressed below. Regarding inclusion, grantees agreed to include a percentage of women and youth in their activities. A review of closeout reports and Aftab, AIT, and Petrochem grants confirm this.

Aftab succeeded in reaching their youth (10 percent) and women (20 percent) engagement goals (see Table 2). Their 2022 closeout report states that in courtyard events, they reached "at least" these percentages; and that in capacity-building events for LSPs, they reached at least 20 percent youth and 10 percent women. Similar results were recorded for refresher capacity-building events. The data were not disaggregated by location. The case study found no evidence of LSPs in Faridpur and the only Aftab sub-dealer (male) in Faridpur was unaware of any Aftab LSPs.

AIT's grant indicates their engagement will include 10 to 20 percent women and 25 percent youth. Table 2 shows that they reached 12 percent women and 21 percent youth through their training activities. AIT committed to developing 50 LSPs and confirmed having done so in their 2022 closeout report. No LSPs were found to be active in Faridpur as of March 2023. AIT noted in their report that one of the challenges is that "women entrepreneurship is still a hurdle," though the report also states having empowered 15 percent women in the project.

Petrochem claimed a 50 percent inclusion rate of women/youth as expressed in the 2022 closeout report, which is not reflected in the farmers-trained data (Table 2). Petrochem used a "hub and spoke" model—with OSSCs as the hub and WMF as the spokes, establishing 60 WMFs and 30 OSSCs. One of the four in Faridpur never became active, yet she is listed in the BANA-provided dealer/sub-dealer database as one of the 60 established.

CBL agreed to provide financial literacy training and make loans available to qualified clients. Of the 182 loans identified by age and gender, four percent were to women and 12 percent to youth, with an overall inclusion rate of 13 percent (Table 2). The grant did not mention a loan-related inclusion target.

Table 5-H. BANA-trained farmers by grantee and demographics

-	**Women**		**Men**		**Inclusion rates**		
-	*Adult*	*Youth*	*Adult*	*Youth*	*% women*	*% youth*	*% women & youth*
Aftab Faridpur	8	0	22	44	11%	58%	
Afab BANA-wide	3,150	1,092	12,175	3,094	22%	21%	38%

-	Women		Men		Inclusion rates		
-	*Adult*	*Youth*	*Adult*	*Youth*	*% women*	*% youth*	*% women & youth*
AIT Faridpur	26	7	195	107	10%	34%	
AIT BANA-wide	283	50	1,042	545	12%	21%	31%
Petrochem Faridpur	49	27	766	74	8%	11%	
Petrochem BANA-wide	1,702	566	5,639	827	26%	16%	35%
CBL BANA-wide	2	6	159	15	4%	12%	13%

8.1. Women's roles in aquaculture and attitudes toward women working in aquaculture

BANA's Gender Strategy describes a gender-transformative approach to change the attitudes and roles of women in the aquaculture sector. This includes BANA's partner (grantee) selection and the partners' attention to:

- Equal opportunity employment
- Gendered budgets
- Maintaining diversity and equality in staffing procedures and attendance/participation in events
- Gender-related targets
- Sex-disaggregated monitoring
- Zero tolerance for sexual harassment and gender-based violence

Also, BANA sought to increase capacity building and sensitization of BANA and partners' staff, apply a gender lens in communications, and conduct gender analysis of research and monitoring, evaluation, and learning (MEL) data, reporting gender-related results "fortnightly, quarterly and annually" to the United States Agency for International Development (USAID).

Aftab, AIT, and Petrochem grantees used a family model in which the grantee approaches the family, especially husband and wife (or wives), to encourage participation of women in events such as training and promotion. Grantees emphasized the importance of at least one family member attending each training session. BANA's grantees' training encouraged some women to learn and engage more in aquaculture. Some of the women retailers and farmers linked to BANA grantees were empowered by their involvement in aquaculture.

WMF owners and farmers see aquaculture as an opportunity to earn an income, be more independent, and contribute to the family. Some of the young women in the FGD said that they do not have to ask for money from their parents and can educate themselves (i.e., pay for their own education). Others said that if they earn money, they do not have to ask for money from their husbands for their children's education. Having an income of their own helps them when their husbands are not available. One WMF said, "*Other women are encouraged [by] seeing my success*."

Men's attitudes about women working in aquaculture differed by age—where adult men largely felt that women are and should only be engaged in helping to take care of the fish in the homestead pond, while young men felt that women should be engaged in aquaculture and agriculture. Young male FGD participants agreed that women in the area are not accustomed to working outside of the home "*due to cultural/traditional habit.*" Two of the male dealers said that women are not interested in working outside of their homes. They described women's role in aquaculture as feeding the fish in the homestead pond. Adult male farmers also said that women are mostly involved in fish feeding and/or post-harvest activity.

Women's attitudes also differed by age, where young women perceived their aquaculture work as empowering and older women appreciated the learning that they were able to use to generate increased fish production and income. While no women were found to be employed by dealers/retailers/others in the study, most people agreed that women's involvement in aquaculture is increasing. Most women are said to participate in their homestead pond and as unpaid labor supporting their husbands' businesses.

Women's mobility is constrained by social and cultural norms. Some adult women farmers from the FGD mentioned that they take the long route through neighbors' homesteads and back roads to avoid exposure to unknown people. They use their husbands' phones, as they don't have their own, and talk to people in front of their husbands. None of the women FGD participants had mobile phones.

Besides limited mobility, additional social norm-related constraints include the heavy load of household chores and childcare (unpaid labor), lack of independent decision-making (husbands make decisions), and lack of mobile phones (mentioned by two women). A local retailer said that "*women do not directly come to buy here, but they have the expertise for fish farming. They know better what medicine should be used; in some cases, they know better than men.*" A WMF owner said that women are now willing to do an income generating activities (IGAs) on their own.

Findings: The ET found some women's empowerment among WMF and women farmers, mostly in terms of increased knowledge—which, when used, increased their sales/production and, therefore, income. Grantee closeout reports made clear that engaging women was challenging due to women's abundant responsibilities at home. Some complained about women bringing young children to training sessions. The family approach described in BANA's gender strategy had some success but requires significant time and resources when engaging families and recruiting. The private-sector commercial companies will not continue to engage and train smallholder farmers without support. The ET saw no evidence of equal opportunity employment by grantees in their businesses or in their dealers and retailers in Faridpur. The ET found no evidence of gendered budgets in the grants of the referenced grantees. Most grants stated they would include some percentage of women in their activities.

8.2. Youth roles in aquaculture and attitudes about youths' interest in aquaculture

BANA's youth strategy identifies opportunities for youth engagement in the sector through e-commerce, digitization, and modern technology used in fish farming as a business—combined with youths' willingness to be mobile and their expressed concern for climate change and environmental initiatives. The strategy acknowledges several constraints for youth engagement, including:

- Domination of the sector by older men who control aquaculture assets (ponds)
- Youths' lack of access to capital and technical knowledge
- Youth perceptions about aquaculture as a business
- The pull toward urban environments
- Private-sector actors do not typically trust youth as partners

Contrary to popular wisdom, Faridpur youth are interested in working in aquaculture. Both male and female youth FGD participants indicated their advantages compared to adults: education (female) and use of smartphones (males). In addition, young men are interested in or are engaged in working collectively as a group in aquaculture as an IGA. The Faridpur Feed Association also noted that youth are interested in aquaculture as an IGA, but that recent input cost hikes have discouraged them. Two other adult informants agreed that youth help in the homestead ponds and have an interest in aquaculture as a business, while adult FGD participants said that youth are not interested in aquaculture as an IGA.

Findings: Except for engaging youth through training, the ET saw no other youth engagement in aquaculture in Faridpur. The ET notes, however, that BANA has documented youth engagement, including youth entrepreneurs, elsewhere.

8.3. Environmental issues affecting aquaculture

Typical environmental challenges to aquaculture in Faridpur are the monsoons and jute processing. Study participants' perspectives on these challenges differed, where one person said they are a huge challenge—because monsoons mean that fishponds can overflow, and farmers can lose their investment. Others, including many farmers, said that monsoons mean having sufficient water in their ponds so that they can culture fish. Young female farmers (FGD participants) said they repair their ponds and banks at this time of year. They would like to see some sort of net or something to keep out insects, frogs, and snakes that can harm or eat the fish. A dealer noted that the rainy season is not a problem due to the canal system in place—saying that flooding is rare in her area.

Jute processing also contaminates ponds so that they cannot be used safely to culture fish. The DOF district officer said that Faridpur people are mostly accustomed to capturing fish, not culturing them. Adult male farmers said that the rivers have been overexploited. The DOF officer also indicated that local ponds may not be good for culturing fish because some are very deep, and others lack water-holding capacity. He also said that due to the iron content in some water in Faridpur, ponds are not good for fish hatcheries or nursery operations.

Findings: BANA did not address the above-referenced issues.

ANNEX 8: SATKHIRA CASE STUDY

Summary:

The Evaluation Team (ET) visited 13 Bangladesh Aquaculture and Nutrition Activity (BANA) grantees in Satkhira, held discussions with 29 individual participants, and conducted four (4) Focus Group Discussions (FGDs) in Satkhira. There was a total of 61 participants—18 female and 43 male—of whom 32 were FGD participants. The 13 grantees provided below described services to the aquaculture stakeholders due to being connected with BANA:

Grantee Name	Grantee Focus
Bithi Scientific Hatchery and Fisheries	Ensure quality *tilapia* seed production by practicing BMPs at the hatchery level and strengthening distribution networks.
Mega Feed Ltd.	Promote private extension service by establishing Mega Feed School at dealer and sub-dealer points.
Agro Industries Trust (AIT)	Produce and promote quality native carp floating feed for small and marginal household fish farmers by using local ingredients in the process of formulation.
KNB Agro Industries Ltd.	Improve fish farmers access to quality feed through LSPs connecting OSSCs led by feed dealers. Develop new feed formulation using locally sourced feed ingredients and marketing. Build collaborative business promotions through B2B facilitation to ensure access to quality inputs and service for fish farmers.
Aftab Feed Products Ltd.	Establish an inclusive and digital feed supply chain management system using cloud-based mobile technology to ensure on-time appropriate quality feed and related service for small-scale fish farmers.
Petrochem Bangladesh Ltd.	Promote quality aqua inputs through WMFs. Ensure advisory services for small-scale aquaculture farmers by developing WMFs.
KAAS Trade	Diversify existing aqua medicine product sales through vertical expansion—including LSPs, institutes, and lead stakeholders.
IMEXPro (BD) Bangladesh	Promote small-scale aqua machinery to make it accessible and available for the smallholders.
Alim Industries Ltd.	Sustainable aquaculture mechanization and market development through modern aquaculture machinery.
MarGEn Ltd.	Sales and distribution of processed frozen and diversified fish items (RTC and RTE). Develop a cool chain management model for aquaculture.
M- World	Promote and distribute *G3 rohu* seedlings to hatcheries, nurseries, and farmers. Facilitate better transportation for carrying fish input and output by introducing "Maacher Gari" (Fish Truck).
Shushilan	Strengthen nutrition-sensitive aquaculture by enhancing nutritional behaviors and private-sector engagements. Promote nutrition-sensitive aquaculture through microfinance support.
Bank Asia Ltd.	Introduce a customized financial package for smallholders involved with fish farmers and aquaculture market actors. Improve access to formal financial packages for aquaculture stakeholders.

