

Research Article

INVESTIGATION OF PHYSICO-CHEMICAL CHARACTERISTICS OF ECOLOGICALLY FRAGILE LAKES OF KUHI, NAGPUR DISTRICT, INDIA

***Pranita P. Belkhode¹, Shashikant Sitre² and Shanta Satyanarayan³**

¹Sevadal Mahila Mahavidyalaya and Research Academy, Nagpur

²Nilkanthrao Shinde Science College Bhadrawati, District Chandrapur

³Previously Associated with NEERI, Nagpur

*Author for Correspondence

ABSTRACT

The present paper deals with the physico-chemical properties of Kuhi lake of Nagpur District, during summer and monsoon months to assess the water quality status for limnological study. The physico-chemical factors such as humidity, water temperature, transparency, pH, dissolved oxygen and various inorganic contents were investigated. The result of the present study revealed that the discharge of waste and drainage in to the lake have contributed to increase the pollution status in the surface water.

The quality parameters were compared with the standards laid down by APHA. The significant variations in chemical parameters were observed at different site of Khui Lake. It has been observed that the quality of water is not acceptable for drinking purpose and domestic use as per our findings.

Keywords: *Limnological Study, Fragile Lake, Physico-Chemical Characteristics, Kuhi*

INTRODUCTION

The lakes provide sufficient water for drinking as well as other useful purposes to mankind. The assessment of the water quality is an important aspect for the developmental activities of that region, because the lakes, reservoirs and rivers are used for supplying water for domestic and other commercial activities. The physico- chemical and biological analysis is needed to obtain a perfect picture of the prevailing water quality at any situation in any region of the subcontinent.

The physico-chemical characteristics of any water body or any aquatic ecosystem and the nature and distribution of its biota are directly related to and influenced by each other and controlled by a multiplicity of natural regulatory mechanisms. Living plants and animals are affected by chemical conditions of their environment and the reactions may be used to measure some of the conditions. A systematic attempt has been made to study the spatial and temporal variations of its hydrochemical conditions with a view to evaluate the current status of water quality of the lake and delineate the source and extent of pollution. The lentic water bodies selected for the present investigation is located at Kuhi at 35 Km to the North - East of the Nagpur district. It is located 21°00'39" N-longitude 79°21'09" E-latitude.

MATERIALS AND METHODS

Water samples from Khui Lake were collected from 4 sampling spots in the morning hours on a quarterly basis in containers and immediately transported to the laboratory for the estimation of various physico-chemical properties during summer and monsoon season. Parameters like temperature, humidity, transparency, pH and dissolved oxygen were recorded at Lake Site where as the parameters like alkalinity, hardness, chlorides, total phosphates, nitrates, sulphates and other parameters were measured as per the guidelines given by APHA 1985.

RESULT AND DISCUSSION

The physico-chemical properties of water samples of Kuhi Lake are presented in Table-1.

During present investigation the observed average water temperature ranged between 28.10C to 30.50C.

Research Article

Table 1: Average of Physico-Chemical Parameters of Different Sampling Stations of Ecologically Fragile Lake of Kuhi Village Nagpur District

Sr. No.	Parameters	Summer Season				Rainy Season			
		Site A	Site B	Site C	Site D	Site A	Site B	Site C	Site D
1.	Temperature (°C)	31	30.5	30	31.5	27	28	27.5	
2.	Color (Hazen Unit)	Below 5	Below 5	Below 5	Below 5	Below 5	Below 5	Below 5	Below 5
3.	pH	7.2	7.85	7.5	7.3	7.8	7.99	8.0	7.7
4.	Dissolved Oxygen (mg/l)	4.9	5.3	5.1	5.4	6.2	6.3	6.4	6.2
5.	BOD (mg/l)	3.1	3.5	3.3	3.4	3.1	3.0	2.9	2.8
6.	COD (mg/l)	99.2	98.4	97.2	96.1	56.2	57.6	56.5	55.4
7.	Total Alkalinity (mg/l)	185	184.8	184.4	185.3	122.1	123.2	124.1	124.5
8.	Total Dissolved Solids (mg/l)	479.2	480.1	478.6	481.2	223.1	224.8	223.5	221.7
9.	Total Suspended Solids (mg/l)	19.2	20.0	20.5	20.7	9.8	10.0	9.5	9.3
10.	Total Hardness (mg/l)	170.2	169.7	170	169.0	112.5	112.0	113	112.5
11.	Calcium (mg/l)	69	68.7	68.9	67.2	55.2	56.0	56.2	55.2
12.	CaCO ₃ Hardness (mg/l)	170	169.7	169.2	168.0	114.5	112.0	113.5	112.4
13.	Magnesium (mg/l)	23.5	24.6	24.5	23.8	12.6	13.7	12.6	13.5
14.	Chloride (mg/l)	112.0	114.0	113.0	114.5	31.5	32.0	31.7	31.6
15.	Sulphate (mg/l)	2.5	2.5	2.4	2.3	1.5	1.5	1.6	1.5
16.	Nitrate (mg/l)	0.310	0.326	0.316	0.332	0.05	0.06	0.06	0.05
17.	Total Phosphate (mg/l)	0.027	0.029	0.030	0.031	0.03	0.03	0.029	0.03
18.	Turbidity NTU	0.1	0.1	0.1	0.1	4.3	4.4	4.3	4.2
19.	Total Carbon Dioxide (mg/l)	165.4	166.8	167.7	165.8	109.2	110.9	111.0	110.7
20.	Electrical Conductivity (µmhos/cm)	675.1	678.2	678.9	678.4	332.4	334.9	334.2	333.4



