

**Promotion and Adaptation of In-Pond Raceway System in  
South-Western Bangladesh**

**Project Completion Report**

Submitted by  
[Afil Aqua Fish Ltd.]



Submitted to  
**Feed the Future Bangladesh Aquaculture Activity**  
**WorldFish**



Date of Submission

[September 21, 2023]

## Project Brief

Project Title	Promotion and adaptation of In-Pond Raceway System (IPRS) in south-western part of Bangladesh	
Agreement Period	Start Date: 01-06-2021	End Date: 31-08-2023
	Extension Date: 31-08-2023	
Duration	26 months	
Total Agreement Amount	US Dollar: 571,873	
Feed the Future Bangladesh Aquaculture Contribution	US Dollar: 58984	Percentage: 10 %
Sub-grantee Contribution	US Dollar: 512889	Percentage: 90 %
WorldFish Contact Person	Name: Mohammad Hasnal Alam	Designation: Market System Specialist
Sub-grantee Contact Person	Name: Rabeya Aktar	Designation: Manager (Accounts), Afil Aqua Fish Ltd.
	Email: rabeyaaktar.ag@gmail.com	Phone: 01742238666

## Abbreviation

SL	Abbreviation	Elaboration
1	BCR	Benefit Cost Ratio
2	DO	Dissolved Oxygen
3	DOC	Day of Culture
4	GoB	Government of Bangladesh
5	ha	Hacters
6	HVF	High Value Fish
7	IPRS	In-Pond Raceway System
8	JUST	Jashore University of Science and Technology
9	KAU	Khulna Agriculture University
10	Kg	Kilogram
11	KU	Khulna University
12	LDC	Least Developed Country
13	MT	Metric Ton
14	POC	Point of Contact
15	RAS	Recirculating Aquaculture System
16	ROI	Return on Investment
17	SGR	Specific Growth Rate
18	USAID	U.S. Agency for International Development
19	USD	US Dollar
20	USSEC	United States Soybean Export Council
21	YDD	Youth Development Department
22	ZOI	Zone of Influence

# Table of Contents

<b>1.0 Executive Summary .....</b>	<b>iv</b>
<b>2.0 Introduction .....</b>	<b>2</b>
2.1 Background of the Project .....	2
2.2 Proposed Solution .....	3
2.4 Geographic Coverage .....	5
2.5 Project KPI and Budget Summary .....	5
<b>3.0 Project Performance.....</b>	<b>6</b>
3.1 Outreach Summary .....	6
3.2 Key Performance Indicators.....	7
3.3 Activity Performance .....	7
<b>4.0 Lessons Learnt.....</b>	<b>12</b>
<b>4.1 Key Lessons Learnt .....</b>	<b>12</b>
<b>4.2 Challenges.....</b>	<b>13</b>
<b>4.3 Key Innovation of the Project.....</b>	<b>14</b>
<b>4.4 Impact and Sustainability of the Intervention/ Business Model .....</b>	<b>16</b>
4.5 Recommendations / Future Directions.....	17
<b>5.0 Project budget and financial management .....</b>	<b>18</b>
<b>6.0 Annexure .....</b>	<b>19</b>
6.1 Annex 1: Impact of the intervention on core business .....	19
6.2 Annex 2: Case Story-1 .....	20

## 1.0 Executive Summary

The Feed the Future Bangladesh Aquaculture and Nutrition Activity (Aquaculture Activity) is a five-year award made by USAID to WorldFish in February 2018. Its aim is to sustain positive aquaculture sector growth in Zone of Influence (Southwest Bangladesh) and Zone of Resilience (Cox's Bazar and Bandarban districts under Chattogram Division) through an inclusive market system approach. On June 1, 2021 Afil Aqua Fish Ltd. started activities with the Aquaculture Activity with the aim to Increase productivity of country's fish production through accessing fish farmers into high-tech aquaculture like In-Pond Raceway System (IPRS). Our objectives included Increase 5-10 times quality fish production from the same water area, promote vertical expansion in aquaculture sector, strengthen local fish supply chains and adapt the IPRS model with our socio-ecological systems. At the end of one year since the beginning we observed that our production matched with our targeted amount. We stocked striped snake head, walking catfish, grass carp, rohu and tilapia into our four cells and produced total 121 MT fish in a cost-effective way. We anticipate that our Return on Investment would be less than two years. IPRS also created a new business opportunity for us. Afil Aqua Fish Ltd. set up the IPRS machinery in their own engineering workshop by following the guideline. With the support of Aquaculture Activity we have learned how to construct the civil and mechanical parts of IPRS. Also we have utilized our expertise on which fish species, which size and how many Day of Culture (DOC) would be suitable in terms of Benefit Cost Ratio (BCR) for IPRS. So, now we can provide our own expertise to other interested fish farmers who want to establish IPRS in their own areas. Also we can sell the IPRS machinery to them by using our own brand name. This will reduce the set up cost of IPRS. In previous these machinery were imported from other foreign country like China but these are now being produced indigenously in our country which will help best to adapt the technology in Bangladesh. We have experienced that walking catfish and grass carp provides the higher BCR compared to other fish species stocked. Also tilapia can perform better in short duration of time. We have also conducted collaborative research with the Fisheries departments of public universities such as Jashore University of Science and Technology (JUST), Khulna Agriculture University (KAU) and Khulna University (KU). The students of these universities conducted different research works on water qualities, BCR and growth performances of the stocked fish species and environmental impact of IPRS. During the project period 400 students of the mentioned public universities as well from the Youth Development Department (YDD) visited the IPRS site to receive hands-on on IPRS.

