



Determination Physico- Chemical Characteristics of water quality in Upper Lake Bhopal (M.P).

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Article History:	Abstract
Article Received- 05/09/2022 Article Revised- 12/09/2022 Article Accepted- 19/09/2022	This study was aimed to analyse physico-chemical characteristic of water quality of Upper Lake Bhopal (M.P). The water samples were collected from five different locations during the Monsoon, winter and summer season in 2021-2022. The collected water samples were analyzed for the physicochemical parameters like temperature, pH, electrical conductivity, total dissolved solids, total alkalinity, chloride, total hardness, calcium, dissolved oxygen, nitrate and orthophosphate. The analysis was carried out according to the standard procedures described by APHA (2005) and Workbook of Limnology (Adoni, <i>et al.</i> , 1985). The experimental values of water samples were compared with standard values given by Bureau of Indian Standard. The results revealed that there was significant seasonal variation in physicochemical parameters of the lake and therefore the lake must be monitored regularly to prevent the changes that are occurred day by day.
CC License CC-BY-NC-SA 4.0	Keywords: <i>Upper Lake, Physico-chemical parameters, Water quality.</i>

Introduction

Life on Earth depends on water, which is a vital element of the ecosystem. Water is essential to the survival of all living things (Smitha et al., 2007). Because they are typically man-made, semi-natural ecosystems designed in a way that allows for water stagnation, freshwater bodies are significant wetlands found in and near human habitations (Yadav et al., 2013). Life depends on the quality of one's drinking water. Because to improper handling and disposal of human and animal waste, industrial and domestic wastewater, and over use of scarce water resources, contaminants like bacteria, viruses, heavy metals, nitrates, and salt have contaminated water supplies (Onwughara et al., 2013). There have been several reports of typhoid, diarrhoea, and other water-borne infections caused by the ingestion of contaminated water. Many researchers have reported on different aspects of water quality evaluation. Today, contaminated water kills more people than disease, AIDS, conflicts, terrorism, and accidents (Uduma, 2014). The physicochemical parameters of the water vary seasonally, and anthropogenic activities such as agriculture, urbanisation, residential sewage, and so on in the watershed region contribute to the deterioration of water quality (Verma et al., 2012).

Globally, lakes have undergone severe degradation or alteration at a rate far faster than their recovery. Due to human pressures, Bhoj Wetland, located in the centre of Bhopal, the capital of Madhya Pradesh, has seen a dramatic decline in water quality over over the last four decades. The numerous ways that people use the lake have resulted in an excessive amount of pollution in it. Pollutant concentrations have increased as a result of encroachment into and surrounding the lake, which has caused the lake's water volume to decrease. The quality of water in the lake has been further deteriorated by the discharge of untreated sewage, agricultural runoff, and sediments from surrounding catchments. Therefore the present study was conducted to find out the water quality of Upper Lake and to describe details of human impact on Upper Lake and suggests some measures for restoration of this important resource.

