Project ID - 827

Competitive Research Grant

Sub-Project Completion Report

on

Development of Mixed Culture Technology of High Valued Galda (*Macrobrachium rosenbergii*) with Two Native Catfish, Shing (*Heteropneustes fossilis)* and Magur (*Clarias batrachus*) in South-western Coastal Ghers of Bangladesh

Project Duration

May 2017 to September 2018

Bangladesh Fisheries Research Institute
Shrimp Research Station
Bagerhat-9300

Submitted to
Project Implementation Unit-BARC, NATP 2
Bangladesh Agricultural Research Council
Farmgate, Dhaka-1215

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Edited and Published by:

Project Implementation Unit
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Acknowledgement
The execution of CRG sub-project has successfully been completed by Bangladesh Fisheries Research Institute Shrimp Research Station, Bagerhat using the research grant of USAID Trust Fund and GoB through Ministry of Agriculture. We would like to thank to the World Bank for arranging the grant fund and supervising the CRGs by BARC. It is worthwhile to mention the cooperation and quick responses of PIU-BARC, NATP 2, in respect of field implementation of the sub-project in multiple sites. Preparing the project completion report required to contact a number of persons for collection of information and processing of research data. Without the help of those persons, the preparation of this document could not be made possible. All of them, who made it possible, deserve thanks. Our thanks are due to the Director PIU-BARC, NATP 2 and his team who extended their whole hearted support to prepare this document. We hope this publication would be helpful to the agricultural scientists of the country for designing their future research projects in order to generate technology as well as increase production and productivity for sustainable food and nutrition security in Bangladesh. It would also assist the policy makers of the agricultural sub-sectors for setting their future research directions.

Published in: September 2018

Printed by:

Acronyms

BFRI	Bangladesh Fisheries Research Institute
SRS	Shrimp Research Station
SRDI	Soil Resource Development Institute
SGR	Specific Growth Rate
MOP	Murat of Potash
MOC	Mustard Oil Cake
HACH	Housing Authority of the City of Auston
SD	Standard Deviation
BCR	Benefit Cost Ratio
PIU	Project Implement Unit
BARC	Bangladesh Agricultural Research Council
NATP	National Agricultural Technology Project
FCR	Feed Conversion Ratio
PCR	Project Completion Report
DoF	Department of Fisheries
AOAC	Association of Analytical Chemist
ANOVA	Analysis of Variance
BTV	Bangladesh Television
SPSS	Statistical Package for Social Science
ha	Hectare
Exp.	Experiment
g	Gram
Kg	Kilogram
%	Percentage
CRG	Competitive Research Grant
PI	Principal Investigator
Co-PI	Co-Principal Investigator
Tk	Taka
GDP	Gross Domestic Product
MT	Metric Ton
PL	Post Larvae
LoA	Letter of Agreement
ppt	Parts per thousand
mm	Millimeter
pH	Power of hydrogen
cm	centimeter
TSP	Triple Super Phosphate
˚C	Degree Celsius
L	liter
µm	micrometer
±	Plus or Minus
>	Greater Than
pp	Project proposal

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Executive Summary

A research program was carried out to investigate the feasibility of polyculture of Prawn (*M. rosenbergii)* with freshwater Catfish (Shing and Magur) in gher farming system of Bagerhat District. A total area of 1.08 ha gher was considered for the study. The total gher area had been splitted into 18 compartments of 0.06 ha each using fine meshed glass nylon net. For conducting this research two experiments were undertaken. In Experiment 01, stocking density of Shing was variable i.e., 200/300/400 nos. per decimal, 50 nos./decimal for Magur and 30 nos./decimal for Prawn juveniles were considered. Whereas, in Exp-02, stocking density of Magur was variable i.e., 50/75/100 nos. per decimal. Exp. -1 was commenced on 18 July 2017 and based on the results of three months of Exp-1, Exp-2 commenced on 03 october, 2017. During the culture trial, ghers were treated with salt (Nacl) (150g/decimal), Potasium permanganate (5g/decimal) along with lime (125 kg/ha) to prevent fish from disease. At least 10% of stocked Catfish and Galda was sampled using cast net. Weight of the sampled fish was taken using portable balance for growth monitoring, feed adjustment and disease checking. Physico-chemical parameters of the experimental gher water were monitored at fortnightly intervals. Except ammonia and iron content the other observed parameters of gher water found congenial for fish health. Soil parameters were analyzed with the assistance of SRDI, Khulna also found suitable for fish culture. All statistical analyses were done using the SPSS (Statistical Package for Social Science) software (version-16). In Exp -1, the highest growth performance (47.0 g) and survival (19.94%) for Shing obtained from T_3 where stocking density of Shing maintained at 400, Magur 50 and Galda 30/decimal. In Exp -2, the highest growth performance (33.32g) and survival (29.94%) for Magur obtained from T_3 where stocking density of Shing maintained at 400, Magur 100 and Galda 30/decimal. Due to sudden natural disaster (flash flood) some fishes escaped from different compartments of the experimental gher. It is also assumed that death of some fish might be occurred due to deteriorated water quality caused by dropping of leaves from surrounding 'Mahogoni' (*Swietenia macrophylla)* trees. It is assumed that the survival rate might have been higher than the present survival rate. Even then the value of Benefit-Cost Ratio (BCR) with present survival rate found 1.4 that seems to be profitable and feasible of this polyculture practice. But further trial is needed to determine the actual survival rate. Reverse experimentation maintaining high stocking density of Magur is also needed due to slow growth of Shing and their hiding tendency that hampers total harvest.

Training/Workshop was conducted for dissemination of this technique to the farmers residing immediate vicinity around the gher. Leaflet, Booklet, Project Completion Report (PCR), Scientific papers will also be generated for dissemination of these mixed culture technology of the high valued Prawn with Shing and Magur.

CRG Sub-Project Completion Report (PCR)

A. Sub-project Description

1. **Title of the CRG sub-project**: Development of Mixed Culture Technology of High Valued Galda (*Macrobrachium rosenbergii*) with Two Native Catfish, Shing (*Heteropneustes fossilis)* and Magur (*Clarias batrachus*) in South-western Coastal Ghers of Bangladesh.

2. **Implementing organization**: Bangladesh Fisheries Research Institute, Shrimp Research Station, Bagerhat-9300

3. **Name and full address with phone, cell and E-mail of PI/Co-PI (s**):

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4. **Sub-project budget (Tk):**
   - **4.1 Total:** 4000000/-
   - **4.2 Revised (if any):** Not Applicable

5. **Duration of the sub-project:** From 9th May2017 to September /2018
   - **5.1 Start date (based on LoA signed):** 9th May2017
   - **5.2 End date:** 30 September 2018

6 Justification of undertaking the sub-project:

Fisheries sector are inseparable from the life and lifestyle of the people of Bangladesh. It contributes 4.37% to the national GDP and almost one-fourth (23.37%) to the agricultural GDP (DoF, 2013). About 1.5 million people are directly employed by this sector (DoF, 2012). Aquaculture of freshwater giant Prawn (*Macrobrachium rosenbergii)* has gained a significant momentum with an expansion of farm lands from 3,500 ha in mid 80s to about 50,000 ha at present. There has been a trend of increasing this area at the rate of 10-20% annually (Alam, 2009). Production of shrimp and freshwater Prawn for the year 2007-2008 was 223,095 MT of which 23% was cultured Prawns. In the year 2007-2008, total quantity of export frozen shrimp and Prawn was 49,907 estimated MT, which earned Tk. 2863.92 core sharing 2.68% to total export earnings (DoF, 2009[1]). Freshwater Prawn *(M. rosenbergii*) locally called Galda, farming in Bangladesh has a number of socio-economic advantages over shrimp farming. Unlike the Shrimp farms which are normally large (average size above 10 ha or 25 ha) and often pirated by non-resident elite owners, the Prawn farms are mostly small (average size less than an acre) and operated by the landowners themselves. Prawn farming (in gher) in the south-west region of Bangladesh is taken as a traditional custom and alternative income source.

