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Determination of monthly changes of various water quality parameters in different ponds at Chandpur district

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ABSTRACT

An experiment was carried out for 90 days at Faridgonj Upazila, Chandpur District, to determine the water quality parameters in the freshwater ponds. Ponds were selected on the basis of size, shape, water color and surrounding conditions. The study was conducted in three treatments where two treatments (T_2 and T_3) have three replications and treatment T_1 have four replications. During the experimental period, the water quality parameters such as water temperature, transparency, dissolved oxygen, nitrate-nitrogen, nitrite-nitrogen, alkalinity, phosphate-phosphorus, ammonia-nitrogen, pH and chlorophyll-a were observed monthly at Limnology Laboratory, Bangladesh Fisheries Research Institute, Riverine Station, Chandpur. The highest temperature (35°C) was recorded in February whereas the lowest (32°C) in January. The highest of pH (7.16) and transparency (36 cm) were recorded in January respectively. The lowest pH (6.28) in March whereas the lowest transparency (28 cm) in February respectively. The highest value (4.92 mg l^{-1}) and the lowest value (3.75 mg l^{-1}) of dissolved oxygen were recorded in March and January respectively. Total Alkalinity of the homestead ponds varied from 28 mg l^{-1} to 122 mg l^{-1} which were recorded in February and January. The maximum concentration of Phosphate-phosphorus, Nitrite-nitrogen, Nitrate-nitrogen and Ammonia-nitrogen were recorded 2.03 mg l^{-1}, 0.26 mg l^{-1}, 0.55 mg l^{-1} and 0.76 mg l^{-1} in March respectively. The minimum concentration of Phosphate-phosphorus, Ammonia-nitrogen and Nitrite-nitrogen were recorded 0.01 mg l^{-1} in January respectively. The lowest value of Nitrate-nitrogen was recorded 0.01 mg l^{-1} in March. The lowest value of chlorophyll-a was recorded (1.43 µg l^{-1}) in March whereas the highest value (72.35 µg l^{-1}) in March respectively. Except Total Alkalinity, all other parameters were not-significantly varied among treatments. The research findings will benefit the pond owners through improvement of homestead production system in Chandpur district and thus improve their livelihood.

Introduction

Fisheries sector plays an important role in the socio-economic development, nutrition, employment generation, poverty alleviation of large number of population and foreign exchange earnings in the economy of Bangladesh. About 60% of the country's animal protein supply is furnished by fish and fishery products **(**DoF, 2014). In our national economy; it contributes 4.37% to the GDP and 2.01% to the export earnings (DoF, 2014). Bangladesh has earned Tk. 4312.61 crore by exporting 85000 metric tons of fish and fishery products in foreign countries in 2012-2013 (DoF, 2014). The production of fish per acre in Bangladesh is much lower consumption is only about 52.87 g/day whereas 60 g/day is the required amount (DoF, 2014). To overcome these situation different experiments has been conducted with water quality and benthos to get higher production with the best uses of natural resources without any harmful effect on environment. Water quality parameter plays an important role in aquaculture because culture of fish and other commercially important aquatic organisms are completely dependent on the different water quality parameters. The quality of aquatic environment depends on four kinds of factors such as physical, chemical, biological and meteorological factors. Environmental factors are critical in aquaculture, because survival, reproduction, growth, maturity and production of fish species depend upon satisfactory environmental conditions. Inadequate maintenance of water quality might cause several problems in fish production. Sometimes, lack of maintenance of water quality may cause great lose for the farmers. Good water quality can increase the primary productivity as well as benthos abundances. The abiotic environment of the water body directly affects in the distribution, population density and diversity of the macro benthic community. The present research was conducted in the Chandpur district of Bangladesh. The area was selected as due to continuous deterioration of water quality, very poor retention capacity of water, low fish production, lack of proper pond management, use of fish culture ponds for various purposes etc. In order to increase the present fish production level and to fisheries development proper and scientific management is essential in which the knowledge of water quality and natural productivity plays an important role.There is approximately 4.3 million ha of inland water in Bangladesh, fishponds alone account for 0.3million ha of this (DoF, 2014). Estimates suggest that 4.27million households in Bangladesh own a pond and these account for 29.5% of Bangladeshi aquaculture (Belton & Azad 2012). If these ponds are successfully managed they can provide household members with a sustainable source of important micronutrients as well as an additional income stream. Developed and scientific fish culture and successful fisheries management depend on various limnological factors of the water body. These limnological factors are physico-chemical conditions of water quality, microorganisms, plankton, benthos etc. According to Hickling (1968) fish farming is a practical application of limnology and freshwater biology. According to Reid (1971) chemical analysis for dissolved gases and solids are highly important for the study of natural waters. In order to fisheries development and to increase the present production level, proper and scientific management is essential in which the knowledge of water quality and natural productivity plays an important role. For broader economic objectives, investigation of water quality parameters is essential for proper exploitation of aquatic resources that leads to economic. The major objectives of the present research work are as follows to determine monthly changes of various water quality parameters in different water bodies and study the response of fishes on the physico-chemical properties

