

Feed the Future Bangladesh Aquaculture and Nutrition Activity

Project Completion Report

Project title:

Business strategy development for promoting Solar powered pump and water recycling system for increasing the hatchery productivity with quality seed production

Intervention duration: 31 October 2018 to 30 April 2019

**Funded by:
USAID Bangladesh under
Feed the Future Bangladesh Aquaculture and Nutrition Activity**

**Technically supported by:
WorldFish Bangladesh and South Asia Office**

**Implemented by
Angel Power Tech Limited
BAFWWA shopping complex,
South building (3rd floor), Dhaka Cantonment, Dhaka**

Introduction

A sub-grant agreement was signed on 30 Oct 18, between WorldFish (WF) and Angel Powertech Ltd (APT) for the purpose of “Business strategy development for promoting Solar powered pump and water recirculation system for increasing the hatchery productivity with quality seed production”. The journey of the project started on 01 Nov 18 and would be ended on 09 Apr 19.

Successive progress of the Project

As per the work plan of the project, an advertisement for appointing a consultant was promulgated in bdjobs.com on 12 Nov 18 and last date of submission of EoI was on 30 Nov 18. Accordingly, two consulting firms, "Inspira Advisory and Consulting Ltd" and a freelance business consultant (Md. Altaf Hossain) submitted EoI. After a thorough check and interview by representative of WF and APT, the freelance business consultant (Md. Altaf Hossain) was selected as consultant; and a Service Contract was signed on 02 Jan 19.

The consultant started his work with an orientation visit at APT Jashore office and fish hatcheries at Jashore area on 08-09 Jan 19. Thereafter, the consultant along with Chairman APT visited Khulna, Satkhira, Kolaroa, area, Barisal, Bhola, Patuakhali area, Dhaka and Mymanshingh area for conducting FGD, KII II etc. as data collecting for analysis. The consultant also discussed with different Banks, VCI and MFIs to know their financial packages.

The Consultant submitted the 1st draft report on 09 Mar 19 and a meeting was held at WF office on that. He was suggested for some modification and after accomplishing accordingly, the Consultant submitted the final draft report on 22 Mar 19. He also delivered a presentation on draft report on 27 Mar 19 in presence of the country director of WorldFish, Bangladesh. He was suggested with some other modification/inclusion and accordingly he completed the job. The consultant finally submitted the report on 31 Mar 19. The report has been attached here as “Annexure-1”.

Financial Aspect of the Project

The sub-grant agreement was signed between WF and APT with total budget of BDT 17,01,500.00. Among which, WF contribution was BDT 13,60,500.00 and APT contribution was BDT 3,41,000.00. The money has been spent as per the procedure mentioned in the sub-grant agreement. On 31 Mar 19, APT received from WF contribution BDT 11,59,021.00 (The 1st instalment of WF contribution was received by APT was BDT 3,40,719.00 on 18 November 2018 and the 2nd instalment received BDT 818,302.00 on 05 February 2019). The last instalment USD 2,466 is yet to receive by APT. So far, the total expenditure on 31 March 19 was BDT 8,98,997.00 and the balance is BDT 2,60,023.00.

So far, the consultant has been paid with a cheque for his first installment of BDT 2,40,000.00 on 09 Jan 19 and a cheque of BDT 2,43,000.00 as his 2nd instalment of payment on 14 Mar 19. The consultant is yet to pay his rest of amount BDT 3,27,000.00.

Salient features of the study:

After a thorough analysis and discussion on the data obtained from FGD, KII, II etc. of the study, the consultant mentioned some marketing strategy of APT products and some recommendations for achieving the strategy. Which are as follows:

Marketing strategy of APT products

Recognizing the financial constraints in both demand and supply sides following options can be considered for marketing of APT products especially the WRS, which has got highest level of interest from the hatcheries.

- a. APT sale their product directly to individual clients (hatcheries and nurseries) at a condition of certain amount down payment (25% to 50% or more) and the rest on credit for an agreed period (one to four years).
- b. Design a project (for example 2 to 3 years project to cover 10% hatcheries from Jashore with WRP) and partner with Bank or VCI as is proposed by the financial institute.
- c. Similar project can be marketed in partnership with MFIs where MFIs will provide financial support require for the project and then recover money on installments by the MFIs. This partnership could be of two modes:
 - i. MFIs provide loan to hatcheries/nurseries and APT receive cash from hatcheries/nurseries for the product and then MFIs recover lend money on installment with profit/service charge. Or
 - ii. MFI and APT jointly sale product to users on credit (at a certain % of service charge) and then collect money by MFIs and deposit 50% (or as agreed) to APT accounts with profit.
- d. Similar project can be designed in partnership with Hatchery Associations and plan for installation of WRS with financial agreement with Bank or VCI.

Recommendations

1. To address the market demand APT needs to earn abilities of mass production which require sound financial solvency for setting the factory and meeting operation cost. Since APT is financially weak therefore, it is necessary for APT to consider:
 - a. Try to get supports from IDCOL who already have expressed their interest to APT products.
 - b. Seek assistance from WF to cover a part of the factory setting cost. or
 - c. Borrow long-term loan from Banks. or
 - d. Extend partnership to raise funds from friend circle. or
 - e. Extend partnership with VCI.

2. To raise fund from any of the above sources APT requires to establish patent right on their products, obtain trademarks and standard testing certificates. However obtaining patent right is a very lengthy process and costly as well.
3. The cost of each solar product is very high comparing to the ability of respective users. Therefore, it is necessary to drop the idea of cash sale of product and follow marketing strategies of other branded products. For example, RAHIMAFROZ selling their solar products on 50% credit payable over the next 5 years at equal annual installments. Therefore, it is important to design sale strategies in the line of the buyers' ability.
4. The pricing of each product needs to be fixed by APT. A clearly outlined brochure needs to be prepared explaining the terms and conditions of obtaining the product including the process, conditions and place of post-sale services. All conditions are to be set based on respective buyers' abilities and choices than the limitations of APT.
5. Instead of targeting to all users (Hatchery, Nursery, Farmer, Transporter etc.) it would be wise to target for working with hatcheries on promoting WRP that has got the highest level of interest from the user market. The marketing plan (especially the coverage) must be within the limit of the supplier's (hence APT) physical and financial abilities. Other users' groups can be reached gradually.
6. High demand does not essentially mean the high possibility of sale of products until conditions of obtaining products meet the ability of the potential buyers. Hence it is important to consider some of the proposals made by the potential buyers during individual interview and in FGDs of respective user groups.

Conclusion

The study has enriched APT a lot, regarding the marketing of its products in the aquaculture sector. Now, APT would be able to reach easily to the clients, respecting their demand of aqua-machineries. APT would try to overcome its financial constraints also, as per the recommendations. The study has also spread the benefits of APT solar products in the stakeholders of whole fish-sector of Bangladesh and the result is already in hand. APT has already received demand two WRS to set-up in Kolaroa and Pabna. The journey of APT has started, and APT hope and expect whole-hearted support from WorldFish in all aspect, in its journey to develop the fish sector of Bangladesh. Again, APT express its cordial gratitude to all members of WF for its unconditional support to our company for contributing in the aquaculture sector of Bangladesh.

Attachment: Annexure-1 (Study report)

Final Report

Business Strategy Development

For

Aqua-machineries of Angel Powertech Ltd.

Angel Powertech Ltd.
Solar Pump Controller

Controller Capacity: 2400 Watt-DC

Working Capacity: 40Vdc-70 Vdc-DC

2014-155H

Model No:

ANGEL-18

Made by: Angel Powertech Ltd.



Notes for the readers

The study was conducted mainly for two key purposes. Firstly, to assess the level of interest as well ability of hatchery, nursery and fish farmers in introducing solar powered machineries and equipments which are environment friendly, cost-effective (in the long-run and in terms of production cost), growth potential and profitable. The second purpose was to find ways to make the product affordable and accessible by the intended users through development of a 'business strategy' for APT that satisfies both potential buyers (hatcherer, nuserer and fish farmers) and supplier of solar products (APT).

The cost benefits analysis of hatcheries and nurseries made by the study team was not for any other purposes but to assess the business trend and affordability of the businesses to invest on solar equipments which requires a reasonably higher level of investment. For example, the key machineries & equipments (Water recirculation system, Egg shaking machine etc) for hatcheries requires Tk. 1.7 million, for Nurseries and fish farmers (pump, Aerator, Gas removal etc) Tk. 0.5 to 0.6 million and for fish transporters Tk. 0.1 to 0.15 million which is significantly higher for each actors. The production cost and sale prices as well other relevant financial assessment was made based on statements of the relevant actors without any evidential justifications which was neither possible nor purpose of the study.

The consultant is not expert in fisheries and the technical terms and information putted here is based on statements of relevant actors (hatcheries, Nurseries and fish farmers) and from secondary sources (the reports and studies of different authors).

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Executive Summary

The aquaculture of Bangladesh has demonstrated a robust growth of 8.2 percent, much higher compared to the average growth rate of all fisheries (5.4 percent) in the last one decade. Behind this tremendous success in growth and expansions of fish aquaculture in Bangladesh, it was the hatcheries' that played the pivotal role and mostly run by private sectors. The availability of fish seed is an essential prerequisite for fish culture and amid of gradual decline of natural sources the main sources of fish seeds in Bangladesh is spawn produced in government and private hatcheries. The gradual diminishing of natural sources (@1.24%) resulting the growth and expansions of hatcheries and making the country dependent on them for fish seed supply required for aquaculture. The rapid growth of hatcheries has also resulted more competitive environment in the sub-sector which ultimately has pushed the adoption of new technologies for increased productivity.

This rapid growth has been driven by increased demand; improvements in technology, communications and infrastructure; and investments made by millions of farm households and small and medium enterprises in the fish value chain. This growth in fish sub-sector has largely contributed to the growth and expansions of a number of interrelated off-farm segments such as input dealers, feeds mills, machineries & equipments, labor, traders and transport services.

After being self-sufficient in fish production for the first time in the year 2018, Bangladesh has started to get global recognition as one of the biggest fish producers. In reaching that target Bangladesh requires to put high attention to two issues; firstly, protecting natural sources of fish seeds and supporting hatcheries to be able to meet the increasing demand from millions of nurseries and fish farms of the country.

But the hatchery sector over the last 4/5 years started encountering multiple constraints as is reported by the hatchery owners. The major challenges are;

- Increasing production cost mainly for power (electricity & diesel), labor & feeds.
- Scarcity and contamination of underground water resulting increased mortality and lower hatching rate.
- Increased competition has resulted quality degradation amid of fall in price of hatchery products affecting to business performances of both nurseries and fish farmers.

Besides the rising constraints in production and marketing process, the biggest challenges hatcheries are started encountering for shortage of underground water and where there is available is containing high percentage of iron as is reported by hatchery owners from Jessore, Kalaroa and Satkhira areas. The situation is acute in Kalaroa and Khulna where the hatcheries are about to shut down their business. In Kalaroa out of 21 hatcheries only 3 were found partially functioning with 2 to 3 jars as is reported by the participating hatchery owners in the FGD. In fultala of Khulna out of 6 hatcheries only one is found operating with a single Jar. The cost of fish seed is very high in these areas including lower growth rate associated with high mortality. Many farmers have suspended or dropped their business amid of the crisis of quality fish seed as is mentioned by both hatchery owners and nursery owners from Kalaroa and Khulna.

In Mymensingh area availability of water is in abundance but iron contamination is very high resulting the mortality rate of 25% to 30% as is reported by Mr. Abdul Kader Tarafder, owner of Shornolata Hatchery from Radhakanai area of Fulbari, Mymensingh. Similar opinion was also expressed by Mr. AKM Nurul Islam, Owner of Brahmaputra Fish Seed Complex, Putimari, Mymensingh.

Aiming to alleviate these three key constraints of the hatcheries, WorldFish, one of the key actors in fish sub-sector development in Bangladesh has piloted the solar powered Water Recirculation Plant (WRP) in Jessore for the first time in Bangladesh. Being impressed of the demonstrated success in removing all three key constraints WF has decided to expand this success to all hatcheries of the country. This study is the initiative of WF to serve two key purposes;

1. Share successes of WRP to hatcheries throughout the FTF working areas aiming to assess the level of interest on WRP and other solar machineries by hatcheries', nurseries and fish farmers and
2. Develop a marketing strategy for APT products to make it affordable and available to hatchery owners, nurseries and fish farmers.

The study was conducted in greater FTF zone of WF (Barisal, Patuakhali, Bhola, Jessore, Satkhira & Khulna areas) including a short visit to Mymensingh district because of existence of large number of hatcheries' and relevant value chain actors suffering from the same problems.

During the study, the team has intensively interviewed 12 hatchery owners, 15 nursery operators, 25 fish farmers, 2 fish transporters, 2 Commercial Banks, 2 MFIs, 2 aqua-machinery dealers/agents. Besides 17 hatchery owners, 20 nursery operators and 11 farmers were also interviewed through FGDs and during presentation of performances of solar products of APT.

As part of the assessment on available financial services, the team has also investigated 6 Commercial Banks (4 public and 2 private) 2 Venture capitals, 2 MFIs, PKSF, IDLC, IDCOL and SME foundation.

