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Assessment of water quality using physicochemical parameters of Ranchi Lake (Bada talab)

Akshay Kumar Verma* & Ashok Kumar Nag
Department of Botany, D.S.P.M. University, Ranchi, Jharkhand, India.

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ABSTRACT

Water is an integral part of life; it is a necessary element on Earth. Up to two-thirds of the human body is made of water. The current study focuses on the seasonal changes i.e. winter (November 2021-February 2022), summer season (March 2022-June 2022) and rainy season (July 2022-October 2022) over a single year in the physicochemical parameters of Ranchi Lake also known as Bada Talab. Standard procedures were used in the study to assess a number of physico-chemical characteristics. Five different sites were taken for sampling of water bodies i.e. S1 (in front of Seva Sadan), S2 (in front of Himanshu Hiramani Eddapa house), S3 (in front of Modern English School), S4 (in front of Siyaram Narsingh Mandir), and S5 (near Vivekananda Statue). The maximum level of Dissolved Oxygen (DO) was identified at site 5 (near Vivekananda Statue), which is a less polluted zone, following a year-long series of assessments conducted in all seasons, including winter, summer, and rainy. In compared to all other locations, site 1 (in front of Seva Sadan) had the greatest levels of Biochemical Oxygen Demand (BOD), Chemical Oxygen Demand (COD), Total Dissolved Solids (TDS), conductivity, total hardness, and total alkalinity. Household and hospital waste is more harmful to this location, and it was discovered to be highly polluted.

Key Words - Seasonal changes, Dissolved oxygen, Biochemical oxygen demand, Total dissolved solids etc.

***Corresponding author :** aklovebotany@gmail.com

INTRODUCTION

The landlocked state of Jharkhand is bordered to the north by Bihar, to the west by Uttar Pradesh and Chhattisgarh, to the south by Orissa, and to the east by West Bengal. The capital of Jharkhand, Ranchi, has special geographical and historical significance. Ranchi, which is renowned for its moderate temperature, was the summer capital of Bihar until the new state of Jharkhand was established in 2000. The diverse topographical features of the state have an impact on its climate. The primary source of drinking water in Jharkhand's cities and rural areas is groundwater. It is impossible to overstate the significance of groundwater for human society (Gupta and Shukle, 2006). Freshwater is now a scarce resource as a result of pollution and overuse (Ghose and Basu, 1968). Ranchi Lake, sometimes called Bada Talab, is a stunning artificial lake situated in the center of Ranchi, the Indian state capital of Jharkhand, built in 1842 by British official Colonel O. Onsely. A healthy ecosystem for all living things and the world's natural resources will be guided by high-quality water (Kumar *et al*., 2017). Research is required in many developing nations, and it will

significantly aid in examining the quality of water by examining its physicochemical characteristics and studying its many biological aspects using advanced methodologies (Cuffney *et al*., 2014). The composition and productivity of the flora and fauna are determined by the synergistic influence of multiple physicochemical parameters, even if each one plays a separate function (Bisht *et al*., 2013)

MATERIALS & METHODS

Ranchi Lake's (Bada Talab) coordinates lie in 23°22'4"N and 85°19'4"E. Samples of the lake's water were collected every season i.e. winter (November 2021-February 2022), summer season (March 2022-June 2022) and rainy season (July 2022-October 2022) over a single year, in sterile 2L plastic bottles. Five sampling locations-S1(in front of Seva Sadan), S2 (in front of Himanshu Hiramani Eddapa House), S3 (in front of Modern English School), S4 (in front of Siyaram Narsingh Mandir), and S5 (near Vivekananda Statue), were identified and used to collect samples. Samples of water were brought into the lab and analysed using a standard procedure to determine the physicochemical characteristics of water bodies. The following physicochemical parameters were monitored using standard procedure. Water temperature (APHA 1995, 2-59 pp), Hydrogen ion concentration (pH) (IS 3025 Part-11), Total dissolved solids (TDS) (APHA-1995), Dissolved Oxygen (DO) (IS 3025 part-38), Biochemical oxygen demand (BOD) (APHA1998), Chemical oxygen demand (COD) (APHA 5220 B), Conductivity (APHA 1998), Total hardness, Chloride, Calcium (APHA 1998), Magnesium (APHA 1998), Total alkalinity.

