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Polyculture potentials of Galda (*Macrobrachium rosenbergii*) with *Heteropneustes fossilis* and *Clarias batrachus* in South-western coastal ghers of Bangladesh

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Abstract. Prawn (*Macrobrachium rosenbergii*) culture is socially more acceptable, technically and economically viable and sustainable. The freshwater catfishes *Heteropneustes fossilis* (shing) and *Clarias batrachus* (magur) adapt well to hypoxic water bodies and high stocking densities as well. So, shing and magur may be a good candidate to culture with prawn in ponds/ghers to save the farmers from losing their investment in case of shrimp mortality and getting additional income from fish. With this view, this study was conducted to evaluate the feasibility of polyculture with three treatments each with three replications. Stocking density of shing was variable i.e., 200nos/decimal in T_1, 300nos/decimal in T_2 and 400 nos/decimal in T_3. On the other hand, stocking density of magur and prawn juveniles was 50 and 30 nos/decimal respectably for all treatments. The experimental ghers were treated with salt (NaCl) (150g/decimal), potasium permanganate (5g/decimal) along with lime (125 kg/ha). After stocking fish were fed using floating nursery feed containing 32%, protein and 7% lipid at the rate of 10-2% for shing and magur nursing, floating oil coated grower feed (27% protein and 6% lipid) at the rate of 6-2% for shing and magur grow out and prawn grower (30% protein and 7% lipid) at the rate of 6-2.5% of estimated fish and prawn biomass. At least 10% of stocked catfish and galda were sampled fortnightly using cast net. Physico-chemical parameters of the experimental ghers water were monitored at weekly. After six months of culture the highest growth performance (47.0 g) and survival (19.94%) for shing obtained from T_3. Whereas the average growth of shing was recorded 37.02 and 41.14g; growth of magur 99.21g and 99.51g and growth of galda 69.74 and 70.19 for Treatment T_1 and T_2 respectively. Except ammonia and iron content the other observed parameters of ghers water found congenial for fish health. The value of Benefit-Cost Ratio (BCR) was 1.4 that seems to be profitable and feasible of this polyculture practice.
Keywords: Polyculture, *Macrobrachium rosenbergii*, *Heteropneustes fossilis, Clarias batrachus*

Introduction

Prawn is found both in brackish water and freshwater environment of Bangladesh and it can tolerate salinity up to 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). 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). Shing and 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.

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 with freshwater catfish (shing and magur) in gher farming system.

Materials and Methods

Experimental design: To know the culture potentials of high valued galda (*M. rosenbergii*) with two native catfish, shing (*H. fossilis*) and magur (*C. batrachus*) in south-western coastal ghers of Bangladesh this experiments were carried out. In this experiment, 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. 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 was dried and cleaned for weeds and unwanted aquatic animals. The dried gher was left exposed to sunlight for several days and then ploughed the land two times with a tractor. The gher was limed at the rate of 250 kg/ha. Five days after liming, gher was fertilized with Masterd Oil Cake (MOC), Urea, Triple Super Posphate (TSP) and Muriate of Potash (MOP) at the rate of 150 kg, 75kg, 45kg and 30kg/ ha respectively. The total gher area was split into 09 compartments 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 ghers and allow water to pass through during heavy rainfall.

Stocking: On 18 July 2017, experiment was 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 I). 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 I. Mixed culture of galda with catfish

Treatments	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

Feed and feeding management: Proximate compositions of different commercial floating feeds were analyzed according to AOAC (1995). Based on analytical results, floating nursery feed (Protein 32%, Lipid 7%, and 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, 8% for 2nd two weeks, 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 performed three times daily at 6:00, 12:00 and18:00 hr for first month. Later feeding was performed two times daily at 6:00 and 18:00 hr. For prawn, commercial pellet feed (30% protein) were applied at the rate of 6-2% of estimated biomass twice daily at 6.00 am and 18.00 pm. The prawn juveniles were fed at the rate of 6.0 - 6.5 % of their body weight (around 2g) 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. SGR was calculated according to Brown (1957) and Ricker (1979) and FCR was 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 (°C), Transparency (cm), Dissolved Oxygen (mg/l), pH, Total Alkalinity (mg/l), Ammonia (mg/l), Salinity, Iron, and Total Dissolve Solid (TDS) were monitored between 8.30 to 9.30 am using Celsius thermometer, Secchi-disk, portable dissolved oxygen meter (Oakton), a portable pH meter (HI 8424, Hanna Instruments, Portugal) respectively. 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.

Plankton was collected from the gher at weekly 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. 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.

Results

***Growth performance*:** After 06 months of culture the average 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 in T_1, T_2 and T_3 respectively (Table II). Highest growth performance (47.0 g) of shing was 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 were fixed. Due to 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 magur36.19%, 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 II).

Water quality parameters: 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 III). 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 and the average transparency 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 $\pm$ 2.05 mg/l, 6.7 $\pm$ 1.65 mg/l and 5.43 $\pm$ 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: 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 (54.96ug/g), minimum in T_2 (37.96ug/g) and 39.26ug/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 (Table IV).