Materials and Methods

The study was conducted in ten ponds for a period of three months from January, 2015 to March, 2015. The experimental ponds are situated at Faridgonj Upazila, Chandpur District, Bangladesh. To observe the physico-chemical conditions of the ponds, water samples were collected at monthly interval. The research was conducted in a completely randomized design into three treatments where three treatments (T_2, and T_3) have three replications and treatment T1 have four replications. Ponds were selected by size, shape, water colour and surrounding conditions. Present study includes three treatment where treatment 1 (T_1) represents small sized pond (6 to 8 decimal), treatment 2 (T_2) represents medium sized pond (8to10 decimal) and treatment 3 (T_3) represents large sized ponds (15 to 18 decimal). All of the selected ponds receive domestic wastes and decomposed organic nutrients from the neighboring households. Pond water is directly used for personal hygiene, washing of clothes, dishes and household materials, bathing of cattle etc. In addition surface run-off also entered into the ponds.

All the ponds are also used for traditional fish culture for carps, tilapia etc. No supplemental feed and fertilizer was used for fish culture but sometimes lime was used. The pond owner complained that the growth performance of fish is very poor. Fish mortality is a regular feature in those ponds, and it increases on cloudy days and after rainfall. The color of the pond water was found dark green, red paint covered or greenish throughout the study period. Moreover the ponds contain heavy silt particles and toxic plastic materials from the neighboring houses.

Analysis of Water Quality Parameters

A number of water quality parameters such as temperature (^{0}C), transparency (cm), dissolved oxygen(mgl^{-1}), pH, total alkalinity (mgl^{-1}), chlorophyll-a (µgl^{-1}), ammonia-nitrogen (mgl^{-1}), phosphate-phosphorus (mgl^{-1}), nitrite-nitrogen (mgl^{-1}) and nitrate-nitrogen (mgl^{-1}) was measured at monthly interval. Temperature and transparency were measured on the spot and rest of the above parameters was measured in the Limnology Laboratory, Bangladesh Fisheries Research Institute, Riverine Station, Chandpur.

Collection and treatment of water samples

For the analysis of water quality parameters, water samples were collected within 9.00 to 11.00 AM on each sampling day. Water samples were collected in plastic bottles with stopper having a volume of 500 ml each and marked with pond and sampling numbers. All of the plastic bottles were covered by black color tape. Water samples were collected by using a tube sampler (3-4 feet) in a manner that it is representative of all layers of the water column. Then the samples were carried out on the laboratory and 250 ml of water sample from each bottle was filtered through glass fibre filter paper (Whatman GF/C) with the help of electronic vaccum pressure air pump for nutrient and chlorophyll-a analysis.

Method used for water quality analysis

Measurement of physical Factors

The physical factors (temperature and transparency) were determined by the following methods:

Water temperature (°C)

During the study period, water temperature was measured on the spot with the help of a Celsius thermometer in the field.

Transparency (cm)

The transparency of water was measured on the spot by using a secchi disc of 20 cm diameter. First, the secchi disc was pierced into the water to the view of naked eye and then the length that was under the water was recorded in cm by a measuring scale at the ponds.

Methods of chemical analysis

The chemical factors were determined by the following methods:

pH (Hydrogen ion concentration)

pH of pond water was determined by using a direct reading digital pH meter (HACH 40d, multi-parameter sensor) on the spot.

Dissolved oxygen (mg l^{-1})

The dissolved oxygen concentration of water was measured by using a portable multi-parameter sensor (HACH 40d) on the spot.

Nitrate-nitrogen (mg l^{-1})

The concentration of nitrate-nitrogen (NO_3-N) was determined by a digital HACH device (DR 6000, a direct reading spectrophotometer), using NitriVer-3 and NitraVer-6 powder pillow.