## 2.0 Introduction

### 2.1 Background of the Project

Bangladesh is losing agricultural land at a rate of nearly 1% per year, according to data from Bangladesh Bureau of Statistics. This is a threat to the national nutrition security where people meet 60% of their protein demands from fish consumption. Recently Bangladesh has qualified to graduate into a developing nation from a Least Developed Country (LDC). Economics World House Rules suggests that gradual introduction of intensive technology led labor-saving machinery will best suite the sustainable transformation of economy. They also recommend that the advanced farmers have to shoulder on feeding majority population to keeping pace with the rise in economy. An in-pond raceway system (IPRS) is an intensive aquaculture practice where controlling water flow and dissolved oxygen (DO) are controlled to get the maximum yields of limited time and space. In 2005 Dr. Jessie Chappell has invented IPRS at Auburn University in California, USA. Adoption of this technology has been supported by United States Soybean Export Council (USSEC) later. USSEC depicts that temperature and other environmental conditions of Bangladesh support much for IPRS than that in other countries in the subcontinent and no harmful effluent to the environment is discharged from the system. Already 2 number of IPRSs, one in Rajshahi and another in Dhaka division, have been established in Bangladesh where 10-13 times higher yields have been found comparing the same unit areas adopting improved traditional to semi intensive practices. IPRS is a strictly principal driven project and it involves high cost and quality inputs as seed, feed, machineries and equipment and constant electricity facilities, wider supply chain networks as well expertise on high-tech aquaculture practices. Afil Aqua Fish Ltd. complies with all the characteristics to adapting IPRS in FtF ZOI areas. It comprises strong business portfolio of hatcheries, nurseries and grow out, feed factory, transportation of both live and freezing facilities with agricultural marketing departments. Since Afil has been producing High Value Fish (HVF) as Sol, Magur, Gulsha, Pabda tengra and white fish more than 15 years, quality inputs and traceability can be easily ensured. USSEC states that payback period for tilapia culture in IPRS is 4.3 years which decreases for HVF culture over there. For the producers fish market price is a highly challenging now esp. in Corona pandemic. As Afil Aqua has it's own marketing department, transportation and supply chain networks, it can easily cope with market price fluctuations or decreases. The company has received 4 times national awards due to contribution in aquaculture sector.

## 2.2 Proposed Solution

Our economy is transforming from Least Developed Country to developing nation but our water areas are decreasing day by day. So, we are going to face aquaculture production deficit as well nutrition insecurity within very short time unless we can adapt intensive technologies as IPRS. Advance farmers need to access into adaptation of IPRS as success of any technology depends on it's proper use. Afil Aqua Fish Ltd. has all the necessary financial and human capacity to establish, expand and promote IPRS in different FtF ZOI areas. Afil Aqua comprises around 81 hector (ha) water areas and In 1st year IPRS is going to be constructed in a pond of 244 meter (m) long and 91 m wide, where water areas is 2.23 ha with 44500 cubic meter (Qm) water volume. Number of 4 cells will be constructed there as for each cell 10000 Qm water volume is required. Average width of dykes will be 3 m except one dyke which will be 4.27 m, and where IPRS cells are to be attached with and sludge removal tanks are to be installed. Size of each cell will be 220 Qm (22 m long X 5 m wide X 2 m depth) where stocking will be done and size of Quiescent zone will be 6 m wide where waste removal system will be installed. For feeding auto feeder machines and for continuous water quality checking computerized water quality monitoring systems will be installed. For uninterrupted power supply along with 2-3 phase electricity supply line 1 back up automatic generator will be incorporated in the system. After completion of pond construction, civil engineering works, machineries set ups and stocking will be done. Stocking will be in each cell with magur, sol, rui and grass carp individually. Every 5 years' interval pond bottom will be dried out to remove bottom mud followed by liming and the cells will be disinfected by bleaching and potash each year. Other than this continuous stocking and harvesting will be done in an uninterrupted way and liming will be continued before and after the stocking done in pond waters. During stocking average weight will be 5 gm for magur, 10 gm for Sol, 100 gm for rui and grass carp each. Culture period will be 4 months for magur, 6 months for sol and 8 months for rui and grass carp each. So, during project period of June 2021-May 2022 for magur two crops and for the rest species one of that will be produced where the target biomass will be 90-100 Kg/Qm/cycle. From 2nd years onward 3 crops magur and 2 crops sol will be produced in the same set up. Outside the cells carps of 30 pieces per decimal (40.47 square meter) will be stocked as filter species where each carp's average weight will be 100 gm. Marketing department will continuously monitor fish prices in different markets near and distance and provide necessary arrangements as transportation facilities so that higher prices can be ensured after fish harvest. USAID funded Feed the Future Bangladesh Aquaculture Activity project implemented by WorldFish has a very strong expertise of providing technical services about aquaculture, Afil Aqua

earnestly wishes to work with them. Considering the business risks involved regarding newness of the technology, high cost engagement, lack of specific research works and information in establishing IPRS in Bangladesh we need a cost sharing proportionately as WorldFish: Sub-grantee = 10:90 as of total cost USD 425594. In 1st year total fish production will be 118 Metric Ton (MT) including cultured species 110 MT and filter species 8 MT where in 2nd year that will be total 163 MT. This project will initially accommodate 1 fisheries officer to manage the aquaculture activities. Other than this the project will employ 3 supervisors and 3 electricians who will be act as shift basis of 8 hours per shift. Since 3rd year the project will be expanded through adding another 2 ha areas with additional 4 cells. In 1st year 110 advanced farmers in ZOI areas who can afford to invest in IPRS will be capacitated through trainings of 5 batches with exposure visit to the project area. In 2nd year another 110 advanced farmers will also be capacitated in same way. In addition exposure visits include 400 fisheries' students in 1st year where it will include another 600 students in 2nd year and the same will continue up to 5th years since inception. In 1st year 20 fisheries' students at masters level will get opportunity to research on different subjects on IPRS. Afil Aqua will be benefited of those research results. As IPRS minimizes harvesting cost and reduces risks of fish theft, so the company will have opportunity to expand the project. Afil Aqua Fish can provide seeds, feed and different inputs supports as well advisory services to those farmers. In addition by increasing adoption of IPRS in different localities fish value chains will be strengthened there through increased linkages with backward and forward markets actors. During project period at least 150 mobile fish vendors and 3 online chain shops will access into the supply chain for reaching fish to the consumers. Country economy will also be enriched of increased fish yields within limited time and space through intensive culture system. Traceability can be easily ensured of the system so country people will be benefited of having quality fish produces. Technical supports in the project will be sought from WorldFish and DoF.

