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Investigation of Improved Extensive Culture System of Shrimp with Special Reference to Soil-water Characteristics in South-West Region of Bangladesh

Md. Motiur Rahman[1], Md. Ariful Islam[1*] and Khan Kamal Uddin Ahmed[1]

[1]Bangladesh Fisheries Research Institute, Shrimp Research Station, Bagerhat-9300, Bangladesh.

Authors' contributions

This work was carried out in collaboration between all authors. Author KKUA designed the study, wrote the protocol. Authors MMR and MAI participated in field investigations and data collections. Author MMR performed the statistical analysis, wrote the first draft of the manuscript, managed the analyses of the study and the literature searches. All authors read and approved the final manuscript.

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ABSTRACT

Water and soil quality parameters are important catalyst for gaining sustainable shrimp and prawn production. In this context, an investigation was carried out to assess soil-water quality and production parameters of 9 selected improved extensive shrimp Ghers in Bagerhat districts of Bangladesh over a growing cycle. The physico-chemical parameters of soil-water were measured and analyzed by standard methods. Total yield (3,138.46 kg/ha/cycle) of fishes was also calculated from the stocking and harvesting data. Most of the parameters of soil and water correlated significantly with each other suggesting a high degree of interactions between different parameters in the system. A pattern of qualitative and quantitative difference of zooplankton over phytoplankton was recorded in these farms Therefore, a high degree of salinity fluctuation and iron deposition in waters was also documented. However, significantly lower concentrations of phosphorus in the soil indicated a net retention and trapping of phosphatic nutrients in the environment. Moreover cropping pattern was two cycles

**Corresponding author: E-mail: arifulbau@gmail.com;*
Communication ID: matiur.bfri@gmail.com;

(fishes single, paddy single) per year, feeding frequencies was once in daily and fish production ranged from 2076 to 4640 kg/ha/cycle. The present findings indicate that improved extensive culture systems served as less health risk and economically viable for sustainable fish production.

Keywords: Water and soil quality; improved extensive; shrimp; Ghers; Bangladesh.

1. INTRODUCTION

Shrimp aquaculture is one of the fastest growing economic activities in coastal areas of Bangladesh and the 5th largest shrimp producer in the world [1]. In Bangladesh annual shrimp production is 2,23,582 metric tons and 2nd largest of total inland aquaculture [2]. The two main region of shrimp production are located in the south-western part composed of Khulna, Satkhira and Bagerhat districts; and the other one is located in the south-eastern part of the country composed of Chittagong and Cox's bazaar districts and 0.276 million hectares of land are currently under brackish water shrimp cultivation [3]. About 75% of the total shrimp farms are located in Khulna, Bagerhat and Satkhira districts. *Penaeus monodon* or *Machrobrachium rosenbergii* is the major targeted species cultured in Bangladesh [4]. Shrimp farming in Bangladesh has been expanding since the early seventies and reached an industrial scale followed by increasing demand for shrimp in the export market. It alone contributes more than 70% of the total export earnings from all the agro-based products [5]. More than two millions of people directly and indirectly are engaged in shrimp aquaculture activities (Harvesting, Culture, Processing, and Exporting) [6]. The rapid expansion of shrimp farming in Bangladesh for the last two decades is likely to lead both short and long-term negative environmental impacts leading ecological imbalance, environmental pollution, acceleration of land degradation, low salinity deforestation of mangrove, sedimentation and disease outbreak [7]. Mangrove is a suitable habitat for brackish water fishes and unique ecosystem of our environment [8]. However, mangrove wetlands are still being converted to Gher for aquaculture [9]. Fish farming in Bangladesh relies on the supply of artificially formulated feed application of agrochemicals, antibiotics and disinfectants [7]. Farm owners apply different types of chemicals and drugs for remediation of PL mortality, viral death of shrimp, and finfish disease in their farms (locally called Gher in Bengali). The farmers are not aware of the impacts of the use of those chemicals on farms' environment. 21% farmers used potassium permanganate, 18% used aqua-nourish, 17% used capsule and 14% agro-fish and almost all chemicals were used mainly for improving water quality and preventing diseases [10]. Indiscriminate and overuse of the chemicals and drugs might be the cause of death of many living organisms [7]. Shrimp Gher water and sediments are important sinks for various pollutants like pesticides and heavy metals [11]. The long-term use of different chemicals and drugs in the shrimp and prawn farming has negative impacts on the environment as well as the human being. Therefore, this sector has been highly criticized by the seafood importing countries in terms of negative social and environmental issues [12] in 2009, EU which is the largest importer got nitro furan in prawn/shrimp and Bangladesh had to adopt self-imposed ban on seafood export. As a result, this shrimp and prawn farming and trade became vulnerable in the export market [13]. Therefore, it is now a critical issue to identify the major sources of the contaminants in the shrimp and prawn farms. The present study was conducted to assess the impacts of shrimp and prawn farming on water and soil quality parameters of Gher in the south western region of Bangladesh particularly in Khulna, Bagerhat district which is expected to contribute to knowledge generation for sustainable seafood farming and trade in Bangladesh. The specific objective of the present study was to assess the effects of shrimp and prawn farming on water and soil quality parameters as well as to assess the relationships between the different physico-chemical parameters. Physical and chemical properties of water in shrimp farms are useful indicators of the farm environment [14]. For sustaining eco friendly farm environment requires a basic understanding of the physical, chemical and biological processes occurring in shrimp farming systems and information is needed about the relative proportions or properties of the soil-water and its components [15]. Physico-chemical, biological parameter of water and soil qualities of improve extensively managed commercial shrimp farms in Bangladesh have not yet been documented. The present study reports the physical and chemical properties of soil and water, qualitative and quantitative variation of plankton and gross yield of improved extensive shrimp culture systems in Bangladesh.