Bangladesh is considered to be one most suitable country in the world for giant freshwater Prawn *(M. rosenbergii)* farming due to its fertile land and agro-climatic conditions. Freshwater Prawn (*M. resenbergii*) is widely cultured due to its advantages over other in terms of size,

growth, salinity tolerance and high price in international markets. Prawn (*M. resenbergii)* has significant aquaculture potential and is commercially cultured (Ahmed, 2001; Muir, 2003a). Due to several problems like as disease and shortage of good quality post larvae (PL) of shrimp, most of the farms have moved towards Prawn farms under brackishwater condition. Prawn is found both brackishwater and freshwater environment of Bangladesh and it can tolerate salinity upto 15 ppt (Farmer's opinion and personal observation; Islam and Mahmud, 2012. It has been observed that total farm output increases through the inclusion of suitable fish and/or Prawn in rice fields (Alam *et al*., 2006 ; Cai *et al.*1995[5]). Besides, Prawn is not yet susceptible to the prevailing white spot virus disease (Hameed *et al,* 2000) that causes huge economic losses to the Shrimp. For these reasons, Prawn culture is socially more acceptable and technically and economically more viable and sustainable. On the other hand, Shing (*Heteropneustes fossilis*) fish was abundantly available in open water system of floodplains, canals, beel and haors of Bangladesh.

But due to over exploitation and ecological changes in its natural habitats, this species have become threatened. Indiscriminate destructive practices have caused havoc to aquatic bio-diversity in Bangladesh (Hussain and Mazid, 2001). Currently, Shing (*H. fossilis)* is one of the threatened fish in Bangladesh (IUCN Bangladesh, 2000). Shing & Magur are more demandable fish in market and that's why profit can be obtained by their culture. They can be cultured in any types of water body even in low saline water. They can survive in adverse environment such as less oxygen, high temperature of water, low salinity, even in polluted water. They can culture in less water and with more density. Along with individual culture, they can also be cultured with carps, tilapia etc. as mixed culture.

From nutritional point of view, Shing and Magur are excellent food fishes. Besides protein, flesh of Shing and Magur also contains vitamins, iodine and fat which is good for patients and convalescents. Polyculture of these three species has not yet been practiced. Although a freshwater species, in early stages of Prawn needs higher salinity level up to juvenile stage and can survive and grow normally in salinity up to 8 ppt. The year-round salinity level of the South-West coastal region provided the opportunity for horizontal and vertically expansion of mixed Prawn farming.

Shing (*H. fossilis*) and Magur (*C. batrachus*) is a very hardy fish and can survive for quite a few hours outside the water due to the presence of accessory respiratory organs. It can tolerate slightly brackish water. The fish adapts well to hypoxic water bodies and to high stocking densities (Dehadrai *et al.,* 1985).
So, freshwater Catfish (Shing, Magur) may be good candidates to culture with Prawn (*M. rosenbergii)* in ponds/ghers to save the farmers from losing their investment due to shrimp mortality, in addition to getting additional income from fish. With this view, a research program was proposed to evaluate the feasibility of poly culture of Prawn (*M. rosenbergii)* with freshwater Catfish (Shing and Magur) in gher farming system.

7 Sub-project goal:

- **a.** Development of mixed culture technology of Prawn, Shing and Magur;
- **b.** Demonstration the overall mixed culture activities to the farmers around the gher vicinity.

8 Sub-project objective (s):

- **a.** To adopt the mixed culture technique of Prawn *(M. rosenbergii*) and Catfish (*H. fossilis and C. batrachus,*);
- **b.** To determine the production performance and survival rate of mixed culture practice;

c. To assess the water quality parameters of gher ecosystem and
d. To investigate the economic potentiality of these culture practices.

9 Implementing location (s): The experiment was conducted on farm in village-Betaga, Upazilla – Fakirhat of Bagerhat District. Laboratory activities were performed in the SRS Laboratory of BERI, Bagerhat.

10 Methodology in brief:

Experimental Design:

In order to develop mixed culture technologies, two experiments were carried out. In Experiment 1, stocking density of Shing was variable i.e., 200/300/400 nos. per decimal, 50 nos./decimal for Magur and 30 nos./decimal for Prawn juveniles. Whereas, in Experiment 2, stocking density of Magur was variable i.e., 50/75/100 nos. per decimal, 30 nos./decimal for Prawn juveniles but the nos./decimal Shing was chosen from the best treatment of the 1st experiment based on production performance. As a result, the second experiment was started after 03 months of the 1st experiment. Each experiment was provided with three treatments and three replications.

Gher Preparation:

A total area of 1.08 ha gher was considered for the experiment. Prior to stocking, gher had been dried and cleaned for weeds and unwanted aquatic animals. Then, the dried gher was left exposed to sunlight for several days and then ploughed the land two times with tractor machine. Then the gher was limed at the rate of 250 kg/ha. Five days after liming, gher was fertilized with MOC, Urea, T.S.P and M.O.P at the rate of 150 kg, 75kg, 45kg and 30kg/ ha respectively. Then the total gher area had been split into 18 compartments (Uses 9 compartments for each experiment) using fine meshed glass nylon net. Area of each compartment composed of 0.06 ha. Gher was filled-up with rain water. Again prior to stocking, all of the treatment compartments were fertilized with organic fertilizers such as rice bran, molasses and yeast at the rate of 50 kg, 25 kg and 250 tea spoonfuls/ha respectively which were soaked into water for 24 hours and the extracts were applied to gher compartments. Subsequently all the treatments were fertilized fortnightly with urea and TSP (1:2) at the rate of 40kg/ha until harvesting.

Fencing and Sanitizing:

Fine meshed nylon net and bamboo splits locally called 'bana' were fixed on the dikes around the gher to resist the entry of potential disease carrier fauna such as snail, snake, crab etc. from outside. Fencing had other motives such as to prevent the escape of fish from gher and allow water to pass through during heavy rainfall.

Experiment 1: Mixed Culture of Galda with Catfish (Shing as variable)

Stocking:

On 18 July 2017, Exp-1 had been commenced by stocking around 1.5g sized Shing and 3g sized Magur fingerlings in nine gher compartments. Juveniles of Prawn 1.5g were stocked on 03 August, 2017 after 15 days of stocking Catfish (Table 01). As Shing and Magur might have a bit carnivorous characteristic, juveniles of Prawn were stocked after habituating the previous two species with artificial feed. The amount of feed was adjusted fortnightly on the basis of sampling of experimental fish.