Table II. Treatment wise data on Initial & Final weight (X±SD) of Shing, Magur and Galda

Treat-ments	Repli-cation	Shing				Magur				Galda			
		Initial Wt (g) (X±SD)	Final Wt (g) (X±SD)	Survival rate (%)	SGR	Initial Wt (g) (X±SD)	Final Wt (g) (X±SD)	Survival rate (%)	SGR	Initial Wt (g) (X±SD)	Final Wt (g) (X±SD)	Survival rate (%)	SGR
T_1	R_1	1.59±.65	39±5.74		1.78	2.87±0.63	96.50±7.97		1.95	1.80	73.22±11.92		2.05
	R_2	1.59±.65	35.07±5.51	16.89	1.71	2.87±0.63	100.10±9.50	36.19	1.97	1.80	67±5.94	29.87	2.00
	R_3	1.59±.65	37±5.99		1.74	2.87±0.63	101.03±11.0		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		1.82	2.87±0.63	102.21±9.31		1.98	1.80	72.1±7.919		2.04
	R_2	1.59±.65	40.43±3.71	18.63	1.79	2.87±0.63	100.93±8.97	35.67	1.97	1.80	68.26±13.85	25.60	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		1.86	2.87±0.63	118.93±14.3		2.06	1.80	76.71±11.93		2.07
	R_2	1.59±.65	48.21±12.87	19.94	1.89	2.87±0.63	109.79±12.2	38.67	2.02	1.80	77.24±12.03	30.14	2.08
	R_3	1.59±.65	47.36±12.53		1.85	2.87±0.63	107.79±18.9		2.01	1.80	78.03±8.10		2.09
	x̄		47.00		1.84	x̄	112.17		2.03		77.32		2.08

Table III. Water quality parameters in different treatments

Treatment	Transparency (cm)	Depth (m)	Temp. (^{0}C)	pH	Ammonia (mg/l)	Iron (mg/l)	Total Alkalinity (mg/l)	Nitrite (mg/l)	Nitrate (mg/l)	O_2 (mg/l)	Total PO_4--P (mg/l)
T_1	25±0.77	1.65± 0.20	18.11± 6.69	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	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	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

Table IV. Soil quality of different treatment of the experiment

Treat-ment	pH	Salinity (EC)(dc/m)	Organic Matter	Total Nitrogen (%)	Phosphorus (ug/g)	Potassium (mg/100g)	Cu (ug/g)	Zn (mg/g)
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	01.10	2.44	0.142	10.25	0.33	54.96	1.88

Plankton biomass: Plankton biomass of all treatments was more or less similar (Table V). 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 V. Plankton monitoring in different treatments

Treatments	Group of Plankton		Name of Plankton
T1	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.
		Rotifera	*Brachionus* sp.
T2	Phytoplankton	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*
T3	Phytoplankton	Bacillariophyceae	*Navicula, Cyclotella, Melosira, Rhizosolenia, Tabellaria, Diatoms, Amphora, Asterionella, Cyclotella, Bacteriostrum,*
		Chlorophyceae	*Uroglena, Gonatogygon, Spirogyra, Chlamydonzonas, Closterium*
		Cyanophyceae	*Microcistis, Anabena, Oscillatoria, Aphanizomenon*
		Euglenophyceae	*Euglena*
	Zooplankton	Copepoda	*Cyclops, Mesoyclops, Helidiaptomus, Diaptomas*
		Crustacea	*Nauplias, Daphnia*
		Cladocera	*Diphansoma*
		Rotifera	*Filnia, Brachionus*

***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 (Table VI). 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.

Table VI. Benefit of Cost Ratio Analysis

Subject	N	Minimum	Maximum	Mean
Full cost basis net return per ha	1	511,290.00	511,290.00	511,290.00
Cash cost basis net return per ha	1	666,900.00	666,900.00	666,900.00
Benefit cost ratio full cost basis	1	1.41	1.41	1.41
Benefit cost ratio cash cost basis	1	1.61	1.61	1.61
Valid N (list wise)	1			

Discussion

After culturing 6 months, growth of fish in ponds was investigated and the results obtained from the experiment 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.

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 provide more space, food and less competition that reported by various authors like Haque *et al.* (1994) and Chakraborty *et al.* (2005). 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 find out the reason behind such growth performance, effects of physiochemical parameters and feeding frequency for better growth performance as well as more production and benefit.

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 in the whole 6 months culture period and showed very little variation among the treatments. Water Temperature was ranged 15-22^{0}C and Water transparency was22-26 cm in all experiment, which was more or less similar with the findings of Shil *et al.* (2013).

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), and Mollah *et al.* (2011). The pH values of the pond water under the three treatments were found acceptable range for fish culture. Hossain *et al.* (2015) reported that average values of pH ranged from 6.5 to 8.1 in Kaillabeel. Dewan *et al.* (1991) stated that the optimum pH range for carp polyculture in pond was record as 6.5 to 9.0. Similar results were obtained by culturing stinging catfish (*H. fossilis*) by Ali *et al.* (2005), culturing Thai sharputiby Ahmed *et al.* (2015), Israfil (2000) and Kabir (2003). Highest ammonia content was recorded in T_3 (0.3) due to high stocking density and more amount of fecal materials were 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 the other observed parameters of gher water found congenial for fish health.

Rahman and Ahsan (2001) found gher bottom soil pH 7.06 of Atkapalia, Noakhali, that strongly supported the present study. Rahman and Ahsan (2001) also recorded 2.32 dS/m salinity for crop land in PO ions in southeastern part of Bangladesh that supported strongly with 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. Haque (2006) estimated range pond. 0.1-0.3% nitrogen in the Ponds of coastal region, Bangladesh that also supports the present study. Jahiruddin and Satter (2010) estimated 4 μg/g phosphorus of field soil in Noakhali district that supported the present study. Shamsi (2016) found 30.5% Bacillariophyceae; 32% Chlorophyceae; 20.8% Myxophyceae and 13.0% Desmidiaceae in Phytoplanktonic biomass of aquaculture that coincide with the present study.

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