BANA grantees supported fish hatcheries to ensure biosecurity measures for brood fish management and seed production. These are good efforts to ensure production of carp and tilapia quality seed. The availability of high-yielding *G3* rohu seed increased slowly, but the availability of natural CPG and brood

fish was a challenge even though BANA supported the development of *G3* rohu and the natural CPG supply chain. However, due to BANA's investment, the seed supply chain is functioning well among the actors—such as hatchery owners, spawn/fry traders, nursery operators, fry/fingerling traders (*patilwala*) and farmers. Fish feed and aqua medicine is available in Satkhira, but quality and affordability are still challenges for farmers. BANA supported several private feed and medicine companies in addressing the above challenges, but little effort was made to control the quality and lower the unit price. The recent increase in the price of raw materials and the hike in the dollar conversion rate impacted feed and medicine prices. The project also supported local feed millers to manufacture feed using local ingredients; but due to a lack of capital and license, these mills are not functioning well.

BANA grantees capitated the market actors (dealers and sub-dealers) and added LSPs and WMFs in their distribution channels for better access to inputs, water quality testing facilities, and advisory services on BMPs. The market actors organized farmers' trainings and established OSCCs to ensure availability of those services. The farmers' knowledge and practices improved and advisory services continued, but water testing services are not available in the project areas. The ET did not find a LSP in the project areas. Two grantees, Alim and IMEXPro, facilitated the improvement of technologies such as aerators, secchi disks, and water testing kits for maximizing fish production, but those are not suitable/effective for small and marginal farmers. As a result, the business of those companies did not pick up as expected.

Shushilan (an NGO) and Bank Asia developed a new/suitable loan product with easy access for the small and marginal fish farmers. Shushilan provided a two-month grace period to the farmer for repaying the loan, and Bank Asia developed a referral-based agent banking loan model and uses a digital platform for loan disbursement and payment.

Parmeeda and MerGEn, worked to strengthen the fish supply chain through post-harvest management, packaging, transportation, developing RTE and RTC fish products, and selling to the urban market. MerGEn continued the business with incremental growth of the RTE and RTC markets, but Parmeeda's business model for safe fish production and marketing was unsuccessful due to insufficient capacity building support for BANA project participants.

BANA contracted with private companies to develop digital platforms (apps) and implemented them across the project areas to improve the information dissemination channel among the farmers, input sellers, output buyers, and service providers' market. But in Satkhira, the ET did not find them being used at the field level.

Most of the participants said that policies/regulations have a minimal effect on overall growth of the aquaculture sectors. However, policy review and enforcing practices to enable marginal farmers access to loans is a critical factor for growth of the sector. Inclusive growth is one of the major focuses of the BANA project. In Satkhira 10 grantees' data were analyzed—revealing that NGOs' activities are more inclusive than private-sector ones for capacity building and access to loans. These grantees trained 8,871 fish farmers—of whom 42 percent were women and 25 percent were youth.

All participants agreed that women contributed a great deal to fish culture in the homestead ponds. But social and cultural challenges limit them to participating in commercial fish production. On the other hand, youth participation in the aquaculture sector is increasing because aquaculture is the main livelihood option in this area.

1. Increased aquaculture productivity (IR1)

Satkhira is a fish-growing zone where both carp and tilapia are produced. Shrimp and crab also grow as high-value economic crops in Satkhira—particularly in the saline-prone areas. Most of the people's livelihoods depend on aquaculture sectors. A good deal of fish is exported from this area to other districts of Bangladesh. So, one of the principal demands of the people is increased fish productivity by accessing and using quality seed, feed, technology, and services.

Availability and affordability of seed and feed usually is not a big challenge for the farmer except for the recent feed price hike. But ensuring quality of seed and feed, and access to technology and services, are challenges in this area—because extension services are weak or unavailable.

BANA contributes much to fish seed quality improvement, enhanced knowledge, and use of BMPs; and it introduces technologies and services for increasing fish productivity. However, further improvement is required for improving feed quality, lowering the feed price, and strengthening access to service markets.

1.1. Seed (availability, quality, affordability)

In Satkhira, most participants mentioned that seed is available at a reasonable price in this region but identifying and ensuring quality fish seed is still a challenge for the farmers, which may affect fish productivity. Farmers can measure the quality of fish seed by observing some physical characteristics (shiny skin, no external symptom/spot of infection, speedy and anti-wave movement in water), although seed quality depends on hatchery management. In collaboration with BANA, the Bithi hatchery in Satkhira produced tilapia seed (GIFT and monosex), and the Modhumoti hatchery in Jashore produced carp seed. Both hatcheries practiced biosecurity measures that contributed to improving brood management, quality seed production, and reduced mortality. The DOF representative for Satkhira shared that seed quality could be ensured by using mature broods (age 1.5 years, and size above 2 kgs for rohu), avoiding cross-breeding between different fish species, and brood replacement after two to three breeding cycles.

BANA provided support to hatchery owners to ensure biosecurity measures, supplied *G3* rohu fingerlings and developed a supply chain of inducing agent Carp Pituitary Gland (CPG) for fish breeding. M-World (a BANA grantee) distributed *G3* rohu fingerlings to selective nursery operators and farmers. The ET observed that *G3* rohu seed is not widely available in this region. Modhumoti hatchery owner said that BANA selected United Agro to collect and supply natural CPG. But the company did not supply the CPGs to the BANA selected hatcheries rather, sold them to other hatcheries or abroad.

> The owner of Bithi Scientific Hatchery and Fisheries said: "Companies like Mega, CP, *etc.*, have brand value. [They] supply monosex *tilapia seed and I (hatchery owner) am competing with them in the market for selling my monosex tilapia seed. I try to develop [a] brand of my seed.*"

BANA also supported the hatchery in collecting GIFT tilapia broods from the BRAC hatchery to produce monosex tilapia seed. The hatchery owner mentioned that some feed companies like Mega, Paragon, CP, Quality, and Nourish supply monosex tilapia seed in this region.

BANA grantees the Modhumoti and Bithi hatcheries expressed that they maintain biosecurity and collect/culture good-quality brood fish. They invested their own capital to buy more ponds for producing broodfish on their own. Both hatcheries plan to expand their business for selling *G3* rohu and monosex tilapia seed to other districts across the country.

Hatchery owners and DOF representatives highlighted that good-quality brood fish availability and supply chain development is important for quality fish seed production. In addition, labeling, branding, certification, and promotion could create competition among the hatcheries and ensure a quality seed supply in the market.

Finding: Farmers' accessibility to and affordability of quality seed was improved due to BANA's intervention. However, for sustaining a quality seed supply chain, further support is required for brood fish production and strengthening the brood fish and CPG supply chain. Availability of *G3 rohu* seed will greatly impact fish productivity.

1.2. Feed (availability, quality, affordability)

As discussed with DOF representatives, the ET knew that they were authorized to monitor feed quality. As a routine task, they collected feed samples from the local feed dealers every month and sent them to the lab (Khulna) for testing. If the sample failed to meet the quality standard, they sealed the shop and notified the respective feed company.

Most participants—farmers, feed dealers, and DOF representatives—said that feed quality and affordability were the major challenges for the farmers in this region. The ET met approximately 10 field representatives of BANA grantees (feed companies), who claimed that their feed was best in quality, considering the protein content. However, a DOF representative mentioned that quality

depends on the composition of feed ingredients such as protein, fat, fiber, ash, moisture, *etc.* Protein content is the most important quality indicator; and for carp culture, 25 to 30 percent protein is necessary in feed formulation. All companies provided this information on the feed bags; and during trainings, meetings, demonstrations, and field days, they engaged dealers to disseminate the feed quality information to the farmers. Feed companies also included this information in their promotional materials, (posters, leaflets, festoons, *etc.*).

Another challenge is the ability of marginal and small farmers to buy fish feed. The current feed price is 1.5 to two times higher than in 2020. In 2020 the feed price was 35 to 40 tk/kg; now it is 65 tk/kg. Among the participants, most of the feed company representatives and dealers assume that sales will be lower this year because farmers will reduce feed use in their ponds/*gher.*[49] We heard from the companies' field staff and dealers that due to the increase in the price of raw materials for feed, an adjustment is applicable to all companies. However, companies use their best judgment when adjusting feed prices compared to their competitors, and the unit feed price difference among the companies is 2 to 3 tk/kg.

DOF staff and FGD participants (adult women and men) mentioned that farmers use local feed such as rice bran, oil cake, and crushed maize; and apply zeolite, chemical fertilizer, and sometimes compost to ensure natural food availability in the pond/*gher*. They buy feed ingredients from the local market and sometimes use local feed mill for formulating and producing the feed. However, due to a lack of technology, local feed mills did not maintain quality like commercial feed companies. There is a 5 to 10 tk/kg price difference between feed from commercial feed companies and local mills.

Farmers and other participants said that they do feed management based on their own experiences; neighbor farmers' experiences; and advice from dealers, company representatives, and the DOF. Their feed management (dose and application) practices are irregular. Generally, farmers use natural feed (household feed like cooked rice or rice bran) in their homestead pond, where they grow fish for their own consumption. But for commercial fish production, the feed management depends on fish growth stage, fish density, availability of natural food and the overall financial capacity of the farmer.

Two BANA grantees, KNB and Matrix, support the local feed millers through capacity building, establishing linkages, and providing access to inputs, machinery, services, finance, *etc.* The ET found that KNB has facilitated business to business (B2B) relationships to increased feed sales, and Matrix has a future business plan to increase maize and machinery sales to the community feed millers. KNB also conducted several trials in the field to find a new feed formulation ratio that uses local ingredients and reduced the feed pellet size to 0.5 mm. Two grantees used different approaches for building business relationships with small feed millers.

i) As a regionally based company, KNB connected with small feed millers across the country and supplied KNB feed to those millers. The small millers directly sell KNB feed or repackaged feed under their own brand. The small millers also manufacture their own feed by renting KNB machines, then packaging the feed and selling it in the market.

BANA intended to develop the small millers' capacity on business management, strengthen their distribution channels and increase their outreach through KNB. However, it was dropped due to KNB not being able to meet the new feed demand of those small millers (smaller size) and the legal barriers to renting machines and packaging KNB feed by other companies.

ii) Matrix intended to develop the capacity of the small feed millers on business management; establishing linkages; and providing access to machinery, raw materials/ingredients, services, finance, *etc.* It capacitated 50 feed millers and turned 12 millers into CFCs (Community Feed Centers). Three feed millers among the 12 CFCs were trained from the Satkhira district. These engagements came with several lessons, such as:

[49] *Gher* means an aquatic place or area where there is fish or shrimp commercial culture in an artificial or natural environment.