Table 1: Mixed Culture of Galda with Catfish (Shing as variable)

Treatment	Replication	Species	Stocking Density/decimal
T_1	3	Prawn	30
		Shing	200
		Magur	50
T_2	3	Prawn	30
		Shing	300
		Magur	50
T_3	3	Prawn	30
		Shing	400
		Magur	50

Experiment 02: Mixed Culture of Galda with Catfish (Magur as variable)

Stocking:

Based on the results of three months of Exp -1, Exp -2 had been commenced on 03 October, 2017 by stocking 1.5g sized Shing and 3g Magur fingerlings in nine compartments of the other parts of the gher. After 7 days interval, Juveniles of Prawn were stocked for avoiding probable carnivorous attack of Catfish (Table 02). The amount of feed was adjusted fortnightly on the basis of sampling.

Table 2: Mixed Culture of Galda with Catfish (Magur as variable)

Treatment	Replication	Species	Stocking Density/decimal
T_1	3	Prawn	30
		Shing	Best growth after 3 months culture period of Exp-01
		Magur	50
T_2	3	Prawn	30
		Shing	Best growth after 3 months culture period of Exp-01
		Magur	75
T_3	3	Prawn	30
		Shing	Best growth after 3 months culture period of Exp-01
		Magur	100

Feed and Feeding Management:

Proximate compositions of different commercial floating feeds were analyzed according to AOAC (1995) method in the Shrimp Feed and Nutrition Laboratory of Shrimp Research Station, Bagerhat. Based on analytical results, floating nursery feed (Protein 32%, Lipid 7%, Moisture 7%) floating oil coated grower (Protein 27%, Lipid 6%, Moisture 9%) and Prawn grower (Protein 30%, Lipid 7%, Moisture 7%) were found suitable for mixed culture. After stocking, Shing were fed 32% protein containing floating commercial pellet feed at the rate of 10% for 1st two weeks (Floating pre-nursery 1.5mm) , 8% for 2nd two weeks (Floating Pre-nursery 1.8mm), 7% for 3rd two weeks, 6% for 4th two weeks, and it reduced to 2% from the subsequent weeks (up to 12th two weeks floating Grower feed). For Magur, commercial pellet Feed was given at the rate of 6 % of estimated fish biomass for first two weeks and it reduced to 4- 2% from the subsequent weeks (up to 12th two weeks). Feeding was continued three times daily at 6:00, 12:00 and18:00 hour for 01month. Later feeding continued two times daily at 6:00 and 18:00 hour. For Prawn, commercial pellet feed (30% protein) were applied at the rate of 6-2% of estimated biomass twice daily at 6.00 in the morning and 18.00 in the evening. The Prawn juveniles were fed at the rate of 6.0 - 6.5 % of their body weight (around 2gm) for the first two weeks, 5.5% for 3rd two weeks, 4.5 % for 4th two weeks, 3.8 % for 5th two weeks, 3.5 % for 6th two weeks, 3.2 % for 7th

two weeks, and thereafter it reduced to 2.5% from the subsequent weeks (up to 12th two weeks). During the culture trial, all the ponds were limed after 15 days interval at the rate of 125 kg/ha to maintain pH and water qualities. Subsequently culture ponds were also treated with salt (150g/decimal) and Potassium permanganate (5g/decimal) along with lime to prevent fish from disease.

Estimation of Growth, Survival, Production and Feed Utilization:

Prawn/Fish were sampled using seine and cast net. The length (cm) and weight (g) of individual fish were recorded separately with the help of a measuring scale and a portable sensitive balance. Weight of each species was measured separately to assess the health condition of fish and growth. Sampling and feed adjustment were done fortnightly. Percentage and Survival rate calculation were done according to De Silva (1989). SGR calculated according to Brown (1957) and Ricker (1979) and FCR calculated according to Brown (1957) and Gangadhara *et al.* (1997).
SGR (%/day): [(In. Final body weight – In. Initial body weight) / days × 100]
FCR: Feed fed (g dry weight)/Live weight gain (g)
Survival Rate: (Final number – Initial number) × 100

Water quality parameters determination and plankton population monitoring:

Physico-chemical parameters viz., surface water Temperature (^{o}C), Transparency (cm), Dissolved Oxygen (mg/l), pH, Total Alkalinity (mg/l), Ammonia (mg/l), Salinity, Iron, Total Dissolve Solid (TDS), Iron etc. were monitored between 8.30 to 9.30 am using Celsius thermometer, Secchi-disk, portable dissolved oxygen meter (Oakton), portable pH meter (HI 8424, Hanna Instruments, Portugal) respectively on a fortnightly basis. Total alkalinity and TDS were determined following the titrimetric method according to the standard procedure. Nitrate-Nitrogen, Iron and ammonia were determined using HACH Kit. After having water quality report if need necessary action was taken.

Plankton was collected from the gher at fortnightly interval for quantitative and qualitative estimation. Ten liters water sample was collected from each replicate experimental gher and then filtered through bolting silk plankton net (25 µm) to obtain a 50 ml sample. The collected samples were preserved immediately with 5% buffered formalin. Plankton expressed as cells per liter of water of each pond. The quantitative and qualitative analysis of phytoplankton and zooplankton were done according to Stirling (1985). After having plankton report, necessary action was taken.

Study of Macrophyte and Aquatic Vascular Plants

Macrophytes and aquatic vascular plants also play a vital role in the limnological properties of ghers. So, growth of different types of macrophytes and aquatic vascular plants in the ghers observed on a regular basis. In the experimental ghers huge amount of different types of snail, little crab was found.

Soil Quality Analysis

Soil sample collected on a quarterly basis from respective sites and carried to the laboratory for processing and finally analyzed with the assistance of Soil Resource Development Institute (SRDI), Khulna.

Health Management

Fish were checked frequently by netting whether they grew regularly and became diseased or not. No outbreak of disease was observed throughout the culture period. During the trial, ghers treated with salt (150g/decimal), Potassium permanganate (5g/decimal) along with lime (125

kg/ha) were found to prevent fish from disease. In early winter, as an advance preventing measure, lime and salt (1kg/decimal) were applied. Excepting ammonia and iron content the other observed parameters of gher water were found congenial for fish health. Gasoline was used to mitigate ammonia problem. Banana tree and dry paddy straw was used to mitigate iron problem.

Statistical and Economic Analysis

All statistical analyses were done using the SPSS (Statistical Package for Social Science) software version-16. The growth performance and feed utilization data were analyzed using two-way ANOVA. Standard deviation (±SD), calculated to identify the range of means. Comparison of treatment mean carried out using Two-way analysis of variance (ANOVA), followed by testing of pair-wise differences using Duncan's Multiple Range Test (Vann, 1972). Significance assigned at the 5% level (P>0.05). A simple algebraic economic analysis was carried out to determine the net return and Cost-Benefit-Ratio of Prawn with Shing and Magur culture in different treatments.