Nitrite-nitrogen (mg l^{-1})

The concentration of nitrite-nitrogen (NO_2-N) was determined by a digital HACH device (DR 6000, a direct reading spectrophotometer), using NitriVer-3 powder pillow.

Ammonia-nitrogen (mg l^{-1})

Ammonia-nitrogen (NH_3-N) was also determined by a digital HACH device (DR 4000, a direct reading spectrophotometer). The chemical reagents used for this purpose were Nessler reagent, mineral stabilizer and polyvinyl alcohol.

Phosphate-phosphorus (mg l^{-1})

The concentration of phosphate-phosphorus (PO_4-P) was measured by a digital HACH device (DR 6000, a direct reading spectrophotometer), using a reagent named PhosVer-3 powder pillow.

Total alkalinity (mg l^{-1})

Total alkalinity was measured by titrimetric method with 50 ml of water sample by using 0.02 N sulfuric acid (H_2SO_4) titrant and methyl orange as an indicator.

Chlorophyll-a (μgl^{-1})

Chlorophyll-a was measured by using the filter papers (Whatman GF/C) used for filtering the water samples. The filter papers were dissolved in 10 ml acetone and kept overnight, then centrifuged (Denlay centrifuge, model BS-400) for 30 minutes at 1000 rpm and made ready for the analysis of chlorophyll-a. The DR-6000 (a direct reading spectrophotometer) at 664 nm and 750 nm wave length was used to determine chlorophyll-a by following Vollenweider's equation from Boyd (1979).

Chlorophyll-a in μg/L = $(11.9 \times (A_{664}-A_{750}) \times V \times 1000) / L \times S$

Where,

A_{664}= the absorbance at 664 nm

A_{750}= the absorbance at 750 nm

V= the acetone extract in ml

L= the length of cell in cm^2

S= the volume in ml of sample filtered

Statistical analysis

For the statistical analysis of the data, a one-way ANOVA (Analysis of Variance) & DMRT (Duncan's Multiple Range Test) was done by using the SPSS (Statistical Package for Social Science) version-16. Significance was assigned at the 0.05% level. Means were given with standard deviation (± SD).

RESULTS

Water quality parameters

Monthly variations of some physico-chemical parameters of water of the studied ponds such as temperature, transparency, dissolved oxygen, pH, Total Alkalinity, Chlorophyll-a, Ammonia, Phosphate, Nitrite and Nitrate were observed and analyzed throughout the study period. One way analysis of variance (ANOVA) was performed to measure whether any difference exists in the mean values of water quality parameters among different treatments. The overall mean values of each water quality parameters are presented in Table 1.

Table 1: Mean (±SD) values of water quality parameters recorded from different treatments

Parameters	Treatment			Level of Significance
	T_1	T_2	T_3	
Temperature (°C)	32.75±0.75	33.38±1.19	32.70±0.67	NS
Transparency (cm)	31.42±2.23	32.50±1.85	32.10±2.56	NS
Dissolved Oxygen (mg l^{-1})	4.74±0.17	4.55±0.37	4.48±0.44	NS
pH	6.88±0.16	6.92±0.12	6.75±0.30	NS
Total Alkalinity (mg l^{-1})	56.83±19.36^{a}	52.00±20.23^{b}	78.00±22.41^{ab}	*
Chlorophyll-a (μg l^{-1})	17.02±11.37	25.05±29.82	26.94±17.19	NS
Ammonia (mg l^{-1})	0.19±0.15	0.05±0.04	0.12±0.11	NS
Phosphate (mg l^{-1})	0.38±0.16	0.41±0.22	0.68±0.59	NS
Nitrite (mg l^{-1})	0.04±0.01	0.00±0.00	0.06±0.02	NS
Nitrate (mgl^{-1})	0.11±0.07	0.09±0.06	0.17±0.15	NS

NS= Mean values are not significantly different (P>0.05).

*Mean values with different superscript letters in the same row indicate significant different at 5%significance level

Water temperature (°C)

The water temperature of pond water was found to be more or less similar in different treatments. Water temperature in Treatment 1 (T_1), Treatment 2 (T_2) and Treatment 3 (T_3) varied from 32 to 35, 32 to 34 and 24 to 34 °C respectively. The maximum value of water temperature (34 °C) was found in March in T_3, while the minimum (24 °C) was found in March in same treatment. The Mean (±SD) values of water temperature were found32.75±0.75, 33.38±1.19 and 32.70±0.67 °C respectively in T_1, T_2 and T_3 (Table 1). Statistical analysis showed that there was no significant difference (P>0.05) among three treatments. Monthly variations of Water temperature (°C) in three treatments were shown in Figure 1.