Objectives of the partnership include increase 5-10 times quality fish production from the same water area, Promote vertical expansion in aquaculture sector, strengthen local fish supply chains and cope with the changes in socio-ecological systems. Throughout the project period (June 2021-September 2022) 135 advanced farmers will be capacitated directly through trainings on IPRS and exposure visits. Out of these 135 advanced farmers at least 11 farmers will be motivated to adopt the technology in their own localities. During 5 years around 550 advanced farmers will visit the project area. Also the company will employ a Fisheries Officer with aquaculture background and 6 more staff including 1 farm in-charge, 2 supervisors and 3 electricians during



the project period. For research activities the company will make collaboration with at least 3 local public universities. Also in project period 20 fisheries' students will get opportunities to conduct research of different important subjects on IPRS. The company will be directly benefited of the research findings revealed from the research activities of the universities' students. It will overall enrich the aquaculture sector through the research works conducted by the university students on IPRS. Also the research information will contribute promoting and adapting IPRS in different areas under FtF ZOI.

## 2.4 Geographic Coverage

The program was established at Sharsha upazilla under Jashore district and later it will be promoted and adapted in Khulna, Baherhat, Satkhira and Barishal districts.

## 2.5 Project KPI and Budget Summary

The KPI of the project is as follow:

Activity	KPI	Unit	Targets
Capacity building training on IPRS and exposure visit to project site for advanced fish farmers	# of event	Number	5
	# fish farmer (UHC)	Number	110
Exposure visit to project site for fisheries' students	# students (UHC)	Number	400
Research works of fisheries' students	# students (UHC)	Number	20
Video clips preparation and social media broad casting, Module, Leaflet, Festoon development	# of videos	Number	1
Linkage workshop with advanced farmers in different district	# of training	Number	1
Linkage Workshop with exporters	# of training	Number	2

Budget summary of the project

#	Activity	% of WorldFish	% of Grantee	Total cost BDT	WorldFish	Sub-Grantee
01	Staffs Salary	16%	84%	4,761,300	777,300	3,984,000
02	Staffs Benefits	0%	100%	207,000	-	207,000
03	Equipment, Supplies and Operation Cost	4%	96%	1,370,100	50,500	1,319,600
04	Travel	72%	28%	518,500	373,600	144,900
05	Activity Cost	9%	91%	44,203,838	4,050,097	40,153,741

06	Grand Total (BDT)	10%	90%	51,060,738	5,251,497	45,809,241
07	Grand Total (USD)	10%	90%	571,873	58,984	512,889

## 3.0 Project Performance

### 3.1 Outreach Summary

The outreach of the farmers was through five Capacity Building Training and 420 fisheries students were reached through the exchange visit and research works.

#### Capacity Building Training

Through five Capacity building training on IPRS and exposure visit to project site for advanced fish farmers total 148 advanced fish farmers were reached.

#### Exposure visit

Total 405 fisheries students from different public universities such as JUST, KUA and KU and Department of Youth Development of GoB visited the site of Afil IPRS as part of their practical course under the course curriculum of their respected universities and agencies. The number of exposure visit was five and out of total 405 students 115 of that were female.

#### Linkage workshops

Three linkage workshops were conducted including 110 participants including four local hub owners of Brothers' Sea Food, a fish exporter; four representatives from three banks such as Bank Asia, Shahjalal Islami Bank and



Director of Afil Aqua Fish is delivering speech in the linkage workshop

Bangladesh Krishi Bank and the rest 102 advanced level fish farmers. The objectives of these linkage workshops were to create links among the advanced fish farmers with the fish exporters as well with the financial institutions.

#### Research works

Total 21 students from different public universities as JUST and KU participated in research works on different topics on IPRS. Out of this 21 students 6 of that were women.

### 3.2 Key Performance Indicators

Activity	KPI	Unit	Targets	Achievement	Remarks
Capacity building training on IPRS and exposure visit to project site for advanced fish farmers	# of event	Number	6	6	Achievement 100%
	# fish farmer (UHC)	Number	135	148	Achievement 109%
Exposure visit to project site for fisheries' students	# students (UHC)	Number	400	405	Achievement 101%
Research works of fisheries' students	# students (UHC)	Number	20	21	Achievement 105%
Video clips preparation and social media broad casting, Module, Leaflet, Festoon development	# of videos	Number	1	2	Achievement 200%
Linkage workshop with advanced farmers in different district	# of training	Number	1	1	Achievement 100%
Linkage Workshop with exporters	# of training	Number	2	2	Achievement 100%

### 3.3 Activity Performance

#### Capacity Building Training

The purpose of the events was to develop capacities of the stakeholders regarding establishing IPRS and increase fish productivity by promoting and adapting of that through participatory method including lecture and practical sessions. Including the participant very insignificant number of women (two women) participated in the event. During the capacity building session first lecture session was held through the facilitation of POC of the project, Project Engineer of Afil



MD of Afil Aqua Fish is taking a session

Group and Senior Upazilla Fisheries Officer, Sharsha upazilla, Jashore. Details discussions were held in lecture sessions through participatory method as-

