

SEASONAL VARIATIONS IN PHYSICO-CHEMICAL PARAMETERS IN UPPER LAKE OF BHOPAL (M.P.)

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Abstract- Limnological study of Upper Lake includes comparison of water quality parameters of five different sites in every season (Monsoon, Post-Monsoon, Winter, Summer) from sept.19, 2011 to June 19, 2012 of Upper Lake, Bhopal. Water sample collected were analyzed for their Limnological characters viz. Air and Water Temperature, Transparency, pH, TDS, Conductivity, Dissolved Oxygen, Free CO₂, Chloride, Total Alkalinity, Total Hardness, Calcium Hardness, Magnesium Hardness, Nitrate, orthophosphate, data obtained from these analysis were statistically analyzed to determine and check the present status of Lake.

KEYWORDS: lake, physico-chemical parameters, seasonal variations.

I. INTRODUCTION-

Water is a transparent fluid which forms the worlds streams, lakes, oceans and rain ,and is the major constituent of the fluids of living things. Water covers 71% of the Earth's surface. It is vital for all known forms of life. Only 2.5% of the Earth's water is freshwater , and 98.8% of that is in ice and groundwater. Less than 0.3% of all freshwater is in rivers lakes , and the atmosphere, and an even smaller amount of Earths freshwater is contained within biological bodies and manufactured products. Safe drinking water is essential to humans and other life forms even though it provides no calories or organic nutrients. Access to safe drinking water has improved over the last decades in almost every part of the world, but approximately one billion people still lack access to adequate sanitation. There is clear correlation between access to safe water and gross domestic product per capita .A report, issued in November 2007, suggests that by 2030, in some developing regions of the world, water demand will exceed supply by 50%.water plays an important role in world economy, as it functions as a solvent for a

wide variety of chemical substances and facilitates industrial cooling and transportation. Approximately 70%of the fresh water used by humans goes to agriculture. Water is essential for life on earth and of crucial importance for society. Also within our climate water plays a major role. Water resources in India has reached a point of crises due to improper urbanization and industrialization. Water quality parameters provides the basis for judging the suitability of water for different uses. Therefore it has become obligatory to analyze important water parameters of water bodies in regular interval of time. Keeping in view the above facts, an attempt has been made to examine the suitability of Upper Lake water for drinking and other purposes.

Bhopal is arguably the oldest man-made lake in India, and was created by Raja Bhoj in the 11th century by constructing an earthen dam across the Kolans River. The upper lake is a major source of portable water for the city of Bhopal, Madhya Pradesh, India. Latitude 23° 12' (23.2000) and Longitude 77° 18'(77.3000). The basin has a maximum depth of 11.7m and storage capacity 101.5m, cm and the surface area is 32.29 sq. km. Extent of pollution that has occurred due to urbanization, anthropogenic activities; increased human interventions in the water bodies. Burgeoning population and water scarcity is affecting the quality of life significantly; India is no exception to this. Providing water in adequate quantity and quality for domestic water supply, irrigation and industrial requirements in all parts of the city is a tremendous challenge from several angles economic, technical management and social. Earlier studies on Bhoj wetland by Bajpai et al., (1993) reported the deteriorating effect of idol immersion on water quality of upper lake. Parashar et al., (2006) found seasonal variations in physico-chemical characteristics in Upper Lake of Bhopal. Pani and Mishra (2000) in their study reported more deteriorating condition of lower lake as compared to upper lake. Garg and Garg (2002) worked on three lakes of Bhopal (Lower lake, Upper Lake and

Mansarovar Lake) to assess the potential fertility of lentic waters and analyzed their floral ecology.

II. MATERIAL AND METHODS-

During the study period, surface water samples from all the five selected sampling stations (comprising of Hamedia, Koi-Fiza, Mazar, Boat Club and Central Point) were collected every season of year Sept.2011-June 2012 using a plastic bucket. Water quality parameters such as temperature of water and air around lake, transparency, pH, TDS, total alkalinity, Dissolved oxygen, free carbon di-oxide, electrical conductivity (EC) were determined in the field itself by using digital thermometers for determining air and water temperatures, sacchi disc for transparency, digital pH meter for determining pH, digital conductivity for determining conductivity, digital portable TDS meter for determining TDS, Dissolved Oxygen was determined by the Wrinkler's method with Azide modification. While for the analysis of chloride, calcium and magnesium hardness, nitrate and orthophosphates the were brought to the laboratory in plastic bottles of one liter capacity and analyzed using the standard APHA (1995) and Adoni (1985) methods.

III. RESULT AND DISCUSSION-

For the proposed study, five sampling stations were fixed in Upper Lake, Bhopal viz; Hamedia(S1), Koi-Fiza(S2), Mazar(S3), Boat Club(S4) and Central site(S5) for collection of water samples. Variations of physico-chemical parameters seasonally (Monsoon 2011, Post-Monsoon 2011, Winter 2012 and Summer 2012) are presented in tables 1,2,3 and 4 respectively.

Air Temperature :-

The air temperature oscillated between 21 0C to 40 0C. The minimum temperature 21 0C was recorded at station 1 winter. The maximum air temperature was recorded in summer, at station 5. The air temperature showed highest peak in summer and showed declined trend towards the winter.

Water temperature :-

The range of surface water temperature was between, 18 - 25 oC. The lowest value was recorded at station 1 and 3 during winter and the maximum value was recorded at station 5 during summer, the maximum temperature in summer may be regarded due to low water level, clear atmosphere and greater solar radiation.

Transparency:-

The transparency of the system showed wide fluctuation and ranged between 24 - 63 cm. The lowest value was recorded in monsoon at station 1 and maximum during summer at station 5. George (1976) reported the transparency variation from 47.4 cm to 85.5 cm in lower lake of Bhopal. Unni (1984) reported a range of 17 to 130 cm in different reservoirs of M.P.