Nav Lake (Nav Talav) Outside the Kuhi Village

In general, the temperature values were low during rainy and high during summer, almost matching the environment temperature. Fluctuation in air and water temperature is due to the influence of season, location and difference in the time of collection. Similar results, were recorded by Jha and Barat (2003) in Mirik lake, Darjeeling. Radhika *et al.*, (2004) studied the abiotic parameters of a tropical freshwater Velayani lake Thiruvananthapuram, District-Kerala observed the same results as rise of water temperature in summer and low during rainy season which supports our results.

Transparency is directly proportional to the amount of suspended organic and inorganic particulate matter present in water body. The other factors which affect the transparency of water body are plankton growth, wind velocity, rainfall, nature of water body and prevailing weather conditions. The minima & maxima of transparency in the lake water was recorded in the summer and rainy respectively. Our results are well in

Research Article

agreement with Sharma and Sarang (2004) who reported minimum transparency during monsoon and maximum during winter.

Water samples of Kuhi Lake were odourless and colourless.

Results as illustrated in Table-1 shows that water samples of Kuhi Lake have the pH value from 7.85 and 7.99, During present investigation. Average minimum and maximum pH value ranged between 6.5 to 8.5. PH is the measure of the concentration of hydrogen ions, which provides the range of the acidity or alkalinity of a solution. During the study period the value of pH oscillated from 7.00 to 7.50 which is very close to normal range. Similar findings were recorded by Sadhwani (2010) while studying the limnological parameters of Shaha lake, Karanja (lad), District Washim (M.S.). Pearsall (1930) and Zafar (1996) observed that the pH of water appear to be dependent upon the relative quantities of Calcium Carbonates and bicarbonates being alkaline when the quantities of Carbonates is high. The present water body was observed to be being free from human interference and industrial effluents.

Dissolved oxygen is an important parameter which affects chemical as well as biological reactions in an ecosystem. Dissolved oxygen content indicates the health and ability of water body to purify itself through biochemical processes. Oxygen is also needed for many chemical reactions that are important to lake functioning, such as oxidation of metals, decomposition of dead and decaying matters etc. The average dissolved oxygen during research work was found to be in the range of 5.3 to 6.3 mg/L. Minimum value was recorded in summer and maximum in rainy season. Similar trend of dissolved oxygen was also observed by Yeole and Patil (2005) while studying physicochemical status of Yedshi lake in relation to water pollution and Yeole and Patil (2007) while studying nutrient dependent hydro biological status of Yedshi lake, District Washim (M.S) Carbon dioxide dissolved in water is the source of carbon that can be assimilated and incorporated into the living matter of all aquatic autotrophs (Hutchinson, 1957). A good water should have solubility of oxygen (7.0-7.5mg/l) at 30°C and this much oxygen saturated water have pleasant taste. D.O. of water samples of Kuhi Lake sites range between 5.3 to 6.3 mg/l, which may be due to the presence of organic matter.

This is an important parameter to assess the pollution of surface water, where contamination occurred due to the disposal of domestic waste. The values of water samples of Kuhi Lake ranged from 3.5 and 3.0 mg/l, which was less than 30mg/l (permissible value) and hence the water of Kuhi Lake is not suitable for drinking and other domestic use.

The maximum permissible value of COD is 250mg/l for drinking water. The higher value 98.4 and 57.6 mg/l of water samples of Kuhi Lake indicates the pollution of water. The values observed indicate that the water is not potable.

Alkalinity is a measure of the capacity of water to absorb hydrogen ions. The total alkalinity of water samples of Kuhi Lake was 184.8 and 123.3 mg/l which is much less than 200 mg / l permissible value (200-600) and hence the water of Kuhi Lake is not suitable for drinking. A decrease in the value of alkalinity during post monsoon period attributed to heavy monsoon showers that resulted in the dilution of water.