With regards to APT products specially the WRP significantly higher level of interest was shown by the participants when they were demonstrated the videos and explained the cost benefit of the products. All hatchery owners we met from Jessore, Kalaroa, Satkhira, Paikgachha, Bhola and Mymensingh have expressed their deep interest for Water recirculation System. They considered WRS as a solution to their two key problems which are about to shut their business; firstly; the production cost and secondly; crisis of and contamination of underground water. All hatchery owners are ready to buy solar operated WRP if provided on 50% credit to be repaid over a period of 12 months to 4 months installments.

But the nursery operators and fish farmers did not show much interest for solar operated water pumps, aerator, and gas removal machines due to high initial cost and available traditional alternatives.

The commercial institutes have shown varied level of interest to support marketing initiatives of APT products. Being impressed of the demand, the Microfinance Institutes and Venture Capital Investors have shown good interest to partner with APT in marketing of their products. Among the Commercial Banks, the public Banks have demonstrated interest to finance APT if basic banking requirements are met by the company.

It is revealed from the study that the hatcheries, nurseries and fish farmers of Jessore, Khulna, Mymensingh and Satkhira areas are in serious problem with their business and passing through a range of crisis ranging from production cost to quality and marketing of their products. The WRP has appeared to them as a potential solution to their key problems; firstly, cost for production and secondly, crisis and or quality of water that affect both mortality and quality of fish seeds. At this moment there is no other solution to their problems

except trying to install the WRP. Hence it is expected that the rich hatcheries may come forward to negotiate with APT with possible options to get the WRP.

APT on the other hand has no capacity of selling products on credit amid of financial weakness. Hence both parties require to compromise at a point comfortable for both. For example; most hatcheries are willing to pay 25 to 50% cost of product during purchase and the rest could be offered on credit by APT. By this time some hatchery owners have contacted with APT and expressed their interest for further discussion with APT about WRP.

From the study APT has got the opportunity to assess the demand of their products, understand the market size as well the abilities of potential buyer groups. In addition, the choices, priorities and reservations of financial markets including the area for opportunities are also better understood by APT. Based on these finding now APT requires to design an operational plan (project plan) to materialize the marketing opportunities in partnership with financial organization that offer possible best option to APT. To enhance its financial capacities the available possible options for APT are;

The first option is of partnering with VCI or MFIs who will strongly help APT in marketing products. The biggest benefit of partnering with MFI and VCI is that they will protect the business interest of APT and help growth and expansion by sharing risk and opportunities as of their own interest. Collecting repayment from hatcheries on installments would be much easier and cost effective in this case. The other option is of lending from Bank and works alone shouldering all challenges associated in marketing of product. The highest risk APT has to be bear in this case is for collecting installments on time from hatcheries. However, it is up to APT to decide on the right partner to move forward with its business.

Introduction to the Study

Overview of the Fish sub-sector

Bangladesh is one of the world leading fish producing country and is ranked as the third top inland fish producing country in the world after the People's Republic of China and India, reports BSS. In achieving the third position, Bangladesh has produced a total of 10,48,242 tonnes of fish from inland water bodies in 2016, about 2.4 percent higher than 2015, according to the FAO's fisheries and aquaculture report. The country is also the fifth

- 3rd in inland fish production
(**10.48** lakh tonnes)

- 5th in aquaculture production
(**22** lakh tonnes)

- 11th in marine fish production
(**1.13** lakh tonnes)

- Total **41.34** lakh tonnes of fish produced in 2016-17

biggest aquaculture producer in the world (22 lakh tones) and 11th in Marine fish (1,13 lakh tones) production. During 2016 – 2017 fiscal year Bangladesh has produced a total of 41,34,000 metric tons of fish, including a first-time surplus of 84,000 tons. (The State of World Fisheries and Aquaculture 2018). Bangladesh is self-sufficient in fish production and per capita fish

consumption by its people has reached to 62.58 grams which is surplus than their daily protein demand as per the report of the Bangladesh Bureau of Statistics (BBS). Fisheries sub-sector contributes 3.69% to GDP and 23.81% to agricultural GDP (DoF 2016).

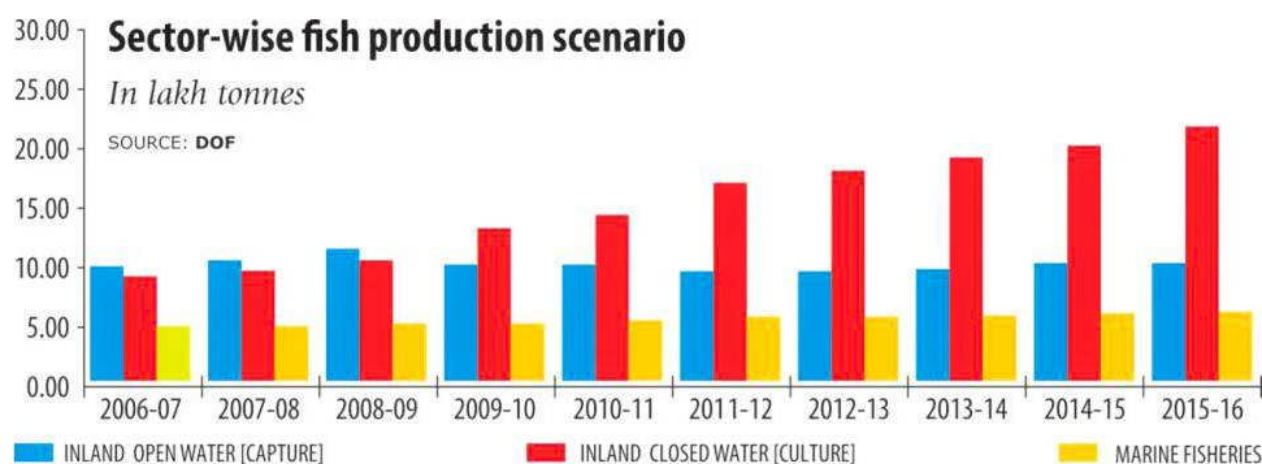
Fish is the second most valuable non-crop agricultural product in Bangladesh and major contributor to the livelihoods and employment of millions of people. An estimated 1.20 million people of Bangladesh are fishers and earn their livelihood from fishing. A further 16.60 million people indirectly earn their livelihood from fisheries and aquaculture and related activities, and employed in the backward and forward linkages of the value chain such as the downstream activities of fish trading, fish seed production, collection of shrimp and prawn seed, fish handling, processing and marketing, net making, input supply and processing. Among the people involved in the sector 10% are women.

This sector is contributing significantly in food security through providing safe and quality animal protein. Fish, alone, contribute about 63% of the animal protein in the daily dietary requirements of Bangladeshi people. Fisheries sub-sector contributes 3.69% to GDP and 23.81% to agricultural GDP (DoF 2016). This sector contributes to employment of 17.80 million people which is approximately 11% of total population. The industry is growing at an average rate of 5.2% over the last five years. The culture and consumption of fish therefore has important implications for national income and food security. Bangladeshi people are popularly referred to as "**Mache Bhate Bangali**" or "fish and rice makes a Bengali".

The overseas fish trade is an important source of foreign currency earnings for the country and provides benefits at both the macro and microeconomic levels. Fish is the third largest contributor to Bangladesh's export earnings and is growing annually by 5-8 %. Revenue from exports of non-fish agricultural goods is gradually being outpaced by fish products, to the extent that fish has become the most important primary commodity that Bangladesh exports (Dey et al. 2008). The country exports frozen shrimp and other fish and fisheries products to more than 50 countries, including Belgium UK, Netherlands, Germany, USA, China, France, Russian Federation, Japan and Saudi Arabia. In 2016-17, the country earned BDT 42876.40 million by exporting almost 68.31 thousand MT of fish and fisheries products.

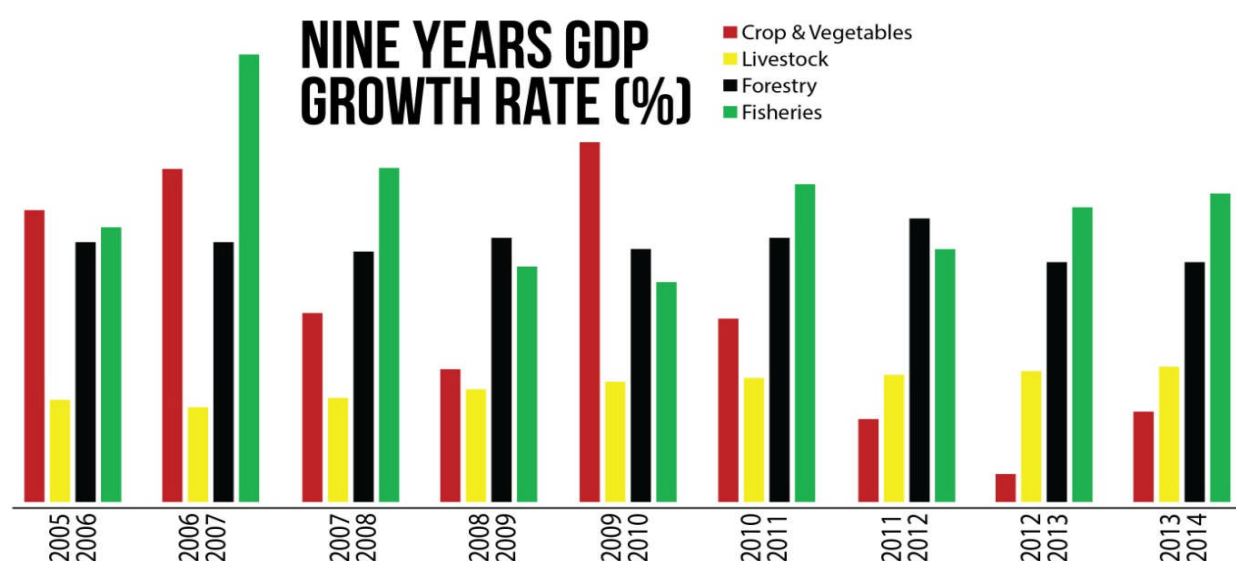
Growth of Aquaculture in Bangladesh

With a manifold growth in farmed fish market over the last three decades, Bangladesh has been experiencing a quiet revolution in aquaculture. With rapid expansions, Aquaculture has increasingly been playing a major role in total fish production (4.13 million tons) of the country and presently more than half of the total production (56.92 %) comes from aquaculture (2.20 million tons). Aquaculture production of 33000 MT in 1960, increased to massive 1.73 million MT in 2012 and at 2.20 million MT in 2016.



This rapid growth has been driven by increased demand; improvements in technology, communications and infrastructure; and investments by millions of farm households and small and medium enterprises in the fish value chain. This growth in fish sub-sector has largely contributed to the growth and expansions of a number of interrelated off-farm segments such as input dealers, feeds mills, machineries & equipments, labor, traders and transport services.

Although farming of fish in this country, yet a low intensity semi-subsistence activity, rapid commercialization, gradual intensification and specialization have taken place over the last decade, leading to unprecedented expansion in production of farmed fish (Belton and Azad 2012). Horizontal expansion of aquaculture has been taking place on the riverine floodplains which have been enclosed to facilitate the intensification of production (Sultana 2012).



As is reported by the fish nurseries and farmers from all visited places, over the last couple of years, significant numbers of crop farmers have converted their crop lands to fish ponds, what many think a natural phenomenon related to ever decreasing benefit-cost ratio farmers are receiving from paddy farming. Aquaculture production of 33000 MT in 1960, increased to massive 1.73 million MT in 2012 and 2.20 million MT in 2016.

Hatcheries - the key player of aquaculture development

The aquaculture of Bangladesh has demonstrated a robust growth of 8.2 percent, much higher compared to the average growth rate of all fisheries (5.4 percent) in the last one decade. Behind this tremendous success in growth and expansions of fish aquaculture in Bangladesh, it was the hatcheries' that played the pivotal role and mostly run by private sectors. The availability of fish seed is an essential prerequisite for fish culture and amid of gradual decline of natural sources the main sources of fish seeds in Bangladesh is spawn produced in government and private hatcheries. The gradual diminishing of natural sources (@1.24%) resulting the growth and expansions of hatcheries and making the country dependent on them for fish seed supply required for aquaculture. The rapid growth of hatcheries has also resulted more competitive environment in the sub-sector which ultimately has pushed the adoption of new technologies for increased productivity.

Prospects of Hatcheries and forward value chain actors

Bangladesh is endowed with a vast expanse of inland open waters characterized by rivers, canals, natural and man-made lakes, freshwater marshes, estuaries, brackish water impoundments and floodplains. The potential fish resources resulting from these are among the richest in the world; in production, only China and India outrank Bangladesh. The inland fish diversity of is attributed to the habitats created by the Bengal Delta wetlands and the confluence of the Brahmaputra, Ganges and Jamuna rivers that flow from the Himalayan Mountains into the Bay of Bengal.

Until 70s, there was an abundance of fish in the natural waters and the inland capture fisheries contributed about 90% of the country's total fish production which was almost 20 times higher than higher compared to the then aquaculture production of the country. Presently, however, capture fish production has declined to about only 26% of total production with a negative trend of 1.24 % per year. Whereas cultured fish production has increased to 57% of total national production.

There are, however, serious concerns surrounding the slow decline in the condition of natural fish seeds/spawn sources and open water fish stocks which have been negatively impacted upon through a series of natural and anthropogenic induced changes. The decline of fish stocks in natural waters over the last three decades has largely contributed the rise of aquaculture amid of increasing demand from the national consumer market. The demand from national market will continue to increasing due to increasing population pressure of the country. This trend indicates the increasing importance of hatcheries to support increasing aquaculture due to gradual decline of natural stocks of fish seed/spawn and capture of fishes from inland water bodies.