2. MATERIALS AND METHODS

2.1 The Study Area

The study was conducted in Rampal, Kachua and Sadar Upazilla of Bagerhat district throughout a production cycle from July 2013 to June 2014. Three improved extensive farms were randomly selected in each Upazila, which were categorized in three (T_1, T_2, T_3) treatments. In each category (treatment) of farms, three Ghers were considered as replicates. The Ghers ranged in size between 0.26 and 0.47 ha (mean 0.39± 0.12 ha) and a mean depth of 1.1 m throughout the growing cycle. All the Ghers were similar in configuration, basin and contour type, well-exposed to sunlight and natural air flow.

2.2 Shrimp Farming Techniques and Farm Management

The Farm owners were interviewed for detailed information on husbandry and management practices using FGD tools. Farm records were used to quantify the manure and fertilizers, supplemental feeds, shrimp harvests and to have information on the management practices applied and inputs used. Perhectare shrimp yield was calculated from the final biomass obtained in each individual Gher. Gher preparation began from mid February to mid March with ploughing the enclosed land and encircling it with fence, Then lime CaO, $Ca(CO_3)_2$, $Ca(OH)_2$ was applied at the rate of 250-300 kg/ ha which was left for about a week for drying under the sunshine. After one week of drying, water was introduced by allowing the high tide of new moon or full moon to enter into the Ghers. After entering water the Ghers were fertilized with Urea 50 kg/ha, TSP 25/ha and semi compost cow dung 500 kg-700 kg/ha. After 5-7 days of fertilization, Ghers were filled with water up to a depth about 15-20 cm and then after one week, the depth of each Gher was finally maintained at about 90 cm on an average stocking in the rearing Ghers was done after plankton production. Shrimp fries (15–20 days old post larvae) were collected from hatchery or wild and transferred into the rearing Ghers. Continuous stocking and Partial Harvesting of shrimp was done in definite intervals. Then feeding starts and feeding frequencies was once in a day. Farmers used both commercially manufactured pelleted feed which are locally available and homemade feed (Snail, Rice husk, Rice, Wheat husk, Wheat, Mustard Oil cake, Coconut oil cake, Cow dung etc). Bio-security and hygiene practices were maintained properly. The mixed culture practices (*Penaeus monodon* with fin fishes or *Macrobranchium rossenbergii* with fin fishes or shrimp with prawn including fin fishes) are the main target practices for improved extensive farming. The amount of feed supplied was calculated based on shrimp biomass. The other forms of post-stocking management included only periodic liming of the ponds as a measure of disease prevention.