Figure 1:- Map of Ranchi District

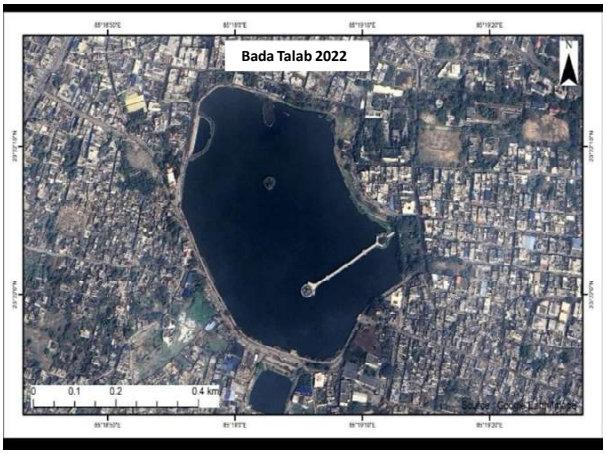

Figure 2:- Map of Ranchi Lake (Bada talab)

RESULTS & DISCUSSION

A total of twelve parameters were investigated for the physicochemical analysis of water indicated in (Table 1) during the winter season (November 2021 to February 2022). Temperature was measured highest 35°C at site 4 (in front of Siyaram Narsingh Mandir). The acceptable water temperature range is 25 to 30°C (Dheenan *et al.*, 2014). The highest pH of 8.2 was measured at location 5 (near Vivekananda Statue). Additionally, human activity causes water sources to become more acidic rather than basic (Zaghloul *et al*., 2019). In the same way Site 5 was also shown to have the highest levels of dissolved oxygen (6.6 mg/l), calcium (78.4 mg/l), and magnesium (38.4 mg/l). Fish and other aquatic biota will die if the water's oxygen content is lower, which is a sign of a river's poor quality (Bi *et al*., 2021).

The highest recorded biochemical oxygen demand (BOD) was 220 mg/l at site 1 (in front of Seva Sadan). The highest recorded COD values (760 mg/l) and COD values (720 mg/l) were from sites 1(in front of Seva Sadan) and 2 (in front of Himanshu Hiramani Eddapa House), respectively, and were found to be above the permissible limit. Site 1 revealed the highest levels of total dissolved solids (TDS) (598 mg/l), conductivity (996 mg/l), total hardness (366 mg/l), chloride (138 mg/l), and total alkalinity (442 mg/l).

Twelve parameters in all were investigated for the physicochemical analysis of water over the summer

(March 2022 to June 2022) and are given in Table 2. The highest temperature was recorded 47.1°C at site 4 (in front of Siyaram Narsingh Mandir). The highest pH of 8.3 was reported at site 5 (near Vivekananda Statue). In the same way Site 5 was also shown to have the highest levels of dissolved oxygen (6.5 mg/l), calcium (76.3 mg/l), and magnesium (36.9 mg/l). The highest biochemical oxygen demand (BOD) of 222 mg/l was recorded at site 1 (in front of Seva Sadan). The highest recorded COD values (764 mg/l) and 718 mg/l) were from sites 1(in front of Seva Sadan) and 2 (Himanshu Hiramani Eddapa House), respectively, and were judged to be above the allowable limit. Site 1 revealed the highest levels of total dissolved solids (TDS) (854 mg/l), conductivity (990 mg/l), total hardness (372 mg/l), chloride (134 mg/l), and total alkalinity (438 mg/l). Conductivity assesses the quality of aquatic biota in water resources and is regarded as a crucial physical pollution indicator (Manjula and Warrier, 2019).

During the rainy season (July 2022 to October 2022), a total of twelve parameters were examined for the physicochemical examination of water listed in Table 3. The highest temperature was recorded 38°C The pH was recorded maximum (7.98) from site 3 (in front of Modern English School). Dissolved oxygen (6.8 mg/l), Calcium (76.4 mg/l) and Magnesium (35.6 mg/l) was reported to maximum from site 5 (near Vivekananda Statue). Biochemical

Table 1: - Physicochemical Analysis of Water Samples Collected in winter season (November 2021 to February, 2022)

Sl. No.	Water Quality Test	Site 1	Site 2	Site 3	Site 4	Site 5	Permissible limit (as per Indian standard) (Bureau of Indian Standards New Delhi IS 10500)
1	Temperature (°C)	30.5	30.2	33.9	35	31.8	-
2	pH	6.75	6.83	8.02	8.1	8.2	6.5-8.5
3	Dissolved oxygen (mg/l)	3.2	3.8	5.8	6.4*	6.6*	4-5
4	Biochemical Oxygen Demand (B.O.D.) (mg/l)	220	180	48	28	24	350
5	Chemical Oxygen Demand (C.O.D.) (mg/l)	760*	720*	240	130	125	250
6	Total Dissolved Solids (TDS) (mg/l)	598	580	578	582	520	-
7	Conductivity (mg/l)	996	980	972	942	930	-
8	Total Hardness (mg/l)	366	361	350	336	334	2000
9	Calcium(mg/l)	9.7	12.4	72.4	75.3	78.4	200
10	Chloride (mg/l)	138	132	110	109	102	1000
11	Magnesium (mg/l)	29.6	30.2	34	36	38.4	100
12	Total Alkalinity (mg/l)	442	402	392	374	362	600