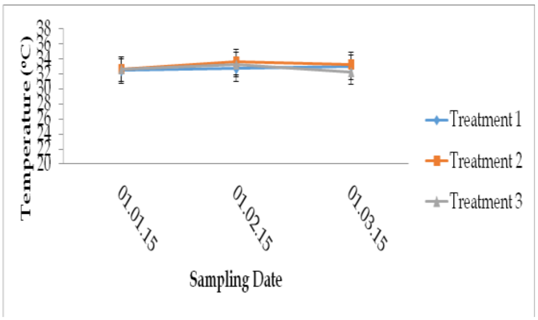

Figure 1: Monthly variations of water temperature among three treatments

Transparency (cm)

During the study period, the water transparency in T_1, T_2 and T_3 were ranged from 28 to 36 cm, 30 to 36 cm and 29 to 36 cm respectively. The maximum value of water transparency (36 cm) was found in T_1 and T_2, while the minimum (27 cm) was found in T_3. The mean (±SD) value of water transparency in T_1 was 31.42±2.23 cm and T_2 was 32.50±1.85 cm and T_3 was 32.10±2.56 cm respectively (Table 1). The statistical analysis showed that there was no significant difference (*P*>0.05) among three treatments. Monthly variations of Water transparency (cm) in three treatments were shown in Figure 2.

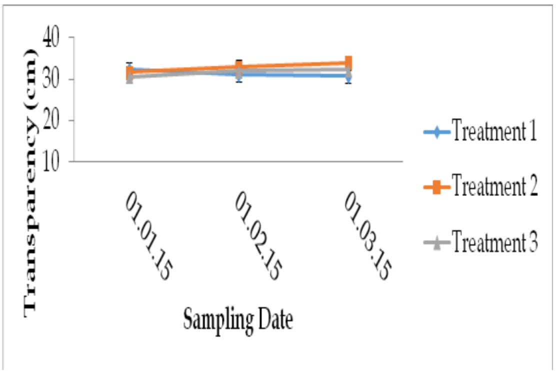

Figure 2: Monthly variations of water transparency among three treatments

Dissolved Oxygen (mg l^{-1})

Dissolved oxygen ranged from 4.33 to 4.97 mgl^{-1}, 3.83 to 4.85 mgl^{-1} and 3.75 to 4.92 mgl^{-1} in T_1, T_2 and T_3respectively. The maximum value of dissolved oxygen (4.97 mg l^{-1}) was found in T_1, while the minimum (3.75 mg l^{-1}) was found in T_3. The Mean (±SD) values of dissolved oxygen were found4.74±0.17, 4.55±0.37 and 4.48±0.44 (mg l^{-1}) respectively in T_1, T_2 and T_3 (Table 1). The statistical analysis showed that there was no significant difference (*P*>0.05) among three treatments. Monthly variations of dissolved oxygen (mg l^{-1}) in three treatments were shown in Figure 3.

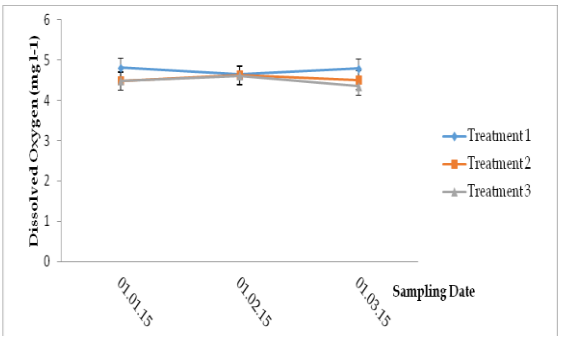

Figure 3: Monthly variations of dissolved oxygen concentration among three treatments

pH (Hydrogen ion concentration)

Throughout the experimental period, pH ranged from 6.66 to 7.16, 6.66 to 7.04 and 6.28 to 7.10in T_1, T_2 and T_3respectively. The maximum value of pH (7.10) was found in T_1 and T_3, while the minimum (6.16) was found in T_1. The Mean (±SD) values of pH were found6.88±0.16, 6.92±0.12 and 6.75±0.30 respectively in T_1, T_2 and T_3 (Table 1). The statistical analysis showed that there was no significant difference (*P*>0.05) among three treatments. Monthly variations of pH in three treatments were shown in Figure 4.

