RESEARCH ARTICLE

Analysis of some physicochemical parameters and their effect on the productivity of fishes in two different types of aquatic bodies of Unamgaon and Seipargaon of Patharkandi block of Karimganj district, Assam, India

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ABSTRACT

Water quality is determined by various physicochemical and biological factors, as they may directly or indirectly affect its quality and consequently its suitability for the distribution and production of fish and other aquatic animals. The role of various factors or parameters like temperature, carbon dioxide, pH, alkalinity, hardness, conductivity, biochemical oxygen demand (BOD), dissolved oxygen (DO), plankton population etc. cannot be overlooked for maintaining a healthy aquatic environment and therefore productivity depends on the physicochemical characteristics of the water body. The two selected study areas of Patherkandi block of Karimganj district have many ponds and fisheries. This survey work was properly supported by chemical analysis of the water samples and it was found that if physicochemical parameters of the water are maintained properly, we can get good productivity of fishes and it would surely help the local fishermen.

Keywords: Karimganj, Productivity, Water, Physicochemical parameter, BOD, DO

INTRODUCTION

Fish is an inexpensive source of protein and an important cash crop in many regions of world and water is the physical support in which they carry out their life functions such as feeding, swimming, breeding, digestion and excretion (Bronmark and Hanson 2005). Many workers have reported the status of water bodies after receiving various kinds of pollutants altering water quality characteristics (i.e., physical, chemical and biological). Dhawan and Kaur (2002) observed that feeding and fertilization work together to make efficient and effective increase in fish production. In most of the countries, fishes are cultivated in ponds (lentic water) but unfortunately such cultivators are not so aware of importance of water quality management in fisheries. If they are properly guided and make aware about water quality management practices, they can get maximum

fish yield in their ponds to a greater extent through applying low input cost and getting high output of fish yield.

Water quality in fish ponds is affected by the interactions of the chemical components. Carbon dioxide, pH, alkalinity and hardness are interrelated and can have profound effects on pond productivity, the level of stress and fish health, oxygen availability and the toxicity of ammonia as well as that of certain metals. Most features of water quality are not constant. Carbon dioxide and pH concentrations fluctuate or cycle daily. Alkalinity and hardness are relatively stable but can change over time, usually weeks to months, depending on the pH or mineral content of watershed and bottom soils (Boyd 1985).

Deterioration in water quality can result in fish being stressed and vulnerable to disease (ICAR 2006). As fish is cold blooded animal, its body temperature changes according to that of environment affecting its metabolism, physiology and ultimately affecting the production. The recommended pH range for aquaculture is 6.5 to 9.0. Pond pH varies throughout the day due to respiration and photosynthesis. After sunset, dissolved oxygen (DO) concentrations decline as photosynthesis stops and all plants and animals in the pond consume oxygen (respiration). In heavily stocked fish ponds, carbon dioxide (CO_2) concentrations can become high as a result of respiration. The free CO_2 released during respiration reacts with water, producing carbonic acid (H_2CO_3), and pH is lowered. A total alkalinity of 20 mg/L or more is necessary for good pond productivity. A desirable range of total alkalinity for fish culture is between 75 and 200 mg/L $CaCO_3$. (Boyd 1985). Dissolved oxygen concentration (DO) is considered the most important water quality variable in fish culture. Low dissolved oxygen concentrations potentially alter all aspects of predator-prey interactions including encounter rates, attack rates, and capture success (Kramer 1987; Rahel and Nutzman 1994; Breitburg *et al.* 1997). Biochemical Oxygen Demand or BOD is a measure of the quantity of oxygen consumed by microorganisms during the decomposition of organic matter. However, pond habitat can be manipulated by controlling the water characteristics for an optimum environment yielding high fish production.

The objective of the present study is to review and present a concise opinion regarding the optimum levels of some water parameters required for maximum fish production. This study therefore focuses on estimation of some physicochemical parameters (i.e., temperature, alkalinity, dissolve oxygen (DO), biological oxygen demand (BOD), conductivity and pH of two fisheries and two non-maintained ponds. Hence, the present study is aimed at analysis of some physicochemical parameters of water and effect on their productivity of fishes in two different aquatic bodies.

