

Assessment of Water Quality of Harahi Pokhar for Fish Culture, Darbhanga, Bihar

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ABSTRACT

The present investigation has been carried out in Harahi Pokhar (26° 09'N-85° 54' E) located at Darbhanga district, Bihar, for the assessment of water quality for fish culture by measuring various physico-chemical parameters. The different physico-chemical parameters like Temperature, pH, Total alkalinity, TDS, Total hardness, Turbidity, Dissolve Oxygen, BOD, Chloride, Phosphates and Nitrates were carried out. The obtained values of the investigated parameters were temperature 19.2 °C – 30.9 °C, pH 6.20 – 7.90, Transparency 128cm – 148cm, DO 5.78mg/l – 7.12mg/l, CO₂ 2.60 mg/l - 4.80 mg/l, Alkalinity 160 mg/l – 220 mg/l, Hardness 94 mg/l – 120 mg/l, TDS 160 mg/l – 180 mg/l, BOD 4.00 mg/l – 7.48 mg/l, Chloride 8.78 mg/l – 18.70 mg/l, Phosphate 0.2 mg/l – 0.3 mg/l and Nitrate 0.7 mg/l – 1.8 mg/l. All the values were compared with the water quality standards for fish culture. The comparative analysis showed that most of the water quality parameters of the Harahi pokhar were suitable for permissible range for major carps.

Keywords: *Physicochemical analysis, Harahi Pokhar, Fish Culture.*

INTRODUCTION

Harahi pokhar is the one of the popular pond among three ponds and it is located in Darbhanga district of Bihar near Darbhanga railway station. As this pond is situated in the heart of the town it is not untouched from sewage of the town.

Water is a common chemical substance that is essential for the survival of all known form of life. Around 75% of earth's surface is covered with water. Out of this, more than 97% lies in its oceans and only 2.4% of water is considered as fresh water. Surface water in rivers, lakes and ponds are come under this small portion which are easily accessible for human uses. But now days, surface water resources are most vulnerable to pollution due to the unscientific disposal of wastewaters. The quality of surface water is governed by the natural and anthropogenic processes, including rainfall, erosion, hydrologic features, industrial and agricultural activities (Bhat *et al.*, 2014 and Sarthi *et al.*, 2013). Water is the main environment for fish where they perform all their physiological activities like breathing, excretion of waste, feeding, salt balance, reproduction *etc.* so the water quality is the main determining factor for fish and aquaculture. Bronmark and Hansson (2005) state that fishes are totally dependent upon water to breathe, feed and grow, excrete wastes, maintain a salt balance, and reproduce. For fish culture some most important limiting factor which is normally governed by a number of parameters including color, odor, temperature, pH, DO, BOD, TDS, EC, transparency, acidity, alkalinity and hardness (Boyd, 1990). Each of these parameters has a standard value for fish culture (James, 2000). Ventakatesharaju *et al.* (2010) reported that health of the aquatic ecosystem is depends on the water quality. The majority

of fish culture throughout the world is conducted in ponds. These changes in water quality by industrial effluents, agricultural pollution and human waste are creating the environment unfavorable for aquatic lives. The concentration of various chemical parameters level increases due to human activities, and lack of environmental regulation (Mehedi *et al.*, 1999), which inhibits conducting fish culture. According to Swann (1993) pond habitats can easily be manipulated by controlling the water characteristics.

Present study aims at investigating the physicochemical parameters of pond water and comparing the analyzed values with the standard values for fish culture.

MATERIALS AND METHODS

Study Area:

Harahi pokhar is the one of the popular pond among three ponds of Darbhanga and it is situated at the western side of Darbhanga railway station. Geographically It is located between longitude 85⁰ 54' 21" E and latitude 26⁰ 09' 24"N. This pond is rectangular in shape and covered area of about 1600 ft. X 1000 ft. Water sampling was carried out over a one year period (March 2015 to Feb. 2016) in a month interval. For sampling, different size of bottles and cans were used. For physico-chemical analysis 2L of cane, for BOD 300ml glass bottle and for bacteriological analysis 100ml autoclavable plastic bottles were used to collect surface water samples. For BOD, special care was taken to avoid the mixing of atmospheric oxygen during collection. Collected samples were kept in ice box to maintain 4°C temperature and immediately carried to the laboratory carefully for further analysis. Some of physicochemical parameters like temperature (°C), pH, transparency (cm) and Dissolve Oxygen (DO) were analyzed on spot using Delux water and soil analysis kit (Labtronics, Model LT- 60) while rest of the parameters including, Alkalinity (mg/l), Total Hardness (mg/l), Phosphate (mg/l), Nitrate (mg/l), Chloride (mg/l), and BOD (mg/l) were analyzed in laboratory.