- Identification of current problems and challenges of aquaculture in Bangladesh
- Mitigating measures of those problems and challenges through IPRS
- IPRS constructions including pond preparations, civil constructions as well machineries set up
- Fish stockings including species selection, quantities and qualities as well other compliances
- Feed applications and the relevant compliances
- Water qualities and growth performances of the fingerlings stocked
- Sharing of real experiences of harvesting one crop
- Cost analysis including ROI, BCR and Income statement
- Research works of the local public universities to make available of information of IPRS

Through site visits major hands-on experiences were provided as-

- How to construct and establish White Water Units as well its functions
- How to construct and establish Waste Collection Device as well its functions
- How to construct production cells, stoking as well maintaining
- How to set up supplementary aeration through setting air lift pump
- How to manage wastes from IPRS by using that in vegetables gardening
- How to keep records of water qualities, fingerling stocking, feeding and growth performances

Afil Aqua Fish is committed to promote IPRS in south-western areas by using our technical advisory as well supplying all required machineries and equipment for establishment. After conducting the Capacity Building Training we are regularly following up those participants who want to establish IPRS in their areas. We hope that this year at least 10-12 advanced farmers will establish IPRS in their localities and a strong supply chain of seed, feed and aqua machineries will be establish in those areas.

## Exposure visit

The purpose of the visit was to make people aware about the adoption and adaptation of In-Pond Raceway System (IPRS) among the students of Youth Development Department (YDD) and farmers. At the very beginning, Farm in-charge of Afil Aqua Fish welcomed everybody.



Exposure visit by the students of Youth Development Department, Khulna

Then all participants were introduced among themselves.

POC (Point of Contact) of the project titled as “Promotion and adaptation of In-Pond Raceway System (IPRS) in south-western Bangladesh facilitated over IPRS. The following topics were covered:

- Short description about IPRS
- Principles of IPRS
- Potentials of IPRS
- Components of IPRS
- Cost-Benefit analysis of IPRS

Question and answer session:

- The participants asked the following questions:
- What is the size of each tank
- What is the feeding system
- What is the calculation of production area
- How fish wastes are managed
- How the cost of establishment can be minimized
- How WorldFish can help the participants establishing IPRS in their own area

During site visit following components were observed by the participants:

- Production cells
- White water units
- Feeding areas
- Fish growth
- Waste collection area
- Settling tank

Research works:

Afil Aqua Fish Ltd. conducted research works with three universities (JUST, KAU and KU) on water quality parameters, growth performances and Cost Benefit Analysis of stocked fish species as well as environmental impact of IPRS. Objectives of the activity was to involve local Universities with aquaculture industries so that the both parties can be benefited of each other. Here the Activity facilitated linkage between Afil Aqua Fish Ltd. and the universities for solving critical problems of In-Pond Raceway System (IPRS).

Water quality parameters as Dissolved Oxygen (DO), ammonia (NH<sub>4</sub>) and PH were monitored daily and recorded through prescribed format during the study period. One control pond was taken to compare the results of growth performance of rohu for IPRS and other earthen ponds. Also the feed applied per day specific to the stocked fish was monitored and recorded through a prescribed format. Daily growth of the phytoplankton and zooplankton was monitored and recorded through a prescribed format. Then the relations of water qualities, plankton growth, feed and growth performances of the stocked fish were analyzed critically to draw the results. Growth performances of the primary production in IPRS was found far better in production zone comparing the purification zone. The sludge deposition rate was found higher in waste collection zone comparing the production cells of IPRS. Detail analysis of growth of phytoplankton and zooplankton was conducted through using xls and SPSS software.



**Student of Khulna University is collecting water sample from IPRS pond**

The research on “Growth performance of four different fish species (*C. striata*, *L. rohita*, *C. idella* and *C. batrachus*); cultured under In-pond Raceway System (IPRS) at Jashore district of Bangladesh” was conducted by the students of JUST. The research was conducted on the basis of 90 days culture period from 1st October 2021 - 30th December 2021 to determine the growth performance of *Labeo rohita* (Rohu carp), *Ctenopharyngodon idella* (Grass carp), *Channa striata* (Striped snakehead), *Clarias batrachus* (Walking



Khadiza Khatun of Khulna University is analysing the water samples of IPRS

catfish) cultured under In-pond raceway system. The study was carried out in four concrete cells of IPRS. The selected species are being cultured at cell-1 (Striped snakehead), cell-2 (Rohu carp), cell-3 (Grass carp), and cell-4 (Walking catfish). The whole pond was approximately 2.23 hectare of which 880 m<sup>3</sup> is used for four production cells, each 220m<sup>3</sup>. The stocking density was - 16000 fry of Striped snakehead were stocked in cell 1 (65/m<sup>3</sup>), 13000 fry of Rohu were stocked in cell 2 (50/m<sup>3</sup>), 4000 fry of Grass Carp were stocked in cell 3 (15/m<sup>3</sup>) and 152000 fry of Walking catfish were stocked in cell 4 (552/m<sup>3</sup>). The average initial weight and length of Striped snakehead (300.46±3.66 gm and 33.05±1.33 cm), Rohu (182.66±1.04 gm and 24.54±1.10 cm), Grass carp (285.81±1.19 gm and 29.02±0.61 cm), Walking catfish (4.46±0.38 gm and 7.54±0.8 cm) respectively. The average protein (%) of the feed was 32% and applied four times in a day. In the beginning Rohu and Grass carp were being fed at 5% to 6% of body weight in average which were reduced at 3% of body weight after 45 days and in the beginning striped snakehead and Walking catfish were being fed at 7% of body weight in average which were reduced at 5% of body weight after 45 days. The average final weight and length of Striped snakehead (1006.25±4.03 gm and 70.25±0.46 cm), Rohu (399.6±1.67 gm and 33.29±0.57 cm), Grass carp (3195.76±1.52 gm and 55.96±1.36 cm), Walking catfish (170.34±2.11 gm and 35.60±0.42 cm) respectively. The highest value of weight increment was found in Grass carp (2909.95±2.07 gm). The highest net production was found 25203.80 kg of Walking catfish because of its high stocking density. Best outcome in Average daily gain (ADG) found as 27.71 gm/day at Grass carp. The specific growth rate or (SGR %) was 1.34% (Striped snakehead), 0.86% (Rohu), 2.68% (Grass carp) and 4.04% (Walking catfish). We found above 99% of survival rate. Grass carp had the best growth performance and Rohu showed the lowest growth response in IPRS culture.