2.3 Water Quality Parameters

Water samples were collected twice in every month from the selected farms using 500 ml plastic bottles between 09:00 AM to 10:00 AM. After collection of the samples Dissolve Oxygen (mg /l) was measured immediately in the sampling site. Other parameters of the water samples such as pH, Alkalinity (mg/l), nitrite nitrogen (NO2–N) Ammonia (mg/l) and Iron (mg/l) were measured by using HACH test Kit (Model FF-1A Cat. 2430-02).A water temperature (℃) and salinity (ppt),were recorded directly on the spot by a Celsius thermometer and a refract meter (Atago, Japan).

2.4 Soil Quality Parameters

The tagged samples were sent to Soil Resource Development Institute (SRDI) Khulna for analysis of its parameters. Samples were air-dried and results were expressed as the total dry matter, T-DM (g/kg). Soil pH was determined from a soil suspension in distilled, de-ionized water (soil: water ratio of 1:5, using a digital pH-meter. Phosphate concentrations were determined by shaking the soil samples with 0.5 M NaHCO3 solution (pH 8.5). Phosphorus in the extract was determined by developing blue color using stannous chloride reduction of phospho-molybdate complex and measuring the color spectrophotometrically at 660 nm wavelength [16]. All colorimetric examinations were done using standard calibration curves. Total-P (mg/100 g) was measured by ascorbic acid method [16]. To determine the total nitrogen, and sulfur, samples were oven dried at 45℃ for 2 h and crushed with a mortar. The total nitrogen was determined by using the Kjeldahl method [17,18]. To determine, sulfur, the samples were treated first with water and then with 6M HCl and the parameters were determined by using an elemental analyzer [19]. The organic content of the soil (also called loss of ignition) was determined by combustion of samples in porcelain crucibles at 550℃ for 12 h in a muffle furnace and the final product of the combustion was expressed as the ash content of the sediment [20].

2.5 Plankton Study

For Qualitative and quantitative estimation of plankton were samples were collected at fortnightly intervals from the Ghers by passing depth integrated water samples through fine-meshed plankton net (0.025 mm). After collection, the samples were preserved immediately with 5% buffered formalin in the plastic bottles. Then Plankton density was estimated by using a sub-sampling technique, A Sedgwick–Rafter (S–R) cell was used under a calibrated binocular compound microscope for plankton counting. Planktons were identified to genera level and were counted using the formula proposed by [21] and was expressed as the number of cells per liter of water.

2.6 Statistical Analysis

For all sampling techniques, three replicates were analyzed and means and standard deviations were calculated and expressed as mean (±SD). Significance of variations in the water quality parameters within Ghers were tested using one way analysis of variance, ANOVA, which was followed by Duncan's multiple range test (Duncan, 1995) for significant values. Significance of correlation coefficients was calculated according to (Zar, 1999). Values were considered at 5% level of significance.