Growing challenges for aquaculture

After being self-sufficient in fish production for the first time in the year 2018, Bangladesh has started to get global recognition as one of the biggest fish producers. In reaching that

target Bangladesh requires to put high attention to two issues; firstly, protecting natural sources of fish seeds and supporting hatcheries to be able to meet the increasing demand from millions of nurseries and fish farms of the country.

But the hatchery sector over the last 4/5 years started encountering multiple difficulties as is reported by the president of Jessore hatchery Association Mr. Firoz Khan. The major challenges are;

- Increasing production cost mainly for power (electricity & diesel), labor & feeds.
- Scarcity and contamination of underground water resulting increased mortality and lower hatching rate.
- Increased competition has resulted quality degradation amid of fall in price of hatchery products affecting to business performances of both nurseries and fish farmers.

Besides the rising constraints in production and marketing process, the hatcheries are also started encountering shortage of underground water and where there is available is containing high percentage of iron as is reported by hatchery owners from Jessore, Kalaroa and Satkhira areas. For proper hatching the hatcheries require abundance of water (25 litre/minute/jar). That means 1 kg seed production requires 45,000 liters of water (according to the Mr. Firoz Khan, president of Hatchery Association, Jessore). According to him a single hatchery with an average 30 hatching jars pump out minimum 15 million of underground water during a single hatching season.

The situation is acute in Kalaroa and Khulna where the hatcheries are about to shut down their business. In Kalaroa out of 21 hatcheries only 3 were found partially functioning with 2 to 3 jars as is reported by the participating hatchery owners in the FGD. In fultala of Khulna out of 6 hatcheries only one is found operating with a single Jar. The cost of fish seed is very high in these areas including lower growth rate associated with high mortality. Many farmers have suspended or dropped their business amid of the crisis of quality fish seed as is mentioned by both hatchery owners and nursery owners from Kalaroa and Khulna.

In Mymensingh area availability of water is in abundance but iron contamination is very high resulting the mortality rate of 30% as is reported by Mr. Abdul Kader Tarafder, owner of Shornolata Hatchery from Radhakanai area of Fulbari, Mymensingh. Similar opinion was also expressed by Mr. AKM Nurul Islam, Owner of Brhmaputra Fish Seed Complex, Putimari, Mymensingh.

Problem Statement and origin of the study

To alleviate these three key constraints (production cost, seed quality and water crisis) of the hatcheries that is largely impacting on productivity of the overall aquaculture sector, WorldFish has piloted the solar powered Water Recirculation Plant in Jessore for the first time in Bangladesh. The solar power was used to reduce energy cost (from electricity and diesel) to minimize production cost. On the other hand the water recirculation process aimed at reducing the use of underground water and improving water quality contributing to improving hatching performances.

The WRP was installed in a hatchery name Modhumoti Hatchery located at Chachra of Jessore town. The plant was installed by Mazand Consortium with technical supports from a local company named Angel Powertech Ltd based in Jessore. Being impressed with the performance of WRP which has significantly contributed to the elimination of the key problems (high production cost, quality degradation and abundance use of underground

water), WF has taken initiative to expand this success to all hatcheries. This study is the initiative of WF to serve two key purposes;

3. Share successes of WRP to hatcheries throughout the country to see their interest and
4. Develop a marketing strategy of APT product to make it affordable to hatchery owners

Objectives / purpose of the study

The purpose of this assignment is to assess the feasibility and demand of Solar powered Aqua machinery products developed by APT as well as develop a marketing strategy for them, so that they can promote their product in the market and provide the services to the target groups for increasing the productivity at hatchery, Nursery and farmers level. The specific objectives of the assignment are:

- To know the entry barriers and opportunities for Aqua machineries for penetration in the target market
- To assess different financial offers of different financial institutes and develop a financial package for target groups so that they can afford the price of aqua machineries like Solar powered DC pump and water recirculation system.
- To develop business strategy so the APT can start their business with Aqua machineries

Scope of the study (as per the ToR)

The scope of this study has arisen from the successes of solar powered WRP and water pump which has significantly contributed in removing the key problems of Hatcheries mainly and then nurseries and fish farmers by reducing production cost and mortalities at all levels. The successes of WRP has encouraged WF to popularize the solar powered WRP and other machineries aiming to alleviate growing constraints in the sector specially reducing production cost, improving quality fish seeds and lessen the use of underground water..

In doing so the Consultant has worked in close coordination with Angel Powertech and WorldFish BANA Market Systems team, to undertake the tasks outlined in the Methodology & Activities section. The Aqua machineries produced by APT are categorized in two type base on the investment

Type a. High Upfront Investment Products:

- i. Solar Panel+ Pump
- ii. Water re-circulation system

Type b. Market Competitive Rate Investment:

- i. Underwater gas remover
- ii. Aerator
- iii. Seed carry/transportation
- iv. Egg Shaking Machine
- v. Feed Production Machine
- vi. Hatchery Setup installation for new investors/advisory service

The assignment is summarized into two broad building blocks, whereby tentatively 70% focus is on the first block and 30% focus will be on the second block.

Block 1: Define a financial package with Financial Institute for Type 1 Products

- Understand the current practice and cost-benefit analysis of energy source and water sources and uses
- Understand the current business banking practices of target buyers (Hatchery and Nursery)
- Understand local (in the FtF zone) banking sector actors' perspective/perception (reliability) on the hatcheries and nurseries
- Understand the general willingness to pay (WTP) and Affordability to pay of the hatcheries and nurseries.
- Understand the requirement criteria from Banks and financial institutes for both APT and nurseries/hatcheries
- Design an acceptable offer package having optimum benefits for APT, target buyers and banks/financial institutes to remove the barriers/challenges

Block 2: Prepare a Market Development Strategy design for Type 2 Products

- Understand the competitive landscape (equivalent or non-equivalent products which are solving the same problem) for the products in consideration
- Understand current price points adopted by target customer groups
- Understand the awareness level of the target groups regarding products offered by APT
- Identify the key instigators/catalysts/factors affecting buying decisions
- Prepare a Business strategy for APT

Geographic Coverage

Feed the Future Zone of Influence is the broad regional focus area for this assignment. But for better understanding the study team will also visit in Mymensingh areas. The field assessment will be conducted as below areas:

- A. For Understanding the Target Buyer Insights
 - Barishal region
 - Jashore and Khulna region
 - Small scale visit at Mymensingh region
- B. For Understanding Potential Financial Institutes' insights
 - Dhaka region

Methodologies and Activities

The set objectives of the assignment is achieved through a 3 staged process that included;

1. Consultation meeting with both Angel PowertechLtd. (APT)and WorldFish (WF) and relevant literature review
2. Field assessment for primary data collection (FGD, In-depth individual interview/ KII, Consultation meeting) and finally
3. Analysis of the collected data and information and prepare a report including business strategy.

The assessment has followed both quantitative and qualitative approaches for data/information collection with possible highest preference on qualitative justification. The process is made fully participatory by ensuring maximum involvement of the key stakeholders involved in the fish sub-sector. The study team has visiting selected study areas and conducted several sessions with the key stakeholders from both demand side and the supply side that has included;

A. Demand Side:

1. The Hatchery owners
2. The Nursery owners
3. Fish Farmers and
4. Fish transporter (Fish Seed, Fry, Food Fish etc.)
5. Other relevant actors'.

B. Supply side:

1. Financial service providers which includes
 - a. Commercial Banks,
 - b. MFIs,
 - c. Venture capital etc.
2. Technical supports and service providers like
 - a. Aqua machineries and equipment selling companies
 - b. Machineries and equipment selling dealers and agents of different companies.
 - c. Others if any.

For information collection, various methodologies been used including the literature review. The selected stakeholders were covered by mixed methodologies (based on which method best suits to which group of stakeholders). The key methods for the stakeholders were the FGD, in-depth individual interview and KII. The detailed methodologies for the study were;

1. Consultation meeting with APT & WF team and Literature review: Prior to design field operation plan for data/information collection, the study team conducted consultation meetings with APT & WF team, collected and review available program reports and literatures from WorldFish, APT, Financial service providers, machineries and equipment selling companies as well available internet sources which has enabled the team to;
 - a. Identify and formulate entry areas
 - b. Identify best / promising practices
 - c. Identify potential opportunities and limitations relevant to assignment objectives.
 - d. Gain a solid understanding of the nature and complexity of the environment.

Literature review has enabled the study team in formulating the approach and strategies adopted for data collection, questionnaire preparation, arranging stakeholders' meeting/workshops. This approach has helped the team to cross-check and justifies information of the secondary sources and identifies missing opportunities.

2. **Focus Group Discussions:** Focus Group Discussions were organized with participants from direct and indirect stakeholders of fish sub-sector consisting representatives from Hatchery owners, Nursery owners, Farmers, service providers (both technical and financial) and other relevant actors in the sector. From the FGD the study team has gathered a clear picture of the current market scenario relevant to purpose of the study.

3. ***In-depth Individual Interview (II) / Key Informant Interview (KII)***: In-depth Individual Interview/KII has helped gather a more detailed insight of the support and services which included cost comparison, performance, difficulties, limitations, missing opportunities etc. The II/KII also helped the study team to understand the perception gap between the varied stakeholder groups and thus enabled the team gathering a detailed picture of market scenario and finally identifies the appropriate means of market penetration by APT products and services. The interviewee/key informants was conducted with selected participants from following group of people (representing both demand and supply sides) who are directly or indirectly involved in fish sub-sector ;
- a. Hatchery owners
 - b. Nursery Owners
 - c. Fish Farmers
 - d. Fish transporter (Fish Seed, Fry, Food Fish etc.)
 - e. Aqua machineries and equipment supplying companies and their distribution members
 - f. Financial organizations (Commercial Banks, MFIs, Venture capital companies etc.
 - g. Service provider (if necessary).

In addition, the team also included a section under the title of “Observation by the Consultant” in which the personal opinion of the lead consultant will be included.

Sample size for Field Assessment (Primary Study)

The sample size was fixed not based on target population in specific business rather potential key informants from both demand and supply sides of both Aqua machineries and financial services. In case of machineries and equipment, it is assumed that there will be a limited number of company products in the market distributed by limited number of dealers/distributors/agents. Therefore, there would be very limited variations in cost, distribution process, features and performances of those machineries. Similarly, the financial service providers will also be limited to MFIs and commercial Banks mainly whose policies and procedures may not vary for locations.

Methods / Techniques	Total Number	Total Participants (expected)	Tools to be used	Category of participants
FGD	06	60 (8-10 in each FGD)	<ul style="list-style-type: none"> • FGD Checklist • Facilitators guiding questionnaire 	Hatchery Owners Nursery Owners Fish Farmers
KII/ Individual Interview (II)	75	75	Set questionnaire for each category of participants.	Hatchery owners Nursery Owners Fish Farmers Fish transporter (Fish Seed, Fry, Food Fish etc.) Aqua machineries and equipment supplying companies Dealer/retailer of Aqua machineries and equipment

				Financial organizations (Commercial Banks, MFIs, Venture capital companies etc. Service provider (if necessary).
Consultation meeting with Hatchery owners at Barisal	01	10-12	Facilitators guiding questionnaire	Hatchery owners

Activities undertaken in different phases of the study

Phase-1: Preparatory stage

The preparatory stage consists of two tiered consultation meeting with both WorldFish (WF) and Angel Powertech Ltd. (APT) separately and then collectively with both team.

The purpose of the meetings with APT team was to understand the key features of the selected products, current marketing strategies, perception of the users, key constraints encountering by APT and other relevant information.

The geographic coverage, locations, key stakeholders, number of participants and other key issues related to primary data collection were issues for discussion with WorldFish team..

Phase-2: Preparation of draft questionnaires and field testing by the consultant

After literature review and consultation meetings with both WF and APT, the consultant has prepared draft questionnaires for all stakeholders to be interviewed (as per contract) and proposed a short visit to Jessore mainly for two key purposes; firstly, visit machineries and equipments of APT and secondly, to field test draft questionnaires by visiting some hatcheries, nurseries and fish farmers. During this short visit the consultant has prepared a comparative cost analysis between solar powered and non-solar powered (electric and diesel based) hatchery operation in consultation with APT engineer and hatchery owners.

Phase-3: Tools development and finalization

Based findings from primary study in Jessore, the study tools (questionnaires, checklist) for primary data collection and interview with the key informants and market actors was developed with direct assistances from APT teams. A motivational presentation with key messages was prepared for FGDs participants. The sampling framework was also refined and the coordination, quality control mechanism, and data handling procedure were developed and finalized with direct assistances from WorldFish team.

Phase-4: Field investigation & data collection

After approval of questionnaires by WF the in-depth study plan was prepared by the consultant. The first visit was made to Jessore area covering Jessore, Kalaroa, Satkhira and Khulna areas and conducted FGDs and other interviews with the key informants and different stakeholders from both the demand and supply side to assess the business situation and market scenario of the machineries and equipment in use by the fish sub-sector actors and also crosscheck the data obtained from secondary research. Upon returning from first field visit, the consultant made a short analysis of the key findings and shared them to WF team prior to plan for next visit to Barisal region.

Next field study was made to Barisal under the direct supports and assistances from WF and APT in organizing meeting & FGDs with key informants. The key stakeholders were met from selected upazillas of Patuakhali, Barisal and Bhola districts.