Total alkalinity is the measure of the capacity of water to neutralize a strong acid. It is generally imparted by the salts of carbonates, bicarbonates, phosphates, nitrates, borates, silicates etc. together with the hydroxyl ions in free state. During present investigation average total alkalinity was found to be the range of 184.8 and 123.3 mg/l. The minimum value was recorded in rainy season and maximum in summer. Salwi (1986) and Dash (1993) studied the fluctuations in alkalinity might be due to the entry of alkaline particles through surface runoff and low production of plankton population

Total Solids refer to matter suspended and dissolved in water. Waters with high total solids generally are of inferior palatability and may induce an unfavorable physiological reaction (APHA, 1989). Total dissolved solids in case of water samples of Kuhi Lake is 480.1 and 224.8 mg/l which is much less than 500mg/l (permissible value 500-2000). These values are responsible for hardness of these water samples. T.D.S. values varied between 360- 930 mg/l is commonly objectionable. It may cause water borne

Research Article

diseases to the citizens of that area. Hence it is not acceptable for drinking purpose as well as for domestic use.

Total hardness of water is the measure of the capacity of water to react with soap. Calcium & magnesium are the principal cation that imparts hardness. The total hardness of water therefore reflects as the sum total of alkaline metal cations present in it (Ramchandra *et al.*, 2006). During present investigation average total hardness was found to be minimum in monsoon (Aug. 2015) i.e., 112.0 mg/L and maximum in summer i.e., 169.7 mg/L.

The calcium and magnesium cations are responsible for total hardness of water. Similarly, the sulphates, chlorides and nitrates anions are also responsible for total hardness. Total hardness Kuhu Lake varies from 112.0 – 169.7 mg/l which may be due to the high concentration of Ca⁺⁺, Mg⁺⁺, Cl⁻ & CO₃ ions present in it.

Chloride anion is generally present in natural waters. High chloride content has damaging effect on agricultural crops (Ramachandra *et al.*, 2006). In present investigation, the maxima in summer and minima in rainy were noted. Karne and Kulkarni (2009) reported chloride maxima in summer while minima in winter from freshwater bodies in Khatau Tahsil, (M.S.).

Total hardness of water is the measure of the capacity of water to react with soap. Calcium & magnesium are the principal cation that imparts hardness. The total hardness of water therefore reflects as the sum total of alkaline metal cations present in it (Ramchandra *et al.*, 2006). In present investigation the maxima of seasonal total hardness was recorded in May month whereas minima was recorded in August month.

Sources of sulphates are mainly sulphates rocks such as gypsum and sulphur minerals such as pyrites and also due to air and water pollution. Sulphates contribute to the total solids content and in a reduced and anaerobic condition produced hydrogen sulphide which gives rotten egg odour to the water (Ramchandra *et al.*, 2006). In the present investigation the sulphate contents were ranged between 1.5 to 2.5 mg/L with maxima in summer and minima in monsoon season. Similar results were also reported by Angadi *et al.*, (2005) from Papnash pond, Bidar, Karnataka. The present results are in conformity with above authors.

Phosphorous is one of the major macronutrients responsible for biological productivity (APHA, 1989). All three types of phosphorous i.e. total, Inorganic and organic were estimated from experimental water body. All types of phosphorous recorded maximum in summer.

The nitrate is one of the most oxidized forms of nitrogen and is an essential plant nutrient Nitrate concentration is associated with rain water runoff, and sludge discharge (Jha & Barat, 2003). During present investigation nitrates of the present water body ranged from 0.06 to 0.326 mg/L with maxima in summer. Similar seasonal peak was also recorded by Bhongade and Patil (2010). Summer peak of nitrates may be due to its negative proportionality to dissolved oxygen (Jakher & Rawat, 2003).

The present study indicates that the water samples of all the sampling sites of Kuhu Lake have shown lower concentration in comparison to the permissible limit as recommended by APHA 1989. Hence it is not acceptable for drinking purpose as well as for domestic use.

Conclusion

It is suggested that the domestic waste should not be discharged into the Kuhu Lake of Nagpur district. Sustained efforts should be made to bring out greater awareness among masses about the importance of good quality of drinking water.

REFERENCES

- APHA (1985).** *Standard Methods for Examination of Water and Wastewater* 16th edition, (American Public Health Association).
- APHA, 1985.** Standard methods for the examination of water and waste water, 19th Edn. American Public Health Association Inc., New York, 1193.
- APHA (1989).** Standard methods for examination of water and waste water (17thEdn.). American Public Health Association, Washington, D.C