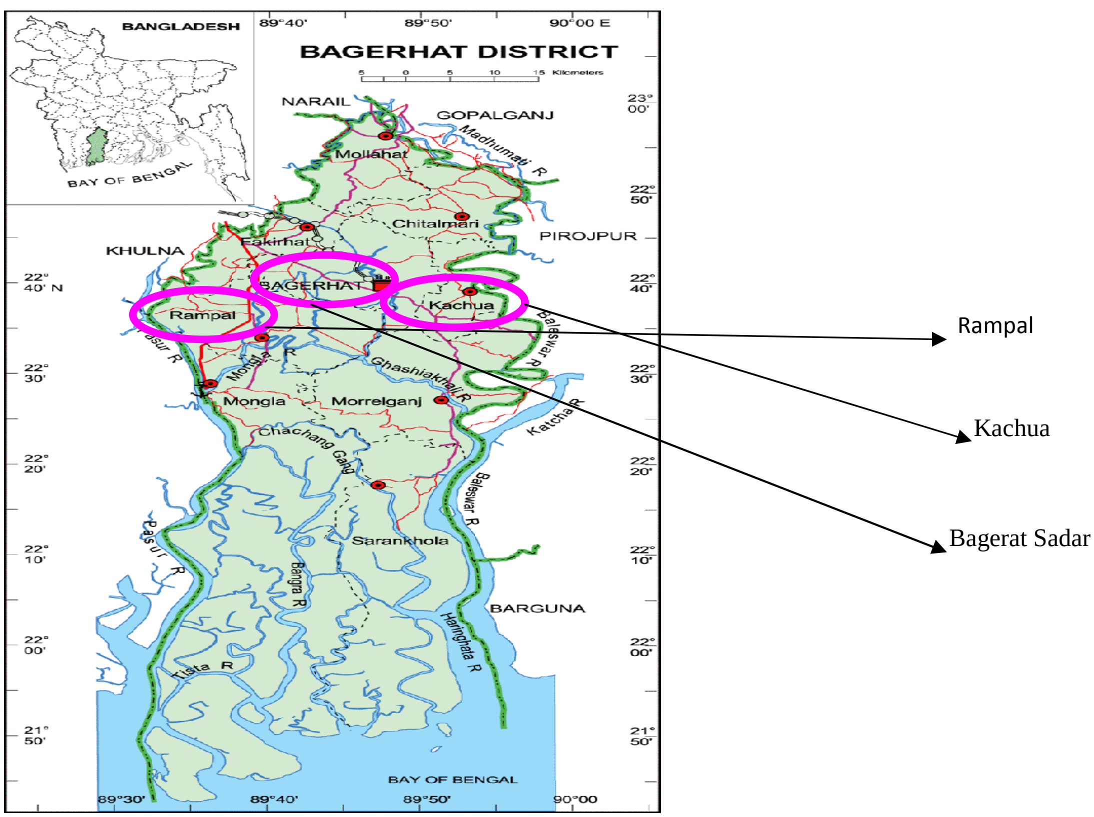

Fig. 1. Map of Bangladesh showing the study sites, Rampal, Kachua, Bagerhat sadar Upazilla under Bagerhat district

3. RESULTS

3.1 Shrimp Farming Techniques and Farm Management

Existed Shrimp culture techniques were evaluated from the degree of management applied (Table 1) throughout the production cycle from the initial stage of Gher preparation to harvesting of shrimp. Per hectare shrimp yields were calculated from the final biomass obtained in each individual Gher. Gross yield was expressed as production in kg/ha/cycle. Average size of Shrimp Gher was (0.39±0.12) ha in size with a mean depth of 1.10 m (Table 2).

3.2 Growth, Survival and Yield Parameters

The mean stocking density of *Penaeus monodon*, was 67,658 thousand post larvae (PL) /ha/cycle and yield varied between 497 to 725 kg/ha/cycle with the range of survival rate being 20–35% (mean 27%) and the individual weight at harvest ranging 30–38 g (mean 34 g).

Table 1. Generalized scenario of management regimens in improved extensive shrimp Ghers

Issues	Improve-extensive
Gher size (ha)	(0.27-0.47); (0.39±0.12)
Gher dikes	Irregular and ordinary
Design and layout	Planned or none
Water control	Clay made inlet and outlet
Water exchange	Tidal exchange (10–20% per day)
Depth (m)	0.5-0.9 (mean 1.1 m)
Source of fry	Wild or hatchery
Stocking density (No./ha)	61,750-74,100
Rearing period	7-8
Crops/yr	Double (fishes Single +paddy Single)
Feed used	Commercial
Aeration	_
Cumulative mortality	
Survival rates	20-35
Bleaching Powder used (kg ha/ cycle)	_
Cow dung (kg ha/cycle)	_
Lime (kg/ ha/cycle)	250-300
Plankton Producers used (kg/ ha/cycle)	_
Production (kg/ ha /cycle)	2076-3705