Selection of the site for study of fish culture

The fisheries were studied in the village Seipar Gaon and the ponds were studied in the village Unam Gaon, Patharkandi which is about 35km from Karimganj district, Assam, India. Generally fisheries are maintained and ponds are non-maintained. Therefore, two fisheries and two ponds were selected for the study.

The sites of both the fisheries are a composite matrix of different variables such as human habitation, agricultural fields, bamboo thickets etc. The powdered rice, oilcake, coconut, mustard ground nuts etc. are commonly used as artificial food for the fishes. In fishery-1 about 40kg of artificial food is supplied for the fishes and in fishery-2 approximately 75kg of food is supplied as their feed. Cleaning of weeds and proper manuring are done regularly. *Cirrhinus mrigala, Labeo calbasu, Channa marulius* etc. are cultivated in fishery-1 and used in self or business purpose. In the fishery-2 especially *Wallago attu* (boal), *Channa marulius* (soal) etc. are cultivated. To increase the production of plankton, manuring like cow dung is properly done. Increase in the production of plankton is essential for good growth of the fishes. To prevent the diseases some substances like bleaching powder, lime etc. are added to the fishery water. These substances are also useful to clean the water. The best time for liming is applied during late fall and winter season when fertilization is suspended. Liming also helps to increase the fertility of the fishery.

Water of the pond-1 & pond-2 are used for drinking purpose and fish cultivation. Cow dung is used for organic manuring. But in pond-1 the supply of food is not properly maintained. Liming is done at winter season. Every year some fries are purchased for stocking such as *Labeo roita, Notopterus notopterus, Hypophthalmichthys molitrix etc*. These fries are developed in the pond and are used for self

consumption. However in pond-2 amount of food is properly supplied so that fish can grow properly. It is a small pond and fishes cultivated here are common carps, silver carps, grass carps and among small fishes *Puntius guganio, Esomus danricus* etc. are found.

MATERIAL AND METHODS:

The two fisheries viz. Fishery-1 and Fishery-2 and two non-maintained pond viz. Pond-1 and Pond-2 were studied. In each area, the ponds/fisheries were randomly sampled and the results are presented in a generalized form.

Water samples were taken from each experimental ponds/fisheries at the different sites after each 15 days interval of time period. Some water parameters viz. temperature, DO, pH, alkalinity and BOD were analysed on the sites while the others were estimated at the laboratory.

Temperature: Mercury in glass thermometer (50^0C) was lowered into water up to 2cm below the water surface, allowed to get stabilized for 2 minutes and readings were taken in degree Celsius (^{0}C).

pH: The pH of samples were measured using a pH meter.

DO: Winkler's titration method was used to estimate the level of DO (mg/l) for each sample of water.

Alkalinity: The values of this parameter were calculated using standard methods.

BOD: BOD was also determined by Winkler's method (Welch 1948).

RESULTS AND DISCUSSION

Water quality generally means the component of water which must be present for optimum growth of aquatic organisms (Ehiagbonare and Ogundiran 2010). Knowledge of hydrological conditions is not only useful in assessing its productivity, but will also permit a better understanding of the population and life cycle of the fish community (Adebisi 1981; Ayodele and Ajani 1999).

The mean variation for physicochemical parameters sampled in the four ponds/fisheries, are shown in table-6 and it is found that Temperature is ranged from 29^0C – 32^0C, DO was between 8.2 mg/l – 9.2 mg/l, pH values between 6.87 – 7.00, total alkalinity between 96 – 120 ppm and BOD was between 3.9 mg/l – 4.5 mg/l. Fish yield of the sampled fisheries are shown in table 7.

Table 1: Temperature of the water samples collected from four different water bodies.