Temperature:

Temperature is the measure of heat and cold. It is measure in °C. When the water is cooler there is more oxygen and when the water is warmer there is less oxygen in the river. It changes with the season and during the day. It must be measure as soon as sample is taken from ponds. For measuring temperature, water sample was taken in a bottle and immediately a probe was immersed into water and waited for 1 minute for reading. Reading was recorded while the thermometer was into the water sample.

pH:

The pH of water sample was carried out to determine the hydrogen ion concentration. It was determined by using a Delux water and soil analysis kit (Labtronics, Model LT- 60), which was first calibrated with buffer 4 and 7 using 1M NaOH and 1M HCL. The pH probe of the analytic kit was rinsed with distilled water before testing. Samples of 20 ml of pond water were measured in labeled beakers, and then the probe was inserted into the sample. The reading was taken when the pH meter displayed a constant value. The probe was rinsed with distilled water and cleaned with tissue paper after each insertion in the various samples (Ehiagbonare and Ogunrinde, 2010).

Transparency:

The transparency of water is the measure to the cleanliness of the water. It depends upon the concentration of total suspended solids (TSD) and biota in water. Transparency affects the intensity of light and so aquatic system. For measuring transparency of pond water Secchi disk was used. A Secchi disk is an 8-inch diameter disk with alternating black and white quadrants and a mark string is attached to its center. It was lowered into a pond until it disappeared from sight and the depth at which it disappeared and reappeared were averaged and measured as transparency of water.

Total Dissolve Solid (TDS):

TDS was also determined by Delux water and soil analysis kit (Labtronics, Model LT- 60). Probe was inserted into the analysis kit and calibrated. After calibration probe was immersed into the water samples and readings were noted.

Dissolved Oxygen (DO):

Dissolved Oxygen (DO) was carried out to determine the amount of oxygen present in water. It was also estimated by Delux water and soil analysis kit (Labtronics, Model LT-60). For estimation DO of the water sample, at first DO probe was inserted into the kit and knob of the kit was adjust on the point representing DO. Before immersing DO probe into water sample it was uncapped and reading was recorded when stable.

Biological Oxygen Demand (BOD):

Biological Oxygen Demand (BOD) is defined as the amount of oxygen absorbed by water sample during specified period, at specified temperature for the aerobic destruction or use of organic matter by living organisms. The difference in dissolved oxygen between the initial and the fifth day measurement represent biochemical oxygen demand. BOD of waste water is the amount of dissolved molecular oxygen consumed by micro organisms to oxidize only bio waste present in 1 dm³ of waste water incubated at 20⁰C for a period of 5 days. It is the widely used method for the assessment of water quality. To determine oxygen consumed by micro-organisms Winkler's Iodometric method was used. For this two 1 liter water bottles were taken and both of them were filled with 50ml of water samples and 1 ml of sludge containing nutrients like MgSO₄, FeCl₃, CaCl₂ solution and 1ml of phosphate buffer to maintain pH 7.2 and then that 50ml of water was further diluted to 900ml with distilled water, and both were further saturated with O₂ bubbling air. One bottle was incubated at 20⁰C for 5 days and DO of another water bottle was determined immediately. DO content in the sample was determined after the 5 days of incubation and BOD was determined by using following mathematical calculation.

$$\text{BOD (mg/l)} = (\text{DO}_0 - \text{DO}_5) \times \text{diluted factor}$$

Where, DO₀= Initial DO in the sample

DO₅= DO after 5 days.

Free CO₂:

Free CO₂ was determined by Welch (1948) method. It was determine by titrating the sample with strong alkali (NaOH) at ph 8.3. 100 ml of sample was taken in a conical flask and 10 drops of Phenolphthalein was added as indicator. And then it was titrated against

0.05N NaOH and at the end point was recorded when pink colour was appeared. Free CO₂ was calculated by following formula.

$$\text{Free CO}_2 \text{ (mg/l)} = (\text{ml} \times \text{N}) \text{ of AgNO}_3 \times 100 \times 35.5 \text{ ml sample.}$$

Total hardness:

Total hardness is the measure of presence of dication such as Ca²⁺ and Mg²⁺ salts. It is also responsible for the spawning fish. In this study total hardness is measured by titration using EDTA (ethylenediaminetetraacetate) and suitable indicator.