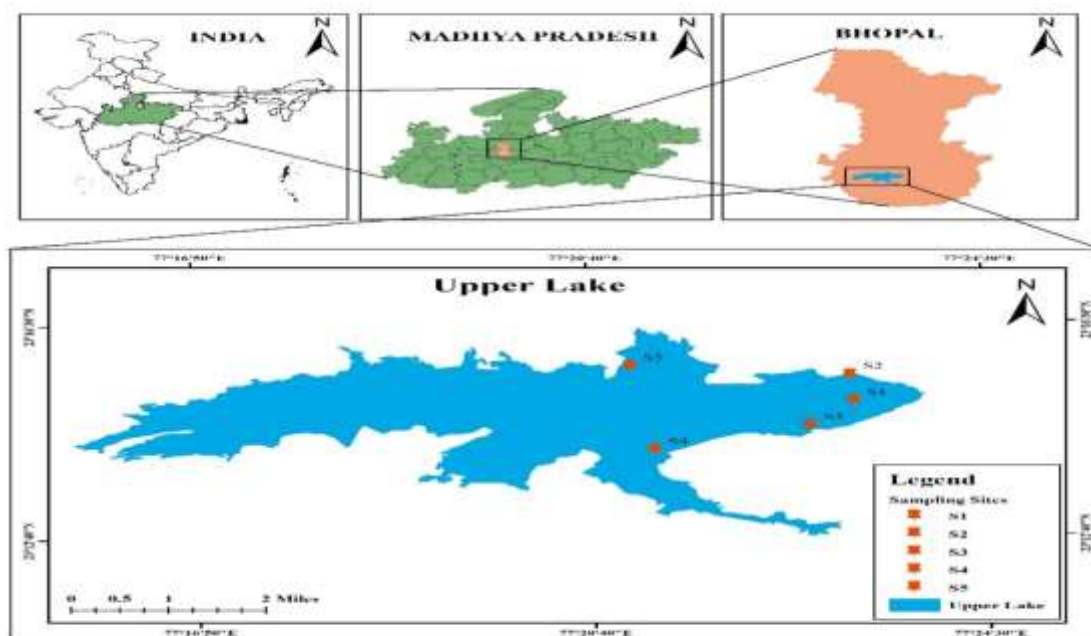
2. Materials and Methods

2.1 Study area

The study area selected was Upper Lake located in the city of lakes Bhopal, Madhya Pradesh, India. The geographical location is 23° 12' to 23° 16' N latitude and 77° 18' to 77° 23' E longitude. The total area covered is 31 Sq. Km and the depth varies from 4 to 8 metres. The lake is fed by Kolans River in rainy season. The maximum length of the Upper Lake is 10.6 km while the width comes out to be 3.25 Km. Maximum elongation is in the east-west direction.

2.2 Sample Collection and analysis

The surface water samples were collected from five different locations of Upper Lake during the Monsoon, winter and summer season in 2021-2022. The collected water samples were analyzed for the physicochemical parameters like Temperature, pH, Electrical Conductivity, Total Dissolved Solids, total alkalinity, chloride, total hardness, Calcium, dissolved oxygen, nitrate and orthophosphate. The analysis was carried out according to the standard procedure as mentioned in the APHA (2005) and Workbook of Limnology (Adoni, *et al.*, 1985). All tests were performed three times and the results were found to be reproduced within $\pm 3\%$ error.



Map-1: Showing location of different sites of study area.

RESULTS AND DISCUSSION

The data on seasonal fluctuations in physico-chemical parameters of surface water at the five sampling stations in the Upper Lake, Bhopal (M.P) have been given in the Table -1.

Table-1: Physicochemical characteristics of surface water at Upper Lake, Bhopal (M.P).

Parameters	Units	Results			BIS: 10500	
		Monsoon	Winter	Summer	Desirable	Permissible
Water Temperature	°C	26±1.2	22±1.2	29±1.3	-	-
pH		8.2±0.7	8.5±0.5	7.9±0.4	6.5-8.5	No relaxation
Conductivity	µS/cm	380±3.05	300±3.45	320±3.05	300	No relaxation
TDS	Mg/l	250±5.09	215±3.62	224±4.09	500	2000
Total Alkalinity	Mg/l	110±4.21	93±2.03	98±3.34	200	600
Chloride	Mg/l	40.9±0.45	21.9±1.23	35.2±0.34	250	1000
Total Hardness	Mg/l	120±3.7	96±2.45	104±3.4	200	600
Calcium Hardness	Mg/l	70±2.6	54±2.4	61±2.23	75	200
Dissolved Oxygen	Mg/l	6.1±0.06	7.3±0.07	5.5±0.05	5	No relaxation
Nitrate	Mg/l	1.1±0.05	0.87±0.02	1±0.04	45	No relaxation
Orthophosphate	Mg/l	0.83±0.04	0.76±0.02	0.94±0.03	1	No relaxation

Temperature

Temperature is an important factor, which regulates the biogeochemical activities in the aquatic environment. The temperature of Upper Lake ranges between 22±1.2 °C to 29±1.3 °C. The Highest temperature was recorded during the summer season and the lowest was recorded during winter season. The Highest temperature during summer was due to greater solar radiation, low water level, clear atmosphere and higher atmospheric temperature.

pH

pH indicates the concentration of hydrogen ions. Being one of the most important factors in measuring water quality. Practically every aspect of water, like acid and base neutralization, water softening, precipitation, coagulation and acidification is pH dependent. It is greatly affected by photosynthetic activity of aquatic plants by exposure of air temperature, disposal of sewage and disposal of industrial water (Khanna and Bhatia 2003). The pH of Upper Lake ranges between 7.9±0.4 to 8.5±0.5. The Highest temperature was recorded during the winter season and the lowest was recorded during summer season. During summer the photosynthetic activity gets reduced due to higher temperature resulting in a slight buildup of CO₂ concentration into the water with a subsequent decrease in Ph.

Electrical conductivity

Electrical conductivity is the ability of water to convey electric current and is a method for determining the water's purity (Murugesan *et al.*, 2006). It also indicates the presence of biogenic and abiogenic impurities in water (Upadhyay *et al.*, 2012). Electrical conductivity recorded in Upper Lake ranges between 300±3.45 µS/cm to 380±3.05 µS/cm. The high value of conductivity was recorded during the monsoon season where as low value was recorded during winter season.