No. of sample collection	Date of sample collection	Pond-1	Pond-2	Fishery-1	Fishery-2
1	03.08.15	29.0^0C	29.5^0C	28.0^0C	28.0^0C
2	19.08.15	28.0^0C	27.0^0C	30.0^0C	29.0^0C
3	04.09.15	27.0^0C	30.0^0C	31.0^0C	30.0^0C
4	19.09.15	29.0^0C	31.0^0C	30.0^0C	32.0^0C
5	05.10.15	30.0^0C	32.5^0C	31.0^0C	29.0^0C
6	28.10.15	28.0^0C	29.5^0C	32.0^0C	31.0^0C

Table 2 : Variation of dissolve oxygen of the water sample in different water bodies.

No. of sample collection	Date of experiment	Pond-1	Pond-2	Fishery-1	Fishery-2
1	03.08.15	8.3mg/l	10.3mg/l	8.4mg/l	7.3mg/l
2	19.08.15	9.0mg/l	8.6mg/l	8.3mg/l	8.3mg/l
3	04.09.15	7.9mg/l	10.1mg/l	7.5mg/l	9.0mg/l
4	19.09.15	6.2mg/l	7.7mg/l	6.8mg/l	7.3mg/l
5	05.10.15	9.1mg/l	10.2mg/l	9.4mg/l	8.8mg/l
6	28.10.15	9.3mg/l	9.0mg/l	8.9mg/l	9.2mg/l

Table 3: pH of water samples at different water bodies.

No. of sample collection	Date of experiment	Pond-1	Pond-2	Fishery-1	Fishery-2
1	03.08.15	6.99	6.66	6.78	6.75
2	19.08.15	7.00	6.98	6.54	6.88
3	04.09.15	7.10	7.00	6.59	6.79
4	19.09.15	6.67	6.91	6.76	6.64
5	05.10.15	6.99	7.00	6.84	6.97
6	28.10.15	7.20	6.99	6.68	6.93

Table 4: Total alkalinity of the water sample of different water bodies

No. of sample collection	Date of experiment	Pond-1	Pond-1	Fishery-1	Fishery-2
1	03.08.15	90ppm	86ppm	98ppm	120ppm
2	19.08.15	114ppm	120ppm	68ppm	124ppm
3	04.09.15	90ppm	104ppm	94ppm	86ppm
4	19.09.15	120ppm	140ppm	80ppm	70ppm
5	05.10.15	104ppm	96ppm	110ppm	110ppm
6	28.10.15	98ppm	120ppm	98ppm	100ppm

Table 5: BOD values of the water samples of different water bodies (after 3 days).

No. of sample collection	Date of experiment	Pond-1	Pond-2	Fishery-1	Fishery-2
1	05.08.15	4.1mg/l	3.8mg/l	4.3mg/l	4.7mg/l
2	21.08.15	3.9mg/l	4.0mg/l	4.5mg/l	4.1mg/l
3	06.09.15	4.3mg/l	4.1mg/l	4.2mg/l	4.5mg/l
4	21.09.15	4.1mg/l	4.0mg/l	4.7mg/l	4.2mg/l
5	07.10.15	3.7mg/l	3.5mg/l	4.0mg/l	4.2mg/l
6	30.10.15	3.5mg/l	4.0mg/l	4.2mg/l	4.1mg/l

Table 6: Mean variation in physicochemical parameters of the water samples in water bodies.

Study sites	Temperature (^{0}C)	DO (mg/l)	Alkalinity (ppm)	pH	BOD (mg/l)
Pond-1	32^{0}C	8.3mg/l	100ppm	6.99	3.9mg/l
Pond-2	29^{0}C	9.2mg/l	120ppm	7.0	4.0mg/l
Fishery-1	30^{0}C	8.2mg/l	96ppm	6.92	4.3mg/l
Fishery-2	31^{0}C	8.4mg/l	100ppm	6.87	4.5mg/l

Table 7: Fish yield in different fisheries throughout the year.