Table 2. Stocking, survival rate, growth and yield of *Penaeus monodon* in selected improved-extensive shrimp Ghers of Rampal, Kachua, & Bagerhat Sadar Upazilla of Bagerhat Districts

Ghers no.	Size (ha)	Stocking density (ha^{-1})		Survival rate (%)		Average weight (g)		Gross yield (kg/ ha/ cycle)		Total (kg/ ha/ cycle)
		Shrimp	Fin fishes	Shrimp	Fin fishes	Shrimp	Fin fishes	Shrimp	Fin fishes	
1	0.40	25688	988	25	91	35	1210	224	1087	1311
2	0.26	17339	963	35	88	36	913	218	773	991
3	0.52	38532	1284	28	95	35	822	377	1002	1379
4	0.36	24897	711	20	97	37	1430	184	986	1170
5	0.60	37050	1482	30	93	31	1070	344	1474	1818
6	0.34	25194	671	32	89	30	780	241	465	706
7	0.30	18525	741	28	97	37	1271	191	913	1104
8	0.36	25589	800	20	95	35	850	179	646	825
9	0.37	24675	1370	29	93	38	1135	271	1446	1717
Mean	0.39	26387	994	27	93	34	1053	247	976	1224

3.3 Water Quality Parameters

The recorded mean water quality parameters of improved extensive farms throughout the experimental period are shown in (Table 3). Temperature was found more or less similar and ranged from 26.8±3.96℃, 25.2±5.63℃ and 24.7±5.59℃ in T_1, T_2 & T_3 treatments respectively. However water temperature had a positive relationship with DO (r=0.656) indicating DO increased with increasing temperature .The dissolve oxygen was recorded higher in T_3 & lowest in T_1 treatments respectively and significantly different ($p<0.01$) in three treatments. The value of pH was found higher in T_1 than that of T_2 & T_3 treatments respectively and had a positive correlation with (r=0.868, $p<0.01$) salinity. The level of ammonia & alkalinity content was recorded trace & more or less similar amount in three treatments respectively. Ammonia had a significant correlation with pH (r=0.541) suggesting that NH_3 enhanced the pH and Alkalinity had a significant ($p<0.01$) inverse correlation with ammonia (r= -0.353) and nitrite (r= -0.015) indicating that higher alkalinity content reduced the ammonia and nitrite level of the farms. The maximum salinity was recorded in T_1, whereas the minimum salinity was observed at T_2 treatment respectively and highly significant (r= -0.763, $p<0.01$) in location. Presence of Iron was found 0 (zero) in T_2 & T_3 and trace amount in T_1treatments and had a positive correlation (r= 0.411, $p<0.01$) with location (Table 4).

3.4 Soil Quality Parameters

The recorded mean soil quality parameters are shown in (Table 5). Among the parameters such as pH, organic content and total nitrogen and available phosphorus, there was no significant ($p>0.01$) difference found in three treatments. However organic content highly correlated (r= 0.881) with production. The soil pH was inversely correlated with total nitrogen (r= -0.214) and potassium (r= -0.114) which reveals that pH increased with decreasing level of total nitrogen and potassium in three farms (Table 6). The highest value of organic content found in T_2 followed by T_3 & T_1 treatments (Table 5) and significantly ($p<0.05$) correlated with available phosphorus (Table 6). The mean soil salinity was

Table 3. Water quality parameters of improved extensive culture system of Rampal, Kachua, & Bagerhat Sadar Upazilla of Bagerhat Districts

