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Seasonal variation in physico-chemical and biological analysis of Baraila Lake, Vaishali, Bihar

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Abstract- Some of the physico-chemical and biological characteristics of Baraila Lake in Vaishali Bihar such as colour, odour, temperature, electrical conductivity (EC), total suspended solids (TSS), total dissolved matter (TDS), turbidity and pH, alkalinity, hardness, chloride, sulphate, nitrate, fluoride were investigated. Dissolved Oxygen (DO), Chemical Oxygen Demand (COD), Biochemical Oxygen Demand (BOD), iron, copper, lead and microbiological parameters such as total coliform and plantain were investigated. In the results of this study we have found that the lake water is slightly contaminated and not suitable for drinking purpose, but suitable for bathing, aquaculture and irrigation

Key words: Quality, water, aquaculture, physico-chemical, parameters.

INTRODUCTION

Water is one of the most important resources on this earth. Without water there would be no life on this earth. Water is the source of all biological life and their sustenance. Water quality has become a major global issue due to increase in human development activities. Pollution is also one of the serious problems as a large part of India's surface water resources including Bihar have been contaminated with chemical and biological pollutants. Lake pollution in Bihar is in a serious condition due to the huge amount of pollutants released by urban activities. Health and sustainable development of agriculture would not be possible without fresh water. The physico-chemical and microbiological parameters of the lake water of different sampling points have been studied. The objective of this study was to evaluate the water composition and quality of the Baraila Lake in Vaishali, Bihar.

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STUDY AREA

Baraila Lake is a prominent floodplain marsh spanning about 1625.34 ha of surface area. It is located from 25°57'N to 25° 36'N latitudes and 87° 53'E to 87°25'E longitudes in the Vaishali district. This lake was notified as Bird Sanctuary by the Bihar government in 1997. Baraila lake/wetland, place to stay of many attractive birds, in Bihar's Vaishali district. The lake/wetland is a natural home for some 59 species of migratory birds and about 106 variety of local avian. The use of fertilizers, pesticides and manure are main source of water pollution in this area. Water is important factors for every living organism on this planet. Water is generally used for drinking, fisheries and other domestic purposes in this area. The available fresh water to man is hardly 0.3 to 0.5% of the total water

available on the earth and therefore its judicious use is imperative. Fish is a source of protein and very important cash crop in many part of India. The role of various factors like Temperature, Water colour, pH, TDS, TSS, EC, TA, TH, Ca, NO_3^-, SO_3^-, Cl^-, DO and BOD etc can't be overlooked for maintaining a healthy lake environment and for increasing fish production. The entire lake is eutrophic (algal boom) and its water may be suitable for drinking but can be use for bathing and fish culture.

The freshwater is of vital concern for mankind since it is directly linked to human welfare. On the other hand, Baraila Lake also provides a habitat for invertebrates, fishes and aquatic birds. Therefore scientific study needs to review strategies for conservation and better utilization of lakes. It is with this background, the present work was undertaken between July 2018 to May 2019.

Notable contribution are those of APHA(1981)[1], APHA (1995)[2], Battish (1992)[3], Bohl (1989)[4], Boyd and Tucker (1992)[5], Chatterjee (1992)[6], Chatterjee and Raziuddin (2002)[7], Drum *et al.* (2002)[8], Freeze and Cherry (1979)[9], Singh and Kumar (2011)[10], Gupta (2005)[11], Golterman (1978)[12], Goel (2009)[13] Horton (1965)[14], Jhingran (1988)[15], Joseph *et al.* (1993)[16], Kumar (2018)[17], Mahesh *et al.* (2013)[18], Munawar (1970)[19], Chandra *et al.* (2009)[20], Rejil (2013)[21], Singh (2012)[22], Singh *et al.* (2011)[23] Singh *et al*. (2009)[24], Singh *et al*.(2009)[25].

Fig. 1- Picture of Baraila Lake

Fig. - Collection of sample from Baraila Lake

MATERIALS & METHODS

The methodology of proposed work purely analytical done according to the procedure recommended in APHA and NEERI guidelines for ambient water quality. The physical, chemical & microbiological characteristics of Baraila Lake were evaluated during pre monsoon seasons. The sampling was done from different sampling site of Baraila Lake. All the collected samples are immediately preserved in dark sterile boxes and processed for following different analysis.

