

Physico-Chemical Properties of Fresh Water Fish Pond in Relation to Fish Farming in Darbhanga District

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Abstract

Life on the earth is never possible without water. Water is one of the essential constituents of the environments. The study of Physico-chemical parameters of local freshwater fish ponds in Darbhanga district at Panchobh village has been studied for a period of one year from July 2017 to June 2018. Water samples were collected from the ponds and analyzed using standard laboratory methods and procedures. This study was designed to assess the quality of pond's water in Panchobh village, Darbhanga District in Bihar state has been evaluated on a seasonal basis. The observations of the present study suggests that the fish culture in this freshwater ponds in Darbhanga district at Panchobh village is good to take up fish culture practices. However if we adopt some water quality management practices and pond management techniques, it might give good positive results for fish culture, it is concluded.

Key words: Freshwater, fish ponds, Physico-chemical parameters, Fish farming.

INTRODUCTION :

Water is one of the most important components on earth and it covers three- fourth of the earth's surface. Freshwater has become a scarce commodity due to over exploitation, population growth and also pollution. Industrial effluents, domestic sewage and municipal wastes are being continuously added to the fresh water reservoirs affecting the water and changing its physico-chemical quality and making it unfit for fish production. A pond is referred to as a man-made or natural water body. Water quality means the component of water which must be present for optimum growth of aquatic organisms. The source of water supply to the pond may be from river or from spring or from rain. A pond must be manageable for controlled farming; Life in aquatic environment is largely governed by physico-chemical characteristics and their stability. Various changes that organisms bring about in the water are essential for their own existence. Rearing of fishes in localized water is known as Pisciculture. The determinant of good fish growth in water body includes dissolved oxygen, total hardness, alkalinity, temperature, etc. Conversely other parameters like BOD, COD indicates pollution level of a given water body. Concentrations of physico-chemical parameters increase due to human activities and also by lack of environmental regulations. The maintenance of healthy aquatic system is dependent on the physico chemical properties and biological diversity. The interactions of both the physical and chemical properties of water play a significant role in composition, distribution, abundance, movements and diversity of aquatic organisms. Water is the home of fishes and its quality is most over looked. The qualitative aspect of pond and its management is ignored until it affects fish production. Water quality is generally considered as means of the certain component of water which are present and facilitate for the optimum growth of aquatic organisms. The Water quality is group of physical, chemical and biological factors which influence the use of water for the purpose of fish culture. These factors include dissolved oxygen, pH, hardness, turbidity, alkalinity, ammonia and temperature. Other parameters such as biological oxygen demand (BOD) and chemical oxygen demand(COD) indicate the pollution level of a given water body. The Productivity depends on the Physico-chemical characteristics of the water body. In recent years, the Inland water bodies in the Darbhanga district have been subjected to alteration of ecological condition. This is partly due to the human activities, population growth, use of petroleum and its by products, over exploitation and exploration and indiscriminate use of pesticides in agriculture practices which resulted in the pollution of the aquatic environment. More over uncontrolled discharge of domestic waste water into the ponds has resulted in Eutrophication of ponds. The entry of the pollutants in the fresh water affects on enhancement of oxygen demand and nutrient load in the water. promoting toxic algal blooms and leading to destabilized aquatic ecosystem. Water of such poor quality may be acidic, rich in nutrients and organic matter , high in suspended solids or polluted with industrial or agricultural chemicals. Such a deterioration in water quality can result in fish being under stress and vulnerable to diseases. Fish ponds in freshwater areas of Darbhanga district play a vital role in fisheries to supply the much needed animal protein to the people inhabiting especially rural areas. There is dearth of information on production of fish from fish ponds in Darbhanga district. It is therefore important to know about Water quality parameters and their management which have influence on growth and survival of quatic organisms especially fish objective of the present investigation was to provide data on water chemistry and biological characteristics of the fresh water fish ponds of selected in Darbhanga district at Panchobh village.

Review of Literature :

Review of related literature is an important research effort as it provides comprehensive understanding of what is already known about the topic. It helps to avoid duplication of what has already been done, and provides useful directions and helpful suggestions for research work. 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).