Parameters	Rampal (T_1)	Kachua (T_2)	Bagerhat Sadar (T_3)
Temperature (℃)	26.8±3.96	25.2±5.63	24.7±5.59
pH	7.9±0.26	8.1±0.50	8.0±0.72
DO (mg/l)	5.85±2.17	5.50±0.73	7.00±1.55
Salinity (ppt)	9.8±4.32	2.75±2.63	2.33±2.08
Alkalinity (mg/l)	157±21	184±37.31	144±15.59
Ammonia (mg/l)	0.1±0.1	0.0±0.0	0.05±0.05
Nitrate (mg/l)	0.23±.06	0.19±0.03	0.0±0.0
Iron (mg/l)	0.15±0.15	0.0±0.0	0±0

Table 4. Pearson's correlations of water quality parameters of improve extensive culture system of Rampal, Kachua, & Bagerhat Sadar Upazilla of Bagerhat Districts

	Location	Production	Temp	DO	pH	Salinity	Alkalinity	Ammonia	Nitrite	Iron
Location	1									
Production	.791	1								
Temp	.174	.625	1							
DO	.046	.^{b}	.656**	1						
pH	.530**	.993	.486**	.629**	1					
Salinity	.763**	.925	.205	-.083	.868**	1				
Alkalinity	-.363**	.725	.085	.120	.183	-.445**	1			
Ammonia	-.004	-.925	.043	-.011	.541**	.023	-.357**	1		
Nitrate	.509**	.625	.293*	-.131	.378	.296	-.015	.010	1	
Iron	.411**	.345	.125	.114	.327**	.125*	-.175	-.015	.141	1

***. Correlation is significant at the 0.01 level (2-tailed).*

**. Correlation is significant at the 0.05 level (2-tailed).*

b. Cannot be computed because at least one of the variables is constant

Table 5. Soil characteristics of improved extensive culture System of Rampal, Kachua, & Bagerhat Sadar Upazilla of Bagerhat Districts

Parameters	Rampal (T_1)	Kachua (T_2)	Bagerhat Sadar (T_3)
Organic matter. (%)	2.88±2.00	3.5±0.89	3.07±1.60
pH	7.7±0.36	7.64±0.29	7.6±0.40
Salinity (EC) (ds/m*)	4.33±3.87	3.96±2.4	5.83±4.87
Phosphorus (µg/g)	13.41±5.83	9.58±3.56	16.39±7.62
Total N_2 (%)	0.159±0.11	0.19±0.05	0.135±0.038
Potassium (m.eq./100 g)	0.813±0.10	0.99±0.56	0.614±0.123
Sulfur (µg/g)	89.69±41	70.69±11	89.69±41
Zinc (µg/g)	7.73±5.05	0.56±0.43	9.96±4.93

Table 6. Pearson's correlations of soil quality parameter of improved extensive culture systems in Rampal, Kachua, & Bagerhat Sadar Upazilla of Bagerhat Districts

Location	Production	pH	Salinity	Organic	K	N	P	S	Zn	Location
Production	1									
pH	.518	1								
Salinity	.795	.053	1							
Organic	.881	.021	.399	1						
K	.534	-.114	.124	-.042	1					
N	.820	-.217	.135	-.010	-.033	1				
P	.761	.265	.707**	.321*	.264	.214	1			
S	.835	.033	.876**	.158	.099	.173	.540**	1		
Zn	.535	.082	.635**	.229	.171	.163	.592**	.493**	1	
Location	.572	.217	.690**	.264	.261	.112	.756**	.407**	.443**	1

***. Correlation is significant at the 0.01 level (2-tailed).*
**. Correlation is significant at the 0.05 level (2-tailed)*

Table 7. Qualitative and quantitative estimation of plankton in improved extensive farms in Rampal, Kachua, & Bagerhat Sadar Upazilla of Bagerhat Districts