The Cost Benefit-Ratio (BCR) was determined as: BCR = Total net return/Total input cost

11. Results and discussion

Results:

Experiment 1: Mixed Culture of Galda with Catfish (Shing as variable)

Growth performance

On 18 July 2017, Exp-1 had been commenced by stocking around 1.5g sized Shing and 3g sized Magur fingerlings in nine gher compartments. Juveniles of Prawn around 1.5g stocked on 03 August, 2017 after 15 days stocking of Catfish. As Shing and Magur might have a bit carnivorous characteristic, for habituating these species with artificial feed, juveniles of Prawn were stocked later. After 06 months of culture the average final weight of Shing was recorded 37.02, 41.14 and 47.0g; Magur 99.21, 99.51 and 112.17g; and Galda 69.74, 70.19 and 77.32g for Treatment T_1, T_2 and T_3 respectively (Table 3). It was evident from Exp -1 that the highest growth performance (47.0 g) of Shing obtained from T_3 where stocking density of Shing, Magur and Galda were 400, 50 and 30/decimal respectively and the lowest (37.02g) was recorded from T_1 where stocking density of Shing, Magur and Galda were 200,50 and 30/decimal.

Survival rate

Initial stocking density of Shing was variable i.e., 200/300/400 nos. per decimal, Magur of 50 nos./decimal and Prawn juveniles of 30 nos./decimal. Due to sudden natural disaster (flash flood) some fishes escaped from different compartments of the experimental gher. It is also assumed that death of some fishes might be occurred due to water quality deteriorated by the leaves dropped into gher from surrounding 'Mahogoni' (*Swietenia macrophylla)* trees. Even then, at the end of rearing, the survival of Shing was recorded 16.89 %, 18.63%, and 19.94%, survival of Magur 36.19%, 35.67% and 38.67 % and survival of Galda 29.87%, 25.60 %, 30.14%, in T_1, T_2, T_3, respectively. Highest survival for Shing (19.94%), Magur (38.67%) and Galda (30.14%) were found in T_3 followed by T_1 and T_2 (Table 3).

Table 3. Treatment wise data on Initial & Final weight (X̄±SD) of Shing (as variable), Magur & Galda of Exp. 01.

Treatment	Replication	Shing				Magur				Galda			
		Initial Wt (g) (X̄±SD)	Final Wt (g) (X̄±SD)	Survival rate (%)	SGR	Initial Wt (g) (X̄±SD)	Final Wt (g) (X̄±SD)	Survival rate (%)	SGR	Initial Wt (g) (X̄±SD)	Final Wt (g) (X̄±SD)	Survival rate (%)	SGR
T_1	R_1	1.59±.65	39 ± 5.74	16.89	1.78	2.87±0.63	96.50 ± 7.97	36.19	1.95	1.80	73.22 ± 11.92	29.87	2.05
	R_2	1.59±.65	35.07 ± 5.51		1.71	2.87±0.63	100.10 ±9.50		1.97	1.80	67 ± 5.94		2.00
	R_3	1.59±.65	37 ± 5.99		1.74	2.87±0.63	101.03 ± 11.06		1.98	1.80	69 ±7.54		2.02
	x̄		37.02		1.75	x̄	99.21		1.96		69.74		2.02
T_2	R_1	1.59±.65	42.29 ± 5.07	18.63	1.82	2.87±0.63	102.21 ± 9.31	35.67	1.98	1.80	72.1 ± 7.919	25.60	2.04
	R_2	1.59±.65	40.43 ± 3.71		1.79	2.87±0.63	100.93 ± 8.97		1.97	1.80	68.26 ± 13.85		2.01
	R_3	1.59±.65	40.71 ± 4.69		1.79	2.87±0.63	101.14 ± 6.32		1.98	1.80	70.23 ± 11.37		2.03
	x̄		41.14		1.79	x̄	99.51		1.97		70.19		2.02
T_3	R_1	1.59±.65	46.14 ± 8.97	19.94	1.86	2.87±0.63	118.93 ± 14.30	38.67	2.06	1.80	76.71 ±11.93	30.14	2.07
	R_2	1.59±.65	48.21 ± 12.87		1.89	2.87±0.63	109.79 ± 12.16		2.02	1.80	77.24 ±12.03		2.08
	R_3	1.59±.65	47.36 ± 12.53		1.85	2.87±0.63	107.79 ± 18.97		2.01	1.80	78.03 ±8.10		2.09
	x̄		47.00		1.84	x̄	112.17		2.03		77.32		2.08

Physicochemical Characteristics of water

In case of water Transparency, temperature, Depth, Salinity, pH, Ammonia, Iron, Nitrite, Nitrate, Dissolve Oxygen, Total alkalinity and Total Phosphorous PO_4--P in T_1, T_2 and T_3 of Exp. 1 was more or less similar and congenial for Prawn and Fish culture (Table 4).

Table 4: Water quality parameters in different treatment of Exp-1. x

Treatment	Time (am)	Transparency (cm)	Depth (m)	Temperature (^{0}C)	Salinity (ppt)	pH	Ammonia (mg/l)	Iron (mg/l)	Total Alkalinity (mg/l)	Nitrite (mg/l)	Nitrate (mg/l)	O_2 (mg/l)	Total Phosphorous PO_4--P (mg/l)
T_1	9.00	25±0.77	1.65±0.20	18.11±6.69	0	7.84±0.23	0.21±.20	0.97±1.16	110±17.048	0.03±.101	0.22±0.52	5.43 ± 2.05	0.24±0.01
T_2		22±1.77	1.15±0.40	17.11±7.69	0	7.55±0.22	0.21±.10	1.13±0.86	102.44±10.05	0.043±.101	0.32±0.42	6.7 ± 1.65	0.25±0.04
T_3		25±1.34	1.60±0.80	18.22±5.69	0	7.64±0.34	0.3±.40	0.97±0.98	80±20.048	0.033±.101	0.52±0.62	5.43 ± 3.45	0.22±0.05

The mean values of water temperature were 18.11±6.69, 17.11±7.69 and 18.22±5.69 ^{0}C in T1, T2 and T3 respectively. In case of water transparency, the average values were 25±0.77, 22±1.77 and 25±1.34 ^{0}C in T_1, T_2 and T_3 respectively. Dissolved oxygen is one of the most important factors for fish culture which was recorded during the experimental period. The average values of dissolved oxygen ranged from 5.43 ± 2.05 mg/l, 6.7 ± 1.65 mg/l and 5.43 ± 3.45 mg/l in treatments 1, 2 and 3 respectively. The pH values of the pond water under the three treatments were found acceptable range for fish culture. The pH values of water varied from 7.3 to 8.07 and the mean values were 7.84±0.23, 7.55±0.22 and 7.64±0.34 in T_1, T_2 and T_3, respectively. The ranges of total alkalinity were 93 to 127 mg/, 92 to 112 mg/ and 60 to 100 mg/ in T_1, T_2 and T_3, respectively. The mean values of total alkalinity were recorded in 110±17.048, 102.44±10.05 and 80±20.048 mg/l in T_1, T_2 and T_3, respectively. Highest ammonia content was recorded in T_3 (0.3) due to high stocking density and more amount of fecal materials were released in the ponds and minimum in T_1 (0.2) due to lower stocking density compared to T_2 and T_3.

Physicochemical Characteristics of soil

In case of pH, Salinity, Organic Matter, Total Nitrogen (%), Phosphorus, Potassium, Copper (Cu) and Zinc (Zn) in T_1, T_2 and T_3 of Exp. 1 soil was more or less similar and congenial for Prawn and Fish culture (Table 5).