Boyd (1985) 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.

Breitbart *et al.* (1997) 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.

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.

Gaikwad, R. W. & Sasane, V. V. (2013) has explained, the present work is aimed at assessing the water quality of the groundwater in and around Lonar Lake. Water quality has been determined by collecting groundwater samples and subjecting the samples to a comprehensive physiochemical analysis. For assessing water quality, pH, total hardness, calcium, magnesium, bicarbonate, chloride, nitrate, sulphate, total dissolved solids, iron, manganese and fluorides have been considered. The higher values has been found to be mainly for Iron, Total hardness, chloride, fluoride, calcium and magnesium, many literature shown that groundwater quality in Lonar Taluka has been badly affected by nitrate contamination. The analysis reveals that the groundwater of the area needs some degree of treatment before consumption, and it also needs to be protected from the perils of contamination. Many different options are now in progress for treatment of water locally. Various community based programs have been tried in the past, but only few of these purely community run plants are successful. The future lies in providing safe drinking water in rural areas with a mixture of these options so that the objectives of providing safe water at low cost for sustaining over a long time and reaching to maximum number of people is achieved.

Mahesh, M. K., Sushmitha, B. R. & Uma, H. R. (2013) have explained, a water quality index (WQI) developed by the Canadian Council of Ministers of the Environment (CCME) was applied to Hebbal lake of Mysore, Karnataka State, India, to study its impact on aquatic life, livestock and to know whether it is suitable for recreation, irrigation and drinking. The index of the lake is rated as poor with respect to drinking, recreation and livestock, marginal with respect to Aquatic life and excellent for irrigation purpose. The overall water quality is rated as poor. The water quality is almost always endangered or deteriorated and the conditions often deviate from natural levels. Anabaena and Microcystis aeruginosa form blooms, Phacus pleuronectes is also recorded and the lake water is unsuitable to protect aquatic life. Incidence of Fish kill occurred in 2011 due to contamination of water.

Materials and Methods :

Physico-chemical characteristics of water of Poorni pond in Darbhanga district at Panchobh village were studied at monthly intervals from July 2017 to June 2018 by choosing fixed spot by composite sampling method using labeled plastic container of five liter capacity. The method adopted for different physico-chemical parameters were followed according to the procedure described in the APHA, AWWA and WPCF 1998. The Physico-Chemical parameters were analyzed by -

1. pH: by Digital pH meter
2. Temp: by Thermometers
3. Turbidity: by Nephello Turbid Meter
4. DO: Using standard Winkler method by titration
5. CO₂: By titration method
6. Alkalinity: By titration method
7. Cl: By titration method
8. Total hardness: by using EDTA complexometric by titration
9. BOD: By titration
10. COD: Open condensation and digestion by titration
11. PO₄: By Spectrophotometer
12. NO₃: By Spectrophotometer

Results and Discussions :

The study area Poorni pokhar (Pond is locally called in Pokhar) is located between 26.1542⁰ N and 85.8918⁰ E. Poorni pond covering an area about 15 acres. The above said pond is in Panchobh village of Darbhanga District. This is one of the biggest tank coming under minor irrigation source of Panchobh village. It is approximately 200 years old pond artificially built for irrigation and domestic use. Since there is no research work has been carried out on this pond, an attempt has been made to assess the suitability of the physico-chemical characteristics of this pond water for pisciculture.

Colour :

Colour is an important parameter for any aquatic water body and indicates the purity of the water. National Agricultural Extension and Research states pale color, light greenish or greenish waters suitable for fish culture. Delince (1992) stated that the abundance of phytoplankton and zooplankton is responsible for the determination of the color of an aquatic body and Green, bluish green/ brown greenish color of water indicates good plankton population hence, good for fish health. In the present study, the pond water color is light green so the pond water is good for fish productivity.

pH :

pH is an important limiting factor in fish culture. It indicates the acid base balance of the water. The survival and growth of fish is also depending on pH of the water. The ideal pH for the growth of fishes is between 7.5 to 8.5, above and below this is stressful to the fishes. In present study pH ranged between 7.0 to 8.1. Similar range was also obtained by [3] who reported a range of 7.3-8.3.