Group	Spp.	Rampal (T_1)	Kachua (T_2)	Bagerhat Sadar (T_3)
Chlorophyceae,	*Gonatozygon*	-	-	-
	Volvox	(5×10^3 nos./L)	(3×10^3 nos./L)	(2×10^3 nos./L)
Cyanophyceae	*Microcystis*	(13×10^3 nos./L)	(12×10^3 nos./L)	(15×10^3 nos./L)
Bacillariophyceae	*Melosera*	(5×10^3 nos./L)	(14×10^3 nos./L)	(9×10^3 nos./L)
	Cyclotella	(3×10^3 nos./L)	(7×10^3 nos./L)	(4×10^3 nos./L)
	Nitzschia	(6×10^3 nos./L)	(12×10^3 nos./L)	(8×10^3 nos./L)
	Fragilleria	-	(02×10^3 nos./L)	-
	Diatom	(1×10^3 nos./L)	(03×10^3 nos./L)	(02×10^3 nos./L)
Euglenophyceae	*Euglena*	(3×10^3 nos./L)	(12×10^3 nos./L)	(7×10^3 nos./L)
Rotifers,	*Brachionus*	(12×10^3 nos./L)	(2×10^3 nos./L)	(6×10^3 nos./L)
Copepods,	*Cyclops*	(8×10^3 nos./L)	(15×10^3 nos./L)	(16×10^3 nos./L)
	Mesocyclops	-	-	-
	Diaptomus	(12×10^3 nos./L)	(8×10^3 nos./L)	(9×10^3 nos./L)
	Moina	(11×10^3 nos./L)	(3×10^3 nos./L)	(14×10^3 nos./L)
Crustaceans	*Nauplius larvae*	(06×10^3 nos./L)	(12×10^3 nos./L)	(10×10^3 nos./L)

found maximum in T_3 compared to T_1 & T_2 treatments significantly ($p<0.05$) correlated with phosphorus (r= 0.707), sulfur (r= 0.876), zinc (r= 0.635) and location (r= 0.690) which indicated that Sulfur, Zn, P proportionately increased with the increase of soil salinity (Table 6).

3.5 Qualitative and Quantitative Plankton Count

A number of zooplankton groups were found dominated over phytoplankton groups in improved extensive farming systems. Among the zooplankton groups euglenophyceae, rotifers, copepods, crustaceans and phytoplankton group's bacillariophyceae, cyanophyceae, chlorophyceae were available in three treatments and higher quantities of zooplankton compared to phytoplankton were recorded might be due to availability of nutrients and favorable water quality parameters in improved extensive farming system.