Upon returning from Barisal region, the consultant has met with some public and private Banks to cross check findings from local Banks in addition to assess opportunities of accessing to “Green Funds” opportunities of Banks by APT.

The third and final visit was made to Mymensingh to assess business performances of hatchery, nurseries and fish farmers as well interest for solar powered Water Recirculation Plant.

Phase-5: Data analysis, review, draft report preparation

After completion of field assessment, the consultant has analyzed primary information collected from fields and summarized the field findings into a draft report. The consultant has carefully reviewed and cross checked all secondary and primary findings to assess if any additional data or information is missing prior to prepare the draft report of the study.

Phase-6: Validation of information

Upon completion of the draft report, the consultant has further crosschecked information from relevant sources (actors) over telephone aiming to validate collected data and information prior to finalization of the report.

Phase-7: Final report preparation

The draft report will be shared to both WF and APT for feedbacks from them. Upon incorporating all feedbacks from WF & APT and crosschecking of information (if necessary) from different stakeholders the consultant will prepare and submit the final report to the Chairman of APT.

Findings from the Field study

Findings from the pre-study assessment in Jessore

Prior to conduct the in-depth study a two days long (on 8th and 9th January) primary assessment was made by the consultant in Jessore areas and mainly with hatchery and Nursery owners. The purpose of this initial study was to

- Prepare a cost-benefit analysis between solar and electric/diesel powered hatchery
- Develop the key messages to be shared with target audiences for the study (hatchery, Nursery and fish farm owners).
- Pre-test the developed questionnaires to be used for in-depth field study.

To develop the key, messages for the study a comparative cost analysis between solar and electric/diesel energy was made by the Consultant accompanied by the Chairman of APT and his Engineer Mr. Milon. In doing so solar powered Modhumoti hatchery was taken as a model which was compared with the average cost/expenses of two electric powered (with backup of diesel engine) hatcheries namely National Fish hatchery and Rupali Fish hatchery all located in Chacchra, Jessore. The key findings on impact and comparative cost analysis were as below;

Impact on cost and profits

- a. Significantly reduced operation cost (zero electricity cost)
- b. Reduce production cost for
 - i. No electricity and diesel bill
 - ii. Reduction in hatching time (from 80 hours to 72 hours)
 - iii. Reduced labor cost
- c. Higher profits due to low production cost
- d. Dominance in market price (can provide best offer in price without compromising profit margin).
- e. Very less water use.
- f. Balanced Oxygenation in water for healthy & quality produces

Impact on Product (fish fry)

- a. Hatching rate has doubled (4 to 5 lacs of renu from 1 kg egg which was 2 to 3 lacs before)
- b. Quality of renu/fry improved / healthy fries.
- c. Mortality rate is very low
- d. Brood to hatching and delivery time reduced (from 6 days to 5 days now)
- e. Higher percentage of Oxygen in re-circulated water.
- f. Growth rate is much higher due to healthy water condition.
- g. No iron particles in re-circulated results healthy environment in water (direct underground water contains high percentage of iron).

Comparative Production cost of hatcheries in a single lot (6 days)

- | | |
|--------------------------------------------------------------------|------------|
| 1. Electricity cost (with diesel engine back up for 2 hours a day) | Tk. 7,620 |
| 2. Diesel cost (for diesel operated power supply) | Tk. 13,898 |
| 3. Solar operated plant cost | Tk. 2,324 |

The above figures are the direct production cost (from power) of a hatchery containing 30 Jars and for a single lot/cycle for 6 days with a product capacity of 120 kg to 125 kg. But according to the opinion of hatchery owners, the cost for diesel would be tk. 19,000 to 20,000 and for electricity tk, 13,000 to 14,000 per lot. The other issues having impact on cost of production and profit like mortality, manpower and water uses have not included in this calculation. However, the other benefits from solar powered WRP are (as is expressed by hatchery owners);

- Healthy seeds / fish fry
- Very little mortality
- Reduced Hatching period (72 hours in place of 80 hours)
- Growth rate is higher
- Zero production cost from power
- Significantly less use of underground water.

Based on above information a short motivational presentation was prepared to share with Hatchery owners, Nursery and Fish Farmers to check/assess their interest to solar powered water pumps, WRP, Egg shaking and Gas removal and Oxygenation machines including other solar powered items. The presentation was also supported with Videos and pictures of solar powered machineries of Angel Powertech Ltd (APT).

In-depth study

The in-depth study was carried out in all selected areas on following dates in mentioned places;

Date	Place	Locations	Activities	Accomplishments
27 th January to 30 th January 2019	Jessore region	Jessore, Kolaroa, Fultola, Paikgaccha	FGD, KII and Ind. Interview	4 FGD's (2 hatchery & one for each Nursery and Fish Farmers). KII and II: Total 32 from all groups
11 th February to 15 th February 2019	Barisal	Amtoli, Kolapara, Nalcchithi, Rangabali and Bhola	FGD, KII and Ind. Interview	1 FGD (Nurseries) KII and II: Total 27 from all groups
17 th February to 20 th February 2019	Dhaka	Dhaka Town	KII	06 Commercial Bnaks (Sonali, Janata, Pubali, BKB, Dutch Bangla, Mutual Trust,
3 rd March to 4 th March 2019	Mymensingh		KII	KII total 8 covering 2 hatcheries, 2 nurseries and 4 Fish Farmers.

Activities during field study and target accomplishment

The study was unfortunately coincides with hatching time of hatcheries therefore, it was difficult of meeting hatchery owners and keeping them in meeting for longer period as expected. However, the team overcame the problem by meeting them individually and organizing FGD as of their convenience and meeting them twice in group.

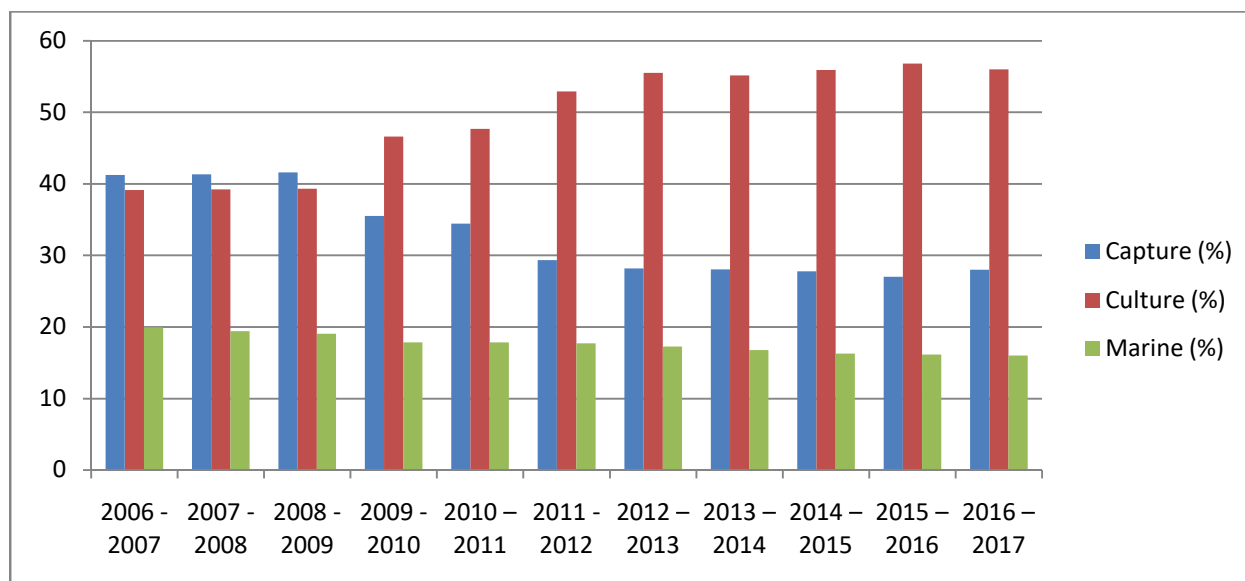
Meeting with hatcheries, nurseries and farmers in Barisal region was highly difficult because of distant locations and isolations. For example; visiting two hatcheries (in Bhola and in Rangabali) took a full day for each. One farmers' FGD in Barisal region could not be organized due to several km distances between farmers locations. However, the team was able to meet farmers individually to get their opinions as per plan. Moreover, majority nursery owners the team met in FGD were fish farmer as well.

Findings from in-depth study

The hatcheries, Nurseries and Fish Farmers are greatly suffering from manifold difficulties and constraints resulting to high production cost (cost for electricity, fuel, labor, fish feeds, medicines and other associated expenses) but the market share and sale price of products is reducing. Increased competition (in locality and regions) not only have reduced market shares of each hatcheries but also have impacted on product quality and prices of produces. Almost all hatcheries are forced to sale produces on credit to nurseries as is the case for nurseries to fish farmers. On the other hand water crisis (shortage and contamination) is becoming a serious concern for the hatchery owners which is also affecting the nurseries and farmers in the value chain. During the study all direct actors in fish sector reported to have losses in their businesses over the last two years. Based on the findings a further investigation was made by the Consultant and the detail findings are as below;

Decline in production of aquaculture

As is reported by hatcheries from Jessoe and Barisal regions that last two years there was a fall in their business and many fish farmers have dropped their business amid of increased mortality of fingerlings and fish feeds. This information can be justified by the report of DoF for the period of 2016-2017 where it is clear that there was a fall in aquaculture production during the reporting period which further is expected to be reflected in the annual report of 2017-2018 periods.



Source: DoF Annual Reports

However, during the same period there was a rise in inland capture of fish which was due to bumper production of Hilsha fish as a result of imposed ban on fishing during breeding/spawning season. Moreover, release of fish fry in open water bodies like beels, haors and inland rivers is another factor for increased amount of capture fish during 2016-2017 periods as is reported by local fishers.

Farmers drop-out from business during last two years was reported by hatcheries from all places. The key reason was the rise in production cost (mainly for rise in feed price) and fall in sale price at markets. More specific and evidential information was found in Bhola from Barisal region. Mr. Mamun a very dynamic and enthusiastic hatchery owner (Bhola Monosex Tilapia Hatchery) has also reported the fall of business and sale during 2017-2018 periods. He has 60 hatching Jars with annual production capacity of 15 million tilapia fry. He reported to have experienced the fall in sale as well price from the 2nd half of 2017 to December 2018. The sale figure of Mamun for last three years is as follow;

2016	2017	2018
80 lakh	90 lakh	60 lakh

Mr. Mamun has total 600 farmers enlisted who usually buy fish fry from his hatchery regularly. In early 2017, around 575 farmers have ordered and purchased fish fry from his hatchery but from the late 2017 to end of 2018 only around 400 farmers have purchased tilapia fry resulting a fall in 33% sale during the period. Two key reasons he has mentioned for the fall in production and price as well drop-out of farmers. They are;

1. Increased price of fish feeds (a rise of 15 to 20%) caused an increase of 20% production cost at farmers' level while the sale of fish in market did not raise resulting loss in business.
2. Poor communication resulting increased mortality during Fry transportation by the farmers. Traditional fry transportation (in hari or drum with hand agitations) and delay in reaching the destination (travel by ferry or riksha van) are two key reasons for increased mortality.

Reasons for declination

The key reasons for market failure as is mentioned by all actors are;

- Cost of production (power, labor and other essentials)
- Increased price of fish feeds
- Increased mortality rate (Kolaroa, Fultola& a part of Jessore).
- Marketing of fish fry (Poor communication system for bhola) and fishes.
- Abundance of Imported fish in the market.

Demand and constraints analysis for Solarequipments

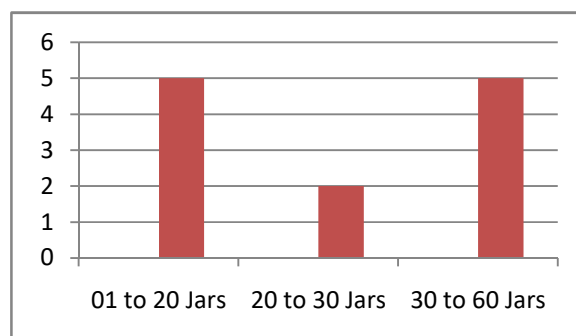
During the study, the key actors in fish sector (from hatcheries, nurseries and farmers) were met both individually and collectively in FGDs. In both meeting, the study team explained in details the importance of solar powered WRP and other machineries and how it contributes to enhance their business performance by removing existing constraints. Detailed comparative cost analysis was also presented in those meetings along with demonstration of performances of machineries in video clips. The summarized findings from the study are stated below;

1. The Hatcheries

Hatcheries are the key actors in contributing the significant rise of aquaculture in Bangladesh. Starting slowly from mid 70's of last century the hatcheries have demonstrated a faster growth and expansions over the last two and half decades (till 2015) amid increasing demand from national markets, improvement of technologies, communications, storage facilities, and infrastructures followed by investments from millions of farmers and nurseries in fish business.

Until 2015, the business was satisfactory despite fall in price of their products amid increasing competitions as is reported by hatchery owners from Jessore areas. Over the last few years the hatchery business started encountering a series of problems as is reported by Mr. Firoz Khan, president of the Hatchery Association of Chacchra, Jessore. The key problems as is mentioned before are the increased production cost and fall in sale price amid increased competition coupled with quality degradation as is the case in Jessore areas. In Kolaroa, Khulna and Satkhira areas the situation is worse than Jessore where crisis of underground water and contamination of iron resulted shut downing of many hatcheries. In Kolaroa out of 21 hatchery only 3 are running partially. In Khulna (Fultala) out of six hatcheries only is functioning with two hatching jars. The key problems in both areas are scarcity of underground water, iron contamination, lower hatching rate and high mortality of hatched fish fry's.