- **pH:** pH value of water sample is determined by pH meter using standard buffer solution of ph 4.0,7.0 & 9.0.
- **Temperature:** Temperature was measured with the thermometer immersed directly in the water body, after a period of time sufficient to permit constant reading.
- **Colour:** Colour is measured by visual comparison method.
- **Turbidity:** It is determined by Nephalpmeter.
- **Conductance:** Conductance is the measure of salinity and measured by conductivity cum TDS meter.
- **Total Dissolved Solid:** It is determined by conductivity cum TDS meter.
- **Total Hardness:** The hardness of water body was determined as per standard methods (APHA, 1995)[2]
- **Total Alkalinity:** Total alkalinity is analysed as per prescribed method with standard hydrochloric acid solution.
- **Chloride:** Chloride measured by Argentometric titration method with standard silver nitrate using potassium.

- **Sulphate and Nitrate:** Both are determined by HACH UV-VIS spectrophotometer.
- **Fluoride:** It is measured by SPADNS method by HACH UV-VIS spectrophotometer.
- **Iron, Copper & Lead:** All these three heavy metals were analyzed by AAS.
- **Dissolved Oxygen:** The water sample was analyzed by Wrinkler's method with Azide modification.
- **Biochemical Oxygen Demand and Chemical Oxygen Demand:** It was determined by standard method.
- **Total Coliform:** It was determined by Multiple Test tube method.
- **Planktons:** It was determined by using standard method prescribed by APHA.

RESULTS & DISCUSSION

Table 1- Seasonal variations in Physico-Chemical & Biological Characteristics of Baraila Lake, Vaishali, Bihar

S. No.	Parameters	Pre-Monsoon		Monsoon		Post-Monsoon		Standard Value (BIS)	Analytical Methods
		Mean	±SD	Mean	±SD	Mean	±SD		
1	PH	8.05	0.06	7.44	0.07	7.66	0.08		
2	Colour	Yellow	0.00	Light yellow	0.00	Light yellow	0.00	-	Visual comparative
3	Temp (^oC)	35.15	0.20	32.99	0.14	27.418	0.09	40	Thermometertric
4	Turbidity (NTU)	4.69	0.08	5.72	0.15	5.24	0.06	-	Nephelometer
5	Conductivity (µs/cm)	784.46	0.96	674.93	0.48	815.28	0.71	-	Conductivity metre
6	TDS (mg/l)	211.65	0. 67	292.00	0.00	283.50	1.87	1500	TDS metre
7	Total hardness (mg/l)	684.51	0.93	620.96	0.60	634.56	0.94	-	Titrimetric
8	Ca (mg/l)	104.05	0.61	184.20	0.64	173.30	0.54	-	Titrimetric
9	Mg (mg/l)	102.04	0.26	38.82	0.37	8.46	0.49	-	Titrimetric
10	Chloride (mg/l)	195.30	0.96	156.99	0.92	177.89	0.48	600	Titrimetric
11	Total Alkalinity (mg/l)	681.34	0.49	725.5	0.57	674.05	0.75	-	Titrimetric
12	Nitrate (mg/l)	47.81	0.38	54.77	0.47	45.34	0.45	45	UV- spectro photo Meter
13	Sulphate (mg/l)	228.63	0.93	289.70	0.58	195.74	0.72	400	UV- spectro photo Meter
14	Phosphate (mg/l)	1.66	0.02	2.10	0.02	1.23	0.03	5	UV- spectro photo Meter
15	Fluoride (mg/l)	0.64	0.01	0.77	0.00	0.60	0.00	1.5	UV- spectro photo Meter
16	Iron (mg/l)	0.50	0.00	0.41	0.05	0.36	0.02	0.5	AAS
17	Copper (mg/l)	0.00	0.00	0.00	0.00	0.00	0.00	1.5	AAS
18	Lead (mg/l)	0.00	0.00	0.00	0.00	0.00	0.00	-	AAS
19	DO (mg/l)	6.37	0.05	5.83	0.06	7.04	0.04	5	Titrimetric (winkler's)
20	BOD (mg/l)	4.97	0.07	4.39	0.10	1.35	0.09	3	05 days incubation at 20^oC
21	COD (mg/l)	8 7.78	0.85	93.55	0.50	98.27	0.33	-	Open Reflux
22	Total Caliform (MPN/100ml)	238	13.17	76	5.05	142	9.85	500/ 100 ml	Multiple Test tube method
23	Planktons (count/litre)	450.88	190.05	457.71	187.11	446.83	191.46	-	Counting cell Sedgwick Rafter (S-R) cell