The research on “Water quality and cost-benefit analysis of four different fish species; cultured under In-pond Raceway System (IPRS) at Jashore, Bangladesh” was conducted by the students of JUST. The present study was conducted to determine the cost and benefits of *Labeo rohita* (Rohu), *Ctenopharyngodon idella* (Grass carp), *Channa striata* (Striped snakehead) and *Clarias batrachus* (Walking catfish), reared under In-pond Raceway System (IPRS) for 90 days from 1 October to 30 December 2021 at Afil Aqua Fish Ltd., Sharsha, Jashore. In total, 13000, 4000, 16000 and 152000 individuals of *L. rohita*, *C. idella*, *C. striata* and *C. batrachus* were stocked, respectively in 2nd, 3rd, 1st and 4th cell of IPRS. The mean water parameters of Cell 1 (Striped snakehead) such as water temperature  $26.23 \pm 3.78$  °C, pH  $7.99 \pm 0.24$ , DO  $6.53 \pm 0.32$  mg/L and ammonia were  $0.026 \pm 0.01$  mg/L; at Cell 2 (Rohu) water temperature  $25.77 \pm 4.59$  °C, pH  $7.91 \pm 0.17$ , DO  $6.40 \pm 0.38$  mg/L and ammonia were  $0.02 \pm 0.01$  mg/L; at Cell 3 (Grass carp) water temperature  $25.97 \pm 4.48$  °C, pH  $7.91 \pm 0.19$ , DO  $6.21 \pm 0.25$  mg/L and ammonia were  $0.03 \pm 0.02$  mg/L; at Cell 4 (Walking catfish) water temperature  $25.77 \pm 4.59$  °C, pH  $7.91 \pm 0.27$ , DO  $6.52 \pm 0.24$  mg/L and ammonia were  $0.02 \pm 0.01$  mg/L respectively in 90 days of the culture period. At the end of the 90-day rearing experiment, total final production was 5198.8 kg (Rohu), 12783 kg (Grass carp), 16099.9 kg (Striped snakehead) and 25879.8 kg (Walking catfish) where the total cost was BDT 704555 (Rohu), BDT 667545 (Grass carp), BDT 2190129 (Striped snakehead) and BDT 1826029 (Walking catfish). The revenue income was BDT 779220 (Rohu), BDT 1917456 (Grass carp), BDT 4427479 (Striped snakehead) and BDT 5693557 (Walking catfish). The net benefit was BDT 74665 (Rohu), BDT 1249911 (Grass carp), BDT 2237349 (Striped snakehead) and BDT 3867528 (Walking catfish). And finally the cost-benefit ratio was 1.19 (Rohu), 3.11 (Grass carp), 2.07 (Striped snakehead) and 3.20 (Walking catfish) respectively. The findings from our study revealed that *Clarias batrachus* (Walking catfish) showed the best figure in respect of higher benefits and the lowest outcome found in *Labeo rohita* (Rohu carp).

## 4.0 Lessons Learnt

### 4.1 Key Lessons Learnt

Afil Aqua Fish, in the first cycle, has sold 121 Metric Tons (MT) of fish from the IPRS where they could receive only maximum 12 MT fish from their 2.23 hacters (ha) water area. This is a tremendous achievement in terms of fish production from pond aquaculture in Bangladesh. This 10 times increased production results has attracted wide range of advanced fish farmers in



Bangladesh. Advanced farmers are very interested to invest in vertical expansion and to adopt technology like IPRS but some of them are facing financial problems. Some corporate level farms who have huge capacity as in terms of hatchery, nursery, grow out farming areas, feed industries and financial ability are yet to reach through our intervention. Some of the shrimp/prawn farmers in coastal areas are facing losses in their businesses due to lack of export as well profitability. They are trying to transform their businesses to white fish produces but due to lack of technology they are not being able to transform their businesses. These advanced level farmers might be the clients of IPRS but adaptation of IPRS in the coastal belts needs some research works i.e. which species are suitable in what context as well their cost benefit analysis etc. Before the intervention of the Aquaculture Activity, IPRS machinery were imported from different foreign countries which increased the capital investment to establish IPRS but through the Activity's intervention, Afil Aqua Fish was able to produce IPRS machinery in their own workshop. This will certainly reduce the establishment costs of IPRS. In different advanced countries research organizations are well linked with the aquaculture industries. When an aquaculture farm face a difficult problem, they go to the universities or research institutes to solve the problem but we have no such trends in our country. The Aquaculture Activity has started such trend. Through the initiative of the activity, fisheries department of three universities, JUST, KAU and KU are conducting collaborative research works on different issues of IPRS. They have worked on growth performance and cost benefit analysis of stocked species e.g. striped snake head, walking catfish, grass carp and rohu. The University has recommended that among the species walking catfish and grass carp are best in culture into IPRS in terms of growth performances and CBR. Also KU has conducted a comprehensive research on environmental impact of IPRS and they have suggested that IPRS is not producing any environmental hazard.