- Small feed millers can reduce the cost of feed per unit; ensure a feed supply according to demand from the farmers; diversify the millers' business by selling feed ingredients and medicine; and provide pond water testing services.
- The challenges were getting feed manufacturing licenses from the authorities, lack of business knowledge and skills, poor/low capacitate infrastructure, lack of capital/access to credit, and economies of scale in purchasing ingredients and production.

The ET did not find good progress in the partnership due to the short period of support, lack of capital to increase the production capacity of the small feed millers, and BANA failing to prioritize the challenges.

Finding: Commercial feed is available but ensuring its quality and affordability is a big challenge for the farmer. The DOF is authorized to monitor feed quality, and locally manufactured feed is cheaper than commercial feed. Local small-feed millers faced legal, capacity, and financial challenges to grow their businesses. The ET found distinct differences in feed use practices between large commercial farmers and marginal farmers, homestead ponds and commercial ponds/*gher*. Feed uses depend on the natural food status of the ponds/*gher*.

1.3. Other inputs, e.g., aqua medicine, equipment, technologies, services

Farmers also need other inputs such as medicine, equipment, and services for fish production. Similar to the feed distribution channel, Aqua Medicine Product (AMP) is available in the project area—but most of the farmers said that the price of medicine is high. On the other hand, farmers' access to aqua services, equipment, and technologies is limited. According to FGD farmers, the demand for the pond/*gher* water quality testing service is high. At present, farmers rely on their experience, water color, and fish behavior; take advice from the dealer/neighbor farmers; and use medicine to improve their ponds' water status.

BANA's grantees—Petrochem, KAAS, IMEXPro, and ALIM—work to ensure the availability of AMPs, water and soil quality testing kits, equipment (Aerator, Secchi disks, PH meter), and services for farmers. Petrochem, KAAS, and IMEXPro continue to sell AMP; but according to the FGD farmers, they did not provide the testing and advisory services. As per agreement, Petrochem was to recruit and train WMFs and equip their businesses with signage, furniture, and testing kits to establish One Stop Service Centers (OSSCs). KAAS and IMEXPro facilitate similar services from their dealer points, but none of the interviewed participants received the testing kits. The ET heard that Argon (a KAAS associate) provided free pond water testing services to farmers through their staff from dealer points.

One dealer said that ALIM stopped their business operations in this area, but ALIM said that the business model for LSPs and dealers did not work well because the aerator is a new product, need space due to large size and it suitable for commercial farmers. Therefore, sales were slow and ALIM shifted their business model, *i.e.,* operated their business from the Satkhira district sales point, where the territory officer was posted. The officer responded to customer demand by transporting the machine from their factory (Dhaka/Sylhet) and ensuring installment support and after-sales service by their trained mechanics.

BANA contracted with feed companies—*i.e.*, Aftab, AIT, and KNB—for extension of the testing services by adding new LSPs in their distribution channel; and established a service center at the dealer points close to the farms. However, ET found only one testing kit available to the Aftab sub-dealer at Shyamnagor, who was recruited in February 2023. AIT and KNB did not provide testing kits to the dealer points; as a result, the service center was not operational.

Dealers, sub-dealers, LSPs, and WMFs said that they received training from BANA grantees and the WFC trainer on improved fish production technology, testing technologies, nutrition knowledge (carp-mola polyculture, vegetable cultivation in dikes) and gender and youth inclusion. The dealers, LSPs and WMFs organized similar trainings for farmers in the community centers called "learning schools." BANA's grantees conducted a demonstration pond to show the results of BMPs to the farmers and convinced them to follow BMPs for fish production. The farmers in the FGD confirmed that they received training and practiced it during fish production. Farmers, especially the commercial farmers,

mostly follow BMPs to maximize production from the ponds/*gher*, but small and marginal farmers use BMPs depending on their financial ability to do so.

The ET analyzed 10 BANA grantees (one bank, one NGO, one output marketing company, three feed companies, two medicine companies, and two private service providers) who were active in the Satkhira district for fish farmer capacity building. These grantees trained 8,871 fish farmers on BMPs—of whom 42 percent were women and 25 percent were youth. But women and youth together, the coverage was 48 percent. There is a big difference between the ability of NGOs and the private sector to address the inclusive growth agenda in the business. This is more conducive to NGOs than to the private sector. Out of 3,807 fish farmers that Shushilan trained, 87 percent were women and 44 percent were youth. On the other hand, private companies trained 5,064 fish farmers—of which 5 to 20 percent were youth and 5 to 12 percent were women. We found that four companies did not train women and youth during implementation of their activities.

Finding: Aqua medicine is available in this region, but it is costly. Farmers' knowledge of BMPs has increased because the BANA contracted companies and NGOs' field staffs—plus dealers, sub-dealers, and WMFs—organized trainings, demonstrations, and individual counseling. BANA grantees introduced and made available aqua equipment, technologies, and services such as a water testing facility in this region; however, the supply chain of these services was in the early stages. Water testing services are useful to all types of farmers, but affordability and uses of equipment and technology are more suitable for the medium and large commercial farmers.

2. Market system (IR2)

There are several private companies and market actors with active aquaculture businesses in this region. Fish seed, feed, input and output market services are available, but the existing aquaculture market system is a bit challenging for the small and marginal farmers, women, and remote farmers to access services and output markets—particularly the seed and feed market. The market actors are well connected with each other, and their business is continuing.

BANA supports private companies to ensure input availability and quality, strengthen the services market by adding market actors/services providers within the distribution channel, establish service centers, improve post-harvest management and transportation, and diversify the fish product and marketing channels.

2.1. Market linkages (inputs—seed, feed, medicine, equipment, technology, and credit)

Market linkages among the actors are a bit different between fish seed and other input supply chains. With seed, it goes from the hatchery to the spawn/fry trader to the nursery operator to the fingerling trader to farmers. So, farmers have several options for getting the fish seed. Farmers—particularly the marginal and small farmers—get fish seed from fingerling traders. The relationship between the actors depends on the length of business period, transaction behavior, trust, *etc.* Based on the demand for fish seed, sometimes nursery operators and spawn/fry traders link to outside hatcheries/nursery operators/feed companies (for monosex tilapia) to get fish seed. This link starts with a referral and continues based on transaction behavior and trust.

The ET heard from the DOF and hatchery owners that the sources of brood fish are hatchery owners own production, DOF managed farms, private fish farms, and farmers. The ET found that hatchery owners produce their own broods to ensure consistent production of seed. BANA provided a GIFT tilapia brood to the Bithi hatchery and *G3* rohu seedling to the Modhumoti hatchery. However, in some cases, hatchery owners do not use a quality brood—especially when demand for seed is high. The DOF said that strengthening brood fish production and supply chain development is very important to ensure quality seed production.

The other input (feed, medicine, and equipment) distribution channel consists of company to dealer to retailer to farmer. Retailers/sub-dealers were not common for all companies. Farmers get their inputs, *e.g.,* feed, medicine, and services, from the dealers and retailers. In most cases, retailers are recruited/selected by the dealers to extend their business to remote locations. A strong linkage is seen between companies and dealers to ensure a smooth product supply, and between dealers and

retailers to reach more customers and increase sales. Most of the dealers' doing business with other input suppliers, such as agro input suppliers and fertilizer suppliers, to add products for increasing their business portfolios. This is also helpful for the farmers to get multiple products from one point. Among BANA grantees, only Aftab took SKF as an associate partner to supply AMP from the dealer point.

Marginal and small farmers buy feed ingredients from retailers based on the local market. They also buy feed from the local feed millers. Both retailers and local feed millers buy their feed ingredients from the local suppliers as well as from Dhaka. Local feed millers mostly use the feed for their own farm as well as selling it to neighbor farmers.

None of the actors in the case study mentioned using Apps. However, some of them use mobile phones for communication and bKash/other MFS for financial transactions with other actors.

The ET knew from the fish buyers, commission agents (Arotder) and FGD participants (fish processing labor) that wholesalers (big buyers) might be local or from a distant market buy fish from the wholesale market. The commission agent has good connections with wholesale buyers. A distant wholesaler appoints an agent to buy fish, process and package them, and arrange transportation. Farmers organize their own transportation or, sometimes, the commission agent provides this service to the farmers. BANA grantee MarGEn trained wholesale market labor on better cleaning, grading, icing, and packaging of fish for transportation to distant markets. Cold storage and refrigerated vans were not available in the marketplace for transporting fish to distant markets.

Fish farmers have good links with commission agents as well as local-level small buyers for selling their fish. If the catches are small, then farmers negotiate with a local buyer to come to his farm, catch fish, and get paid. However, a large percentage of the fish come to the wholesaler's market and farmers do this on their own. Farmers said that they transport live fish by mixing ice and salt with water in a plastic drum to get a higher price, *i.e.,* 30 to 40 tk/kg compared to packaging the fish in jute/plastic bags or bamboo baskets.

During the contract period, private companies and Shushilan organized several trainings/meetings, demonstrations, and video presentations with fish farmers to improve their knowledge of fish management practices. In those events, farmers made connections with company staff/technicians, and dealers and retailers. Most of the market actors agreed that implementing project activities such as adding LSPs/WMFs/lead farmers in the supply chain to reach last-mile customers; organizing learning schools/trainings/meetings to improve farmer knowledge of BMPs, establishing OSSC to extend water and soil testing services; and conducting demonstration ponds and promotional events increased the customers, sales, and income of the private companies. However, after the agreement ended, most of the grantees no longer continued those activities in the field.

Figure 1 describes the linkages among the actors of different components of the aquaculture sector in case study locations of the Satkhira district. The aquaculture sector is divided into three components: i) inputs, ii) production and iii) market. Inputs (seed, feed, and medicine, equipment and feed ingredients) are supplied by private companies as their core business. The right side of the box below describes the support services for inputs supply, fish production and marketing, the left side box describes the functions of the actors in each stage. The black arrow shows the product movement (seed, feed, medicine, equipment, feed ingredients and fish) from one actor to other and the green arrow shows both product and services/advice flow.