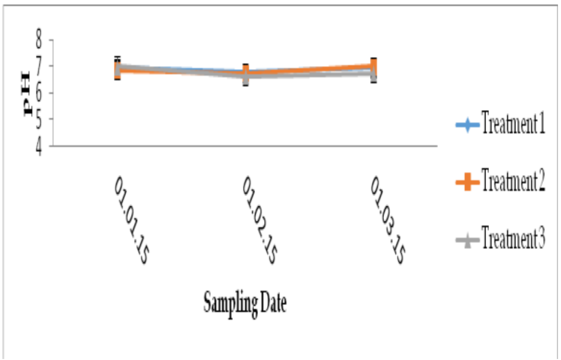

Figure 4: Monthly variations of pH among three treatments

Total Alkalinity (mg l^{-1})

The total alkalinity of the experimental ponds varied from 40 to 98, 28 to 90 and 50 to 122 mg l^{-1} under T_1, T_2 and T_3respectively. The maximum value of total alkalinity (122 mg l^{-1}) was found in T_2, while the minimum (28 mg l^{-1}) was found in the same treatment. The Mean (±SD) values of total alkalinity were found56.83±19.36, 52.00±20.23 and78.00±22.41 respectively in T_1, T_2 and T_3 (Table 1). The statistical analysis showed that there was significant difference (*P*<0.05) among three treatments. Monthly variations of total alkalinity (mg l^{-1}) in three treatments were shown in Figure 5.

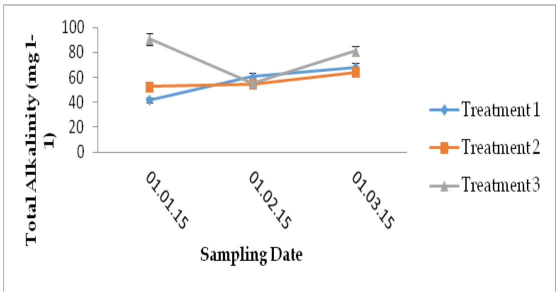

Figure 5: Monthly variations of total alkalinity among three treatments

Chlorophyll-a (μg l^{-1})

The values ofChlorophyll-a (μg l^{-1}) ranged from 3.33 to 45.70, 1.43 to 72.35 and 7.62 to 62.36 μg l^{-1}in T_1, T_2 and T_3respectively. The maximum value of Chlorophyll-a (460.77 μg l^{-1}) was found in T_2, while the minimum (4.76 μg l^{-1}) was found in T_1. The Mean (±SD) values of Chlorophyll-a were found to, 17.02±11.37, 25.05±29.82 and 26.94±17.19 μg l^{-1} respectively in T_1, T_2 and T_3 (Table 1). The statistical analysis showed that there was no significant difference (P>0.05) among three treatments. Monthly variations of Chlorophyll-a in three treatments were shown in Figure 6.

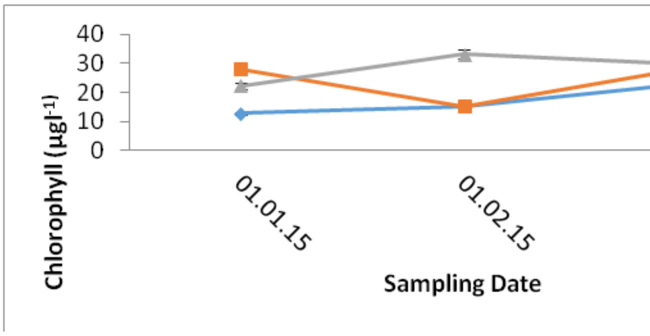

Figure 6: Monthly variations of Chlorophyll-*a* among three treatments

Ammonia-nitrogen (mg l^{-1})

The ammonia-nitrogen (NH3-N) concentrations ranged from 0.01 to 0.76, 0.01 to 0.11 and 0.01to 0.61 mgl^{-1} in T_1, T_2 and T_3 respectively. The maximum value of ammonia-nitrogen (0.70 mgl^{-1}) was found in T_3, while the minimum (0.01 mgl^{-1}) was found in T_1 and T_2. The mean (±SD) values of ammonia-nitrogen (NH_3-N) were found to0.19±0.15, 0.05±0.04 and 0.12±0.11mgl^{-1}inT_1, T_2 and T_3 respectively (Table 1). The statistical analysis showed that there was no significant difference (P>0.05) among three treatments. Monthly variations of ammonia-nitrogen in three treatments were shown in Figure 7.