## **4.2 Challenges**

At the very beginning stage of establishing IPRS the challenges included as there was no such information available in our country regarding the machinery, fish species to be stocked, stocking density etc. Through reviewing the literatures found in internet, the Aquaculture Activity provided information of the mentioned issues to Afil Aqua Fish Ltd. Also the Aquaculture Activity facilitated staff of Afil Aqua Fish Ltd. to visit to IPRS of "Akbar Fisheries" in Chapainowabgonj. Thus Afil Aqua Fish Ltd. was able to set up IPRS. Also at the beginning stage mortalities were observed for striped snakehead (Sol fish). We learned that sol fish remains in stagnant water but IPRS 24-hours water flow is continued at a rate of 170 m<sup>3</sup> per hour. Then we reduced the water flow to

almost in zero and thus sol fish survived. There was also a chance of mortality for walking catfish due to their cannibalistic behavior but fortunately that did not happen. We provided quality feed (32% protein rich) to the catfish and thus the problem was overcome. After setting up the IPRS we had to face challenges to adopt IPRS by the advanced level fish farmers. We provided capacity building training course to 148 advanced fish farmers. Among these most were interested but though they have enough land to establish IPRS, they are facing fund crisis. The partners of Aquaculture Activity like Bank Asia or City Bank may take role to solve the problems. The advanced farmers who have no fund crisis are yet to reach the information of IPRS. If we can aware them, we believe that they will adopt the technology. In our country the prospect of the aqua machinery is still lag behind. Therefore, in spite of creating the IPRS machinery within the country, the machine did not became popular to the other advanced fish farmers. Afil Aqua Fish has created and assembled the machine in their own workshop and the performance of these machine is similar to that in other IPRS.

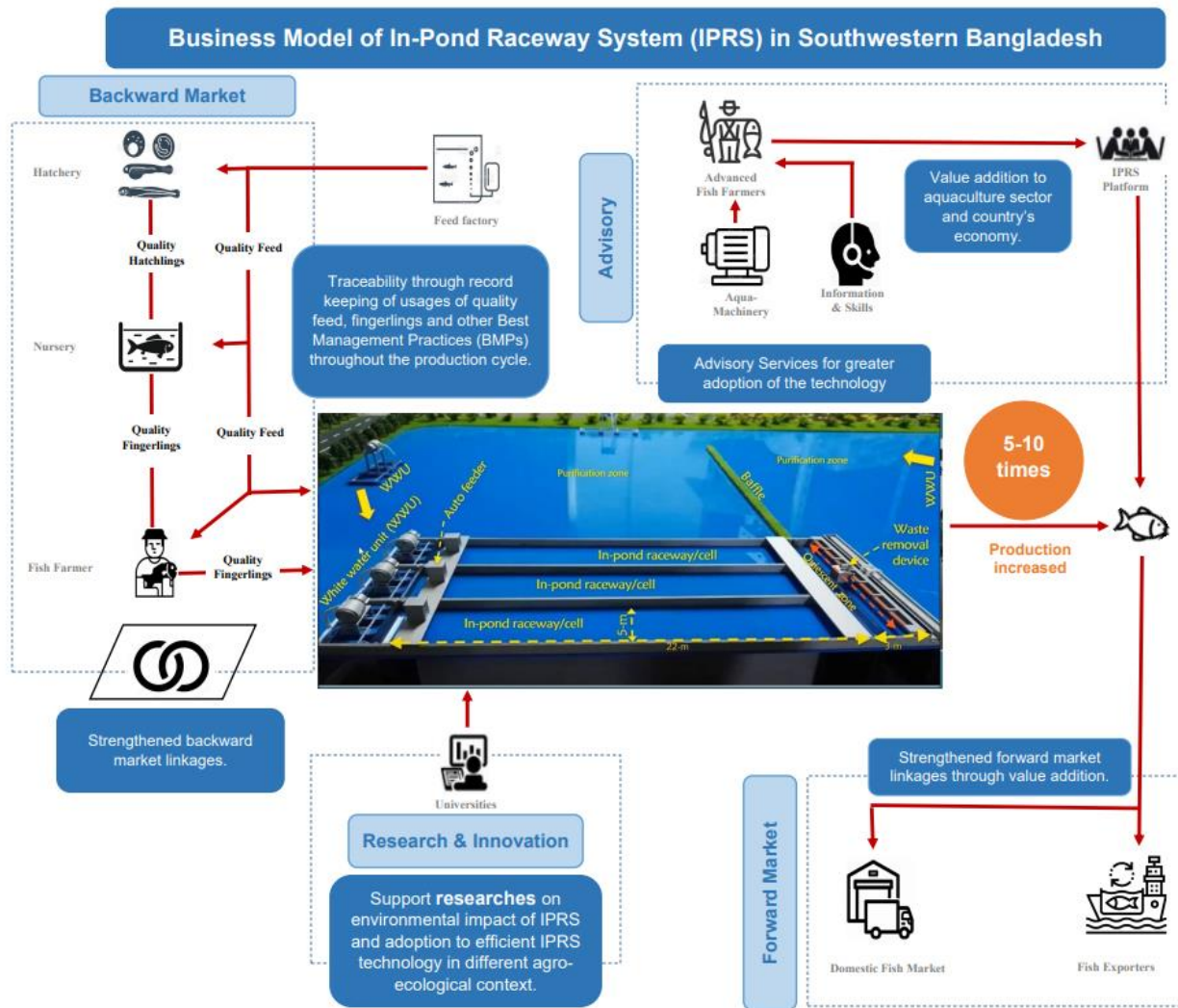
### **4.3 Key Innovation of the Project**