Study sites	Fish yield in weight (Kg)		Fish yield in amount (Rs.)		Profit (in Rs.)
	Pre-stocking	Post-harvesting	Pre-stocking	Post-harvesting	
Pond-1	50kg	550kg	Rs.3,000/-	Rs.55,000/-	Rs.52,000/-
Pond-2	45kg	480kg	Rs.2000/-	Rs.48,000/-	Rs.46,000/-
Fishery-1	90kg	850kg	Rs.5000/-	Rs.85,000/-	Rs.80,000/-
Fishery-2	120kg	990kg	Rs.7000/-	Rs.99,000/-	Rs.92,000/-

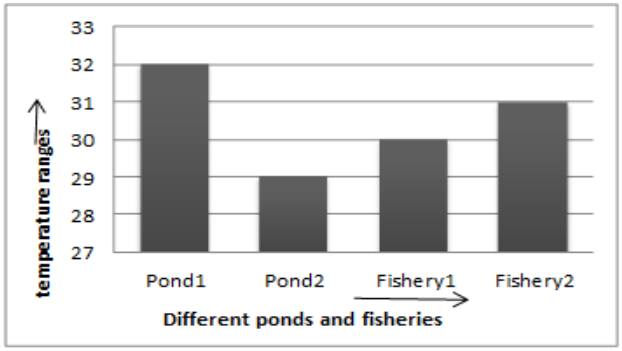

Fig. 1: Graphical representation of mean temperature at different ponds

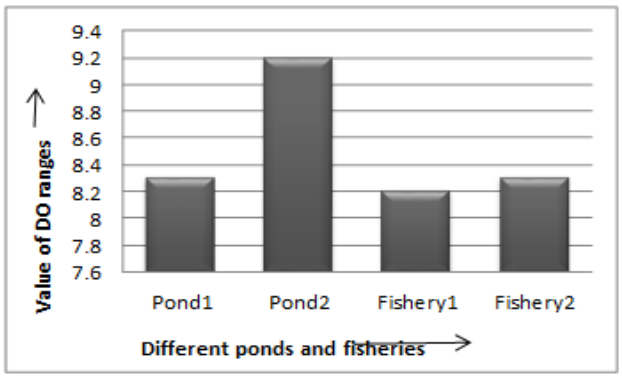

Fig. 2: Graphical representation of mean DO at different ponds

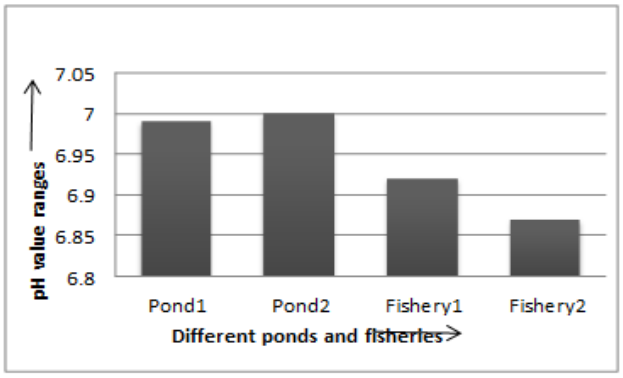

Fig. 3: Graphical representation of mean variation of pH at different ponds

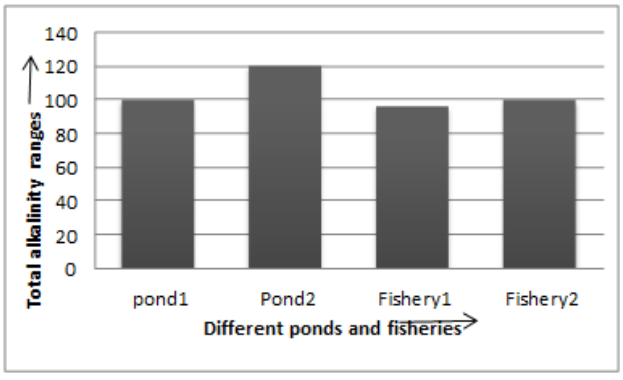

Fig. 4: Graphical representation of mean of total alkalinity at different ponds

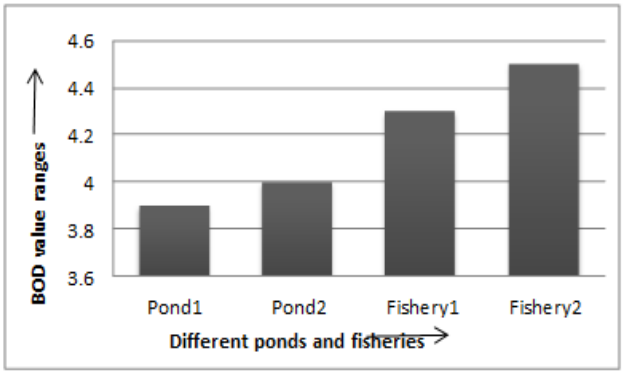

Fig. 5: Graphical representation of mean variation of BOD at different ponds.

The various physicochemical parameters recorded for the water of two fisheries and two ponds were favorable for fish culture. Mean recorded surface water temperature of 27^{0}C to 32.5^{0}C (Table 1) agreed to the ranges recorded by Ugwumba and Ugwumba (1993). The least temperatures of 27^{0}C might be due to shading of water in pond-2 by brunches of trees surrounding it. This prevented sunrays from direct contact with the water surface. Fig. 1 clearly showed the fluctuation of temperatures in the studied water-bodies.

DO with higher ranges 6.2 – 10.3 mg/l recorded (Table 2) is within the ranges documented by Swingle (1969) and Boyd (1985) for good water quality on fish culture. This is because oxidation converts otherwise poisonous compounds to useful materials. It also encourages good feeding, food utilizing and high stocking density for fish eggs, larva and adults (Alabaster 1982). Pond-2 showed high variation of DO (Fig. 2)

The recorded average pH values of 6.54 – 7.20 (Table 3) were within the pH values of 6.5-9.0 as documented by Swingle (1961) and Boyd (1985). This value is most suitable for fish production for maximum productivity. Fishery-2 showed less variation of pH (Fig. 3).

The total alkalinity of 70 – 124 ppm recorded (Table 4) agreed within the ranges documented by Boyd (1981) for natural waters. All the four studied water-bodies show almost similar values of alkalinity (Fig. 4).