Total Alkalinity:

Total alkalinity is the measure of bases present in water such as carbonate. It also helps to maintain buffer system of water which is essential for aquatic life. In this study alkalinity was determined by adding few drops of phenolphthalein in 100 ml of water sample I in a 250 ml of conical flask. It was then titrated against 0.02 N sulphuric acid till the pink colour disappeared and the titer value was noted for calculation.

Chloride:

It was determined by titration method in the form of chloride ion. 50 ml of sample was taken in Erlenmeyer flask and 2ml of K₂CrO₄ was added in it. It was then titrated against 0.01N AgNO₃. Then chloride was determined by the formula:

$$\text{Chloride (mg/l)} = (\text{ml} \times \text{N}) \text{ of AgNO}_3 \times 100 \times 35.5 \text{ ml sample.}$$

Test for Nitrate, and Phosphate:

The concentration of nitrate was determined by measuring 10 ml of the water sample into a Nessler tube and the same amount of distilled water was measured into a Nessler tube, 0.5 mL of brucine and 20 mL of concentrated H₂SO₄ was added to each, thereafter the turbidity of colour produced by each tube was measured using a Digital spectrophotometer (Labertonic, Modal LT- 31) at a wavelength of 470 nm (Ehiagbonare and Ogunrinde, 2010). Phosphate were measured using Nessler reaction and Ascorbic acid method respectively (Njoku *et al.*, 2015).

RESULTS AND DISCUSSION

The monthly variations of different physico-chemical parameters of Harahi pokhar are shown in (Table-1). The results are summarized on the month basis. The finding reveals very interesting facts which are summarized in sequences of physicochemical parameters. The temperature of pond water was found in the range 19.2⁰ C – 30.9⁰ C. The lowest temperature was recorded in the month of January and highest in the month of May. The findings are close to recommended range 24 to 30⁰ C (Santhosh and Singh, 2007). As we know that water pH is one of the important parameters which play a crucial role in different life sustaining chemical reactions. In this study, pH of surface water varied from 6.70 to 8.60, which is close to pH range for fish culture (Santhosh and Singh, 2007). It was minimum during the month of September, while maximum value was observed in the month of June. (Table -1). The water was neutral to alkaline in nature throughout the year. The relatively low value of pH in September could be due to a rain. Again all the samples were observed under the range of safe limit (6.5 - 9.0), suggested by BIS for surface water quality. Transparency was found between 128 – 248 cm.

Table 1
Physico-chemical properties of Hrahi Pond water from March 2015 to Feb. 2016.

Months	Temp. (°C)	pH	Trans. (cm)	DO (mg/l)	CO ₂ (mg/l)	Total Alk. (mg/l)	Total Hard. (mg/l)	TDS (mg/l)	BOD (mg/l)	Cl (mg/l)	PO ₄ (mg/l)	NO ₃ (mg/l)
March-15	24.8	7.50	138	5.90	3.98	191	120	167	4.78	10.42	0.3	1.0
April-15	29.5	7.34	136	5.78	4.56	192	118	169	5.82	10.00	0.2	1.2
May-15	30.9	7.84	137	6.22	4.80	160	110	174	4.83	9.20	0.2	1.8
Jun-15	29.9	7.90	135	6.70	3.80	180	104	175	6.84	8.78	0.3	1.6
July-15	28.2	7.80	132	6.80	2.86	200	95	172	6.82	9.76	0.3	1.0
Aug-15	27.0	6.20	128	6.82	2.90	210	94	174	6.87	9.68	0.2	0.9
Sep.-15	26.8	7.22	128	6.82	2.60	218	98	180	6.90	12.40	0.2	0.7
Oct.-15	26.0	7.23	130	6.90	2.48	220	100	178	7.48	14.30	0.3	0.8
Nov.-15	24.1	7.58	148	6.98	2.68	216	105	160	5.26	16.50	0.2	1.3
Dec.-15	22.0	7.23	142	7.00	3.10	208	108	162	4.22	18.70	0.3	1.1
Jan.16	19.2	7.44	136	7.12	3.34	200	114	163	4.00	16.40	0.2	1.2
Feb.-16	20.6	7.48	137	6.98	3.87	205	118	165	2.68	12.80	0.3	1.1