Temperature :

A prior knowledge of maximum and minimum water temperature of the water body is essential for fish culture. Ideal temperature 24°C to 30°C holds good for fish culture in pond. In present study temperature ranged between 25.2°C to 26.4°C .

Table : 1

Physico-Chemical parameter analysis of Poorni pond at Panchobh village in Darbhanga District.

Period	pH	Temp.	Tur.	Do.	Co ₂	Alk.	Cl.	TH.	BOD.	COD.	PO ₄	NO ₃
July 2017	7.2	25.8	28.0	7.8	3.0	82.0	22.0	100.0	3.0	10.0	0.3	1.2
Aug. 2017	7.0	26.2	20.0	7.9	4.3	85.0	15.0	106.0	2.0	12.0	0.3	1.0
Sept. 2017	7.7	26.4	22.0	7.3	3.0	94.0	25.0	108.0	3.0	18.0	0.2	1.8
Oct. 2017	7.8	26.3	30.0	7.5	2.0	92.0	30.0	105.0	5.0	20.0	0.2	1.3
Nov. 2017	7.9	26.1	38.0	7.9	-	90.0	32.0	108.0	4.0	16.0	0.3	0.9
Dec. 2017	8.1	25.9	44.0	7.7	3.0	93.0	33.0	104.0	3.0	12.0	0.3	0.8
Jan. 2018	7.9	25.7	60.0	7.8	2.0	80.0	28.0	100.0	4.0	8.0	0.2	0.4
Feb. 2018	7.7	25.5	70.0	7.9	3.0	95.0	30.0	106.0	5.0	6.0	0.3	0.3
March 2018	7.2	25.3	64.0	7.6	1.0	84.0	32.0	110.0	4.0	8.0	0.3	0.6
April 2018	7.8	25.2	72.0	7.4	2.0	88.0	35.0	96.0	3.0	10.0	0.2	0.7
May 2018	8.0	25.4	56.0	7.5	1.0	89.0	40.0	106.0	2.0	8.0	0.3	1.0
June 2018	7.6	25.8	42.0	7.7	2.0	70.0	32.0	80.0	3.0	6.0	0.2	1.2

Electrical conductivity :

Electrical conductivity (EC) is a useful tool to evaluate the purity of water. It is dependent on the ionic concentration and water temperature. A total load of salts in a water body is directly related to its conductivity. Conductivity is also regarded as an indication of its freshness or otherwise of a water body. It has been reported that high values of conductivity are an indication of pollution. Verheust 1997 reported that conductivity can be used as an indication of primary productivity and thus fish production. The EC was recorded maximum during post monsoon and minimum during monsoon season. Similar results were observed by some workers Ramulu and Ancy Mol. These values fall within the WHO and ICMR limits, so the water would be regarded as safe for fish production.

Turbidity :

Turbidity refers to the decreased ability of water to transmit light caused by suspended particulate matter and phytoplankton. The range of turbidity obtained in the present study was 20 to 72 NTU. According to Zweigh 20-30 NTU is suitable for fish culture. But in present study we observed little more turbidity comparatively with Zweigh findings.

Dissolved oxygen :

Dissolved oxygen is a measure of amount of gaseous oxygen dissolved in an aqueous solution that plays a vital role in the biology of cultured organisms. Of all the dissolved gases in water, oxygen is the most important for the survival of organism under aquaculture. In present study DO obtained in the range of 7.3 to 7.9 mg/l. the minimum concentration of DO is 4 mg/l should be maintained in fish ponds at all times. Present study DO values agree with those of, pointed out that the minimum DO should be 5 mg/l for tropical fish.

Carbon dioxide :

Free Carbon dioxide in water is the byproduct of metabolism. More than a particulate level, carbon dioxide in water is toxic to the life in water. In present study the value of CO₂ is ranged between Nil to 4 mg/l, but the water supporting good fish population should contain 5 mg/l free carbon dioxide. According to this, the CO₂ which we obtained in our findings coincides with above value.