The values of Biological oxygen demand recorded in table 5 were between 3.5 – 4.7 mg/l and they were according to the values as documented by Boyd (1981, 1985). These marked differences of the values of physicochemical parameters in the different ponds

might be due to effect of temperature, plankton density and concentration of organic and related factors. Maximum BOD values were found in fishery-2 (Fig. 5).

Fish yield and water parameters showed a close interrelationship and it is found that no single parameter can be singled out in relation to fish growth and health. Among fisheries and ponds, fishery-2 and pond-1 shows better production than the fishery-1 and ponds-2 respectively. However, five of these parameters (i.e., temperature, DO, pH, alkalinity, BOD) must be kept at optimum level to guarantee high fish yield. The mean high temperatures of 30^0C, 31^0C, 32^0C and 29^0C recorded for Fishery-1, Fishery-2, Pond-1, and Pond-2 respectively might have resulted in better feeding and food conversion for the fishes. This is supported by Lin (1951) who documented that temperature ranges of 27^0C to 32^0C will allow tropical fish to eat more and grow faster.

CONCLUSION

The present study was conducted to analyse the physicochemical parameters of the selected sites among fisheries and non-maintained ponds. It is concluded that all the studied and documented physicochemical parameters are needed for fish growth and survival.

After analyzing some water parameters, it is found that fisheries shows better result in fish production than the ponds. Though water parameters of ponds are not so much suitable for fish cultivation in comparison to fisheries but if the local community or owner of the ponds maintains them, then the ponds may show an increase in its fertility to fish production and growth and this will help in abundance of protein rich fishes. The increase in fish yield helps in the socio-economical development of the people as well as the community. This study showed that fish yield is dependent on the quality and management of water characteristics and fishery-2 is the best maintained aquatic body for fish production.

Conflicts of interest: The authors stated that no conflicts of interest.

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