PHYSICAL PARAMETERS

1. pH- The water of Baraila Lake remain alkaline throughout the year. The pH value recorded ranges from 7.0 to 8.5. The highest value of pH was recorded during summer season and the lowest was recorded during monsoon season. The low value during monsoon may be due to dilution of rain water.

2.Temperature- The temperature of Baraila Lake ranges from 25.7°C to 36.7°C the highest temperature was noted during the summer season and the lowest was recorded during the winter season.

3. Turbidity- Suspension of particles in water interfering with passage of light is called turbidity. Baraila Lake ranges on 4.1 NTU to 6.1 NTU. The high value was

recorded during monsoon season and low value was corded during winter season. The maximum values of turbidity in monsoon may be due to rainfall lot of sediments from the surrounding area.

4. Conductivity- Electric conductivity recorded in Baraila Lake ranges from 671 ìS/cm to 817.5 µS/cm. The high-value of conductivity was recorded during the summer season were as low value was recorded during monsoon season.

5. TDS- Total dissolved solids are the solids present in water in the dissolved state. In Baraila Lake the amount of total dissolve solid recorded ranges from 203 ppm to 302 ppm. The high amount of TDS was recorded during summer season were as low amount of TDS was recorded during monsoon season. Concentration of total dissolved solids during summer, which decrease during rainy seasons due to dilution of rainwater.

CHEMICAL PARAMETERS:

6.Total Hardness- The hardness of water is the measure of the capacity of water to react with soap. The amount hardness in the water of Baraila Lake recorded, ranges from 612.4 ppm to 687.1 ppm. The maximum value was recorded during summer and minimum value was recorded during monsoon season. The amount of hardness recorded in Baraila Lake is within the desirable limit. The hardness of water is due to excessive presence of calcium and magnesium.

7.Calcium- It is reported that calcium and magnesium are the principal cations that impart hardness. The amount of calcium recorded in Baraila Lake ranges from 93.2ppm to 188.2 ppm. The amount of calcium recorded was maximum during summer season were as minimum during winter season. The amount of calcium increases during summer season due to rapid oxidation / decomposition of organic matter. Ohle classified water bodies into: (i) poor (ii) medium and (iii) rich water body with regard to calcium content. The desirable value of calcium as per BIS is 75ppm, which shows that water of Baraila Lake is within a desirable limit.

8.Magnessium- The magnesium amount recorded in the water of Baraila Lake ranges from 35 ppm to 108.1 ppm. The maximum amount was recorded during winter season were as minimum amount was recorded during monsoon season.

9. Chloride- The chloride concentration was used as an important parameter for detection of contamination by sewage. It is reported that chlorides usually occur as NaCl, $CaC1_2$, $MgCl_2$, and in widely varying concentration in all natural water. The value of chloride recorded in Baraila Lake ranges between 153.8 ppm and 196.9 ppm. The high amount of chloride was recorded during summer season and low value was recorded during winter season. It is reported an increase in chloride content of water during summer seasons.

10. Total Alkalinity- The alkalinity recorded for different season in Baraila lake ranges from 670 ppm to 729 ppm. The high value of alkalinity was recorded during monsoon and the low value of alkalinity was recorded during summer season. The changes in alkalinity depends on carbonates and bicarbonates and also depends upon release of CO2.

11.Nitrate- The nitrate in Baraila Lake ranges from 44.1 ppm to 56.7 ppm. Nitrate concentration of more than 5 mg/l in water usually indicate pollution made by human and animal or fertilizer runoff.