Research Article

- Angadi, S.B.; Shiddamaltayya, N. and Patil, P. C. (2005)** Limnological studies of Papnash pond, Bidar (Karnataka). *J. Env. Biol.*, 26: 213-216.
- Bhongade, S.S. and Patil, G.P. 2012.** Limnological study of Mohgavhan Lake, Karanja (Lad) District – Washim, (M.S.) India. *Vidyabharati International Interdisciplinary Research Journal*, 1(2):27-33
- Bandeella NN, Vaidya DP and Lomte VS (1998).** Seasonal temperature changes influenced alterations in carbon dioxide and PH in Barul dam of Maharashtra *Journal of Aquatic Biology* **13**(1-2) 43-46.
- Birge EA and Juday C (1921).** Further limnological observation on the Finger Lake of New York, *Bulletin of the United States Bureau of Fisheries* **3** 210-252.
- Chaurasia S (1996).** Seasonal Fluctuation of Zooplankton in Burha tank water, Raipur, *Indian Journal of Environmental Project* **16**(2) 140-2.
- Edmondson WT (1959).** *Freshwater Biology*, 2nd edition. (John Willey and Sons, Inc. New York London) 1148.
- Hutchinson, G.E. 1957.** A treatise on limnology Vol.1 Geography, physics and chemistry. New York, John Wiley & sons, New York : 1015.
- Hanazato T and Yasuna M (1985).** Population Dynamics and Production of Cladocera Zooplankton in the Highly Eutrophic Lake Kasu Migaura, *Hydrobiologia* **124** 13-22.
- Jha, P. and Barat, S. 2003.** Hydrobiological study of Mirik Lake in Darjeeling, Himalayas. *Journal Environment Biology*. 24(3): 339-344..
- Jakher, G.R., Rawat, M. 2003.** Studies on physico-chemical parameters of a Tropical Lake, Jodhpur, Rajasthan, India. *J. Aqua. Biol.*, 18(2):79-83.
- Karne AV, Kulkarni PD (2009).** Studies on physicochemical characteristics of freshwater bodies in Khatavahsil, Maharashtra. *Nature Environment and Pollution Technology* 8(2): 247-251.
- Kapil, N., and Bhattacharya, G. K. (2009)** ‘Temporal, Spatial and Depth Variation of nutrients and Chlorophyll content in an Urban Wetland’, *Asian Journal of Water, Environment and Pollution*, Vol. 6, No. 2, pp.43-55.
- Khatavkar RS, Shah NV, Rao KR and Noval RA (2004).** Variation in Physico-chemical parameters in fresh water tank around Solapur City (MS) *Journal of Aquatic Biology* **19**(1) 11-4.
- Kudesia VP (1998).** *Water Pollution*, fourth edition, (Pragati Prakashan, Merut (India)).
- Kodarkar MS and Chandrashekhar SVA (1994).** Biodiversity of some zooplanktonic groups in Saroornagar lake, Hyderabad Nat seminar, sq-mm, Echo-Environ, Impact and Organism Response, *Limnology* 2-12.
- Lendhe RS, Yeragi SG (2004).** Physico-chemical parameters and Zooplankton Diversity of Phirang Kharbav Lake, Dist Thane (M.S.) *Journal of Aquatic Biology* **19**(1) 49-52.
- Malathi D, Chandrashekhar SVA and Kodarkar MS (1998).** Studies on Branchionus from Lake Hussainsagar, Hyderabad, India. *Journal of Aquatic Biology* **13**(1-2) 7-12.
- Meshram CB (1996).** Limnological study of wasali Lake Amravati (M.S.) Ph.D. Thesis, SGB Amravati University.
- Muley DV and Patil IM (2006).** Study of water quality and fish diversity of Purna River (M.S.) *Journal of Aquatic Biology* **21**(1) 68-75.
- Pearsall, W.H. 1930.** Phytoplankton in English lakes. The proportion in the water of some dissolved substances of biological importance. *Rev. Algol.* 18: 306-320
- Ramachandra, T. V., Ahalya, N., and Mandy Payne. (2006)** ‘Status of Varthur Lake: Opportunities for Restoration and Sustainable Management. *Technical Report*: 102, CES, Bangalore.
- Radhika, C. G., Mini I. and T. Gangadevi, 2004.** Studies on Abiotic parameters of a tropical fresh water lake – Vellayani Lake, Trivandrum, Kerala, *Pollution Research*, 23(1):49-63.
- Sharma, L. L. & N. Sarang (2004) Physico-chemical limnology and productivity of Jaisamand Lake, Udaipur, (Rajasthan), *Polltion Research*, 23 (1) pp. 87-92.
- Sadhvani (2010).** Limnological parameters of Shaha lake., Karanja two water bodies in Washim District, (M.S.). *Journal of Aquatic Biology* **23**(1) 13-17.
- Yeole, S.M. and Patil, G.P. 2007.** Nutrient dependent hydrobiological status of Yedshi Lake, Tq. Mangrulpir, Dist. Ashim (M.S.), Ph.D. Thesis, Amravati University, Amravati.
- Zafar, A.R. 1996.** Liminology of Hussain Sagar Lake, Hydrabad, India. *Phykos*, 5: 115-126.