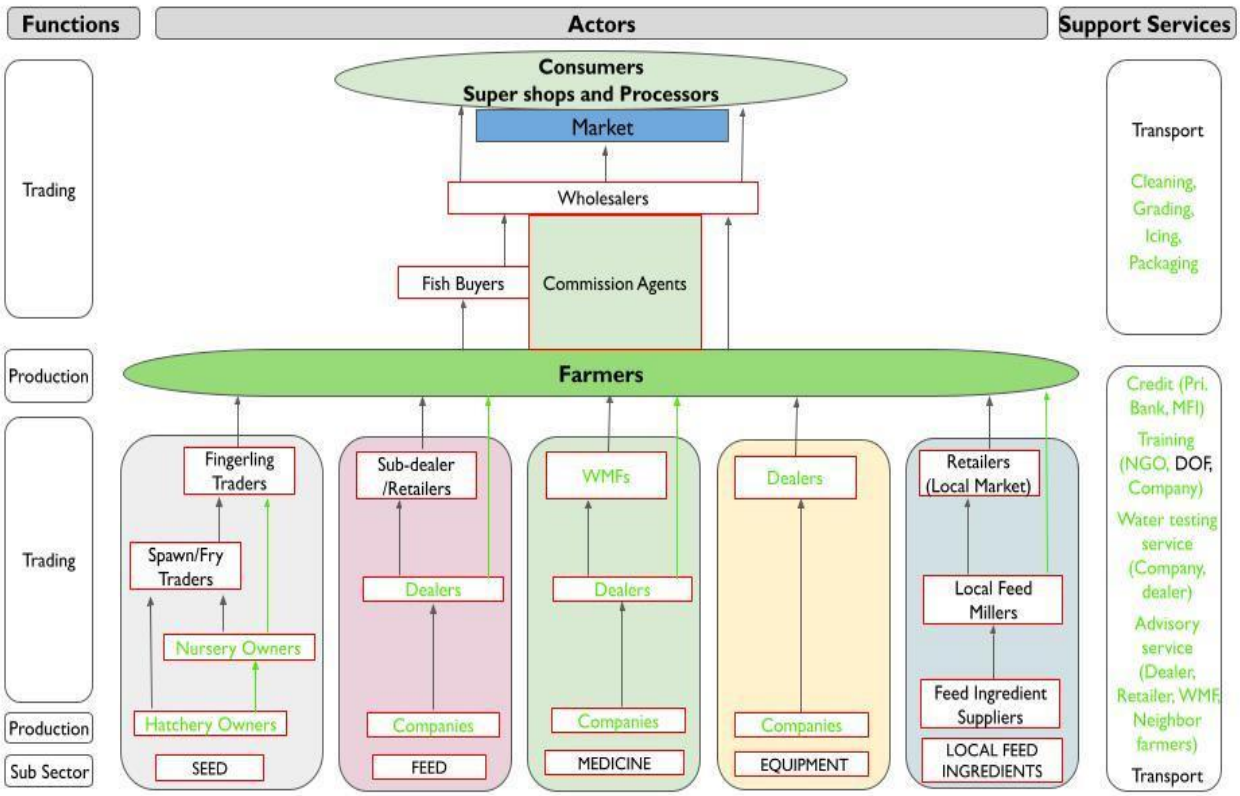


Figure 10. Market linkages among the actors in aquaculture sector, Satkhira district case study

In the above figure, BANA's distinct contribution will be highlighted in green (actors in the box and arrow).

Through the companies, BANA improved market actors' business capacity, facilitated training and advisory services, strengthened market linkages, and the product and services distribution channel. But beyond BANA's contracted companies, there are other companies who also continue their businesses with the same activities and services in the same distribution channel.

The ET heard from all farmers and traders that they need capital for fish production and business continuation. Dealer/sub-dealers have good linkages with banks and financial institution to get loans and women farmers have good linkages with MFIs to get loans. However, farmers get credit from informal sources such as dealers, nursery operators, commission agents, and local lenders based on their relationship, trust, and referral. This engagement is very localized. Farmers practice credit purchases from the input sellers. In that case, farmers pay more than the retail price. Commission agents provide the loans (dadon) on these conditions: 1) farmers have to sell their fish through the agent's sales point, 2) farmers get a lower price compared to the local market price of that day, and 3) their payment is delayed.

Finding: Participants agreed that strategic collaboration among BANA grantees would add more value to the farmers, but grantees in the same geographic location selling similar products did not know each other's interventions to support the farmers. BANA didn't facilitate/coordinate among the grantees at the central, regional and district levels to share the individual grantee's interventions, approach, and targets. Linkages among the regional and local small feed millers could add value for making feed available with low prices and ensuring quality with monitoring activities.

Farmers learn from BANA's grantees such as Shushilan and private companies, on improving fish production and practicing in their ponds/gher. This information-sharing linkage was effective during the grantees' contract period; but after the end of the contract, these kinds of services no longer existed except for individual counseling—and a few meetings and demonstrations from the companies ended.

Access to credit is important, but small and marginal farmers have less or even no access to the banks and formal financial institutions. BANA's grantees Bank Asia and Shushilan developed loan products and an easy loan application process and provided loans to the fish farmers. However, scaling it is a challenge.

The ET did not find a strong presence of BANA's grantees in the output marketplace.

2.2. Private-sector engagement

Several private companies (both BANA's grantees and non-grantees) were engaged with local market actors to sell their products and services (seed, feed, medicine, equipment, production-related advisory services, loans, *etc.*), expand market/outreaches, and sustain their businesses.

Private companies in the fish seed market: Multifunctional private actors in different layers—such as companies, hatchery owners, spawn/fry traders, nursery operators, and fry/fingerling traders (Patilwala)—are involved in producing, rearing, and selling seed to the farmers. These private sectors exist in Satkhira and at the regional (Jashore) and national levels, *e.g.,* the Aftab, Mega, CP, and BRAC hatcheries. Government farms in Satkhira supply carp seed to the farmers. Among them, BANA supported the Bithi Scientific Hatchery and Nursery in producing monosex and GIFT tilapia seed/fingerlings and supplying them to the farmers. In addition, national-level non-BANA-supported companies such as Aftab, Mega, and CP supply monosex tilapia seed in Satkhira. Also, the Modhumoti hatchery, based in Jeshore, produced and supplied carp seed to the farmers.

BANA grantees and other private companies supply products and services such as CPG, brood fish, feed, medicine, technology, oxygen, and transport services to the hatchery owners and nursery operators for producing and selling fish seed.

Private companies in the fish feed market: BANA supported national companies such as Mega, Aftab, AIT and the regionally based KNB in selling feed to the farmers through their distribution channels. The local-level market actors such as dealers and sub-dealers/retailers are engaged in selling products; at the same time, they organized capacity-building events for the farmers. Other companies such as Nourish, CP, Soudi Bangla, Paragon, *etc.*, sell feed in this region through established distribution channels, but the market actors did not organize capacity-building events like the BANA grantees did.

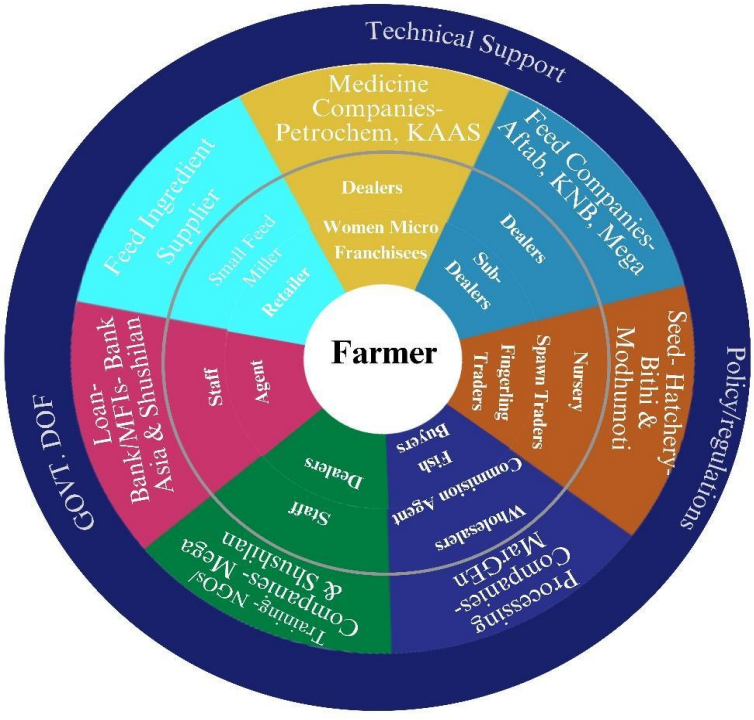


Figure 11. BANA supported private-sector engagement in the aquaculture sector, Satkhira district case study.

Figure 10 above describes the different ways in which private companies, NGOs, banks, and market actors engage to support the farmers for producing fish in the Satkhira district.

Private companies in the AMP market: Different types of aqua medicine are used by the hatchery owner, nursery operators, and fish farmers to protect their fish from disease. BANA supported Petrochem, Argon, ACI, SKF, FishTech, and non-BANA supported companies Biocare and EON in selling AMPs through the dealer and retailer network. Most of the companies add medicine along with their other agro products. The ET heard that the SKF partnership with Aftab feed provided wider opportunities for farmers to get feed, medicine, and advisory services from the dealer and sub-dealer points. Most of the farmers said that Petrochem's medicine is good compared to that from other companies, but the price is higher. However, Petrochem established WMFs at the village level, which could be a unique model for the product and service delivery channel.

Equipment: Very few companies sell aqua equipment in Satkhira. BANA grantee Alim sells aerators; and grantee IMEXPro sells secchi disks, oxygen meters, pH test kits, ammonia test kits, and soil test kits. These companies engaged dealers and developed LSPs to connect with farmers to sell the equipment. But the ET did not find any LSPs in the field. Farmers can test pond water, soil quality, and pond food status with this equipment. The ET did not find other companies who sell equipment in Satkhira.

Credit: Most of the FGD farmers said that they have limited or no access to formal public or private banks and financial institutions for getting land. But the large farmers have access to the banks for loans. Small and marginal farmers have good access to MFIs to get loans, but the loans are not for fish production. BANA contracted with Bank Asia and Shushilan to develop loan products and easy terms for disbursing loans to the farmers.

Marginal and small farmers do not have enough cash to invest in fish production because the return on investment comes after four to six months (pond preparation to first harvest). On the other hand, the dealer's business model is cash purchases and credit sales. Dealers have access to loans from private and public banks due to their established business center, reputation, and business volume. The challenge is for farmers to get suitable loans for fish production.

Access to private and public banks is very challenging for the marginal and small farmers because of terms and conditions, attitudes of the bank employees, the complex/time-consuming process, *etc.* Another source of credit is MFIs, and most of the farmers are members of MFIs. They take loans from the MFIs for business purposes but use them for fish production because MFIs do not provide loans for fish production. The challenge was the weekly loan payment schedule—although farmers get returns at least three months after stocking fish seed in their ponds. The fixed interest rate is about 12.5 percent.

Bank Asia and Shushilan (BANA grantees) were meant to make loans available to farmers, but the outreach was poor, *i.e.,* 1,336 farmers (Bank Asia–346, and Shushilan–990) received loans. Farmers said that the interest rate for MFI loan is high, and the terms are not suitable for fish production—although Shushilan provided a two-month grace period to the farmers. In interviews with two Bank Asia loanees, one expressed that he is not interested in taking out a second loan because the amount is too small; and getting a larger amount would require a guarantor, documents for collateral, CIB data check, *etc.* The other farmer was frustrated because he did not receive a second loan nor the reason for being turned down.

The ET in Satkhira visited two BANA grantees, Bank Asia and Shushilan, who provided loans to the fish farmers. Bank Asia provided a total of 346 loans to the fish farmers; among them, 3 percent were adult women and 17 percent were youth. Similarly, Shushilan provided loans to 990 households in Satkhira. Among them, 96 percent were women and 23 percent were youth; and women and youth together totaled 97 percent. Both banks and MFI provided loans to 1,336 fish farmers. Among them, 72 percent were women and 22 percent were youth; and women and youth together totaled 77 percent.