The intensively interviewed 12 hatchery owners from all three regions can be categorized in three groups based on number of hatching Jars in operation. Among the 12 hatchery owners 42% (5) owns up to 20 Jars, 16% (2) having up to 30 Jars and the other 42% (5) hatchery owners own more than 30 and upto 60 Jars. From economic perspective they are from rich, middle and lower middle group.



Key features of the interviewed hatcheries

The key features of the hatcheries interviewed during the field visit can be summarized as;

No. of hatching Jars	No. in operation	Production Target	Actual production	Power cost (electricity + diesel)	Agree to pay advance
Jessore					
23	23	3000 Kg	1500 kg	Tk. 16,000 /month	20%
41	41	5000 kg	4000 kg	Tk. 29,000 / month	50%
42	42	2700 kg	1600 kg	Tk. 35,000 / month	50%
24	24	2500 kg	2500 kg	Tk. 15, 500 / month	33%
Kalaroa					
08	04	296 kg	196 kg	Tk. 1,700/month	20%
14	08	810 kg	500 kg	Tk. 20,000 m (diesel)	20%
12	08	40 kg	130 kg	Tk. 14, 000 month	25%
Barisal					
07	07	740 kg	500 kg	Tk. 3, 700 /month	No advance
10	10	800 kg	600 kg	Tk. 4, 800/month	No advance
60	30	100 Lac fry	60 lac fry	Tk. 7,000/month	50%
Mymensingh					
48	25	500 lac	450 lac	Tk. 80,000 /month	50%
35	20	1500 kg	1500 kg	Tk. 32,000 / month	50%

The problems encountering by the hatcheries were almost similar with few location specific exceptions. The key findings from hatchery owners can be summarized as below;

- The business is encountering a range of constraints and difficulties due to;
 - High production cost related to high cost for
 - Electricity and fuel (diesel)
 - Labor and employees (underuse to human resources).
 - Other related materials like PGs.
 - Increased mortality due to water contamination, power fluctuation etc.
 - Lower market price of products (Renupona) due to
 - Higher market competition (Increased number of hatcheries, increased volume of products but quality degraded)
 - Loss of regional and national markets due to establishment of hatcheries in Bhola, Patuakhali, Kustia, Satkhira and other places which were their consumer market before.
 - Farmers' awareness has resulted less number of purchase (proportionate use as per size of their ponds).
- Water crisis and excessive iron and ammonia contaminated water resulting severe loss due to lower hatching rate and high mortality of spawn (kolaroa and Khulna area).

Upon hearing the constraints from the hatchery owners an audio visual presentation was made by the study team in FGD's. In both KII and FGD's the team systematically explained how WRP is going to resolve their existing constraints specially by reducing production cost, solving problems related to water scarcity and contamination and finally improvement in quality of produces. A detailed comparative cost analysis was demonstrated to explain how WRP is able to contribute help overcome the current business crisis's, increase business profitability and protect underground water for future uses.

Response to Water Recirculation Plant (WRP) by hatcheries:

Very exciting responses were noticed by the study team while presented the comparative cost-benefit analysis between solar operated WRP and electricity and diesel operated hatcheries. The team explained in details about how WRP can enhance productivity, increase profitability, protect valuable underground water use for future necessity and improve the quality of produces. The operational procedures were explained including the auto operational system by which fears of mortality due to power failure can be removed.

The team noticed the enlightened faces of the participants (mainly the hatchery owners) when demonstrated and explained how WRP can successfully help them overcoming their major business constraints such as the cost of production, water crisis & contamination and quality of produces. But when the price of each product was disclosed then their faces became gloomy for their inability of spending so much money to buy the products under the situation when the businesses are passing through a number of constraints. They find it very appropriate to overcome their current crisis but the costs of each package as is offered by APT do not match with their abilities.

Willingness to buy WRP

Irrespective of financial strength all 12 hatchery owners expressed willingness to buy WRP and other solar equipments useful to their business promotion. With regards to down payment 05 hatchery owners wanted to pay 50% in advance and the rest amount to be repaid in monthly installment within a period of 12 to 24 months. The other 05 hatcheries were willing to pay 25% in advance and the rest in installments for 3 to 4 years period. Only 02 hatchery owners (from Barisal) expressed inability to pay advances and have proposed for 5 years period for repayment on monthly basis.

Regarding the size of monthly installment, almost all hatcheries opined to keep it within the range of present power cost (electricity and diesel cost) that means the amount they do spend paying electricity and diesel cost. However, the top end hatchery owners (42% respondents) have agreed to pay more than the power cost (almost double) if found profitable due to reduced mortality and other cost minimization.

Besides these intensively interviewed 12 hatchery owners, the consultant also met another 17 hatchery owners both in FGD and personally and cross checked the key findings from in-depth interviews such as the market situation, productivity, cost of production, water crisis's and other constraints related to productivity and marketing of produces. No major differences were found rather a very high level of interest was expressed for WRP by all hatchery owners.

Key barriers in obtaining the WRP by hatcheries

Despite very high demand the key barrier as is understood from the demand side is the inability to buy products in cash as is proposed by APT. The cost of solar products is usually very high and it is nearly impossible for businesses spending such a big amount while they are suffering from manifold crisis. The only way the hatcheries can obtain WRP if offered on partial credit and reasonable time for repayment.

On the other hand, the barriers from the supply side is two folds; firstly, financial weakness and secondly; poor infrastructural capacities in meeting so high level of market demands. The last but the most important limitation of APT is its reservations in accepting existing approaches of marketing products.

When proposed about Bank loan they expressed disinterest for high rate of interest on loan by Banks. Moreover many of them already have taken large amount of loan from Banks; for

example the President of Hatchery Association has a loan of Tk. 70 lacs from Islami Bank Bangladesh. Majority nurseries and fish farms reported to have received loans either from Banks or MFIs.

2. Nurseries and Fish Farms

The nurseries and fish farmers are facing almost similar problems with their produces. Majority of nursery operators were found engaged in fish farming as well. During the study a total 15 Nursery operators and 25 Fish Farmers were interviewed intensively from all three regions. In addition, 20 nursery operators and 11 farmers were also interviewed during FGD and presentation of solar products. One FGD planned in Barisal could not be organized due to scattered locations of farmers including time constraints.

Most of the nurseries and farmers reported to have incurred loss in their business due to rise in production cost while price of fishes in consumer market remained stagnant or some cases fall. The specific reasons can be listed as common problems related to fish ponds, feed cost, water quality, natural calamities (temperature, drought, excessive rains, floods), communications, market access, price fluctuations etc. The key problems of nursery owners and fish farmers can summarize as;

- Encountering challenges in business due to;
 - Higher cost of production due to high;
 - Cost for Electricity and fuel for pump operation
 - Labor & employee (under use of capacity due to periodical work for fulltime employee)
 - Cost for feeds and other essentials.
 - Mortality of fish fry's for
 - Low quality fish fry
 - Accumulation of methane gas
 - Oxygen shortage and contamination of water
 - Fluctuation of water temperature
 - Low price of fish in consumer market due to
 - Over supply than demands (for increased competition)
 - Sale at pond side due to poor communication.
- Increased leasing cost for ponds.
- High cost for credit

Fish prices depend on size, weight, quality, seasonality, supply and demand, and distance to markets. Despite substantial improvements in road condition particularly in peri-urban areas, remote villages still face an accessibility problem, which in turn affects the quality and price of fish. Heavy rains often destroy the muddy roads in villages making them eventually inaccessible for the vehicles to carry fish to the markets. This leads to high transport costs and hence low profit margins for them. Almost all farmers and nursery owners have reported the loss or very marginal profit during over the last two years due to high cost for feeds and pond leasing. As is reported by Mr. Mamun owner of Bhola Monosex tilapia hatchery that he has lost 30% of his enlisted fish farmers (who used to collect fish fry from his hatchery) over the last 18 months period. Those farmers have suspended their business amid of loss in fish trading as he came to know from the farmers.

A credit line was found exist between the key value chain actor of fish business starting from hatchery to nursery and then farmers. Nurseries often receive produces from hatcheries on partial credit for shorter period. Similarly, fish farmers also receive fingerlings from nurseries

on partial credit. Some farmers have reported about the high cost they used to pay for this credit from nurseries.

The tragic fact is that the fish farmers who contributed to the recognition of Bangladesh to be the third in fish producing country are facing miseries with their produces. The rapid growth in fish production is proving to be a curse for the inland fish farmers: its market did not increase accordingly and neither did its price.

Demand assessment for Solar products of APT

In every meeting (Both Individual Interview and FGD) with nursery operators and farmers the demand for APT products relevant to their business were assessed. The key products presented to them were;

1. Water Recirculation Plant (WRP)
2. Solar powered Pump
3. Aerator
4. Gas removal machine
5. Fish feed producing machine

Not much interest been showed to buy solar pumps by both nursery operators and fish farmers. The reason is very practical because the ponds are located in different places of the village and the source of power, the solar panel cannot be shifted to destinations. The solar pump could be useful only for farmers and nursery owners having ponds adjacent to each other which is not the case for the actors covered by the interview and meeting.

The aerator and gas removal machine has got some attention from both nursery owners and farmers but the cost appeared to them very high and out of their reach. The product may get attention only if the price can be reduced and payment procedure can be designed considering the ability of the users. No interest was found for fish feed producing machine where it was discussed and the price for the product was not been able to specify.

3. Fish transporters

Transportation of fish fry is a common activity in fish value chain and prevails in all places throughout the country. This activity takes place between hatchery to Nursery and Nursery to fish ponds. A total four fish transporters were interviewed during the study

In the study areas, the fish fry were transported by means of bus, truck, pick-up van, boats, ferry, and manually driven van. The fry traders usually follow the traditional approach for fry carrying. Traders are aware of the fish seeds requirement for oxygen and thus they continuously agitate the water in the carrying pots during transportation. In Jessore, modified transportation system in a large modified water tank supported with Oxygen cylinder was found. The tank can be placed in riksha van to truck and pickups and safe to carry to longer distances without causing any harm to fish fry's. However, the system would be costly for carriers or transporters who carry small amount of fish for different locations.

In Bhola, Patuakhali and Barisal areas the traditional transportation system exists. Transportation of fish seeds in some places like bhola, Patuakhali and some parts of Barisal are done via rickshaw and boats mainly and seeds are carried in large sized silver pots (hari/pateel). Poor road communications and small amounts of demand from individual farmers is one of the key reasons to carry in silver pots.

While shared about the improved transportation system used by transporters in Jessore area (in large plastic containers supported with Oxygen cylinder), the transporters from Barisal, Patuakhali and Barisal found it impractical for them due to communication system where they are to shift fish seed carrying pots from rickshaw van to boats and ferry's for reaching destinations. Moreover, the cost for the system appeared to them is very high compared to their business size and not user friendly due to communication system.

Financial services from Bank and other source

Supply Sides

While investigated about loans from Banks or MFIs/NGOs or from other sources, some nursery owners and fish farmers (20% and 40% respectively) have reported to have loans from Banks and MFIs. But from MFIs the team came to know that majority farmers are receiving loan from them. MFIs provide Enterprise / Business loans of varies sizes (Tk. 1000 to Tk. 10,00,000) to their members. The larger loans are only provided to limited number of trusted clients having multiple sources of income and possess satisfactory credit repayment record for longer period. Bangladesh Krishi Bank (BKB) and Janata Bank have reported to have "Fisheries loan" for the producers but practical scenarios is very different from both supply and demand sides. The sectors Banks are usually finances are Agriculture, Business, Industry and services etc.

1. Commercial Banks

Like BKB and Janata Bank, Islami Bank Limited (IBL) also provides loan to clients from fish sector but those are only for business operations (business loan) not for machineries, equipments or constrictions. Islami Bank Limited has reported to have funding option for promoting Solar power schemes in the name of "**Green Banking**". The maximum size of Solar Scheme loan is Tk. 500,000 (0.5 million) and the rate of interest is 10%. The loan has to repay on monthly installment and over a period of maximum 36 months. This facility is in paper but not in practice because they have no money in Green Banking Fund.

The Banks are greatly suffering from liquidity problems and thus unable (or reluctant) to provide long duration larger loans to its clients like hatcheries as it reported by the Bankers from the supply side. Small loans (size varies between Tk. 50,000 to Tk. 300,00) for shorter duration (06 months to 12 months) are encouraged to potential clients. However, they have provisions for collateral free loans amounting to Tk. 200,000 to Tk. 500,000 for fisheries and agriculture but due to liquidity crisis they are unable to provide it. Small loans of short duration are not suitable for hatcheries' but the Nurseries and Fish Farmers. However, there are exceptions for politically influential clients. For example the President of the hatchery Association of Jessore Mr. Firoz Khan was given Tk. 70 lakh (Tk. 07 million) CC loan at a very comfortable terms and conditions which is not for all but the fortunate people. Janata Bank Jessore has reported that they provide loans to actors in fishery sector like Hatchery, Nursery and Fish Farmers as per following terms and conditions. But while the respondent was asked to mention the number of loans they have issued could not reply. It seems that the provision is in paper but not in practice. However, the managers from local Banks have said that the provisional opportunities can only be obtained with permissions from their Head Offices.