12. Sulphate- Sulphur is constitutes nearly 0.1% in the earth crust. It occurs as hydrogen sulphide in spring waters, coal, gas, sewage gas etc. In natural water, sulphide is the second most common anion, being from most sedimentary rocks. In the present investigation, the values of sulphate recorded are 193.7 mg/lit. to 293.3 mg/lit in Baraila Lake.

13. Phosphate- The phosphate in Baraila Lake ranges between 1.1 ppm to 2.2 ppm. It was observed that the constant addition of even low levels of nitrogen and phosphorous to an aquatic environment could greatly stimulate algal growth. The decrease in Phosphate values in monsoon was due to absorption by planktons.

14. Fluorid- The amount of fluoride recorded in Baraila Lake ranges between 0.5 ppm to 0.9 ppm. The maximum was recorded during the monsoon season and minimum was recorded during winter season.

15. Heavy Metals (Iron, Copper & Lead)- Trace elements analysed in all the surface water samples indicate that many of the trace elements are also not within prescribed limit by Bureau of Indian Standards. A plot of the analytical results shows that iron varies from 0.31 mg/l to 0.56 mg/l, Copper & lead was not detected in Baraila Lake.

16. DO- It is reported that the measurement of dissolved oxygen is a primary parameter in all pollution studies. The amount of dissolve oxygen is higher in those

places where there is a good aquatic life. In Baraila Lake the amount of dissolve oxygen recorded ranges from 5.39 ppm to 7.21 ppm. The maximum value of dissolve oxygen was in monsoon season and the minimum value was in summer season.

17. BOD- BOD refers to the amount of oxygen used by microorganism in the aerobic oxidation of organic matter. The BOD recorded in Baraila Lake ranges between 1.10 ppm to 5.32 ppm. In Baraila Lake the amount of DO is more in compare to BOD which shows that water of Baraila Lake is free from organic waste showing less microbial activity.

18. COD- The chemical oxygen demand (COD) test is commonly used to indirectly measure the amount of organic compounds in water. Most applications of COD determine the amount of organic pollutants found in surface water (e.g. lake and river), making COD a useful measure of water quality. In the present investigation, the chemical oxygen demand values recorded are 85.8 mg/lit. to 100 mg/lit. in Baraila Lake, It is recorded the maximum chemical oxygen demand in summer, moderate in winter and minimum in monsoon at six stations of Baraila Lake, Vaishali. In the present investigations, higher value during summer maybe due to higher decomposition activities and low levels of water. However minimum chemical oxygen demand in winter is due to low temperature, low decomposition activities and dilution effect.

BIOLOGICAL PARAMETERS:

19. Total Coliform- The Total coliform number decreased from pre-monsoon (summer) to monsoon. The Total coliform numbers per 100 ml of water ranged from 32 to 334 in Baraila Lake. The coliform group of organisms meets the criteria for a satisfactory biological indicator of water contamination. The high concentration of organic matter of fecal origin possibly arises from the residential inhabitants at the bank of the river. The lesser density in the lake water might be possibly due to the inhibition of microbial multiplication by the toxic effluents.

20. Planktons- The study revealed that the Baraila Lake sustain moderate populations of planktons. However, the density of planktons is ranges from 275 to 754 in Baraila Lake. In soft waters the population density is observed to be less and generally does not exceed a few thousands of organisms per litre.

CONCLUSION

- After studying all the parameters of physical and chemical & Biological parameters, it was found that maximum numbers of parameters were within permissible limit.
- And Biological study also revealed that the total coliform & plankton's count recorded during the study does not show any indication of pollutant. Therefore it may be concluded that Baraila Lake is free from pollution and can be counted as pollution free lake but BOD level of this lake is slightly high which show organic load i.e. pollution load.
- The observation of the different parameters are within the permissible limit for fish culture except the concentration of plankton. It may be due to over stocking or more organisms feeding on plankton. We observed that water of this lake is free from any pollutant. Lake water may be a good source of drinking water, agriculture work and fisheries.

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