BANA grantee MarGEn facilitated a male youth group which engaged in the wholesale fish market for fish cleaning, grading, and packaging. The training was appreciated by the participants. After the training, however, no communication between this group and MarGEn was found. The ET heard from the adult male group that BANA grantee M-World was supposed to provide improved support for fish transportation, but they have never seen the vehicle.

> *"[W]e know the proportion of fish and ice according to seasonality (in summer [we] usually require 2 kilo ice for 1 kg and the proportion differ[s] in winter and it is less than [in] summer. But … earlier, during the winter season, it was equal)."* ~ Youth male group, Syamnagor, Satkhira

Output market: The ET held a discussion with two commission agents to get a snapshot of the fish output market in Satkhira. Different types of market actors are engaged in this market—such as fish buyers, commission agents, wholesalers/agents, ice suppliers, packaging materials suppliers, and transporters. Farmers have good linkages with fish buyers and commission agents for selling their fish. Commission agents have a good network with wholesalers/agents. Wholesalers/agents have linkages with ice suppliers, packaging materials suppliers, and transporters. They told us that good relationships and trust among the actors in the chain increased the efficiency of the fish market system. BANA has made few efforts to strengthen the forward market system in Satkhira.

App uses: According to the closeout report of BANA grantees Aftab Feed, ACI Agro., The Right Kind, M-World, Coxbazarshop.com, MarGEn, and Parmeeda developed and facilitated market-related online support to buyers, producers, suppliers and consumers for strengthening the input distribution channel, accessibility to and availability of fish production information, and fish marketing. However, in Satkhira the ET did not find any users of apps developed by the BANA grantees, but market actors as well as farmers communicated by using mobile phones and doing transaction with MFS providers such as bKash, Nogod, *etc.* Later, we heard from the BANA team that out of a total of eight apps developed, three are currently functioning.

Finding: In Satkhira, BANA grantees such as companies and market actors are well engaged in the inputs business; however, the service market still is not mainstreaming with the input supply chain. The engagement of Bank Asia and Shushilan provided some access to finance, but no strategy was found for engaging other financial institutions and creating greater access for the farmers. Farmers did not use BANA-developed mobile apps for accessing information and communicating. The ET found that BANA made minimal efforts to engage private companies in the output market.

2.3. Enabling an environment for inclusive growth

Most of the study participants, particularly market actors and FGD participants, indicated that there are no policy or regulatory issues hindering the growth of the aquaculture sector. However, Mega feed company representative said that the Ministry of Environment, Forest, and Climate Change (MEFCC) is enforcing the use of a jute bag for feed packaging instead of plastic bags, which is the current practice. However, jute bags do not adequately protect feed from air, moisture, and other contamination. This change will increase feed prices, limit farmers' purchasing capacity, and create further challenges to fish sector growth.

From the discussion with Bank Asia, the ET learned that it is relatively easy to approve a small loan (up to tk. 40,000), but above that amount, the farmer needs a guarantor, collateral, *etc.*, due to unfavorable policies and regulations.

Small feed millers have policy barriers to continuing B2B business with regional or national feed companies. Similarly, the local/community feed millers who want to grow their businesses have licensing and access to capital barriers.

Finding: BANA's engagement was not found to listen and collect policy and regulation challenges faced by aquaculture stakeholders in the field.

3. Nutrition and hygiene (IR3)

Rural poor and other marginal people have less access to nutritious food—particularly pregnant women and children under 5. The BANA project has targeted 400,000 rural fish farmers; therefore, emphasizing the nutrition component will add huge value to the family nutrition of the targeted people. The major focuses are awareness, access, and practicing nutrition activities within the family. Both Shushilan and private companies facilitated the activities in the field; and most of the participants, including farmers, appreciated this activity.

3.1. Nutrition awareness and practices

Nutrition message dissemination by NGOs: In Satkhira, the ET held a discussion with Shushilan staff and a female youth group. The female youth farmers who received training from Shushilan said that previously they discarded the mola fish heads rather than eating them; but after receiving training, they started to eat *mola* with the heads. They said that they are accustomed to cultivating mola in their ponds. Their dependency on purchasing vegetables from the market has decreased because they can meet their demand with their own production.

The use of "tippy taps" is not common, said the study population. One female youth farmer was aware of tippy tap, explained its function, and uses it in her home. Female youth and adult farmers said that they use plastic buckets for storing water and wash their hands after using the toilet, before eating, before cooking, *etc.* Hygiene information was provided by Shushilan.

Nutrition message dissemination by non-nutrition actors: Most of the study participants said that nutrition messages—including family nutrition; handwashing; and consuming vegetables, fruit, and mola fish—are commonly discussed during training. Female youth farmers mentioned that in the courtyard sessions, the trainer discussed the benefits and nutritional value of mola fish and vegetables, provided orientation on vegetable and fish production technology, and presented the importance of nutrition for infants, young children, and pregnant women. However, no dealers or sub-dealers incorporated nutrition-focused information/activities in their businesses or provided nutrition messages to customers during transactions. One dealer (KAAS) noted that he provides messages to his customers/farmers on the benefits of eating fish.

Knowledge of the health benefits of eating mola fish and vegetables increased, and both are seen as a good source of vitamins; fish is rich in protein and minerals and the mola fish improves vision, according to the male and female adult farmers trained by Petrochem and M-World. One informant noted that farmers know about the benefits of consuming nutritious foods like fish, meat, vegetables, and fruits.

Finding: Farmers are well informed about nutrition. Both NGO and private company initiatives for disseminating nutrition messages are well accepted by the participants. They practice carp-mola polyculture, cultivate vegetables in pond/gher dike, eat mola with head, other fish and egg on a regular basis.

3.2. Access to diverse and nutritious foods

According to the male and female adult farmers, including a statement from female youth farmers, fish and vegetables are common (most of the days in a week) in the daily meal of their family members, including children and pregnant women. According to the female youth farmers, young children like eggs and meat but they do not like to eat leafy green vegetables daily.

Male adult farmers mentioned that vegetables are not produced in pond dikes due to shade, but they are produced in the *gher* dikes. The Mega feed dealer and Argon staff noted that vegetables are grown in this area on homesteads and *gher* dikes where soil salinity is low. All FGD female participants said that consumption of fish and vegetables increased due to the production of mola and carp in their own ponds and in dikes.

FGD farmers (male and female adult farmers and female youths) said that mola is naturally produced in the *beel.*[50] They will continue carp-mola polyculture and dike/homestead vegetable production for

[50] In Bangladesh, the word 'Beel' means a lake with static water, surrounded by the community.

family consumption since these add nutrition for family members and additional income upon selling the surplus.

Introducing RTE and RTC foods in secondary schools also affected overall fish consumption in one of the studied locations, according to the KII informant from Shushilan. Orientation on preparation of diverse fish recipes and selling by women entrepreneurs also changed practices.

Finding: Shushilan-facilitated nutrition activities add value for improving farmers' knowledge and access to diverse food items, particularly processed fish.

4. Cross-cutting themes

The inclusion of women and youth within the mainstream market is a priority in this project. The inclusion of male youths is not tougher compared to the inclusion of women in rural Bangladesh—because women are still limited by the patriarchal hierarchy, sociocultural norms, *etc.* BANA contracted both NGOs and private companies to facilitate nutrition agenda; but in reality, achieving it was poor considering employment, access, and participation in different economic activities.

Environmental, social, and economic issues impacted the aquaculture sector in Satkhira. Increased salinity limits the carp and tilapia culture opportunity in the Assasuni and Shyamnagor upazillas. Investment in the aquaculture sector is high at the beginning and also needs operational cost support to feed the fish. Access to capital is a big challenge for the small and marginal farmers. BANA provided limited support for access to finance, but no engagement was found for addressing environmental issues.

4.1. Attitude and role of women in aquaculture

The ET heard different opinions from male and female participants. From the FGD with female adults and youth, we heard that women's participation in aquaculture has increased due to engagement with NGO activities and increased income. They are used to working outside of the home and sometimes have to go to the local marketplace to sell their fish and collect inputs. But women participants (FGDs and WMFs) stated that their engagement in the aquaculture sector is appreciated by people in their communities.

> *"We need to take care of pond/gher fish production when our male counterpart[s] [are] engaged outside [of the] business (labor selling, trading, sick, etc.). If necessary we visited [the] market to buy inputs and [sell] fish."* ~ Adult women's group, Debhata, Satkhira

Most of the male participants said that aquaculture activities are not suitable for women, and sociocultural norms discourage women from participating in aquaculture activities, *i.e.,* they can take care of homestead ponds but not *gher*, which are generally located in the field. The male youth FGD said that women should work within the house to take care of the homestead pond fish culture, poultry farming, and managing cattle.

4.2. Attitude and role of youth in aquaculture

The economy of this area is fish centric. Most of the trade, service market, and employment is rolled out in this sector. Although these are informal in nature, they contribute a lot to people's lives. Youth are also looking for employment, and aquaculture is the best option for them because they know the sector from the inside out. So, after they finish secondary school, male youth are engaged in different segments of the aquaculture sector such as fish/shrimp production, crab/soft shell crab farming, input and output trade, transportation, *etc.* Their engagement is treated as either a core livelihood or an opportunity for extra income to contribute to the family.

4.3. Environmental issues affecting aquaculture (e.g., water salinity, fishing bans, etc.)

Most of the participants said that the area floods once a year and experiences cyclones two to three times. In both cases, saline water intrudes into the mainland while cyclones cause all the fish to go out. The tidal surge flushes out *ghers* and ponds and affects the vegetation of the tidal surge area.

Carp fish culture is suitable in sweet water. But in the dry season (mid-February to May), water levels drop in the ponds and *ghers*—causing challenges to the cultured carp. When this occurs, farmers use water pumps to harvest ground water for the *gher*. This adds an extra cost to fish production.

Similarly, in the dry season, both water and soil salinity increase, particularly in the Shyamnagor and Assasuni upazillas. While shrimp, other brackish-water fish, and GIFT can culture in saline water, farmers stop culturing fish then due to low *gher* water depth. During the dry period, farmers dry and repair the *gher,* particularly the dike and bottom of the pond; and disinfect it by using lime and other chemicals to prepare for the cultivation of next year's fish.

A female youth farmer in Shyamnagor said that their income increased. All participants said that access to drinking water is a major problem. They have a shortage of drinking water and need to purchase drinking water, *i.e.,* 12 to 15L, at 25 BDT.

> *"We are growing more veg[etable]s and fish and eating them, but if there is no drinking water then it is meaningless. This is the huge issue in this village with high salinity. They are struggling with this problem of drinking water and all urged us to tell NGOs and donors about this."* ~ Youth female group in Shyamnagor

4.4. Social/economic issues

In Satkhira, there are no social issues affecting aquaculture except the engagement of women in the aquaculture sector. However, the ET understood from a discussion with the participants that the participation of youth and women is increasing. On the other hand, most of the farmers struggle to manage their financial investment during the fish production season. Access to informal credit comes at a high interest rate, and formal credit is a big hassle.