Types of Clients	Loan size	Duration	Repayment	Rate of interest
Hatchery	Any size	12 months	Monthly	09%
Nursery	Any size	12 months	Monthly	09%
Fish Farmer	Any size	12 months	Monthly	09%

Note: Repayment starts after six month of loan disbursement and completes within next 6 installments.

While investigated in head offices, the size of loan and duration of repayment was found different.

Key findings of the meeting with Bankers in Dhaka

The team also met some senior officials from Head Offices and Branch offices of the following Banks in Dhaka to identify potential opportunity relevant to the assignment. The Banks were

1. Pubali Bank Limited Dhaka
2. Sonali Bank HO – Motijheel
3. Janata Bank UGC Branch
4. Bangladesh Krishi Bank
5. Mutual Trust Bank Motijheel
6. Dutch Bangla Bank

Interviewing Bankers in corporate branches are very challenging and time consuming. They were too busy in attending visiting clients as well telephone calls all the time. It took extreme patience to wait for hours for completing the meeting.

All government Banks have mandatory provisions to support agro-based industries including hatcheries, nurseries and fish farmers. SME loans for these groups are available for any amount they do require for their business. The period is for 1 to 3 years and at the rate of 9% interest. SME loans from tk.200,000 to tk. 500,000 do not require any collateral or mortgage. Amount more than tk. 500,000 requires collateral and mortgage.

A very long discussion was held with Mr. Shameem Ahmed AGM- agrobased Loan specialist of Sonali Bank, Dhaka HO about the possibility of funding solar powered agro-machineries. Regarding financing to hatcheries and nurseries to buy solar machineries he said that the individual clients can obtain loans from their nearest branches of Sonali Bank following loan procedures for SMEs. Hence the necessary documents to be required are;

1. Bank statement of one year operation
2. Trade License
3. For mortgage - all legal documents of the property ownership
4. TIN Certificate
5. NID

The AGM also mentioned about a project loan provision for APT. Under this 'project loan scheme' the party can borrow up-to Tk.50 million for a period 7 years to 15 years at the rate of 10% interest. The project loan ration is 50:50 however, if the project is established in own land of the borrower then 30% extra benefits will be received by the borrower. There is also provision for 'Working Capital' which can be reviewed annually (CC loan).

Types of loan from Bank

The common sectors financed by commercial Banks can be categorized as below;

Name of service/Loan	Loan size	Duration	No. of Installment	Rate of interest
Agro based Loan	5 lac.	5 years	60	9%
Industrial Loan	As per need	3 to 5 years	As agreed	9%
Housing Loan	As per need	5 years	mutually	9%
Working Capital	As per need			9%

However, the highest ceiling of loan varies between Banks. For example; the highest ceiling mentioned by Sonali Bank as 3 crore while Janata Bank and Pubali Bank mentioned having no limit (as pre need). The housing highest loan ceiling as is mentioned by Sonali and Pubali Bank is up to 20 crore while Janata Bank, Dutch Bangla Bank and mutual Trust Bank kept it open and as per need. The agro-based project loan size in all Bank is Tk. 500,000 (five lac).

Loan for fish sector

With regards to financial services for fish sector, all Banks have provision for financing to hatcheries, nurseries and fish farmers. The loan ceiling as is mentioned by Sonali Bank, Pubali Bank, Janata Bank are as below;

Types of client	Highest Loan Size	Duration	Repayment	Interest
Hatcheries	5 crore	7 years	As agreed	9%
Nurseries	3 crore	5 years	By client	9%
Fish Farmers	2 crore	5 years		9%

The Krishi Bank's loan size for these cliental group is within the range of Tk. 50,000 to highest Tk. 500,000.

Bank Loans for women in fish business

There is no special provision for lending to women entrepreneurs. The same procedures are to be followed as is for men. In addition, as per instruction of Bangladesh bank, the husbands of women borrowers are to be placed as a guarantor for the loan as is opined by the AGM of Sonali Bank Dhaka HQ Mr. Shameem Ahmed.

2. MFI/NGO Loans

The loans from MFIs are confined to their members and for selective clients having permanent residential status within their working areas. They provide loans to Nursery owners and Fish Farmers along with other businesses like Goat rearing, Agriculture (crop loans), small business and handicrafts etc. The loan ceiling, duration and repayment schedules are as follow;

Name of Loans	Loan Size (Tk.)	Duration	Repayment	Rate of interest
Buniad (Foundation) loan	1000 to 29,000	12 months	Weekly installment	20%
Jagoron (graduation) loan	1,000 to 99,000	12 months to 24 months	Weekly & Monthly	24%
Agroshor (Advanced) loan	100,000 to 10,00,000	12 months to 36 months	Weekly, monthly and onetime.*	24%
Sufolon (crop loan)	20,000 to 50,000	6 motnhs	Monthly or onetime	24%

Note:

1. The repayment schedule for agroschor and Sufolon loan is decided based on the nature of business and convenience of the borrowers.

3. Venture Capital Investment partners

VCI in Bangladesh is fairly new who provide financial supports to growing potential businesses suffering from business capital and thus fails to exploit the highest possible benefits of their business. The mode of funding is usually by purchasing a percentage of shares (depending on the fund requirement of the business but usually 10 to 20%) of the business by VCI partner for a certain period. When the period is over then the shares are either sold to original owner of the business or any other interested party.

There are a total 09 VCI active in Bangladesh and the team has visited two growing VCI named as Venture Investment Partner in Bangladesh (VIPB) located in Gulshan 1 and the Bangladesh Venture Capital located in Sukrabad of Dhaka town. In both meetings, The Chairman of Angel Powertech (APT) Mr. NasirUddin joined the discussion.

In both meetings APT Chairman described his business especially the innovations of solar powered various machineries and equipments which are mostly usable by agriculture sector especially by the aquaculture, poultry and crop sub-sectors. The Chairman also has explained the performances of solar powered machineries installed in two hatcheries (Jessore and Habigonj) and irrigation pumps in Narail and showed the video clips of some other products.

Both VCI showed interest to work with APT in promoting and marketing of APT products. But the Chairman of APT expressed his reservation in sharing his company partnership with VCIs. Rather he proposed both VCIs to finance hatcheries and nurseries to enhance their capacities to buy APT product which was instantly rejected by VCIs.

Personal opinions from Banker, MFIs and Venture Capital Investors (VCI)

While asked about the loan performances of businesses from fishery sector like hatchery, nursery and fish farmers, both Banks and VCI reported to have bitter experience in loan recovery from this borrowers group. The major complains are mainly irregular repayment showing loss in business, improper maintenance of books of accounts (sales and profit records are not maintained properly), false statement about their productivity (hatcheries) and stocks (nursery and fish farms) etc. It was also reported that some Banks are disbursing and recovering their obligated agricultural loans through MFIs/NGOs for fulfillment of their mandatory ratio of agriculture loan disbursement. But it happens unofficially (without record) and under the gentlemen agreement.

On the other hand the recovery rate of MFI loans are highly satisfactory as is reported by MFI leaders from Satkhira and Jessore named NGF, JagoroniChakro and BanchteShekha. The reasons are many like the borrowers of MFIs remain in regular contacts and their businesses are monitored closely by field staffs. The borrowers try not to lose their credibility to respective MFIs/NGOs because they (MFIs) are the only place of getting supports at crisis. Moreover, being a member of the MFI/NGO they usually receive some other welfare benefits like health and education supports for children (where it is applicable), soft loans and reliefs at disaster (natural and manmade) in addition to enjoyment of strong reciprocal social benefits being member of a larger social group.

Demand side

The scenario of demand side was found different than what was stated by the supply sides mainly the commercial Banks about easy access to business loan of any amount by the hatcheries, Nurseries and Fish farmers. The respondents also expressed frustrations about the lengthy process and actual rate of interest which is not 9% but 11% (in some cases more) as is opined by Mr. Amirul Haque, owner of the National Fish hatchery of Jessore. For some private Banks, the rate of real interest goes up to 13% to 14% as is said by one staff from IDLC (requested not to mention his name).

While asked about the Bank loan as an option to purchase APT product, none from hatchery, nursery and farmers agreed to lend from Banks. Moreover, many of them have received loans from commercial Banks for their business.

About APT Products

Demand Side

With regards to APT products significantly high level of interest was shown by the participants when they were demonstrated the videos and explained the cost benefit of the products. All hatchery owners we met from Jessore, kalaroa, Satkhira, Paikgachha expressed their deep interest for Water recirculation System. They considered WRS as a solution to their two key problems which are about to shut their business; firstly; the production cost and secondly; crisis of and contamination of underground water.

The demand could be measured by the responses APT received from some hatcheries and nurseries over the next few days after we met them. They called APT and asked possible ways of receiving the Water Recirculation System (WRS)

None of the respondents were agreed to buy products through Bank loan rather expressed interest to buy directly from Angel Powertech Ltd on installments that better suits to their abilities. As security the potential buyers are willing to give guarantor and mortgage to APT. Although APT is financially very weak and unable to sale product on partial credit but it is also true that none of the interested buyers are capable enough to buy products in cash when their businesses are in struggle to survive amid a number of challenges in production to marketing and pricing. Therefore, it is important for APT to design its marketing strategy in a way that better suits to ability of potential buyers. Hence the recommendation made by the participants can be considered to some extents.

Ranking of interest to products

The participants expressed higher interest on following products. The ranking of product is made based on level of interest of the participants.

<i>Rank</i>	<i>Products</i>
<i>High</i>	<ul style="list-style-type: none"> • Water Recirculation Plant (by hatcheries). • Aeration and Gas removal (nursery and fish farm) • Water Pump (all users like hatchery, nursery & fish farmers)
<i>Medium</i>	<ul style="list-style-type: none"> • Egg shaking machine (hatcheries) • Seed transportation (transporters)
<i>Low</i>	<ul style="list-style-type: none"> • Fish feed producing machine
<i>No Opinion /interest</i>	<ul style="list-style-type: none"> • Modern Hatchery model.

As mentioned before, during the field visit APT has received orders for some products which indicate the high level of interest by the users due to increasing crisis in their business. Most demanded products were water pump and Water Recirculation System (WRS) by Nurseries and Hatcheries. Aeration and Gas removal machine also received high attention by the Nursery owners and Fish Farmers but the price of product was considered big constraint to obtain by the users. Fish seed/fry transporters have shown greater interest to improved transportation system while discussed about it but the cost itself appeared to be the biggest constraint to obtain by the user.

Supply side

The biggest constraint of the supply side is the inability of meeting the high level of interest from the market. Neither the company (APT) is financially sound nor does it have the factory set up for meeting the existing and growing needs of the market. APT can supply product only if they are provided money advance to prepare the machineries. Therefore, it is important for APT to be financially sound prior to plan meeting the existing market demand for WRP and other solar equipments for interested users. Moreover, pricing of each product requires to be specified. Hence a detailed brochure can be prepared by APT detailing about the key features of each product like operational capacities, post sale services, warranty period, post warranty period service conditions etc.

To earn financial capability APT can follow any one of three potential options;

1. Include a partners who is financially sound to support the venture or
2. Partner with VCI under a project scheme for a certain period as is proposed by VCI or
3. Work with Bank under a project scheme as is stated by the AGM of Sonali Bank.

Possible Strategy for Marketing of APT Products

Marketing of APT products

Marketing is not only the exchange of goods or services, but a process of exploring customers' choices, priorities & limitations and then responding accordingly or meeting it at a profit. And thus the process of marketing essentially includes integration of customers' choices into the planning, producing, processing & promoting products and finally distributing the product to its customers at a profit.

The purpose of this study was to gather information about customers' choices (degree of interest), priorities and limitations aiming to design marketing strategy of APT product that better suits to the abilities of intended customers/users with possible highest focus on the value of product to its customers. It was good that the Chairman of APT has accompanied the study team all the way and has got clear understanding of the market size, demand, market competitors, and limitations of the intended users or customers. This has given a good insight of the market situation allowing him designing an effective strategy for marketing of his company products.

An effective marketing strategy is usually the combination of 4Ps of marketing mix which is designed to meet the company's marketing objectives by providing its customers with value. Traditionally, the 4Ps are designed focusing on the sellers (company) view of the market with limited focus on customers preferences, but an effective marketing strategy requires integration of views, choices, priorities as well limitations of both parties, the seller and the buyer.

Product: variety, quality, design, competitive advantages, customization, value addition, post sale services, warranty periods, post warranty services etc are to be added while describing the product to customers. The key advantage of APT product is that currently it has no competitor in the market and carries high demand to its customer. The specialization of WRP is its ability to ensure possible highest profits to its users.

Price: actual cost of the product, value for money, discounts, allowance, payment period, credit terms, process of repayment, benefits for timely payment, penalty for late payment etc. are to be considered in describing the price of the product. Since the installation cost of product is very high therefore, the repayment system has to be designed based on the ability of intended customers to pay for the product.

Place: Currently, the availability of product is at its factory location in Jessore. Since the demand after the promotional campaign started coming from different locations of the country, APT has to decide on future distribution channel of the product convenient to user market.

Promotion: Promotion is a communication tool that encapsulates the first 3 P's by putting the right product in the right place, at the right price, at the right time, with the goal of not only letting the customers know about the product but also help deciding to buy it. Various means can be used like daily news papers, TVs and pestering. Attending SME fairs

organized by SME Foundations, BKB and Bangladesh Bank would be much worthy than other means.

Possible Options for marketing APT products

Recognizing the financial constraints in both demand and supply sides following options can be considered for marketing of APT products especially the WRP which has got highest level of interest from the hatcheries.