Table 5: Soil quality of different treatment of Exp 1

Treatment	pH	Salinity (EC)(dc/m)	Organic Matter	Total Nitrogen (%)	Phosphorus (ug/g)	Potassium (mg/100g)	Cu (ug/g)	Zn (mg/g) soil
T_1	7.3	0.93	3.13	0.182	11.91	0.37	39.26	1.97
T_2	7.2	0.83	2.62	0.161	11.50	0.34	37.96	1.92
T_3	7.5	1.1	2.44	0.142	10.25	0.33	54.96	1.88

The values of soil pH were 7.3, 7.2 and 7.5 in T1, T2 and T3 respectively. In case of soil organic matter, the values were found 3.13, 2.62 and 2.44 in T_1, T_2 and T_3 respectively. The values of Total Nitrogen were 0.182, 0.161 and 0.142 % in treatments 1, 2 and 3 respectively. The values of Potassium were found 0.37 mg/100g, 0.34mg/100g and 0.33 mg/100g in T_1, T_2 and T_3, respectively. The values of Phosphorus were recorded 11.91, 11.50 and 10.25 ug/g in T_1, T_2 and T_3, respectively. Highest Cu content was recorded in T_3 (54.96 ug/g), minimum in T_2 (37.96 ug/g) and 39.26 ug/g in T_1. The values of Zn were recorded 1.97, 1.92 and 1.88 mg/g in T_1, T_2 and T_3 respectively.

Experiment 2: Mixed Culture of Galda with Catfish (Magur as variable)

Growth performance

After 5 months of culture, the average final weight of Shing was recorded 21.75, 20.87 and 22.68 g; Magur 31.84, 33.32 and 31.68g; and Galda 24.61,27.65 and 28.11g in Treatment T_1, T_2, T_3 respectively (Table 6). It was evident from Exp -2 that the highest average final weight of 33.32g Magur was obtained from T_3 with the stocking density of Shing 400, Magur 75 and Galda 30/decimal and the lowest of 31.68g was recorded from T_2 with stocking density of Shing 400, Magur 100 and Galda 30/decimal.

Survival

Due to sudden of natural disaster (flash flood) some fishes escaped from different compartments of the experimental gher. It is also assumed that death of some fishes might be occurred due to deteriorated water quality caused by dropping of leaves from surrounding 'Mahogoni' (*Swietenia macrophylla)* trees. Even then, at the end of rearing, the survival % were recorded as Magur 26.89 %, 29.94%, and 28.54%, Shing 16.59%, 15.67%, and 18.67 % and Galda 18.57 %, 15.20 %, 17.26% in T_1, T_2, T_3, respectively. The highest survivals were recorded as Magur (29.94%), Shing (18.67 %) and Galda (17.26%) in T_3 followed by T_1 and T_2 (Table 6).

Table 6. Treatment wise data on Initial and final weight ($\bar{X}\pm SD$) of Shing, Magur (as variable) and Galda of Exp. 02.

Treatment	Replication	Shing				Magur				Galda			
		Initial Wt (g) ($\bar{X}\pm SD$)	Final Wt (g) ($\bar{X}\pm SD$)	Survival rate (%)	SGR	Initial Wt (g) ($\bar{X}\pm SD$)	Final Wt (g) ($\bar{X}\pm SD$)	Survival rate (%)	SGR	Initial Wt (g) ($\bar{X}\pm SD$)	Final Wt (g) ($\bar{X}\pm SD$)	Survival rate (%)	SGR
T_1	R_1	1.79± 0.65	20.89 ±1.50	16.59	1.6	3.27± 0.63	32.57 ± 2.56	26.89	1.52	1.67	23.64 ±6.69	18.57	1.74
	R_2	1.79± 0.65	21.71± 1.93		1.64	3.27± 0.63	34.74 ± 3.26		1.56	1.67	25.36 ± 6.38		1.80
	R_3	1.79± 0.65	22.61 ±1.43		1.67	3.27± 0.63	31.11 ± 2.69		1.49	1.67	24.84 ± 5.37		1.77
	x̄		21.75		1.65	x̄	31.84		1.52	x̄	24.61		1.77
T_2	R_1	1.79± 0.65	20.07 ±1.76	15.67	1.60	3.27± 0.63	30.43± 4.36	28.54	1.56	1.67	26.96 ± 7.32	15.20	1.85
	R_2	1.79± 0.65	20.75 ± 3.62		1.60	3.27± 0.63	30.14 ± 3.46		1.56	1.67	28.88 ± 5.02		1.87
	R_3	1.79± 0.65	21.79 ± 2.19		1.64	3.27± 0.63	32.93 ± 3.84		1.52	1.67	27.11 ± 6.59		1.86
	x̄		20.87		1.61	x̄	31.68		1.54	x̄	27.65		1.86
T_3	R_1	1.79± 0.65	25.44 ± 4.11	18.67	1.76	3.27± 0.63	34.54 ± 2.7	29.94	1.47	1.67	28.58 ± 4.76	17.26	1.88
	R_2	1.79± 0.65	21.86 ± 1.79		1.64	3.27± 0.63	34.21 ± 4.81		1.48	1.67	27.39 ± 6.77		1.85
	R_3	1.79± 0.65	26.14 ± 2.69		1.78	3.27± 0.63	32.43 ± 2.58		1.52	1.67	28.33 ± 4.76		1.88
	x̄		22.68		1.72	x̄	33.32		1.49	x̄	28.11		1.87

Physicochemical Characteristics of water

In case of water Transparency, temperature, Depth, Salinity, pH, Ammonia, Iron, Nitrite, Nitrate, Dissolve Oxygen, Total alkalinity and Total Phosphorous PO_4-P in T_1, T_2 and T_3 of Exp. 1 was more or less similar and congenial for Prawn and Fish culture (Table 7).

The mean values of water temperature were 28.06±2.28, 27.11±2.69 and 27.16± 2.75 ^{0}C in T_1, T_2 and T_3 respectively. In case of water transparency, the average values were 26±2.43, 24±3.77 and 25±1.77 ^{0}C in T_1, T_2 and T_3 respectively. Dissolved Oxygen is one of the most important factors for fish culture, the mean values of dissolved oxygen were recorded from 6.23±2.65 mg/l, 5.4±1.74 mg/l and 5.25±2.10 mg/l in treatments 1, 2 and 3 respectively.

Table 7: Water quality parameters in different treatments of Exp 2.

Treatment	Time (am)	Transparency (cm)	Depth (m)	Temperature (^{0}C)	Salinity (ppt)	pH	Ammonia (mg/l)	Iron (mg/l)	Total Alkalinity (mg/l)	Nitrite (mg/l)	Nitrate (mg/l)	O_2 (mg/l)	Total Phosphorous PO_4--P (mg/l)
T_1	9.00	26±2.43	1.60±0.10	28.06±2.28	0	7.44±0.43	0.21±.20	0.97±1.16	104.44±17.05	0.053±.10	0.42±0.62	6.23±2.65	0.22±0.04
T_2		24±3.77	1.22±.40	27.11±2.69	0	7.4± 0.45	0.2 ± 0.21	1.23±1.35	100±24.85	0.056±0.09	0.37±0.47	5.4±1.74	0.23±0.04
T_3		25±1.77	1.70± 0.20	27.16± 2.75	0	7.38± 0.50	0.2± 0.19	1.28± 1.36	100± 18.56	0.050 ±0.10	0.41±0.55	5.25±2.10	0.22±0.03

The pH values of the pond water under the three treatments were found acceptable range for fish culture. The pH values of water varied from 7.3 to 7.88 and the mean values were 7.44±0.43, 7.4± 0.45 and 7.38± 0.50 in T_1, T_2 and T_3, respectively. The ranges of total alkalinity were 87.39 to 121.49 mg/, 79.15 to 128.85 mg/ and 85.44 to 122.56 mg/ in T1, T2 and T3, respectively. The mean value of total alkalinity was recorded 104.44±17.05, 100±24.85 and 100± 18.56 mg/l in T_1, T_2 and T_3 respectively. The mean values of ammonia were 0.21±.20, 0.2 ± 0.21 and 0.2± 0.19 mg/l in T_1, T_2 and T_3 respectively.