Total Dissolve Solid

TDS indicates the salinity of water. TDS is a good indicator of water quality due to the fact that it affects the taste, colour and smell of the water. Increased levels of TDS makes water unfit for drinking and irrigation, cause decreased photosynthetic capacity and rise in water temperature (Simeon *et al.*, 2019). The amount of total dissolve solid in Upper Lake ranges between 215±3.62 Mg/l to 250±5.09 Mg/l. The highest amount of total dissolve solid was recorded during monsoon season and lowest was recorded during winter. The amount of total dissolve solid was within the desirable limits of BIS Standards.

Alkalinity

The alkalinity of surface water is primarily determined by carbonate and hydroxide content, but it also contains contributions from borates, phosphates, silicates, and other bases. Alkalinity is a measure of water's

capacity to neutralize a strong acid (Qureshimatva *et al.*, 2015). The amount of total alkalinity recorded in Upper Lake ranges between 93 ± 2.03 Mg/l to 110 ± 4.21 Mg/l. The minimum value of alkalinity was recorded during winter season and the maximum value of alkalinity was recorded during summer season. During summer the water level in many number of lake decreases resulting the death and decay of plants and living organism. Thus during decomposition of this CO₂ is released resulting in the addition of carbonate and bicarbonate, this might also be one of the reason for the increase in alkalinity value.

Chloride

The greater source of chlorides in lake water is disposal of sewage and industrial waste (Mani and Gaikwad, 1998). Human body release very high quantity of chlorides through urine and faeces. The amount of chloride recorded in the water of Upper Lake ranges between 21.9 ± 1.23 Mg/l to 40.9 ± 0.45 Mg/l. The highest amount of chloride in lake water was recorded during the summer season and the lowest amount was recorded during winter season. The high chloride concentration of the lake water may be due to high rate of evaporation or due to organic waste of animal origin (Tripathi *et al.*, 2013).

Total Hardness

The hardness of water is governed by the content of calcium and magnesium salts, largely combined with bicarbonate and carbonate (temporary hardness) and with sulphates, chlorides, and other anions of mineral acids (permanent hardness) (Wetzel, 2001). The total hardness recorded in the water of Upper Lake ranges between 96 ± 2.45 Mg/l to 120 ± 3.7 Mg/l. The highest amount of total hardness in the water of Upper Lake was recorded during summer season and the lowest amount of total hardness was recorded during winter season. The hardness was within the desirable limits of BIS.

Calcium

Calcium is most abundant ions in freshwater and is important in shell construction, bone building and plant precipitation of lime. The amount of calcium in the water of Upper Lake ranges between 54 ± 2.4 Mg/l to 70 ± 2.6 Mg/l. The highest amount of calcium recorded in water was during summer season, whereas the lowest amount of calcium in water was recorded during winter season. The amount of calcium increases during summer season due to rapid oxidation /decomposition of organic matter.

Dissolved Oxygen

The amount of dissolved oxygen recorded in the water of Upper Lake ranges between 5.5 ± 0.05 Mg/l to 7.3 ± 0.07 Mg/l. The lowest amount of dissolved oxygen in the water of Upper Lake was recorded during summer season, whereas the highest amount of dissolved in the water of Upper Lake was recorded during winter season. Dissolved oxygen in water is often attributed to the fact that the oxygen is dissolved more during the period of active photosynthesis. The high temperature and addition of sewage and other waste might be responsible for low value of DO (Saksena and Kaushik, 1994).

Nitrate

Nitrates contribute to freshwater through the discharge of sewage and industrial pollutants, as well as runoff from agricultural fields. The amount of nitrate recorded in the water of Upper Lake ranges between 0.87 ± 0.02 Mg/l to 1.1 ± 0.05 Mg/l. The lowest amount of nitrate in the water of Upper Lake was recorded during winter season, whereas the highest amount of nitrate in water was recorded during monsoon season. The high nitrate concentration during monsoon might be due to influx nitrogen rich flood water that brings about large amount of contaminated sewage water. The monsoon season was the period with the highest nitrate-nitrogen concentration which is known to support the formation of blooms (Blomqvist *et al.*, 1994 and Anderson, *et al.*, 1998)

Phosphate

Phosphate is one of the limiting factors for phytoplankton productivity because of geochemical phosphate deficiency in the drainage basin. The amount of phosphate recorded in the water of Upper Lake ranges between 0.76 ± 0.02 Mg/l to 0.94 ± 0.03 Mg/l. The lowest amount of phosphate recorded in the water of the lake was during winter season and the highest amount was recorded during summer season. The washing of large amount of clothes by dhobis and laundry worker, as well as continuous entry of domestic sewage in some areas are responsible for increase in amount of phosphate (Naseema *et al.*, 2013).

CONCLUSION

The result obtained from the present investigation revealed that there was significant seasonal variation in some physicochemical parameters and most of the parameters were in the normal range and indicates moderate quality of lake water.

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