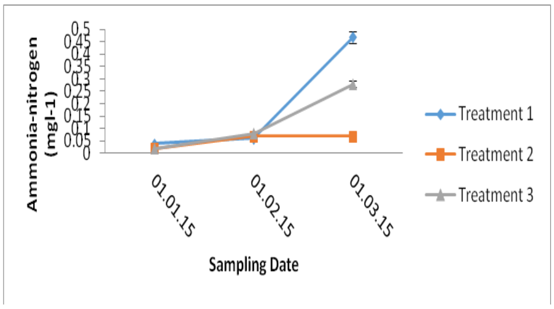

Figure 7: Monthly variations of Ammonia-nitrogen among three treatments

Phosphate-phosphorus (mg l^{-1})

The values of phosphate-phosphorous (PO_4-P) concentrations ranged from 0.02 to 1.45, 0.18 to 0.87 and 0.01 to 2.02 mgl^{-1} under T_1, T_2 and T_3 respectively. The maximum value of phosphate-phosphorous (0.99 mgl^{-1}) was found in T_3, while the minimum (0.12 mgl^{-1}) was found in T_1. The mean (±SD) values of phosphate-phosphorous (PO_4-P) were found to0.38±0.16, 0.41±0.22 and 0.68±0.59 mgl^{-1}inT_1, T_2 and T_3 respectively (Table 1). The statistical analysis showed that there was no significant difference (P>0.05) among three treatments. Monthly variations of phosphate-phosphorous in three treatments were shown in Figure 8.

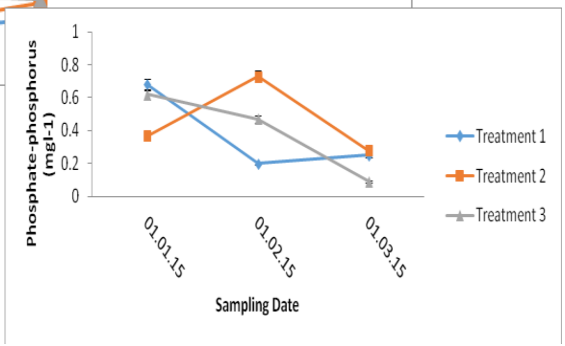

Figure 8: Monthly variations of Phosphate-phosphorous concentration among three treatments

Nitrite-nitrogen (mgl^{-1})

The values of nitrite-nitrogen (NO_2-N) concentrations were found to vary from0.00 to 0.26, 0.00 to 0.00 and 0.00 to 0.38 mgl^{-1} under T_1, T_2 and T_3respectively. The maximum value of nitrite-nitrogen (0.26 mgl^{-1}) was found in T_1, while the minimum (0.00 mgl^{-1}) was found in all treatments. The mean (±SD) values of nitrite-nitrogen were found to0.04±0.01, 0.00±0.00 and 0.06±0.02mgl^{-1}inT_1, T_2 and T_3 respectively (Table 1). The statistical analysis showed that there was no significant difference (P>0.05) among three treatments. Monthly variations of nitrite-nitrogen in three treatments were shown in Figure 9.

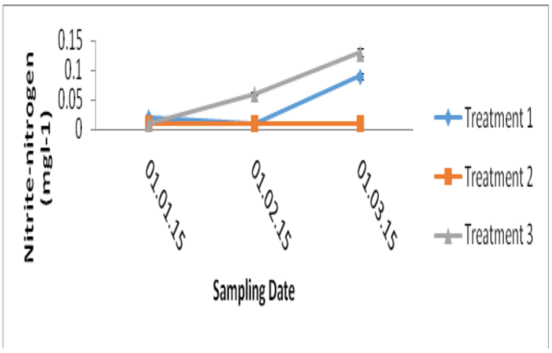

Figure 9: Monthly variations of Nitrite-nitrogen concentrations among three treatments

Nitrate- nitrogen (mgl^{-1})

The nitrate-nitrogen (NO_3-N) concentrations ranged from 0.01 to 0.43, 0.02 to 0.17 and 0.01 to 0.55 mgl^{-1} in T_1, $T_2$and T_3 respectively. The maximum value of nitrate-nitrogen (0.45 mgl^{-1}) was found in T_1, while the minimum (0.01 mgl^{-1}) was found in all treatments. The mean (±SD) values of nitrate-nitrogen were found to 0.11±0.07, 0.09±0.06and 0.17±0.15 mgl^{-1}in T_1, T_2 and T_3 respectively. The statistical analysis showed that there was no significant difference (*P*>0.05) among three treatments. Monthly variations of nitrite-nitrogenin three treatments were shown in Figure 10.