The advanced fish farmers in the southern Bangladesh were looking for an aquaculture technology which would enable them to produce at least 5-10 times more fish production in ponds. Taking this into consideration, the Aquaculture Activity took the initiative to introduce IPRS first in the southern Bangladesh through Afil Aqua Fish Ltd. Unlike the bio flock, Recirculating Aquaculture System (RAS) etc. IPRS is one of the most suitable, cost effective and climate resilient aquaculture technology for pond fish culture. Before intervention of the Aquaculture Activity, the machinery of IPRS were introduced from China or other foreign countries which increased the capital investment cost but through the intervention of the Aquaculture Activity, Afil Aqua Fish Ltd. was able to produce the IPRS machinery in their own workshop. Thus the capital investment cost was reduced. IPRS has huge export potentials. Once an IPRS is established in an area, quality hatcheries, nurseries and small scale fish farmers were able to access into Best Management Practices (BMP) as well as into the traceability system which is one of the important factors to meet the compliance for fish export. IPRS is a climate resilient technology because once one can pour water into IPRS, there is no need to exchange water every year. Within five years water exchange is not required. Hence IPRS is able to produce huge amount of fish with less water. Exporters and buyers other than the local aratdars become attracted to procure fish from IPRS because they can collect bulk amount of quality fish at a time from one place. Thus the IPRS creates the opportunities for strengthening the fish value chains in the market. Before

the intervention of the Aquaculture Activity research organizations like the universities were not so much collaborated with the aquaculture industries. Through the intervention of the Activity, three public universities as JUST, KAU and KU were linked with Afil Aqua Fish Ltd. to conduct collaborative research works so that the IPRS could be adapted with the geo-ecological context of the southern Bangladesh. In Bangladesh totally six IPRS have been established where except in the IPRS of the Aquaculture Activity all have been established by importing the machines from abroad. The IPRS established by the Aquaculture Activity has been established through using the indigenous technique of the light engineering (LE). All the LE machines have been assembled in the workshop of 'Tamim Engineering', a sister concern of Afil Group. These machine have performed well and similar to the machine imported from abroad. Thus the expenditures of the establishment cost have been minimized as well our LE sector have shown its potential in our country. The production and productivity of these machine have shown similar to that in other IPRS in different areas of the country. If these machine can be promoted to Bangladesh our aqua machinery can play a very important role to our economy as well as to the aquaculture sector of the country.

#### 4.4 Impact and Sustainability of the Intervention/ Business Model

The business model of IPRS is briefly described below through a flow chart:



Flow chart: Presenting the business model of In-Pond Raceway System (IPRS)

The business model comprises of 4 components such as strengthening backward market linkages, advisory services to the advanced farmers, research and innovation and strengthening forward market linkages through value addition. When an IPRS is established in an area then the backward fish market actors as hatcheries, nurseries and even small-scale fish farmers are linked with each other to feed the seed input into the IPRS. Feed companies and aqua machinery companies also are linked to provide their input support to the IPRS. Through establishing the

IPRS, Afil Aqua Fish not only produced 5-10 times more fish production but also they created business opportunities to provide information to the advanced farmers as well as to sell their machinery to them. From IPRS quality and same size fish can be harvested at a time which draws attention to the buyers and exporters. Thus IPRS creates linkages with the forward markets. IPRS is a globally proven intensive and climate resilient technology but it is completely new to our country. Hence, lot of research works are required to adapt the technology to our geo-ecological contexts. So, the research organizations like universities have a great scope here to create research collaboration with the aquaculture industries through providing research supports to companies who establish IPRS.

#### **4.5 Recommendations / Future Directions**

Afil Aqua Fish deems the following activities may be important to adopt more IPRS as well as to increase fish production from the same ponds and to contribute for the sustainability of the aquaculture sector:

- Civil construction, machinery and set up costs of IPRS should be reduced in a cost-effective way so that the marginal farmers can afford the technology
- High Value Fish (HVF) should be cultured into IPRS so that the Return on Investment (ROI) can be high within short period of time
- IPRS machinery should be readily available in our country so that capital investment cost can be reduced while importing these machinery from foreign countries
- More research works should be conducted for reducing the establishment cost, species selection, waste water treatment and environmental concern of IPRS in different geo-ecological contexts of Bangladesh
- The fish sludge which is continuously removed from IPRS should be marketed in mini pack to use it as agriculture fertilizer
- IPRS platform should be created to produce more fish and contribute to the national economy
- Inputs/traceability/BMP linkage
- More linkages should be created with the forward market actors so that the fish produced from IPRS can be easily exported to different foreign markets
- Government policy should provide emphasis on vertical expansion of aquaculture and adoption of technologies like IPRS
- As an intensive aquaculture technology IPRS should be included in the technology list of Bangladesh Bank

## 5.0 Project budget and financial management

With the instruction of Mohammed Hanif, Grants POC, we have prepared the budget and followed up on a regular basis. With the time to time instruction of the Grants POC, we maintained the necessary evidence of the activities which were planned and accomplished accordingly.

Total budgeted amount including the extended phase of Afil Aqua Fish Ltd. is given below:

SL	Total amount	Amount of Aquaculture Activity	Amount of Sub-grantee
1	571,873	58,984	512,889
2	100%	10%	90%

Afil Aqua Fish Ltd. contributed the lion share of the budget amounted to USD 512,889, where the contribution of WorldFish was 10%. As the IPRS venture was completely new to Afil Aqua Fish Ltd. and it was completely by the initiative of the Aquaculture Activity, therefore, the Activity can claim the contribution (90%) of Afil Aqua Fish Ltd. as their success. Without the technical and financial contribution of the Activity it was impossible for Afil Aqua Fish Ltd. to accomplish the project successfully. We preserved all the deliverables and vouchers and other evidences in the office of Afil Aqua Fish Ltd. per proper guidance of the assigned Grants POC. The Grants POC visited the office and the project site time to time. He instructed the Manager (Accounts) of Afil Aqua Fish Ltd. whenever required. The Manager (accounts) with the help of finance officers of the office and the project site maintained all the documents and preserved those as per Generally Accepted Accounting Principle (GAAP).