Finding: We found the positive engagement of women in economic activities from the youth and women's group supported by Shushilan. The development of WMFs is a good project initiative for including women in the mainstream market, but the number is tiny. Youth are enthusiastic about being involved in the aquaculture business because aquaculture is the major economic sector in this area.

Flash floods, cyclones, and increased salinity limits are the major environmental issues in Satkhira. They cause lost crops and homestead assets, and limit carp and tilapia culture opportunities in the Assasuni and Shyamnagor upazillas. No BANA initiatives were found to tackle those environmental issues.

ANNEX 9: EQ 2 ANALYSIS

The table below briefly summarizes findings across the case studies in terms BANA interventions successes and remaining gaps in the aquaculture sector.

Table 5-I. Summary of findings from case studies

Thematic Areas	What went well	What are gaps
Seed Rabeya Matshya Bithi Scientific Modhumoti Ma Matshya Meridien Agro	• Quality improved for carp • G3 rohu seed supply to DOF hatcheries and private hatcheries, but comprehensive initiative was not found for expansion. • Affordable, but carp seed price is higher in Cox's Bazar (limited production). • Accessibility improved, but not evenly/ everywhere.	• Work with DOF and private farms to strengthen brood and natural Carp Pituitary Gland (CPG) supply chain. • Work with DOF to establish seed certification system.
Feed Mega Aftab KNB AIT Matrix Victor Feed	• Feed is widely available; challenges are quality and affordability (price) Affordability also depends on farmers' grasp of how to properly use feed. • BANA contracted Matrix to developed capacity of local small feed millers (LSFM) but the initiative was challenged by due to license and investment capital. • BANA linked regional feed company (KNB) and small feed miller to continue B2B but stopped due to legal issues.	• Ensuring feed quality: need to work with DOF to strengthen existing feed quality monitoring. • Supporting LSFM could add value for small and marginal farmers who are extensive farmers[51], but may become semi-intensive farmers. • Supporting B2B business could add value for the farmer who use semi-intensive farming. • Recent introduction of jute bag for feed packaging by Ministry of Environment, Forests and Climate Change (MEFCC), which is not realistic for feed preservation.
Other inputs Petrochem KAAS Green dale ACI IMEXPro Alim	• AMP is available but costly and use is limited. BMP could reduce use of AMPs. • Aerator introduction may be effective for large commercial farmers. • Introduction of pH meter, secchi disk, water testing kits is good initiative.	• Instead of buying equipment, farmers prefer access to water quality testing services with pay/without pay. • Aerator is costly/requires improved infrastructure.

[51] Extensive farmers rely on natural source of feed and homemade feed, have less control on fish production practices, and are heavily reliant on credit, etc.

Thematic Areas	What went well	What are gaps
Capacity building NGOs Private companies	• Training on BMP to farmers, nursery operators and hatchery owners is effective for producing quality seed and increase fish productivity. • Learning school/Mega feed school is a good platform for access to services, information, technical knowledge and strengthening connectivity between dealers and farmers.	• Training module needs to be tailored to context. • Training is expensive and requires dealers/local retailers to bring farmers together. By itself, it does not turn a profit and firms are unwilling to undertake it without support.
Services Most of the private companies	• Petrochem developed WMF and established OSSC: increased access to inputs and advice. • LSP development was intended to strengthen input distribution channel and availability of advisory services • Getting testing services, information and advice from dealer/retailer is effective for the farmer.	• LSP model was not sustainable (except for one grantee).
Finance Bank Asia City Bank Shushilan Mukti Prottyashi	Some of the financial service providers offered new products and/or terms tailored for the aquaculture sector.	• Loan size is too small. • Credit Information Bureau (CIB) data and collateral are challenging for small and marginal farmers to access large loans. • Advocate to Bangladesh Bank along with private commercial banks for low interest and larger loans.
Information Coast trust Gorai M-World ACI Aftab CoxBazar Shop MarGEn Parmeeda	• Developed 8 Apps: three are functioning on a limited scale. • Youth could use the Apps if they had access to smart phones. • BANA is in the process of developing an App to provide comprehensive aqua services.	• Availability and use of smart phone by adult men and women is a challenge. • Apps need to be promoted.

Thematic Areas	What went well	What are gaps
Output market MarGEn Parmeeda CoxBazar Shop Shah Amanot Chhip food	• Dry fish processing, new recipe promotion, and online marketing are very encouraging. • Fresh fish processing to support RTC and RTE, and physical and online marketing have future growth. • BANA intervened in post-harvest management of fresh fish, storage, packaging, icing and transportation (cold chain management) with limited effects, some of the safe handling and hygiene efforts were discontinued by the marketplaces.	• Need organized efforts for strengthening post-harvest management of fresh fish, storage, packaging, icing and transportation (cool chain management) were good initiatives. • Long duration interventions and private sector investment for infrastructure development is necessary for makes the difference. • Develop incentive focus business model for labor, commission agents, wholesaler, transporter to work together.
Enabling Environment (Policy/regulation)	BANA worked on updating National Fisheries Policy 1998 and use of AMP in the country.	Important policy issues to address are: • Local level small feed miller licensing • Legal challenge for B2B business among the feed millers[52]. • Advocate to the Bank for policy review of loan size and collateral for MFI and Banks.

[52] The modality of B2B is not described in detail in the Animal and Feed Act 2010. Thus, business partnership between/among the millers was interpreted as a legal violation.

ANNEX 10: INVESTMENTS BY BANA AND PRIVATE SECTOR ENTITIES

The following table presents the total budget by sub-grant, and the BANA and grantee portion, and the percentage of the grantee's investment.

Table 5-J. Investments by BANA and private sector entities by sub-grant

Sub-Grantee Name	Total Budget USD	BANA USD	Partner USD	% Partner
Zone of Influence	**-**	-	-	-
ANGEL POWERTECH LTD	$20,562	$16,441	$4,121	20%
BITHI SCIENTIFIC HATCHERY AND FISHERIES	$34,124	$24,743	$9,381	27%
BHOLA MONOSEX TELAPHIA HECHARY	$34,128	$24,664	$9,464	28%
M/S SURAIA NUR MOSHSA HATCHERY	$33,128	$24,898	$8,230	25%
MODHUMOTI MOTSO HATCHARY	$34,941	$24,803	$10,138	29%
MATSHYA BANGLA HATCHERY	$26,933	$18,426	$8,507	32%
RABEYA MATHSYA UTHPADAN KENDRA	$29,169	$19,974	$9,195	32%
ASA MATHSYA HATCHERY (AHM)	$34,723	$23,377	$11,346	33%
SOUTH BAY PRIVATE LIMITED	$32,151	$21,225	$10,926	34%
RUPALI FISH HATCHERY	$40,144	$22,351	$17,793	44%
HARUN MATHSYA HATCHERY	$27,162	$19,991	$7,171	26%
BRAC	$142,880	$55,211	$87,669	61%
BHOLA MONOSEX TELAPHIA HECHARY	$22,619	$15,750	$6,869	30%
BHOLA MONOSEX TELAPHIA HECHARY	$25,364	$16,388	$8,976	35%
GORAI	$72,476	$47,786	$24,690	34%
ZOI Sub-IR 1.1 investment	**$610,505**	**$376,028**	**$234,476**	**-**
SPECTRA HEXA FEEDS LTD	$243,645	$158,935	$84,710	35%
VICTOR FEEDS LTD	$220,186	$155,211	$64,975	30%
KNB AGRO INDUSTRIES LTD	$205,122	$105,419	$99,703	49%
AGRO-INDUSTRIAL TRUST (AIT)	$120,018	$66,452	$53,566	45%
AFTAB FEED PRODUCTS LIMITED	$514,204	$229,836	$284,368	55%
MATRIX BUSINESS DEVELOPMENT LTD	$88,801	$39,998	$48,803	55%
KNB AGRO INDUSTRIES LTD	$119,980	$64,659	$55,321	46%
KNB AGRO INDUSTRIES LTD	$45,021	$27,934	$17,087	38%

Sub-Grantee Name	Total Budget USD	BANA USD	Partner USD	% Partner
ZOI Sub-IR 1.2 investment	**$1,556,977**	**$848,444**	**$708,533**	**-**
GREEN DALE	$131,632	$88,314	$43,318	33%
UNITED AGRO FISHERIES	$84,152	$59,999	$24,153	29%
FISHTECH BD	$159,478	$90,636	$68,842	43%
GORAI	$42,399	$29,166	$13,233	31%
ALIM INDUSTRIES LTD.	$115,900	$60,254	$55,646	48%
MD. SHARIFUL ISLAM	$4,221	$2,857	$1,364	32%
FISHTECH HATCHERY LIMITED	$49,808	$22,012	$27,796	56%
KAAS TRADE	$173,796	$96,527	$77,269	44%
IMEXPRO (BD) CORPORATION	$130,313	$65,156	$65,157	50%
AFIL AQUA FISH LTD	$543,057	$57,093	$485,964	89%
SARDAR AGRO	$118,537	$13,513	$105,024	89%
GREEN BIOFLOC	$8,403	$5,413	$2,990	36%
FISHTECH HATCHERY LIMITED	$44,610	$19,577	$25,033	56%
ZOI Sub-IR 1.3 investment	**$1,606,306**	**$610,517**	**$995,789**	**-**
ACI LTD	$418,975	$249,512	$169,463	40%
ISOCIAL	$201,211	$91,212	$109,999	55%
M-WORLD	$140,999	$98,499	$42,500	30%
ENLIVEN	$16,406	$8,997	$7,409	45%
M-WORLD	$91,336	$48,421	$42,915	47%
PETROCHEM BD LTD.	$260,267	$132,466	$127,801	49%
THE RIGHT KIND	$185,880	$185,880	$0	-
MATRIX BUSINESS DEVELOPMENT LTD	$30,179	$30,179	$0	-
ZOI Sub-IR 2.1 investment	**$1,345,252**	**$845,166**	**$500,087**	**-**
PARMEEDA ENTERPRISE	$87,118	$65,438	$21,680	25%
FISH BANGLA LTD	$194,263	$127,214	$67,049	35%
PRANTI AQUACULTURE LTD	$285,068	$168,513	$116,555	41%
BANK ASIA LIMITED	$315,490	$192,672	$122,818	39%