Physicochemical Characteristics of soil

In case of pH, Salinity, Organic Matter, Total Nitrogen (%), Phosphorus, Potassium, Copper (Cu) and Zinc (Zn) in T_1, T_2 and T_3 of Exp. 2 soil was more or less similar and congenial for Prawn and Fish culture (Table 8).

Table No.8: Soil Quality of Different Treatment of Exp-2

Treatme	pH	Salinity (EC)(dc/m)	Organic r	Total Nit	Phosphorus (ug/g) soil	Potassium (mg/100g) s	Cu (ug/g) soi	Zn (mg/g)soil
T_1	7.36	0.93	2.69	0.156	12.59	0.35	46.34	2.003
T_2	7.27	0.96	2.71	0.154	10.28	0.35	41.65	1.97
T_3	7.46	1.03	3.01	0.175	8.59	0.35	61.63	2.03

The values of soil pH were 7.36, 7.27 and 7.46 mg/l in T_1, T_2 and T_3 respectively. In case of soil organic matter, the values were 2.69, 2.71 and 3.01 in T_1, T_2 and T_3 respectively. The values of Total Nitrogen were found 0.156, 0.154 and 0.175 % in treatments 1, 2 and 3 respectively. The values of Potassium were measured 0.35 mg/100g in all treatments. The values of Phosphorus were recorded 12.59, 10.28 and 8.59 ug/g in T1, T2 and T3, respectively. Highest Cu content was recorded in T_3 (61.63 ug/g), minimum in the T_2 (41.65 ug/g) and 46.34 ug/g in T_1. The values of Zn were found 2.003, 11.97 and 2.03 mg/g in T_1, T_2 and T_3, respectively.

Plankton Biomass

Plankton biomass of all treatments were more or less similar (Table 9). A total of 27 species of phytoplankton and 10 species of zooplankton of different groups were identified from the gher. Among them predominant phytoplankton and zooplankton groups were Bacillariophyceae and Copepoda.

Table 9. Plankton monitoring in different treatments

Treatment	Group of Plankton		Name of Plankton
T_1	Phytoplankton	Bacillariophyceae	*Melosira , Navicula , Nitzschia. Rhizosolenia, Tabellaria, Tiialassionema, Fragillaria , Diatoms, Amphora*
		Chlorophyceae	*Uroglena, Gonatogygon, Spirogyra, Volvox, Ulothrix,Clostridium*
		Cyanophyceae	*Microcistis, Aphanizomenon, Trichodesmium*
	Zooplankton	Rotifera	*Brachionus sp.*
		Copepoda	*Cyclops, Mesocyclops, Helidiaptomus, Diaptomas*
		Crustacea	*Nauplias sp.*
T_2	*Phyto plankton*	Bacillariophyceae	*Melosira , Navicula , Nitzschia. Rhizosolenia, Tabellaria, , Diatoms, Amphora,Asterionella, Cyclotella, Bacteriostrum,*
		Chlorophyceae	*Uroglena, Closterium, Gonatogygon, Spirogyra*
		Euglenophyceae	*Euglena*
	Zooplankton	Copepoda	*Cyclops, Diaptomas*
		Cladocera	*Moina*
		Rotifera	*Brachionus*
T_3	Phyto plankton	Bacillariophyceae	*Navicula , Cyclotella ,Melosira Rhizosolenia, Tabellaria, , Diatoms, Amphora,Asterionella, Cyclotella, Bacteriostrum,*
		Chlorophyceae	*Uroglena , Gonatogygon, Spirogyra, Chlamydonzonas, Closterium*
		Cyanophyceae	*Microcistis ,Anabena, Oscillatoria, Aphanizomenon*
	Zooplankton	Copepoda	*Cyclops, Mesoyclops ,Helidiaptomus, Diaptomas*
		Crustacea	*Nauplias, Daphnia*
		Cladocera	*Diphansoma*
		Rotifera	*Filnia , Brachionus*

Table 10. Result of Cost Ratio Analysis

Subject	N	Minimum	Maximum	Mean
Full cost basis net return per ha	1	511290.00	511290.00	511290.0000
Cash cost basis net return per ha	1	666900.00	666900.00	666900.0000
Benefit cost ratio full cost basis	1	1.41	1.41	1.4115
Benefit cost ratio cash cost basis	1	1.61	1.61	1.6136
Valid N (list wise)	1			

Benefit-Cost-Ratio (BCR)

The value of Benefit-Cost Ratio (BCR) with present survival rate was estimated 1.4 that seems to be profitable and feasible for this polyculture practice. But more experimentation is needed further for determining the actual survival rate. Reverse experimentation maintaining high stocking density of Magur is also needed due to slow growth of Shing and their hiding tendency.

Growth performance

After 6 months culture, fish growth was investigated and the results obtained from the experiments indicated that the growth rate varied in different stocking densities. Growth in terms of mean harvesting weight and SGR of *H. fossilis* was significantly higher in T_3 where the stocking density was high compared to the treatments of T_2 and T_1 although same feed was supplied in all the treatments at an equal ratio. The present results don't coincide with the findings of Narejo *et al*. (2005) who achieved best growth at lower stocking densities in shing farming and Ahamed *et al*. (2017) recorded performance of growth of shing during culture with Magur, Tilapia and Silver barb in seasonal ponds.

But In Bangladesh, first time culture of Shing with Magur and Prawn was carried out here and showed different results in all aspects of growth parameters like Individual weight, Survival rate, Production, SGR and FCR. Past research findings indicated that, the lowest stocking densities offer more space, food and less competition that reported by various authors like Ahmed (1982), Hasan *et al.* (1982) and Haque *et al*. (1984) that enhances higher growth performance. The percentage of survival as recorded in the present study was 87, 82 and 81 for T1, T2 and T3, respectively. Survival was found to be negatively influenced by stocking densities. It might be due to high competition among the fishes. The value of Benefit-Cost Ratio (BCR) with present survival rate was estimated 1.4 that seems to be profitable and feasible for this polyculture practice. But more experimentation is needed further to determine the actual survival rate. Reverse experimentation maintaining high stocking density of Magur is also needed due to slow growth of Shing and their hiding tendency. To draw a conclusion, further research is needed to understand the reasons behind existing growth performance, effects of physiochemical parameters and feeding frequency for better growth performance and benefit.