DO level was found between 5.78 mg/l to 7.12 mg/l, which was greater than 5 mg/l, so suitable for fish culture (Bhatnagar *et al.*, 2010). Level of CO₂ was found between the range 2.60 mg/l to 4.80 mg/l. Alkalinity of water was found between 160 mg/l to 220 mg/l which was also under the recommended range 50 mg/l to 300 mg/l (Santhosh and Singh, 2007). The total hardness of the pond was recorded between 94 mg/l to 120 mg/l which was above the recommended range 30mg/l-180mg/l (Santhosh and Singh, 2007). The sudden variation in hardness was recorded during monsoon and TDS was also gave desired result for fish culture as concerned with recommended value (BIS). BOD level was found between 4-00 mg/l – 7.48 mg/l, which indicate the quality of water was moderate to somewhat polluted. According to Bhatnagar *et al.* (2004) the BOD level between 3.0-6.0 mg L/l is optimum for normal activities of fishes, 6.0-12.0 mg L/l is sublethal to fishes and more than 12.0 mg L/l can usually causes fish kill due to suffocation. The value of chloride and phosphate was measured in the range 8.78 mg/l - 18.70 mg/l and 0.2 mg/l – 0.3 mg/l respectively and concentration of nitrate (0.7 – 1.8 mg/l) also came under the desirable range for fish culture (BIS).

CONCLUSION

From the above data it is found that the physico-chemical parameters of Harahi pond, favour for good production of major carps like Rohu (*Labeo rohita*), Catla (*Catla catla*) and Mrigala (*Cirrihinus mrigala*).

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REFERENCES

1. Bhat, S. A., and Pandit, A. K. 2014. Surface Water Quality Assessment of Wular Lake, A Ramsar Site in Kashmir Himalaya, using discriminant analysis and WQI², *J. Ecosys.*, p.18.

2. Bhatnagar, A. and Singh, G. 2010. Assessment of culture fisheries in village ponds: A study in district Hisar, Haryana, India. *International Journal of Environmental Research*. Iran, 4(1):57-64.
3. Bhatnagar, A., Jain, S. N, Garg, S. K, Patra, B. C, Sing, G. and Barman, U. K.2004. Water Quality Management in Aquaculture, In Course Manual of Summer School on Development of Sustainable Aquaculture Technology in Fresh and Saline water, CCS Haryana Agricultural, Hisar (India), p. 203-210.
4. BIS.1991. Indian standards for surface water, Bureau of Indian Standards, New Delhi, IS 2296.
5. Boyd, C. E.1990.Water quality in ponds for aquaculture. Alabama agricultural experiment station, Auburn University Alabama, p.482.
6. Bronmark, C. and Hansson, L. A.2005.The biology of lakes and ponds. Oxford University Press, Oxford, p.285.
7. Ehiagbonare, J. E., Ogunrinde, Y. O.2010. Physicochemical Analysis of Fish Pond in Okada and its Environs. Nigeria, *African Journal of Biotechnology*. 36:5922-5928.
8. Hanna, S. K., Haukenes, A. H., Foy, R. J., and Buck, C. L.2008. Temperature effects on metabolic rate, swimming performance and condition of Pacific cod *Gadus macrocephalus* Tilesius, *Journal of Fish Biology*, 72:1068–1078.
9. James, M. E.2000. Water Quality and Recalculating Aquaculture Systems. Aquaculture Systems Technologies, LLC. New Orleans, LA, p.16- 17.
10. Mehedi, M. Y., Kamal, D., Azam, K., and Y. S. A. Khan.1999.Trace metals in coastal water along the ship breaking area, Chittagong, Bangladesh. *Khulna University Studies*, 1:289-293.
11. Njoku, O. E., Agwa, O. K. and Ibiene, A. A.2015. An Investigation of the Microbiological and Physicochemical Profile of Some Fish Pond Water within the Niger Delta Region of Nigeria. *European Journal of Food Science and Technology*, 3:20-31.
12. Santosh, B and Singh, N. P.2007.Guidelines for Water quality Management for Fish culture in Tripura.
13. Sarthi, P. P., and Singh, A. K.2013. A Simple approach about the Characteristics of Available Surface Water in the Bihar State of India, *Geosc*, 3(2):68-76.
14. Sudhira, H. S., Ramachandra, T. V., and Jagadish, K. S.2004.“Urban sprawl: metrics, dynamics and modeling using GIS”, *Int. J. Appl. E. Obs. Geoin*, 5(1):29-39.
15. Swann, LaDon.1993.Water Sources Used in Aquaculture. Illinois-Indiana Sea Grant Program. AS- 486. Purdue University, West Lafayette, Indiana.p.4.
16. Venkatesharaju, K., Somashekar, P. K. and Parkash, K. L.2010. Physico-chemical and Bacteriological Investigation on the river Cauvery of Kollegal Stretch in Karnataka, *J. Sci. Engineering and Technology*, 6(1):50-59.