Sub-Grantee Name	Total Budget USD	BANA USD	Partner USD	% Partner
THE CITY BANK LIMITED	$317,030	$105,794	$211,236	67%
BYTEALLY SOFTWARE SOLUTIONS PVT LTD	$274,940	$188,195	$86,745	32%
KIU BANGLADESH LIMITED	$366,223	$129,851	$236,372	65%
MARGEN LTD.	$287,828	$94,957	$192,871	67%
MARGEN LTD.	$146,688	$59,272	$87,416	60%
BANK ASIA LIMITED	$250,618	$111,170	$139,448	56%
SEA NATURAL FOOD LIMITED	$293,921	$65,534	$228,387	78%
SHUSHILAN	$117,896	$46,364	$71,532	61%
PLENARY AQUA	$14,866	$7,493	$7,373	50%
KHULNA MUKTI SEBA SANGSTHA	$44,637	$26,936	$17,701	40%
SHUSHILAN	$100,246	$73,963	$26,283	26%
MARGEN LTD	$454,607	$68,119	$386,488	85%
PARMEEDA	$145,548	$83,440	$62,108	43%
ZOI Sub-IR 2.2 investment	**$3,696,987**	**$1,614,925**	**$2,082,062**	**-**
BANGLADESH SHRIMP AND FISH FOUNDATION	$213,560	$176,100	$37,460	18%
ORGANIZATION FOR DEVELOPMENT OF SOCIETY & ECONOMY (ODSE)	$5,190	$4,046	$1,144	22%
BANGLADESH SHRIMP AND FISH FOUNDATION	$54,400	$44,257	$10,143	19%
ZOI Sub-IR 2.3 investment	**$273,150**	**$224,403**	**$48,747**	**-**
BANCHTE SHEKHA	$150,749	$145,939	$4,810	3%
CODEC	$273,952	$266,646	$7,306	3%
DURONTO TV	$276,347	$154,343	$122,004	44%
SHUSHILAN	$231,988	$209,449	$22,539	10%
UNITED PURPOSE	$151,507	$99,936	$51,571	34%
BACKBENCHERS COMMUNICATIONS	$13,250	$6,625	$6,625	50%
SOMOY PROKASHON	$22,609	$11,483	$11,126	49%
CLASSIC MELAMINE INDUSTRIES LTD	$11,040	$6,000	$5,040	46%

Sub-Grantee Name	Total Budget USD	BANA USD	Partner USD	% Partner
MD. MOFIDUL ISLAM NOMAN	$8,691	$8,691	$0	-
ASMA KHATUN	$7,377	$7,377	$0	-
ZOI Sub-IR 3.1 investment	**$1,147,510**	**$916,489**	**$231,021**	**-**
HARVEST RICH	$337,288	$123,142	$214,146	63%
CHHIP FOOD BD	$72,447	$29,808	$42,639	59%
ZOI Sub-IR 3.2 investment	**$409,735**	**$152,950**	**$256,785**	**-**
Zone of Resilience	**-**	-	-	-
CHITAGONG MERIDIAN AGRO INDUSTRIES LTD	$129,436	$85,230	$44,206	34%
MAA MOTHSHA KHAMAR	$21,897	$17,618	$4,279	20%
MAA MOTHSHA HATCHERY & NURSERY	$66,043	$28,990	$37,053	56%
ZOR Sub-IR 1.1 investment	**$217,376**	**$131,838**	**$85,538**	**-**
FISH BOOTH	$6,500	$6,000	$500	8%
FISH BOOTH	$12,253	$10,064	$2,189	18%
ZOR Sub-IR 1.3 investment	**$18,753**	**$16,064**	**$2,689**	**-**
SATATA POULTRY	$31,324	$12,151	$19,173	61%
ZOR Sub-IR 2.1 investment	**$31,324**	**$12,151**	**$19,173**	**-**
MS. SHAH AMANATH TRADERS	$50,964	$26,761	$24,203	47%
MUKTI COX'S BAZAR	$94,208	$38,317	$55,891	59%
COX'S BAZAR SHOP	$48,331	$24,772	$23,559	49%
ZAHANARA GREEN AGRO	$90,549	$31,961	$58,588	65%
PALONGKI KONNA	$18,382	$8,387	$9,995	54%
MS. SHAH AMANATH TRADERS	$84,461	$37,451	$47,010	56%
COX'S BAZAR SHOP	$14,221	$8,594	$5,627	40%
MUKTI COX'S BAZAR	$41,400	$20,313	$21,087	51%
ZOR Sub-IR 2.2 investment	**$442,516**	**$196,556**	**$245,960**	**-**
BOLIPARA NARI KALYAN SOMITY	$7,275	$5,710	$1,565	22%
ZOR Sub-IR 2.3 investment	**$7,275**	**$5,710**	**$1,565**	**-**

Sub-Grantee Name	Total Budget USD	BANA USD	Partner USD	% Partner
COAST TRUST	$269,623	$240,249	$29,374	11%
PROTTYASHI	$222,843	$206,759	$16,084	7%
GRAUS	$192,296	$189,547	$2,749	1%
TAHZINGDONG	$213,767	$213,767	$0	-
RAISA HOMAIRA	$8,076	$8,076	$0	-
GRAUS	$187,273	$174,263	$13,010	7%
TAHZINGDONG	$92,500	$82,074	$10,426	11%
BOLIPARA NARI KALYAN SOMITY	$20,507	$16,682	$3,825	19%
PROTTYASHI	$141,520	$104,889	$36,631	26%
ZOR Sub-IR 3.1 investment	**$1,348,405**	**$1,236,306**	**$112,099**	**-**
ABACUSBIO INTERNATIONAL LIMITED	$132,000	$132,000	$0	-
General Activity support Sub-IR 1.1	**$132,000**	**$132,000**	**-**	**-**
ARITS	$36,520	$36,520	$0	-
General Activity support Sub-IR 2.3	**$36,520**	**$36,520**	**-**	**-**

The following table summarizes the investment by sub-IR in the ZOI and ZOR.

Table 5-K. Investment by zone and sub-IRs (USD)

-	**BANA USD**	**Partner USD**
ZOI investment total	*$5,588,921*	*$5,057,501*
Sub-IR 1.1	$376,028	$234,476
Sub-IR 1.2	$848,444	$708,533
Sub-IR 1.3	$610,517	$995,789
Sub-IR 2.1	$845,166	$500,087
Sub-IR 2.2	$1,614,925	$2,082,062
Sub-IR 2.3	$224,403	$48,747
Sub-IR 3.1	$916,489	$231,021
Sub-IR 3.2	$152,950	$256,785
ZOR Investment total	*$1,598,625*	*$467,024*
Sub-IR 1.1	$131,838	$85,538
Sub-IR 1.2	0	0
Sub-IR 1.3	$16,064	$2,689
Sub-IR 2.1	$12,151	$19,173
Sub-IR 2.2	$196,556	$245,960
Sub-IR 2.3	$5,710	$1,565
Sub-IR 3.1	$1,236,306	$112,099
Sub-IR 3.2	0	0

The following table was received from BANA during the two weeks the report was being written. The information was not used in the analysis.

Table 5-L. Post-grant investment by private sector

-	Name of IP	Thematic area	Key activity with BANA	What BANA is doing now?	Post-BANA Investment (USD)
ZOI	Sardar Agro	Innovation of improved technology (BMP, Machinery)	Introduced bottom sludge removal intensive aquaculture technology.	Sardar Agro is continuing this technology after closing the intervention with BANA. They have harvested 1 crop in 2022 and one more production cycle is ongoing.	$19,000
ZOI	IMEXpro (BD)	Innovation of improved technology (BMP, Machinery)	Promoted small scale aqua machineries and made aqua machineries commercially available for the farmers.	IMEXpro (BD) is continuing their business with aqua machineries and supply the machineries through their existing dealers.	$8,500
ZOI	Alim Industries Ltd.	Innovation of improved technology (BMP, Machinery)	Promoted selling of aerators for aquaculture farmers.	Rice thresher machine and power tiller are their focus products but they are selling aerator too as new product. They sold 200+ aerators after closing the project.	$50,000
ZOI	Bhola Monosex Tilapia Hatchery	Access to Inputs (Seed)	Promoted Tilapia and mola (small indigenous fish) brood and seed to farmers and multiplier hatcheries.	Continuing tilapia and mola seed production.	$10,000
ZOI	Bithi Scientific Hatchery and Fisheries	Access to Inputs (Seed)	Ensured quality Tilapia seed and strengthened the distribution network.	Continuing Tilapia seed production maintaining better management practices (BMP) they learned from BANA.	$10,000

-	Name of IP	Thematic area	Key activity with BANA	What BANA is doing now?	Post-BANA Investment (USD)
ZOI	Fishtech BD	Innovation of improved technology (BMP, Machinery)	Introduced country's first rtPCR based fish disease diagnosis lab at private sector level.	They are continuing disease diagnosis. The main clients are semi-intensive shrimp farmers. Before stocking into ponds/ghers shrimps' naupli/post larvae are checked whether they are carrying white spot syndrome virus (WSSV) and Early Mortality Syndrome (EMS) virus pathogens. Soil and water samples are also regularly checked to count bacterial load. Currently Fishtech BD is collaboratively working with the Sustainable Coastal and Marine Fisheries of the DOF. In addition to private sector hatcheries/farms some universities and research institutions are also working with the lab.	$47,000
ZOI	MWorld (Macher Gari)	Access to information and support services	Introduced country's first digital fish transportation system.	MWorld is regularly maintaining the "Maach Gari" app with the server, call center as well connected with back-end and front-end engineer and other relevant support service providers. They are trying to incorporate the live bidding option as well live GPS tracking in the app.	$6,000
ZOI	Asa Matshya Hatchery (AMH)	Access to Inputs (Seed)	Adopted BMPs including biosecurity measures at the hatchery level so that the supply chain of improved quality monosex tilapia seeds are available for nursery and grow out fish farmers.	AMH is continuing production and marketing of quality seeds of mono-sex tilapia in the market adopting BMPs including biosecurity measures.	$30,000
ZOI	South Bay Private Ltd.	Access to Inputs (Seed)	Adopted biosecurity measures at the hatchery level so that the supply chain of improved quality monosex tilapia seeds are available for nursery and grow out fish farmers.	AMH is continuing production and marketing of quality seeds of mono-sex tilapia in the market adopting the BMPs.	$60,000

-	Name of IP	Thematic area	Key activity with BANA	What BANA is doing now?	Post-BANA Investment (USD)
ZOI	Sea Natural Food Ltd.	Access to Forward Market	Introduced and promoted fish based RTE Foods in the mainstream market.	Sea Natural Food Ltd. Is continuing the fish based RTE foods production and marketing.	$4,000
ZOI	MarGen Ltd.	Access to Forward Market	Marketing fresh fish, fish based ready to eat products, fish-based snacks, in large city and urban markets.	MarGEn Ltd. still continuing the fish-based RTC, snacks production and selling along with fresh fish selling.	$50,000
ZOI	KNB Feed	Access to Inputs (Feed)	Developed micro-feed using locally sourced feed ingredients and produced this feed commercially by improving existing machinery facilities.	They are continuing to produce micro feed. After conducting training and promotional events their feed sell volume has gone up sharply and they set up new machineries to increase production of micro feed.	$3,000,000
ZOI	Matshya Bangla Hatchery (MBH)	Access to Inputs (Seed)	Ensured quality carp seed supply by practicing best management practices and strengthening the distribution network.	MBH is continuing quality carp seed production by ensuring hatchery biosecurity, adopting best hatchery management practices and recruitment of new brood & brood management. Their client based has been increased from 150 to 350 (approximately).	$11,000