- APT sale their product directly to individual clients (hatcheries and nurseries) at a condition of certain amount down payment (25% to 50% or more) and the rest on credit for an agreed period (one to four years).
- Design a project (for example 2 to 3 years project to cover 10% hatcheries from Jessor with WRP) and partner with Bank or VCI as is proposed by the financial institute.
- Similar project can be marketed in partnership with MFIs where MFIs will provide financial support require for the project and then recover money on installments by the MFIs. This partnership could be of two modes;
 - MFIs provide loan to hatcheries/nurseries and APT receive cash from hatcheries/nurseries for the product and then MFIs recover lend money on installment with profit/service charge. Or
 - MFI and APT jointly sale product to users on credit (at a certain % of service charge) and then collect money by MFIs and deposit 50% (or as agreed) to APT accounts with profit.
- Similar project can be designed in partnership with Hatchery Associations and plan for installation of WRP with financial agreement with Bank or VCI.

The proposed options are made based on interest shown by financial institutes (Banks, MFIs and VCIs) to pilot since the products are environment friendly, cost effective and in the line of their interest. To materialize the opportunities from MFIs, Banks and VCs, APT requires to

1. Fix actual cost/value of the WRP & other machineries and
2. Prepare the project plan (operational plan) with actual size and value of the total project,
3. Strengthen itself (APT) with both financial and technical capacities.

However, there is room for further discussion once APT decides on option appropriate to its abilities and designs the project to work with any financial institution.

Product Pricing and sales offer

Pricing for Solar operated WRP products

Targeting to the varied level of necessities as well capacities of consumer markets four different pricing packages is developed for APT's Water Recirculation Plants. Following table shows the actual cost of WRP for each hatchery based on number of hatching jars. The price of solar products (machineries and accessories) and expense for water circulation system has shown separately for buyers' convenience.

Name of product	10 Jars		20 Jars		30 Jars		40 Jars	
	Size/ Number	Price	Size/ Number	Price	Size/ Number	Price	Size/ Number	Price
Water Pump	2.5"	Tk. 65, 000	4"	Tk. 90, 000	4"	Tk. 90, 000	4"	Tk. 90, 000
Solar Panel @ Tk.5000 each	30 pcs	Tk. 150,000	52 pcs	Tk. 260,000	52 pcs	Tk. 260,000	72 pcs.	Tk. 360,000
Battery @ Tk.5715	12 pcs	Tk. 68,580	35 pcs	Tk. 200,035	35 pcs	Tk. 200,035	55 pcs	Tk. 314,325
Accessories	Full set	Tk. 65,000	Full set	Tk. 120,000	Full set	Tk. 120,000	Full set	Tk. 160,000
Total Price		Tk. 348,580		Tk. 670,035		Tk. 670,035		Tk. 924,325
Water Recirculation		Tk. 450,000		Tk. 650,000		Tk. 700,000		Tk. 900,000
Cost for total system		Tk. 798,580		Tk. 1320,035		Tk. 1370,035		Tk. 1824,325

Pricing for Electricity operated WRP products

Because of high initial cost for solar operated WRP, some hatchery owners have expressed interest for WRP operated by present set ups and may be with some adjustment or modifications. Therefore, following offer can be made for hatcheries willing to install WRP without solar panel but modification of existing electricity or diesel operated equipments.

Name of product	10 Jars		20 Jars		30 Jars		40 Jars	
	Size/ Number	Price	Size/ Number	Price	Size/ Number	Price	Size/ Number	Price
Water Pump	2.5"	Tk. 38, 000	4"	Tk. 50, 000	4"	Tk. 50, 000	4"	Tk. 50, 000
Water Recirculation		Tk. 450,000		Tk. 650,000		Tk. 700,000		Tk. 900,000
Total Cost		Tk. 488,000		Tk. 700,000		Tk. 750,000		Tk. 950,000

Sales Offer of APT solar products

Solar operated WRP

Hatchery size	Actual Price	Cash Sale Discount price (Tk)	Rest after 50% down payment	With 10% interest	Monthly installments @ 10% profit on actual price			
					12 months	24 months	36 months	48 months
10 Jars	8,13,580	7,98,580	3,99,290	4,39,219	36,602	18,301	12,2001	9,150
20 Jars	13,40,036	13,20,036	6,60,018	7,26,018	60,502	30,250	20,167	15,125
30 Jars	13,92,036	13,70,036	6,85,018	7,53,518	62,794	31,397	20,931	15,698
40 Jars	18,49,326	18,24,326	9,12,163	10,03,379	83,615	41,808	27,872	20,904

Payment will start from the 2nd month of the completion of plant installation. It is recommended to increase 10% profit on each year's balance to discourage long-term installments.

Electricity and/or diesel operated WRP

Hatchery size	Actual price of	Discounted cash	Rest after 50% down	With 10% interest	Monthly installments @ 10% profit on actual price
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	products	Sale (Tk)	payment		12 months	24 months	36 months	48 months
10 Jars	5,03,000	4,88,000	2,44,000	2,68,400	22,367	11,183	7,455	5,592
20 Jars	7,20,000	7,00,000	3,50,000	3,85,000	32,083	16,042	10,694	8,022
30 Jars	7,72,000	7,50,000	3,75,000	4,12,500	34,375	17,188	11,458	8,594
40 Jars	9,80,000	9,50,000	4,75,000	5,22,500	43,542	21,771	14,514	10,886

Payment will start from the 2nd month of the completion of plant installation.

Recommendations

- To address the market demand APT needs to earn abilities of mass production which require sound financial solvency for setting the factory and meeting operation cost. Since APT is financially weak therefore, it is necessary for APT to consider;
 - Try to get supports from IDCOL who already have expressed their interest to APT products..
 - Seek assistance from WF to cover a part of the factory setting cost. or
 - Borrow long-term loan from Banks. or
 - Extend partnership to raise funds from friend circle. or
 - Extend partnership with VCI.
- To raise fund from any of the above sources APT requires to establish patent right on their products, obtain trademarks and standard testing certificates. However obtaining patent right is a very lengthy process and costly as well.
- The cost of each solar product is very high comparing to the ability of respective users. Therefore it is necessary to drop the idea of **cash sale** of product and follow marketing strategies of other branded products. For example RAHIMAFROZ selling their solar products on 50% credit payable over the next 5 years at equal annual installments. Therefore it is important to design sale strategies in the line of the buyers' ability.
- The pricing of each product needs to be fixed by APT. A clearly outlined brochure needs to be prepared explaining the terms and conditions of obtaining the product including the process, conditions and place of post sale services. All conditions are to be set based on respective buyers' abilities and choices than the limitations of APT.
- Instead of targeting to all users (Hatchery, Nursery, Farmer, Transporter etc) it would be wise to target for working with hatcheries on promoting WRP that has got the highest level of interest from the user market. The marketing plan (especially the coverage) must be within the limit of the supplier's (hence APT) physical and financial abilities. Other users groups can be reached gradually.
- High demand do not essentially means the high possibility of sale of products until conditions of obtaining products meet the ability of the potential buyers. Hence it is important to consider some of the proposals made by the potential buyers during individual interview and in FGDs of respective user groups.

Conclusion

This is true that the hatcheries, nurseries and fish farmers of Jessore, Khulna, Mymensingh and Satkhira areas are in serious problem with their business and passing through a range of crisis ranging from production cost to quality and marketing of their products. The WRP has appeared to them as a potential solution to their key problems; firstly, cost for production and secondly, crisis and or quality of water that affect both mortality and quality of fish seeds. At this moment there is no other solution to their problems except trying to install the WRP. Hence it is expected that the rich hatcheries may come forward to negotiate with APT with possible options to get the WRP.

APT on the other hand has no capacity of selling products on credit. Hence both parties require to compromise at a point comfortable for both. For example; most hatcheries are willing to pay 25 to 50% cost of product during purchase and the rest could be offered on credit by APT. By this time some hatchery owners have contacted with APT and expressed their interest for further discussion with APT about WRP.

From the study APT has got the opportunity to assess the demand of their products, understand the market size as well the abilities of potential buyer groups. In addition, the choices, priorities and reservations of financial markets including the area for opportunities are also better understood by APT. Based on these finding now APT requires to design an operational plan (project plan) to materialize the marketing opportunities in partnership with financial organization that offer possible best option to APT.

Despite huge demands from the market the biggest constraint in responding the market demands lies with the APT especially it's financial and physical strengths. Hence APT requires strengthening itself in both areas either by

1. Sharing company partnership with financially sound individual or company.
2. Partnering with Venture Capital organization (as already proposed by BVC)
3. Arrange seed money from potential donor agencies interested in promoting environment friendly products.

Annexure 1

More detailed pricing of WRP products showing prices of WRP and equipment separately

<i>Hatchery size</i>	<i>Name of product</i>	<i>Cash Sale (Tk)</i>	<i>Rest after 50% down payment</i>	<i>With 10% interest</i>	<i>Monthly installments @ 10% profit on actual price</i>			
					<i>12 months</i>	<i>24 months</i>	<i>36 months</i>	<i>48 months</i>
10 Jars	Solar Equipment	3,48,580	1,74,290	1,91,719	15,976	7,988	5,326	3,994
	Water Recirculation	4,50,000	2,25,000	2,47,500	20,624	10,312	6,875	5,156
Total		7,98,580	3,99,290	4,39,219	36,600	18,300	12,201	9,150
20 Jars	Solar Equipment	6,70,036	3,35,018	3,68,519	30,710	15,355	10,236	7,677
	Water Recirculation	6,50,000	3,25,000	3,57,500	29,792	14,896	9,930	7,448
Total		13,20,036	6,60,018	7,26,019	60,502	30,251	20,166	15,125
30 Jars	Solar Equipment	6,70,036	3,35,018	3,68,519	30,710	15,355	10,236	7,677
	Water Recirculation	7,00,000	3,50,000	3,85,000	32,084	16,042	10,694	8,021
Total		13,70,036	6,85,018	7,53,519	62,794	31,397	20,930	15,698
40 Jars	Solar Equipment	9,24,326	4,62,163	5,08,379	42,364	21,182	14,122	10,591
	Water Recirculation	9,00,000	4,50,000	4,95,000	41,250	20,625	13,750	10,312
Total		18,24,326	9,12,163	10,03,379	83,614	41,807	27,872	20,903

Annexure 2: Energy Cost Assessment

Cost comparison is made based on 20 years operation period of Solar power therefore the cost for electricity and diesels was estimated for 20 years and divided by number lots in 20 years to assess the cost per lot or hatching cycle.

Diesel operated Pump

Capital cost

4" Diesel Engine: Tk. 30,000 each x 3nos = Tk. 90,000/=

Maintenance cost

Tk. 2500/pm x 12 years (per year season 8 months)=2,40,000/=

(the maintenance expected to begin after two years of each pump installed that's why total year has been calculated as 12 years)

Energy (Diesel) cost

1.2ltrs / hour x24 hours=28.8 ltrs x Tk. 70/ liter= Tk. 2,016 (one day)

For 240 days (8 months season a year)= Tk. 4, 83,840/ per year.

So cost for 20 years = (483,840 x 20 years) = 96,76,800/=

Total cost (capital cost + maintenance + fuel)

(90000 + 240,000 + 96, 76,800) = Tk.1,00,06,800

Cost for a single lot = (1,00,06,800 / 720 cycle) = **Tk. 13,898**

Electricity operated Pump

Capital cost

4" Electrical x (4 pumps in 20 years @ 110,000 each pump)=4,40,000/=

Maintenance Cost

Estimated Tk. 3,000 per year x 20 years = Taka 60,000

Energy cost (electricity + diesel)

Electricity bill= (Tk. 25000 /month X 8 month x 20 years) = Tk. 40, 00,000/=

Diesel Backup during load-shedding

Diesel pump 3 no.s x Tk. 30,000 = Tk 90,000

Diesel use during load-shedding (average daily 2 hours x 1.2 liter x Tk.70 / liter x 240 days /year) = Tk. 40,320 x 20 years = Tk. 8,96,400

Total cost for diesel back-up: 90,000 + 8,96,400 = Tk. 9,86,400

Total energy cost for 20 years: (Tk. 40,00,000 + Tk.9,86,400) = Tk. 49,86,400

Total cost for electricity operated hatchery (capital + maintenance + energy cost)

Total cost (4,40,000 + 60,000 + 49,86,400) = Tk. 54,86,400 for 720 lots/cycles (36 lots per year)

Cost for a single lot: (54,86,400 / 720 lots) = **Tk. 7, 620**

Solar power Operated pump

Capital cost

1st installment cost of total plant is Tk. 13,70,000

Maintenance and other cost for 20 years

4" Solar x (2 pumps)=4,40,000/ (including all accessories if necessary)

20 years maintenance cost=100,000/=

Battery change (3 Times within 20 years) = 6,00,000/=

Total maintenance cost= (440,000 + 100,000 + 600,000) = Tk. 11,40,000/

Production cycle/lot per year 54 cycle/lot (cycle will increase in case of solar power).
So total cycle/lot in 20 years = 54 cycle x 20years =1080 cycles or lots.

Total cost for solar plant for 20 years

Tk. 13,70,000 + Tk. 11,40,000 = 25,10,000 for 1080 lots/cycles.