4. DISCUSSION

Improved extensive farming system relied on stocking of wild or hatchery seeds, application of lime and fertilizers and supplemental feeding. Total yield (3138.46 kg/ha/cycle) (Table 1) indicates a level that only obtainable from improved extensive culture system as reported by [22]. Our result of yield (production between 2076 to 4640 kg/ha/cycle) was higher than [23,24] who reported an average yield of *Penaeus monodon* including fin fishes ranged from 1184 kg/ha/cycle to 1562 kg/ha/cycle for improved extensive shrimp culture systems in Bangladesh. According to [15] variations of yield in three (extensive, improved extensive & semi-intensive) culture system due to the variations in stocking and management system. Water quality management is vital catalyst for promoting productivity of shrimp farm directly. A healthy environmental condition and importance of entire management practices at different level from site selection to better production performance is crucial [25]. Water quality for aquaculture refers to the quality of water that enables successful growth and production of the desired organisms. The maintenance of good water quality is essential for survival, growth and production of commercial aquaculture species [26]. The metabolic rate of cold-blooded aquatic animal is closely related to the water temperature. Water temperature varies with the season, length of the day, water depth and meteorological condition [21]. Our present findings were similar to the optimum temperature range from 25 to 30℃ [27, 28]. According to [29] the dissolved oxygen ranged over 6 ppm during dry season and over 4 ppm during wet season in which was similar to the present findings. [30] had been reported that the tolerance DO for shrimp culture <3 mg /L (3-10 mg /L) and optimum range 4-7 mg/L. [31,32] reported that DO values higher than 5 mg/L have often been recommended for improve extensive culture system. This is very similar to finding of the present study. pH is the concentration of hydrogen ions (H^+) present in water is a measure of acidity or alkalinity and indicated as a pulse of shrimp aquaculture. The pH scale extends from 0 to 14 with 0 being the most acidic and 14 the most alkaline. In the present study, pH ranged 7.9±0.26, 8.1±0.50&8.0±0.72 in three shrimp farms, which was similar to the aquaculture standard value [25,33,28,34] Ammonia in water exists in two forms, as ammonium ions (NH_4^+), which are nontoxic, and as the un-ionized toxic ammonia (NH_3). The desirable range of ammonia for shrimp farming is < 0.1 ppm and for prawn farming is 0 ppm. It was reported that the half of shrimp production was reduced in Bangladeshi farms due to the presence of ammonia > 0.45 ppm [34,28]. In this experiment, average ammonia content was 0 to 0.1 ppm in three shrimp farms respectively. This level of ammonia in shrimp farm was near to the optimum level. Among the various form of nitrogenous nutrients, NO_3 is the most important factor for shrimp and prawn farming system and suitable form of nitrogen as an essential nutrient for phytoplankton and other plants. Nitrate is the final product of the aerobic decomposition of organic nitrogen compounds, which are generated from nitrite by oxidation and reduce to ammonia by bacterial action. The recommended level of nitrate for shrimp farming is 0.0 to 0.3 ppm and for prawn farming <0.1 ppm [35,28]. The observed value of NO_3 was 0 ppt of three improve extensive shrimp farms, respectively. The findings of the present study were similar to the optimum level of nitrate requirement for shrimp and prawn farming. Alkalinity is the buffering capacity of water and represents its amount of carbonates and bicarbonates. The suitable range of alkalinity for shrimp farming is 60 -180 and for prawn farming is 20 to 300 ppm [34,28]. In this study, average alkalinity content was 157±21, 187±15.59 and 144±37.31 mg/L in shrimp farms, respectively. The research finding was similar to the recommended level of alkalinity of shrimp farming which might be due to the appropriate management system. Salinity represents the total concentration of dissolved inorganic ions, or salts in water. The optimum range of salinity for prawn farming is 12-16 ppt and for shrimp farming 5-30 ppt [34,28]. In this experiment, the mean salinity was 9.8±4.32, 2.75±2.63 and 2.33±2.08 ppt in shrimp farms, respectively. The finding of the present study was more or less similar to the recommended salinity level in shrimp farming. The observed value of soil pH varied from 7.6±0.40 to 7.7±0.36 in shrimp farms which are adjacent to the findings of [36] who reported that optimum range of pH for shrimp production at 7.8 to 8.0. The average value of organic content in the present study was 2.88±2.0%, 3.5±.89 and 3.07±1.60% in shrimp farms. According to [37] farm soil with less than 0.5% organic matter is low productive, 0.5 to 1.2% average productive, 1.5 to 2.5% high productive and greater than 2.5% as less productive which is very identical to the present study. The findings of the present study revealed that the amount of dead plankton and the uneaten feed was higher in the shrimp farm. The average value of total nitrogen in the present study of shrimp farms was 0.159±0.11, 0.19±0.05 and 0.135±0.038% which was similar to the findings of [36] who reported that the total nitrogen content ranged from 0.11 to 0.18% in shrimp farming. The average phosphorous content was 13.41±5.83, 9.58±3.56 and 16.39±7.62 ppm in shrimp farms, respectively which was higher to the finding of [36]

5. CONCLUSION

Production and water quality parameters of experimental Ghers shows that the low stocked improved extensive culture systems with continuous long culture period has low survival and production of shrimp compare to well managed semi-intensive culture systems. This as usual farming system has negative impacts on salinity deposition on soil, adverse effects on population health, destroying biodiversity and ecosystems, environmental changes, and imbalance in sustainability. Proper management and planning can give a sustainable growth and benefit of shrimp cultivation. So management of soil and water quality is vitally important for two basic reasons in shrimp farming, such as it will directly help to the farmers to maintain optimum farm environmental condition within the water body that will help to maximize survival and growth and the other is the maintenance of a good water quality that will eliminate most of the disease related problems of the particular farms.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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