Alkalinity :

Alkalinity is the sum of negative ions reacting to neutralize hydrogen ions when an acid is added to water. Concentration of alkalinity will be taken care by proper liming. The ideal value for fish culture is 50- 300 mg/l. In present study the alkalinity value we got is ranged between 70 to 95 mg/l.

Chloride :

In present study chloride obtained was in the range of 15 to 40 mg/l. But according to reported chloride value ranged between 10- 25 mg/l in his findings good for fish culture but according to above value, the values which we got in our findings are little more.

Total Hardness :

Hardness of water depends on the dissolved solids and pH. Hardness gives a measure of the total concentration of the divalent metallic cations like Calcium, Magnesium and Strontium. Proper liming can rectify the hardness. The ideal value of hardness for fish culture is 30-180 mg/ltr The hardness in the present study ranged between 80 to 110 mg/ltr. But reported hardness ranged between 25-100 mg/l for good fish culture. The value which we got in our findings are little more but harmony with above findings of.

Salinity :

Salinity plays an important role in the growth of culture organisms through osmoregulations of body minerals from that of the surrounding water. It is a major driving factor that affects the density and growth of aquatic organisms population. It acts as a major ecological factor controlling the phytoplankton population of freshwater. According to Meck 1996 fresh and saltwater fish species generally show poor tolerance to large changes in water salinity. Often salinity limits vary species to species level. During the present study the salinity ranged between 11 to 19 ppt. The maximum value for salinity was recorded in summer season and minimum in premonsoon and monsoon period. High salinity concentration was associated with fungi and bacterial density of phytoplankton population as observed by Rani and Shrivastava also found similar results as observed in the present study.

BOD :

The Biochemical Oxygen Demand is the amount of oxygen taken up by micro-organism that decomposes organic waste matter in water. This is an indication of both sewage and industrial pollution. The optimum BOD level for aquaculture should be less than 10 mg/l. In present study the value of BOD is ranged between 2.0 mg/l to 5.0 mg/l which are harmony. But according to the permissible value of BOD is 4 mg/l. Accumulation of low BOD results in organisms being stressed, suffocated and death may occur. This condition was not observed in the present study.

COD :

The Chemical Oxygen Demand of water represents the amount of oxygen required to oxidize all organic matter, biodegradable and nonbiodegradable by a strong chemical oxidant. This is an indication of both sewage and industrial pollution. The ideal value of COD should be less than 50 mg/l for fish culture. In present study the COD value is ranged between 6.0 mg/l to 20.0 mg/l.

Phosphate :

Phosphate value obtained in this present study ranged between 0.2 to 0.3 mg/l. Phosphate although present in very small quantity in water is important for the production of phytoplanktons, which forms food for fishes.

Nitrate :

Nitrate is not toxic to aquatic animals even in large concentrations. Its favorable range is 0.1 to 4.5 mg/liter, in culture water. In present study Nitrates value obtained in the range of 0.3 to 1.8 mg/l. This value is harmony as desirable limit is 0 to 2 mg/lit and acceptable limit less than 4 mg/l.

Conclusion :

In present study turbidity value is little more so turbidity can be reduced by scattering gypsum on the entire pond water at the rate of 200kg/1000m³ of pond or lime application also will reduced the turbidity level. Other parameters are within the normal range which is suitable for fish culture. There is desirable need to analyze the fish pond water at regular intervals. Liming should be done at regular intervals of time depending on the pH of pond water. Drag-netting operation racking should be done at least once in a month to disturb the pond bottom and to ensure good quality conditions. Lime application will correct pH to a more acceptable level for fertilizer use. There is also the desirable need to analyze the pond water at regular intervals. Farmers should be educated on better managerial practices bordering on feeding practices, pond management, good water exchange practice to reduce organic load and waste accumulation. This will ensure that some of the parameters in this study will not exceed levels that could be harmful to fish in the environment. Such a measure will guarantee the safety of the aquatic ecosystem, humans and environment for good and healthy production of fish for consumption. If pond condition is maintained no doubt a better yield of fishes can be obtained and it is economically advantage to farmers. Further detailed analysis in different seasons involving other related Parameters as well, will throw more light on the status of these ponds.

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