## 6.0 Annexure

### 6.1 Annex 1: Impact of the intervention on core business

The impact of the intervention of the project “Promotion and adaptation of In-Pond Raceway System in south-western Bangladesh” is positive. In the first phase of the project establishment of the IPRS including civil construction, mechanical works or machinery set up as well kick-off IPRS through stocking different High Value Fish (HVF) were emphasized along with the promotion of IPRS in south-western Bangladesh. The integration of the physical, mechanical and biological components of the IPRS was completed accordingly and within the time frame. Through the project 148 advanced fish farmers and 400 fisheries’ students visited the site and learned a lot about IPRS i.e. what is IPRS, how it functions, how to establish that and what is the importance of IPRS. Already the course curriculum of the fisheries departments of JUST, KAU and KU included IPRS as a part of their study. These three universities carried their students of fisheries department through their own cost to visit the site and to learn about IPRS. The department of Youth Development of Khulna also carried their students to the site through using their own fund. About 22 students of fisheries departments of JUST, KAU and KU conducted different research works on IPRS. This included the growth performance and CBR of different fish species stocked into IPRS, water and soil quality parameters as well environmental impact of IPRS. This not only benefited the both parties i.e. the universities and Afil Aqua Fish Ltd. but also it contributed a lot to start collaborative research works of the universities with the aquaculture industries. Before the intervention of the Activity, all IPRS machinery were imported from China or different other countries but through the intervention of the activity Afil Aqua Fish was able to produce IPRS machinery in their own workshop. This not only benefited the company to reduce their capital investment cost but also provided expertise to produce those products. Afil Aqua Fish has a plan to add a new venture of producing and selling of IPRS machinery to the interested fish farmers who want to set up IPRS in their own areas. This has not added a new portfolio of business to Afil Aqua Fish but it is also indicating a positive trend of IPRS machinery production indigenously and to contribute to the national economy by adding more fish production through the increased number of IPRS. The university teachers and students are now jointly working with Afil Aqua Fish Ltd. regarding how to reduce the set up cost of IPRS and how it can be brought to the marginal fish farmers of Bangladesh. Forward market fish actors like the exporters and buyers are already coming to the IPRS site to buy the quality and larger size fish from the IPRS. Afil Aqua Fish is going to make agreements with them for exporting fish in near future.

## 6.2 Annex 2: Case Story-1

### In-Pond Raceway System (IPRS): Hope for Future Aquaculture in Bangladesh

In Bangladesh arable land and water areas are decreasing due to climatic change and population pressure. The demand of fish is also increasing along with the gradual increase in economic status of the people of Bangladesh

Increasing population pressure in Bangladesh is reducing the available arable land in one hand and on the other hand, increasing the demand for fish. With the gradual increase in economic



Quality feeds are being applied at IPRS of Afil Aqua Fish Ltd., at Sharsha, Jashore

status of the people of Bangladesh, the demand for fish is increasing too. The traditional aquaculture practice in Bangladesh can no more meet the increasing demand for fish. Vertical expansion of aquaculture has become essential for mass increase in productivity to meet up the demand of increased population. In this regard to increase the productivity per unit area, aquaculture intensification through mechanization is inevitable.

Feed the Future Bangladesh Aquaculture and Nutrition Activity in partnership with Afil Aqua Fish Ltd., a private agribusiness company introduced 'In-Pond Raceway System (IPRS)' for the first time ever in southern Bangladesh. IPRS is a proven intensive aquaculture technology, which can produce 7-10 times higher quantity of fish compared to the existing culture practices. In IPRS 2.5% pond area is used as fish production zone and the rest 97.5% as water purification zone. IPRS of Afil Aqua Fish Ltd. consists of four production cells, each 220 m<sup>3</sup> installed in 2.23 hectare (ha) pond area.

IPRS is environment friendly and it produces safe fish at relatively lower cost. As fish are stocked at high density in confined cells in IPRS, it significantly reduces production costs through eliminating feed wastage, reducing costs related to harvesting, water exchange, feed



broadcasting, water quality monitoring and deploying guards. Though IPRS has some high initial capital investment, it is realized within 2-3 years.

After the newly established IPRS in September 2021, Afil Aqua Fish Ltd. was able to sell 16,100 Kg shol (striped snakehead) worth BDT 44, 27,500 within three months of culture period from one production cell of 220 m<sup>3</sup>. Presently production of tilapia, rui, grass carp and magur is in progress in four IPRS cells of Afil Aqua Fish Ltd., from which they expect production of tilapia 17,500 Kg worth BDT 13,97,666; grass carp 16,663 Kg, worth BDT 25,82,765; rui 6,135 Kg worth BDT 9,20,250 and magur 34,293 Kg worth BDT 78,87,390 by the end of January 2022.

As part of the joint initiative of Bangladesh Aquaculture Activity and Afil Aqua Fish Ltd. total 105 advanced farmers, university professors and students received hands-on training through visit to the IPRS site of Afil Aqua Fish Ltd. After attending the training, six advanced farmers have already started work to establish IPRS at their own facilities. With expansion and widespread adoption of IPRS technology would enable farmers to produce more fish from their existing farm.

“Establishing IPRS in Bangladesh would help produce more quality fish in less water with higher profitability. We are very grateful to USAID Funded “Feed the Future Bangladesh Aquaculture Activity” implemented by WorldFish for extending their support in establishing the first IPRS in south-western Bangladesh”, says- Mr SK Afil Uddin, Member of Parliament (Jashore-1) and Managing Director of Afil Group. He assures that Afil Aqua Fish Ltd. would help interested fish farmers through providing technical service related to acquisition and installation of equipment in IPRS.

Prepared by  
Rabeya Aktar  
Manager (Accounts)  
Afil Aqua Fish Ltd.  
Jashore