Water quality performance

Water quality parameters such as water Transparency, Temperature, Depth, Salinity, pH, Ammonia, Iron, Nitrite, Nitrate, Dissolve Oxygen, Total alkalinity and Total Phosphorous PO_4-P were recorded throughout 6 months culture period, showed very little variation among the treatments. Ali et al. (2005) recorded water temperature ranged 28.91 to 29.13 ^{0}C from earthen ponds of Sharpunti culture. Ahmed et al. (2015) recorded water temperature of 30.41^{0}C from a pond situated at Bangladesh Agricultural University Campus, Mymensingh. These results strongly agreed with the present findings. Water transparency was 22-26 cm in all experiment, which was more or less similar with the findings of Kohinoor et. al., 2001 as recorded values ranging from 15-58 cm.

Dissolved Oxygen (DO) is one of the most important factors for fish culture. The mean values of DO were more or less similar in all treatments and there was no difference among them. Similar results were found by Ali et al. (2005), Ahamed et al. (2017), Moniruzzaman and Mollah (2010), Ahmed et al. (2005) and Mollah et al. (2011). The pH values of the pond water under the three treatments were found in acceptable range for fish culture. Hossain et al. (2015) reported that average values of pH ranged from 6.5 to 8.1 in Kailla beel. Dewan et al. (1991) stated that the optimum pH range for carp polyculture in pond was recorded as 6.5 to 9.0. Similar results were obtained during culture of Catfish (*H. fossilis*) by Ali et al. (2005), Thai Sharputi by Ahmed et al. (2015), Israfil (2000) and Kabir (2003).

The highest ammonia content was recorded in T_3 (0.3) due to high stocking density and huge amount of fecal materials released in ponds and minimum in the T_1 (0.2) due to lower stocking density compared to T_2 and T_3. Ahamed et al. (2017) recorded ammonia ranged 0.17 to 0.21 in polyculture of stinging Catfish (*H. fossilis*) in seasonal water bodies of greater northern region, Bangladesh. Paul (1998), Kohinoor et al. (2000) and Wahid et al. (1997) also recorded ammonia 0.01 to 0.99 mg/l in BAU campus; Mymensingh which agreed the present findings. The present finding shows that except ammonia and iron content other parameters of gher water were found suitable for fish health.

Rahman and Ahsan (2001) found gher bottom soil pH 7.06 of Atkapalia, Noakhali, which is in agreement with the present investigation. Rahman and Ahsan (2001) also recorded 2.32 dS/m salinity for crop land in PO ions in southeastern part of Bangladesh that is agreed with the present study. On the other hand, Jahiruddin and Satter (2010) estimated 3.5 % organic matter of field soil in Noakhali district moderately supported the study result. Similar results were demonstrated by Haque (2006) for nitrogen contents in the Ponds of coastal region, Bangladesh. Shamsi (2016) found 30.5% Bacillariophyceae; 32% Chlorophyceae; 20.8% Myxophyceae and 13.0% Desmidiaceae in Phytoplanktonic biomass of aquaculture that coincided with the present investigations.

11 Research highlight/findings :

EXP-1:

- The highest average individual growth of Shing (47.0 g), Magur (112.0g) and Galda (77.0g) was obtained from T_3 followed by T_1 and T_2 after 06 months culture
- The highest survival rate was exhibited for Magur (39.0%) followed by Galda (30.0%) and Shing (20 %) in T_3 than that of T_1 and T_2.

EXP-2:

- The highest average individual growth of Magur (33.0g), Shing (22.0 g) and Galda (28.0g) was obtained from T_3 followed by T_1 and T_2 after 5 months culture
- The highest survival rate was exhibited for Magur (29.0%) followed by Shing (18.0%) and Galda (17.0 %) in T_3 than that of T_1 and T_2.
- A total of 27 species of phytoplankton and 10 species of zooplankton of different group were identified from the gher.
- Among them predominant phytoplankton and zooplankton group were Bacillariophyceae and Copepoda.

B. Implementation Position

1. Procurement:

Description of equipment and capital items	PP Target		Achievement		Remarks
	Phy (#)	Fin (Tk.)	Phy (#)	Fin (Tk.)	
(a) Office equipment					
Laser Printer	01	20000	01	19000.00	
Laptop computer	01	60000	01	60000.00	
Scanner	01	10000	01	7800.00	
Digital Camera	01	25000	01	25000.00	
Steel Almira	01	24000	01	24000.00	
Executive table	01	20000	01	19750.00	
Executive chair	01	10000	01	9900.00	
(b) Lab &field equipment					
i) Lab/Field chemicals/Reagents					
Acetone	02	14000	02	14000.00	
H_2SO_4	01	6500	01	6300.00	
HCl	01	5000	01	5000.00	
Ethanol	01	7500	01	7400.00	
Methanol	01	5000	01	4900.00	
NaOH	01	2500	01	2500.00	
Formalin	01	8500	01	8300.00	
Phenolphthalein indicator	01	4000	01	4000.00	
Bromocresol Green-Methyl-Red. Indicator	01	3500	01	3500.00	
Lougol's iodine	01	1000	01	1000.00	
Evaporating Disc	05	1000	05	1000.00	
$KMnO_4$	03	6000	03	6000.00	
$CuSO_4$	03	4500	03	4200.00	
ii) Lab/Field Equipments/apparatus					
Salinity (0-33 ppt) Measuring Refractometer	01	20000	01	20000	
Titration Burrete (50ml)	02	4400	02	4000.00	
Burrete Stand	02	2000	02	2000.00	
Digestion Tube	02	7000	02	6800.00	
Ammonia Salicylate (For 5ml sample)	01	7000	01	7000.00	
Ammonia Cyanurate (For 5ml sample)	01	6500	01	6300.00	

HACH Iron Test Kit (Ferrover Iron)	01	4500	01	4400.00	
HACH Nitrite Test Kit (Nitriver-3)	01	5500	01	5500.00	
Digital Thermometer	01	2000	01	2000.00	
Bolting silk plankton net (25 µm)	01	11000	01	10800.00	
Portable Dissolve Oxygen meter (Oakton)	01	20000	01	19500.00	
Portable pH meter (HI 8424, Hanna Instruments, Portugal)	01	4500	01	4500.00	
Portable Electronic Balance	02	10000	02	9400.00	
Chargeable Digital Balance	01	20000	01	19500.00	
Ekmen-dredge	01	12000	01	12000.00	
Secchi-disk	01	1000	01	1000.00	
(c) Other capital items					
Surrounding/Fencing Net	3000	60000	3000	59400.00	
Harvesting net	1000	50000	1000	49900.00	
Cast net	02	10000	02	9800.00	
Bamboo	220	88000	220	86900.00	
Rope	50	5000	50	5000.0	
Sub-mergible pump	01	15000	01	14900.00	
Torch light (Rechargeable)	02	5000	02	4600.00	
Charger Light	02	4000	02	3900.00	
Prawn Juvenile	10000	1,80,000	1000	179000.00	
Shing Fingerlings	100000	4,00,000	100000	390000.00	
Magur Fingerlings	20000	1,00,000	20000	97000.00	
Prawn Feed	1000	80,000	1000	79475.00	
Shing Feed	12000	9,60,000	10300	817000.00	
Magur feed	4000	3,20,000	4000	315450.00	
Molasses	50	1000	50	995.00	
Lime	600	18,000	600	17970.00	
Dolomite	600	36,000	600	35400.00	
Urea	100	2000	100	1775.00	
TSP	50	2000	50	1975.00	
Rice polish	1000	10000	1000	9900.00	
Yeast	02	2090	02	1970.00	