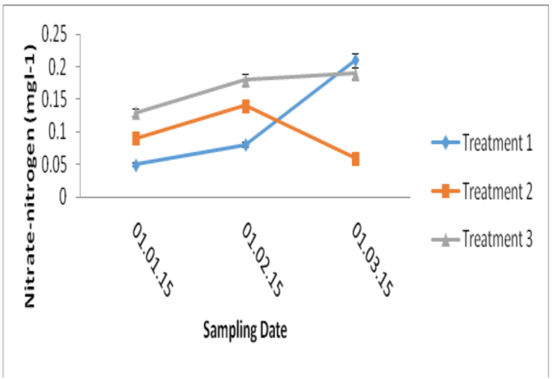

Figure 10: Monthly variations of Nitrate-nitrogen among three treatments

DISCUSSION

The discussion for the results of water quality parameters are given below:

Water quality parameters

Successful Aquaculture depends on the qualities of water, i.e. qualities of the aquatic environment. The suitable water quality parameters are pre-condition for enhance aquatic environment and for the production of massive fish food organisms and finally for fishes and other aquatic animals, such as crustacean, mollusks, amphibians etc.

Physical parameters

Physical parameters are very critical for fish production. Various types of physical parameters such as transparency, air temperature and water temperature which greatly influence on the survival and growth of fishes. The physical parameters have been discussed below.

Transparency (cm)

Water transparency measures the productivity of a pond. During study period, in the ponds under T_1, T_2 and T_3 transparency ranged 28.00 to36.00 cm, 30.00 to 36.00 cm and 29.00 to 36.00 cm respectively. During the study period, transparency of water was ranged from 28 to 36 cm, which was similar with the findings of Kohinoor *et al*. (2001) as recorded values ranging from 15-58 cm. Wahab *et al.* (1994) observed the transparency ranged from 15 to 74 cm in their study. The water transparency values of T_1, T_2 and T_3 were within the productive range in the current experiment.

Water temperature (^{0}C)

Water temperature is most important water quality parameters which influence the growth, food intake, reproduction and other biological activities of fishes. Egna and Boyd (1997) mentioned that tropical aquaculture is commonly done under conditions assumed to be more nearly constant in temperature than conditions in the temperate regions.. In the present study water temperature was found to a favorable limit for fish culture ranged from 32 to 35^{0}C among the treatments, which was not similar to Asaduzzaman (2005), Rahman (2005), Asaduzzaman *et al*. (2006a) and Kunda *et al*. (2008).

Chemical parameters

Dissolved oxygen (mgl^{-1})

Maintenance of sufficient dissolved oxygen in all ponds, without doubt, the most important work of water quality management performed by fish culturists. Over the course of a day, oxygen levels can change even more dramatically than temperature. The dissolved oxygen concentration in the present study was ranges from 3.75 to 4.97 mgl^{-1} almost dissimilar to the findings of Alam *et al.* (1997), and Ali *et al.* (2004) who recorded dissolved oxygen ranges from 4.0 to 7.0 and 4.3 to 6.5 mgl^{-1} respectively.

p^H (Hydrogen ion concentration)

P^H is considered as a critical factor for fish production. Kunda *et al*. (2008) and Alam *et al*. (1997) found p^{H}values ranges from 7.0 to 9.0 and 8.0 to 9.5 which are dissimilar with the findings of the present study (6.28 to 7.16). Swingle (1967) reported that an acidic p^H reduces the growth rate, metabolic activity and other physiological activities of the fishes.

Ammonia-nitrogen (mgl^{-1})

Ammonia-nitrogen is an important factor in fish culture. There are two forms of ammonia-nitrogen available in water, un-ionized ammonia (NH_3) and ammonium ion (NH_4^+). The ammonium ion is non-toxic except at extremely high levels, while un-ionized ammonia is toxic to fish. In the present experiment the mean (±SD) values of NH_3-N were 0.19±0.15, 0.05±0.04and 0.12±0.11mgl^{-1} in T_1, T_2 and T_3 respectively, which were dissimilar to Rahman (2005) and Asaduzzaman *et al.* (2006a) who were recorded that the value of ammonia ranges from 0.01 to 0.82 mgl^{-1} and 0.20 to 0.60 mgl^{-1} respectively. In this experiment the value of ammonia-nitrogen was not suitable range for freshwater fish culture.