One lot= Tk.2,324

Other benefits from solar powered WRP

- Extra production cycle increases (due to short hatching time),
- Reduction of mortality (from 30 % reduces to 5% highest)
- Opportunity of selling unused power at lean season for 4 months per year.
- Saves underground Water use (up to 75% per cycle)
- Manpower saving (automatic system requires no extra manpower)

Annexure 3: Questionnaires

Hatchery Owners

Name and location/address of the Hatchery:

Name of the hatcheryowner:

Contact number:

Years in Business: (asnurserer), (as hatchery owner)

How many hatcheries are there in the region:

Types of fish in production in this hatchery;

- 1.
- 2.
- 3.
- 4.
- 5.

No. of hatching jars:

No. of jars in operation:

Annual production target (36 cycles):

Average production per cycle/lot: 100 to 120 kg

Actual Production over the last three years (Kg):

2016	2017	2018	Total

Volume in Kg.

Unit production cost offishrenu/fries (per kg);

Unit sale price of fish renu/fries (per kg.):

1st two /three cycles (pick price)

Other cycles (average)

Source of business Finance (both establishment and operation)

- ❖ Own source includes family and friends (percentage)
- ❖ Borrowed fund(percentage) with rate of service charge
 - Bank -
 - MFIs -

- Venture Capital -
- Others if any -

Cost of operation (mainly fuel) per season (7 to 8 months)

1. Electricity cost (per month):
2. Diesel cost (per month)
3. Other cost (mainly the manpower used to operate machines):

After calculation of monthly operation cost (related to machineries & equipments) the total expense per season will be calculated.

What are the ways to reduce cost..??

Other key Questions:

4. What are the machineries do you use in your hatchery?
 - a.
 - b.
 - c.
5. Do you use any type of water circulation process? If yes, explain the system.
6. How about the hatchery business (based on income growth) increasing or decreasing?

	2016	2017	2018	Remarks
Amount sold (kg)				
Price (kg.)				

7. If not satisfactory then what are the reasons for it?
 - a. Increased competition (for increased number of hatcheries)
 - b. Increased production cost (electricity/fuel)
 - c. Decrease of market share due to establishment of hatcheries in other districts
 - d. Others if any
8. Approximately what amount of water you have uses for a lot or per year??
9. Do you feel risk to face the water scarcity in future??
10. If yes, what are the solution to save the environment?
11. Are you aware of cost effective solar operated (automatic) DC pump and water circulation / recycling plant?
 - a. Yes
 - b. No

(At this point explain the benefits of solar plants in terms of profit, less use of valuable underground water, environment friendliness, operational efficiencies etc)

12. Are you interested to buy solar pumps and water circulation / recycling plants which will
- a. significantly reduce operation cost (zero electricity cost)
 - b. Reduce production cost for
 - i. No electricity bill
 - ii. Reduction in hatching time (from 80 hours to 72 hours)
 - iii. Less underground water use (low energy cost)
 - iv. Higher hatching ratio
 - c. Higher profits due to low production cost
 - d. Dominance in market price (can provide best offer in price without compromising profit margin).
 - e. Very less water use.
 - f. Recirculation process increases Oxygen density in water

Impact on Product (fish fry)

- h. Quality of renu/fry improve / healthy fries.
- i. Mortality rate is very low
- j. Brood to hatching and delivery time reduced (from 6 days to 5 days now)
- k. Higher percentage of Oxygen in re-circulated water.
- l. Growth rate is much higher due to healthy water condition.
- m. No iron particles in re-circulated results healthy environment in water (direct underground water contains high percentage of iron).

13. Based on all above benefits are you interested to buy solar powered plants?

14. If not then why?

15. If yes, then what are the key barriers in obtaining solar plant?

- a. Finance
- b. Technology

16. If finance is the key issue then what sorts of financial arrangement do you prefer?

- Capital Size / amount
- Mode of repayment (multiple option to be encourages):

Option 1:

Option 2:

Option 3:

- Rate of interest

- Others if any

17. Which financial source you do prefer and why?

- a. Bank

- b. NGO/MFI

- c. Venture Capital Investment

18. Discuss here about other solar equipment/machineries (egg shaking machine) usable by hatcheries and collect their opinions.

Business risk assessment:

What are the key risks or problems in your business

What do you do in minimizing them?

Nursery Owners

Name of the Nursery owner:

Address:

Contact number:

Years in Business:

How many nursery owners are there in the region?

How many ponds do you have in nursery business?

Total area in land (all ponds):

Types of fish in your nursery with amount (estimated);

- 6.
- 7.
- 8.
- 9.
- 10.

Annual production target in all ponds:

Actual Production over the last three years:

2016	2017	2018	Total

Volume in mound.

From which hatcheries you have collected spawn last 5 years? And why..??

- 1.
- 2.
- 3.
- 4.
- 5.
- 6.

Source of business Finance (both establishment and operation)

- ❖ Own source includes family and friends (percentage)
- ❖ Borrowed fund(percentage) with rate of service charge
 - Bank -
 - MFIs -
 - Venture Capital -
 - Others if any -

Cost of operation (mainly fuel) per season (7 to 8 months)

4. Electricity cost (per month):
5. Diesel cost (per month)
6. Other cost (mainly the manpower used to operate machines):

(After calculation of monthly operation cost (related to machineries & equipments) the total expense per season will be calculated).

What are the ways to minimize the cost?

Other key Questions:

19. How do you manage water supply in the pond and removal of water at need?

20. What do you do for;
 - a. Aeration in water (to increase Oxygen supply)
 - b. Bottom gas removal
 - c. Feed spreading
21. How about the Nursery business (based on income growth) increasing or decreasing?

	2016	2017	2018	Remarks
Amount sold (mound)				
Price (mound.)				

22. If not satisfactory then what are the reasons for it?
 - a. Increased competition (for increased number of nurseries)
 - b. Increased production cost (electricity/fuel)
 - c. Decrease of market price due to increased no. of nurseries in the area.
 - d. Others if any
23. Are you aware of cost effective solar operated (automatic) DC pump, gas removal, and aerator and feed spreading machineries water circulation / recycling plant?
 - a. Yes
 - b. No

(At this point explain about the available equipments and the benefits of using solar equipments in terms of profit, environment friendliness, operational efficiencies etc)

24. Are you interested to buy solar equipments which will
 - a. significantly reduce operation cost (zero electricity cost)

- b. Reduce production cost for
 - i. No electricity bill
 - ii. Higher productivity (due to higher level of Oxygen)
 - iii. Less feed due to efficient distribution
 - iv. Higher growth rate
- c. Higher profits due to low production cost
- d. Dominance in market price (can provide best offer in price without compromising profit margin).

Impact on Product (fish fry)

- n. Quality of fry improve / healthy fries.
- o. Mortality rate is very low
- p. Growth rate is much higher due to healthy water condition.

25. Based on all above benefits are you interested to buy solar powered equipments?

26. If not then why?

27. If yes, then what are the key barriers in obtaining solar plant?

- a. Finance
- b. Technology / knowledge
- c. Others if any

28. If finance is the key issue then what sorts of financial arrangement do you prefer?

- Capital Size / amount
- Mode of repayment (multiple option to be encourages):

Option 1:

Option 2:

Option 3:

- Rate of interest
- Others if any

29. Which financial source you do prefer and why?

- a. Bank
- b. NGO/MFI
- c. Venture Capital Investment

30. Analyze here cost efficiencies of solar equipment comparing to existing practices.

Business risk assessment:

What are the key risks or problems in your business?

What do you do in minimizing them?

Fish Farmers

Name of the farmer:

Address:

Contact number:

Years in Business:

How many fish farmers are there in your area?

How many ponds do you have in fish farming?

Total area in land (all ponds):

Types of fish you have stocked with amount (estimated);

- 11.
- 12.
- 13.
- 14.
- 15.

Annual production target in all ponds:

Actual Production over the last three years:

2016	2017	2018	Total

Volume in Kg.

From which hatcheries fingerling you have stocked and why..??

Source of business Finance (both establishment and operation)

- ❖ Own source includes family and friends (percentage)
- ❖ Borrowed fund(percentage) with rate of service charge
 - Bank -
 - MFIs -
 - Venture Capital -
 - Others if any -

Cost of operation (mainly fuel) per season (7 to 8 months)

7. Electricity cost (per month):
8. Diesel cost (per month)
9. Other cost (mainly the manpower used to operate machines):

(After calculation of monthly operation cost (related to machineries & equipments) the total expense per season will be calculated.)

What are the ways to minimize the fish production cost..??

Other key Questions:

31. How do you manage water supply in the pond and removal of water at need?

32. What do you do for;

- a. Aeration in water (to increase Oxygen supply)
- b. Bottom gas removal
- c. Feed spreading

33. How about the fish business (based on income growth) - increasing or decreasing?

	2016	2017	2018	Remarks
Amount sold (mound)				
Price (mound.)				

34. If not satisfactory then what are the reasons for it?

- a. Increased competition (for increased number of farmers)
- b. Cost of fish fry/ fingerlings.
- c. Increased production cost (electricity/fuel)
- d. Decrease of market price
- e. Others if any

35. Are you aware of cost effective solar operated (automatic) DC pump, gas removal, aerator and feed spreading machineries water circulation / recycling plant?

- a. Yes
- b. No

(At this point explain about the available equipments and the benefits of using solar equipments in terms of profit, environment friendliness, operational efficiencies etc)

36. Are you interested to buy solar equipments which will

- a. significantly reduce operation cost (zero electricity cost)
- b. Reduce production cost for
 - i. No electricity bill
 - ii. Higher productivity (due to higher level of Oxygen)
 - iii. Less feed due to efficient distribution
 - iv. Higher growth rate
- c. Higher profits due to low production cost
- d. Dominance in market price (can provide best offer in price without compromising profit margin).

Impact on Product (fish fry)

- q. Quality of fish improve / healthy fish.
- r. Mortality rate is very low
- s. Growth rate is much higher due to healthy water condition.

37. Based on all above benefits are you interested to buy solar powered equipments?

38. If no then why?

39. If yes, then what are the key barriers in obtaining solar plant?

- a. Finance
- b. Technology / knowledge
- c. Others if any

40. If finance is the key issue then what sorts of financial arrangement do you prefer?

- Capital Size / amount
- Mode of repayment (multiple option to be encourages):

Option 1:

Option 2:

Option 3:

- Rate of interest
- Others if any

41. Which financial source you do prefer and why?

- a. Bank
- b. NGO/MFI
- c. Venture Capital Investment

42. Analyze here cost efficiencies of solar equipment comparing to existing practices.

Business risk assessment:

What are the key risks or problems in your business?

What do you do in minimizing them?

Fish Fry transporter

Name of the owner/transporter:

Address/Location:

Contact number:

Years in business:

How the fish fries / fingerlings are transported Starting from hatcheries to next buyers:

What are the key problems in carrying fish fry's?

What do you do in resolving problems?

What other best options you know to solve the problems?

(At this point explain the new system of fish fry transportation):

Are you willing to use the new device?

If not then why (key barriers):

Financial Service Market

Name of Organization / Bank:

Person interviewed with position:

Contact number:

Years in operation in the region:

Major cliental groups:

- 1.
- 2.
- 3.
- 4.
- 5.

Criteria for access to financial services:

- 1.
- 2.
- 3.
- 4.
- 5.

Types of financial services with size of loan range.

Name of services / loans	Loan Size	Duration	No. of installments	Rate of interest

Does your Bank finance to following clients from Fisheries sector?

<i>Types of clients</i>	<i>Loan size (lowest to highest)</i>	<i>Duration</i>	<i>Mode of repayment</i>	<i>Rate of Interest</i>
Hatcheries				
Nurseries				
Fish Farmers				

If not then why (any specific reason)?

Do you have loan package for women clients from Aquaculture sector?**How is the repayment performance of the borrowers from fishery sub-sector?**

<i>Types of clients</i>	<i>Excellent</i>	<i>Good</i>	<i>Average</i>	<i>Bad</i>
Hatcheries				
Nurseries				
Fish Farmers				

Put tick mark in the box

Do you have any specialized finance package for agriculture farm mechanization?

If yes, then please explain

(If no then) Are you willing to finance for environment friendly farm mechanization?

(explain here about the solar plants for fish sector)

If no, what the reasons

Name of the Dealer/Agent

Name of the owner:

Contact number :

Years in Operation:

Types of aqua products / machineries (related to fishery sector) with price:

- 1.
- 2.
- 3.
- 4.
- 5.
- 6.

How many company products do you sale:

- 1.
- 2.
- 3.

Which company products are in highest demand?

- 1.
- 2.
- 3.

Why (the reasons for consumer demand)

- 1.
- 2.
- 3.
- 4.
- 5.
- 6.

Product marketing strategies: (Cash or partial credit system, number of installment and period etc.)

Post sales services (if any):

- Free services

- Partial payment
- Any others (if any)

Product promotional strategies

Managing market competition (how):

- Mode of sale (payment)
- Free services
- Contract services (free or partial payment)
- Personal reputation / relation
- Aggressive marketing (how)

Feedback on consumers' behavior (if any)

Annexure 4: Pictures and photos



Water Recirculation Plant (partial view)



Egg shaking machine



APT Workshop in Jessore



APT Workshop



KII- Hatchery Owner, Jessore



FGD with Hatchery Owners, Jessore



FGD with Nursery Owners, Amtoli, Patakhali



KII with Hatchery owners in Mymensingh



FGD with Hatchery Owners, Klaroa, Jessore



KII with Nursery owner as well fish farmer, Mymensingh



Hatchery and its owners in Rangabali, Patuakhali



Fish Farm, Rangabali, Patuakhali