2. Establishment/renovation facilities:N/A

Description of facilities	Newly established		Upgraded/refurbished		Remarks
	PP Target	Achievement	PP Target	Achievement	
N/A					

3. Training/study tour/ seminar/workshop/conference organized:

Description	Number of participants			Duration (Days/Weeks/Months)	Remarks
	Male	Female	Total		
(a) Training	22	3	25	2 days	
(b) Workshop					

C. Financial and physical progress (Tk.)

Items of expenditure/activities	Total approved budget	Fund received	Actual expenditure	Balanc/ unspent	Physical progress (%)	Reasons for deviation
A. Contractual staff salary	248010	230021	245420	-15399	100	
B. Field research/lab expenses and supplies	2982990	2866902	2921959	-55049	100	
C. Operating expenses	190000	178143	189964	-11821	100	
D. Vehicle hire and fuel, oil & maintenance	125000	125110	121823	3287	2.63	
E. Training/workshop/ seminar etc.	100000	92747	47255	45492	45.49	Unspent for ending seminar arraignment by PIU
F. Publications and printing	110000	102502	10000	92502	84.09	Unspent for PCR publication by PIU
G. Miscellaneous	75000	71164	74685	-3521	100	
H. Capital expenses	169000	162165	168950	-6785	1000	
Total	**4000000**	**3828754**	**3780048**	**48706**		

D. Achievement of Sub-project by objectives: (Tangible form)

Specific objectives of the sub-project	Major technical activities performed in respect of the set objectives	Output (i.e. product obtained, visible, measurable)	Outcome (short term effect of the research)
i. To adopt the mixed culture technique of Prawn (*M. rosenbergii*) and Catfish (*H. fossilis* and *C. batrachus*)	**Two Expt. Conducted** **Expt.-1** Stocking density of Shing was different for each treatment, 200/m^2, 300/m^2 & 400/$m^{2.}$ In Magur (50/m^2) and Prawn (30/m^2), stocking density were same in all treatments. Stocking around 1.5g sized Shing and 3g sized Magur fingerlings in nine gher compartments. Juveniles of Prawn around 1.5g stocked after 15 days stocking of Catfish **Expt.-2** Stocking density of Magur was different for each treatment, 50/m^2, 70/m^2 & 100/m^2 . In Shing (Best growth after 3 months culture period of Exp-01) and Prawn, stocking density were same in all treatments.	Experiment completed successfully with some extent of limitations. **Expt.-1** Highest average individual growth of Shing (47.0 g), Magur (112.0g) and Galda (77.0g) was obtained from T_3 followed by T_1 and T_2 after 06 months culture. **Expt.-2** Highest average individual growth of Magur (33.0g), Shing (22.0 g) and Galda (28.0g) was obtained from T_3 followed by T_1 and T_2 after 5 months culture	The value of Benefit-Cost Ratio (BCR) with present survival rate found 1.4 that seems to be profitable and feasible of this polyculture practice. Surrounding people are interested for practicing these polyculture
ii. To determine the production performance and survival rate of mixed culture practice	Growth rate of Shing, Magur & Galda measured at fortnightly. Final harvest done Data compilation and Statistical analysis completed.	In Exp -1 the highest growth performance of 47.0 g and survival of 19.94% Exp -2, the highest growth performance of 33.32g and survival of 29.94% for Magur obtained	Production increased

iii. To assess the water quality parameters of gher ecosystem	Physico-chemical and biological parameters of gher water monitored fortnightly. Soil sample collected and for analysis of selected soil parameters done with the help of SRDI Data compilation and statistical analysis done for physico-chemical and biological parameters.	Physico-chemical parameters of the experimental gher water monitored at weekly intervals. Except ammonia and iron content the other observed parameter of gher water found congenial for fish health	Coastal region with low/no saline waterbodies pond/gher can be used for these mixed cultures.
iv. To investigate the economic potentiality of these culture practices.	Data compilation was done throughout the project period . Statistical and Economic analysis completed	The value of BCR found (1.4) that seems to be profitable and feasible of mixed culture.	Profitable and feasible culture practice.

E. Materials Development/Publication made under the Sub-project:

Publication	Number of publications		Remarks (e.g. paper title, name of journal, conference name, etc.)
	Under preparation	Completed and published	
Technology bulletin/ booklet/leaflet/flyer etc.	1		
Journal publication	1		
Information development		1	Media Coverage (Mati o Manus on Bangladesh Television)
Other publications, if any			

F. Technology/Knowledge generation/Policy Support (as applied):

i. **Generation of technology (Commodity & Non-commodity)**
Development of mixed culture technology of Prawn, Shing and Magur

ii. **Generation of new knowledge that help in developing more technology in future**
Isolated gher farming, easy water access, clean bottom can further improve production performance

iii. **Technology transferred that help increased agricultural productivity and farmers' income**
Adoption of these mixed culture practice with low/no salinity can be considered through training, awareness buildup, published paper, leaflet, booklet.

iv. **Policy Support**
Amended policy support of the technology or a potential mean for socio-economic upliftment of the coastal poor and marginal fish farmers of the country.

G. Information regarding Desk and Field Monitoring

i) Desk Monitoring [description & output of consultation meeting, monitoring workshops/seminars etc.)

- CRG Sub- Project Implementation Progress Workshop/Seminar held in BARC, Farmgate Dhaka on 21 December 2017. Advised on technical issues.
- CRG Sub-Project Final output Workshop held in BARC, Farmgate Dhaka on 19-20 September 2018. Found satisfactory

i) Field Monitoring (time& No. of visit, Team visit and output):

Monitoring team	Date(s) of visit	Total visit (No.)	Outputs
Technical Division/ Unit, BARC	16/02/2018	01	Design, research activities & achievement were seen
PIU-BARC, NATP-2	09/04/2018	01	Research activities & achievement were monitored
Internal Monitoring	22/06/2018	01	Research activities &

Monitoring team	Date(s) of visit	Total visit (No.)	Outputs
			achievement were monitored and take further required steps for betterment
Others Visitors (Ex-Diector General of Bangladesh Fisheries Research Inatitute)	11/07/2018	01	Design, research activities & achievement were seen

H. Lesson Learned

- Ploughing paddy field for eradicating paddy residual straw is required
- Pond dyke should be free from 'Mahogoni' (*Swietenia macrophylla)* tree because droppings of leaf from this tree might cause water quality deterioration and consequent fish mortality.
- Appropriate species selection is a prerequisite for successful poly culture.

I. Challenges

Natural disaster (Flash flood)
Net cutting by crab: In gher environment, a huge number of crabs were observed in the experimental areas, that had cut the net off around the culture compartments and allowed escaping of fish.
Slow growth of Shing and their hiding tendency: Growth and survival rate of Shing was found lower compared to Magur. Moreover due to the hiding tendency of Shing, total harvesting of the species was found difficult.

Signature of the Principal Investigator
Date ……

Seal

Counter signature of the Head of the organization/authorized representative
Date ……..

Seal

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