Nitrite-nitrogen (mgl^{-1})

The ionized form of nitrous acid (HNO_2) is Nitrite-nitrogen (NO_2-N) and is lethal when it forms ammonium-nitrogen (NH_3-N). The recent evidence showed that nitrite may be limiting factor for fish production. In this experiment nitrite-nitrogen concentrations were recorded from 0.00-0.38 mg1^{-1} and the mean (±SD) values were 0.04±0.01, 0.00±0.00 and 0.06±0.02 mgl^{-1} in T_1, T_2 and T_3 respectively. Alim (2005) recorded that nitrite-nitrogen concentration ranged from 0.00 to 1.021 mgl^{-1} were productive level. The nitrite-nitrogen values were not significantly different among the three treatments.

Nitrate- nitrogen (mgl^{-1})

Nitrate is contributed to the ecosystem through the process of nitrification. So nitrate-nitrogen is most important to fish farmer. In present study the ranges of nitrate-nitrogen lies between 0.01-0.55 mgl^{-1} which were similar to 0.02-3.0 mgl^{-1} that were found in pond water by Dewan *et* al. (1991), Wahab *et al.* (1995), Azim *et al.* (1995) and Kohinoor (2001).

Phosphate-phosphorous (mgl^{-1})

The availability of phosphate-phosphorus is very essential for primary producer such as phytoplankton. The mean (±SD) value of phosphate-phosphorous were 0.38±0.16,0.41±0.22and 0.68±0.59mgl^{-1} in T_1, T_2 and T_3 respectively. The phosphate-phosphorous (PO_4-P) concentration in the present study ranged from 0.01-2.02 mgl^{-1} which was dissimilar to the findings of Wahab *et al.* (1995) who found phosphate-phosphorus ranged from 0.09 to 5.2 mgl^{-1}. However, Uddin (2002) and Rahman (2005) recorded phosphate-phosphorus value ranges from 0.03-0.46 mgl^{-1} and from 0.21- 4.0 mgl^{-1} which were almost dissimilar to the present finding.

Total alkalinity (mgl^{-1})

Essential nutrients are found in higher amount in alkaline waters but highly alkaline condition of water is not favorable for biological production (Rahman, 1992). The mean (±SD) values of total alkalinity in the present experiment were 56.83±19.36, 52.00±20.23and 78.00±22.41mgl^{-1} in T_1, T_2 and T_3 respectively. Total alkalinity in the present study was considered as a suitable range (48.00-285mg1^{-1}) for fish culture. Total alkalinity value 19.0-155 mgl^{-1} recorded by Chowdhury *et al.* (2000) is more or less similar to the present values.

Chlorophyll-a (µgl^{-1})

Chlorophyll-*a* (µgl^{-1}) value is the index of productivity of pond, which shows an inverse relationship with the transparency of water. In this experiment, the mean (±SD) value of chlorophyll-*a* were17.02±11.37µgl^{-1}, 25.05±29.82µgl^{-1}and 26.94±17.19µgl^{-1} in T_1, T_2 and T_3 respectively. The ranges of Chlorophyll-*a* in this study ranges from 1.43-72.35 µgl^{-1} this findings are dissimilar to Hasan (2009) and Paul (1998) who found chlorophyll-*a* in pond water ranging from 10 to 200 µgl^{-1}.

Conclusions

It is observed that water quality parameters and benthos abundance play an important role on the growth and production of fish and other aquatic organisms. The suitable water quality parameters are prerequisites for a healthy aquatic environment and for the production of sufficient fish food organisms. The primary productivity of a water body depends on the physical, chemical and others factors of the environment.

Present investigation stated that the causes of low fish production and high rate of fish mortality due to lack of proper management of water quality, pollution from domestic wastes, surface run-off, washing of clothes, traditional fish farming system etc. To improve fish production from this region proper management of water quality parameters, controlling agricultural, urban and storm water run-off, properly maintaining septic system and residential applications of fertilizers are probably the most effective measures. From this short-term survey on physico-chemical parameters, it could be concluded that there is an urgent need for additional research for better and sustainable fish production in this area.

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