-	Name of IP	Thematic area	Key activity with BANA	What BANA is doing now?	Post-BANA Investment (USD)
ZOI	GreenDale Bangladesh Limited	Access to Inputs (AMP)	BANA supported them to include private extension services for aquaculture producers through establishing one stop aquaculture service center named "GreenDale Service Center (GSC)". New fish farmer groups were developed through building capacity of hatchery & nursery owners, and fingerling traders. GreenDale conducted promotional activities at fish Arot points. As a result, product sales volume was increased, and the smart business platform was established and expanded geographical coverage.	Initially their business was confined within 17 districts and now their business territory expands to more than 40 districts of Bangladesh. When they built their partnership with Worldfish, they had 20 staff and now it has been increased to 37. GreenDale has scaled-up their business model in different districts especially in Mymensingh, Rajshahi, Natore, Comilla and Gazipur. Most of their field staff and major dealer points are equipped with testing kits and providing services to the farmers.	$600,000
ZOI	Harun Matshya Hatchery	Access to Inputs (Seed)	Adopted BMP to improve supply of quality carp seed and strengthened seed distribution network.	HMH is continuing quality carp seed production by ensuring hatchery biosecurity, adopting best hatchery management practices and recruitment of new brood & brood management. Their client based increased from 150 to 400 (approximately).	$9,000
ZOI	United Agro Fisheries	Access to Inputs (AMP)	Local PG collection supply chain development and PG production.	Continuing on a limited scale. Collecting raw CPG through commissioning agents of different regions of Bangladesh. Dry CPG processing and selling is continuing.	$30,000

-	Name of IP	Thematic area	Key activity with BANA	What BANA is doing now?	Post-BANA Investment (USD)
ZOR	Maa Mothsha Hatchery & Nursery	Access to Inputs (Seed)	BANA supported production of supply of good genetic quality seeds of various carp species among fish farmers and nursery operators in Bandarban and Cox's Bazar districts through establishing a carp hatchery.	Production of genetically improved quality seeds of various carp species and selling seed among fish farmers and nursery operators is being continued.	$4,650
ZOR	Satata Poultry	Access to Inputs (Feed)	Supply of quality fish feeds and other aqua inputs to fish farmers and nurseries who are living in rural villages in Lama and Alikadam upazilas and lack access to quality inputs.	Satata Poultry is continuing to supply quality fish feeds and other aqua inputs in the service center. They are also providing advisory services to fish farmers according to their needs and have strengthened market linkages among aquaculture actors.	$15,000
ZOR	CoxsBazarShop.com	Access to Forward Market	Dry fish business promotion through marketing and branding.	They are continuing to sell various RTC (Ready to Cook) and RTE safe dry fish products using an online platform. They are also using their own website and app to sell their products.	$28,000
ZOR	Palongki Konna	Gender & Youth	Promotion and marketing of dry fish powder with the support from BANA.	They are continuing their dry fish powder production and selling through online and offline (sale centers).	$6,260
ZOR	Ms. Shah Amanath Traders (SAT)	Access to Forward Market	Improved quality of dry fish and business generation through marketing and branding with the support from BANA	SAT is continuing safe dry fish production and selling the products through online and offline platforms. SAT is boosting awareness through their Facebook page and hosting their own website.	$50,209
-	-	-	-	-	**$4,048,619**

ANNEX 11: BIBLIOGRAPHY

No.	Title
1	Annual Progress Report February 2018 – September 2018
2	Annual Progress Report October 2018 – September 2019
3	Annual Progress Report October 2019 – September 2020
4	Annual Progress Report October 2020 – September 2021
5	Annual Progress Report October 2021 – September 2022
6	Yr1 Q2 Progress Report_Feb-March 2018
7	Yr1 Q3 Progress Report_Apr-June 2018
8	Yr2 Q1 Progress Report,_Oct-Dec 2018
9	Yr2 Q2 Progress Report_Jan-Mar 2019
10	Yr2 Q3 Progress Report, Apr-Jun 2019
11	Yr3 Q1 Progress Report,_Oct-Dec 2019
12	Yr3 Q2 Progress Report_Jan-March 2020
13	Yr3 Q3 Progress Report_Apr-Jun 2020
14	Yr4 Q1 Progress Report_Oct-Dec 2020
15	Yr4 Q2 Progress Report_Jan-Mar 2021
16	Yr4 Q3 Progress Report_Apr-June 2021
17	Yr5 Q1 Progress Report_Oct-Dec 2021
18	Yr5 Q2 Progress Report_Jan-Mar 2022
19	Yr5 Q3 Progress Report_Apr-June 2022
20	Yr6 Q1 Progress Report_Oct-Dec 2022
21	Aquaculture Activity Year 1 Work Plan (Feb_18-Sep_18)
22	Aquaculture Activity Year 2 Work Plan (Oct_18-Sep_19)
23	Aquaculture Activity Year 3 Work Plan (Oct_19-Sep_20)
24	Aquaculture Activity Year 4 Work Plan (Oct_20-Sep_21)
25	Aquaculture Activity Year 5 Work Plan (Oct_21-Sep_22)
26	Aquaculture Activity Year 6 Work Plan (Oct_22-Feb_23)
27	Program Description - Bangladesh Aquaculture and Nutrition Activity

No.	Title
28	Aquaculture Activity success stories
29	BANA brief Oct2019-Sept2020
30	BANA brief Ot2018-Sept2019
31	BANA environmental due diligence 2018
32	BANA factsheet 2022
33	BANA factsheet July2019
34	BANA Poster no date
35	BANA project brief Oct2020-Sept2021
36	Factsheet: The Aquaculture Activity
37	FTF brief on BANA
Data bases/Lists from WorldFish	
38	A2F_Loan Database
39	Activity Grantees & partners categorized
40	Activity Participants list
41	Dealersubdealer List
42	Performance Data TableSummary 2022
43	IPs training topics
44	NGOs training topics
BANA MEL and Cross-cutting-related documents	
45	Gender Strategy
46	Youth Strategy
47	BANA Baseline Report 2019
48	MEL Plan Bangladesh Aquaculture Activity 2018
49	MEL Plan Bangladesh Aquaculture Activity 2020
50	Mid Term evaluation Report
51	Performance Data Table_Summary
52	Aquaculture Activity Grants Management Manual revised 2023

No.	Title
53	Hamilton et al. 2020 Replication Data for WorldFish Carp GIP Electronic Pond Book
54	Hamilton, M.G. 2021. WorldFish Carp Genetic Improvement Program Data Management System
55	CGIP Publications.docx
56	FTF Indicators template-FY2022_Bangladesh Aquaculture Activity_Nov2022
57	Activity Outcome journal
BANA's Measuring Change in the Market System Assessment	
58	Qualitative Survey Tools Form 1_Bangla
59	Qualitative Survey Tools Form 1_English
60	Qualitative Survey Tools Form 2_Bangla
61	Qualitative Survey Tools Form 2_English
62	Qualitative Survey Tools Form 3_English_Module A
63	Qualitative Survey Tools Form 3_English_Module B
64	Report on Measuring change in the market system-Qualitative assessment
Other Documents	
65	OECD-DAC Evaluation Criteria _ Logical Framework
66	OECD-DAC Evaluation Criteria
67	Hussain, M. Gulam. February 2021. Impacts of COVID-19 Pandemic on the Aquaculture Value Chains in Bangladesh. https://www.fishinnovationlab.msstate.edu/newsroom/2021/02/impacts-covid-19-pandemic-aquaculture-value-chains-bangladesh
68	Kruijssen F, Adam R, Choudhury A, Danielsen K, McDougall C, Newton J, Smits E and Shelley CC. 2021. A gendered aquaculture value chain analysis in northwestern Bangladesh. Penang, Malaysia: WorldFish. Program Report: 2021-02.
69	Bangladesh Department of Fisheries. (2022) Yearbook of Fisheries Statistics of Bangladesh. DOF, Bangladesh, Dhaka.
70	Nabi, M., Halim, M.A., Nahar, S. 2017. Study on production performance and economic of mono-sex tilapia culture at marginal farmer's ponds in Gopalgonj Bangladesh. Int. J. Fish. Aquat. Stud., 5: 104–108.
71	Rana, K.J. and Hassan, M.R. 2013. On-farm feeding and feed management practices for sustainable aquaculture production: an analysis of case studies from selected Asian and African countries. On-farm feeding and feed management in aquaculture. FAO Fisheries and Aquaculture Technical Paper No. 583 No. 583. pp. 21-67. Rome, FAO.
72	Mamun-Ur-Rashid, M., Belton, B., Phillips, M., Rosentrater, K.A. 2013. Improving aquaculture feed in Bangladesh: From feed ingredients to farmer profit to safe consumption. WorldFish, Penang, Malaysia. Working Paper: 2013-34.

No.	Title
73	Prodhan, M.M.H. and Khan, M.A. 2018. Management practice adoption and productivity of commercial aquaculture farm in selected areas of Bangladesh. J. Bangladesh Agricultural University, 16 (1): 111-116.
74	Hossain, M.I., Shikha, F.H. and Hoque, A.B.M. A. 2019. Growth performance of Indian major carps at pond system using shrimp industry waste in their diet. J. Environ. Sci. & Natural Resources, 12(1&2):101-108.
75	Shamsuzzaman, M.M., Islam, M.M., Begum, A., Schneider, P. and Mozumder, M.M.H. 2022. Assessing fisheries policies of Bangladesh: Need for consistency or transformation? Water,14, 3414. https://doi.org/10.3390/w14213414.
76	BBS, 2018. Statistical Yearbook of Bangladesh. Bangladesh Statistical Bureau, Dhaka, Bangladesh.
77	Second National Plan of Action for Nutrition 2016–2025 (2017). Ministry of Health and Family Welfare. Government of the People's Republic of Bangladesh.
78	Lomax, Jake (2020). "AAER Revisited: from systemic change narrative to systemic change analysis." DOI: 10.13140/RG.2.2.32996.81288.
79	Household Income and Expenditure Survey 2022. Key Findings. Bangladesh Bureau of Statistics. Statistics and Informatics Division. Ministry of Planning.
80	Barman, B.K. 2001. Women in small-scale aquaculture in North-West Bangladesh. Gender, Technology and Development 5(2):267–287
81	Asian Development Bank. 2004. An evaluation of small-scale freshwater rural aquaculture development for poverty reduction. Manila, the Philippines: Asian Development Bank
82	Belton, B., Karim, M., Thilsted, S., Murshed-E-Jahan, K., Collis, W. and Phillips, M. 2011. Review of aquaculture and fish consumption in Bangladesh. Studies and Reviews 2011–53. Penang, Bangladesh: The WorldFish Center.
83	USAID. 2019. USAID/Bangladesh: Comprehensive Private Sector Assessment. https://pdf.usaid.gov/pdf_docs/PA00TWMH.pdf.