Table 2: - Physicochemical Analysis of Water Samples Collected in summer season (March 2022 to June, 2022)

Sl. No.	Water Quality Test	Site 1	Site 2	Site 3	Site 4	Site 5	Permissible limit (as per Indian standard) (Bureau of Indian Standards New Delhi IS 10500)
1	Temperature (°C)	39.3	41.5	38.9	47.1	45.3	-
2	pH	6.8	6.94	8.1	8.2	8.3	6.5-8.5
3	Dissolved oxygen (mg/l)	3.4	3.6	5.7*	6.2*	6.5*	4-5
4	Biochemical Oxygen Demand (B.O.D.) (mg/l)	222	182	50	30	26	350
5	Chemical Oxygen Demand (C.O.D.) (mg/l)	764*	718*	216	126	120	250
6	Total Dissolved Solids (TDS) (mg/l)	854	843	831	820	812	-
7	Conductivity (mg/l)	990	978	974	938	934	-
8	Total Hardness (mg/l)	372	368	358	346	341	2000
9	Calcium(mg/l)	9.9	12.2	73.2	72.4	76.3	200
10	Chloride (mg/l)	134	132	108	112	110	1000
11	Magnesium (mg/l)	30.2	31.3	35	36.2	36.9	100
12	Total Alkalinity (mg/l)	438	401	390	362	364	600

Table 3: - Physicochemical Analysis of Water Samples Collected in rainy season (July 2022 to October, 2022)

Sl. No.	Water Quality Test	Site 1	Site 2	Site 3	Site 4	Site 5	Permissible limit (as per Indian standard) (Bureau of Indian Standards New Delhi IS 10500)
1	Temperature (°C)	38	35.9	36.8	34.7	35.4	-
2	pH	6.5	6.72	7.98	7.94	7.92	6.5-8.5
3	Dissolved oxygen (mg/l)	3.2	3.5	5.6*	5.9*	6.8*	4-5
4	Biochemical Oxygen Demand (B.O.D.) (mg/l)	226	186	54	34	29	350
5	Chemical Oxygen Demand (C.O.D.) (mg/l)	780*	726*	220	129	128	250
6	Total Dissolved Solids (TDS) (mg/l)	920	910	885	903	905	-
7	Conductivity (mg/l)	992	980	972	936	932	-
8	Total Hardness (mg/l)	365	356	342	332	326	2000
9	Calcium(mg/l)	9.1	12.4	70.6	75.8	76.4	200
10	Chloride (mg/l)	139	138	112	117	118	1000
11	Magnesium (mg/l)	30.4	31.6	35	34	35.6	100
12	Total Alkalinity (mg/l)	432	406	409	370	368	600

Oxygen Demand (BOD) were maximum (226 mg/l) reported from site 1 (in front of Seva Sadan). Chemical Oxygen Demand (COD) was reported highest (780 mg/l) and (726 mg/l) from site 1(in front of seva sadan) and site 2 (Himanshu Hiramani Eddapa House) respectively which was found above permissible limit. Water with high COD levels always has detrimental effects on the environment and regulations (Jeff and Michalak, 2015). Total Dissolved Solids (TDS) (920 mg/l), conductivity (992 mg/l), total hardness (365 mg/l), Chloride (139 mg/l), total alkalinity (432 mg/l) was reported maximum from site 1 (in front of seva sadan).

CONCLUSION

After regular assessment in various season from winter, summer and rainy over a single year it can be concluded that the highest level of Dissolved Oxygen (DO) was found at site 5 (near Vivekananda Statue) which less polluted zone. The highest level of Biochemical Oxygen Demand (BOD), Chemical Oxygen Demand (COD), Total Dissolved Solids (TDS), Conductivity, Total Hardness and Total Alkalinity were found at site 1 (in front of Seva Sadan) which more polluted zone in comparison to all other sites. Waste from hospital and households are more detrimental for this site and it was found heavily polluted.

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