TDS :-

The TDS fluctuated between 100 - 160 ppm in surface water. The maximum value of 160 ppm was recorded at station 1. The minimum value 100 ppm was recorded at station 5 during post monsoon. Sreenivasan (1970) was of the opinion that waters containing less than 50 mg/l of TDS are unproductive water. Comparison of all above values indicates highly productive condition of water of upper lake.

Conductivity :-

Conductivity ranged between 190 - 260 μ mhos in surface water. The maximum value 260 μ mhos was recorded at station 1 during monsoon, while as the minimum value 190 μ mhos was recorded at station 5, monsoon, Dakshini and Gupta (1984) reported its range 112.05 - 228.96 μ mhos/cm in Badkhal Lake, 92.81 - 154.41 μ mhos/cm in Damdana Lake and 389.64 - 1013.10 μ mhos/cm in Peacock Lake. Khan et al. (1986) recorded its range from 247 - 255 μ mhos/cm.

pH :-

The pH value ranged from 7.5 - 9.5. There was no appreciable variation in pH from station to station in the water body. The highest value 9.5 was recorded at station 1 post monsoon, whereas the lowest value 7.5 was recorded at stations 1 during summer. Nair et al. (1988) found a range from 7.8 - 9.0 in a village pond, Imalia Vidisha, M.P. In present study generally high values were found in summer season and winter and low values in post monsoon season.

Dissolved Oxygen :-

In surface water DO oscillated between 4.6 - 12.8 mg/l. The maximum value 12.8 mg/l was registered at station 5 during monsoon, whereas the minimum value 4.6 was recorded at station 2 during winter. Khan et al. (1986) reported DO in the range of 6.05 - 9.38 and Tiwari (1988) reported 6.3 - 12.5. In lower lake, Bhatnagar (1984) found its range between 0.6 - 1.4 in bottom water.

Chloride :-

Chloride content ranged between 15.92 – 48.99 mg/l. The maximum value 48.99 mg/l was recorded at station 4 during monsoon. Whereas the minimum value 15.92 mg/l was recorded at station 5 during winter. According to Sreenivasan (1964) low chlorides 4 - 10 ppm indicate the purity of water and freedom from pollution, whereas high value of chloride is denoted as pollution of organic matter particularly that of animal origin, Singh (1960).

Total alkalinity :-

Total alkalinity ranged between 18 – 112 mg/l. The maximum value 112mg/l was recorded at station 2 during summer. Whereas the minimum value 18 mg/l was recorded at station 1 during monsoon. Garg et al. (2009) reported alkalinity in the range of 64.25 – 146.24 mg/l in Ramsagar reservoir. Sastry et al. 1970, Patil 1980 and 45.0-165.0 mg/l.

Total Hardness :-

T.H fluctuated between 65 – 136 mg/l. The maximum value 136 was recorded at station 3 during summer whereas the minimum value 65 was recorded at station 5 during summer. Similar observations were noticed by Singh (1960). Garg et al. (2009) reported total hardness in the range of 34 – 75 mg/l in Ramsagar reservoir. Sharma et al. (2007) reported total hardness in the range of 52 – 136 mg/l in three seasonal ponds of Rajasthan.

Calcium Hardness :-

Calcium content varied from 45.5 – 118 mg/l. The maximum value 118 mg/l was registered at station 3 during summer and the minimum value 45.5 mg/l was recorded at station 5 during winter.

Magnesium :-

Mg varied between 9.71 – 18.5 mg/l. The maximum value 18.5 mg/l was recorded at station 1 during post monsoon and minimum value 9.71 mg/l was recorded at station 5 during winter. Sharma et al. (2007) reported magnesium in the range of 6 – 10.2 mg/l in three seasonal ponds of Rajasthan. Values of magnesium were always lower than the calcium, also reported by (Sastry et al. 1970,

Free CO₂ :-

Free Co₂ was less or almost absent. But at the same time high bottom accumulation range 14 – 218 mg/l maximum value was registered during monsoon at station 5 and minimum value was registered at station 2 during winter. Garg et al. (2009) reported free CO₂ in the range of 0.00 – 6.32 mg/l in Ramsagar reservoir. Sharma et al. (2007) reported free CO₂ in the range of 2 – 18 mg/l in three seasonal ponds of Rajasthan.

Nitrate :-

In surface water it varied between 0.51 - 5.5 mg/l. The maximum value 5.5 mg/l was recorded at station 1 during post monsoon and the minimum value 0.5 mg/l was recorded at station 5 during summer. Garg et al. (2009) reported nitrate in the range of 0.011 – 0.033 mg/l in the Ramsagar reservoir. Bhatnagar (1984) reported their range from 1.14-2.25 mg/l at deepest point of Lower lake.

Orthophosphate :-

In surface water, it ranged between 0.01 - 0.10 mg/l. The maximum value 0.10 mg/l was registered at station 1 during winter while the minimum value 0.01 mg/l was recorded at station 5 during monsoon. Garg et al. (2009) reported its range from 0.031 – 0.054 mg/l in the Ramsagar reservoir. Sharma et al. (2007) reported orthophosphate in the range of 0.391 – 2.494 in three seasonal ponds of Rajasthan. The provision of potable water to the rural and urban population is necessary to prevent water born disease (Nikoladze and Akastal, 1989; lemo, 2002). Before water can be described as a potable, it has to comply with certain physical, chemical, and microbiological standards, which are designed to ensure that the water is potable and safe for drinking (Tebutt, 1983). Potable water is defined as the water which is free from disease producing microorganism and chemical substance that deleterious to health (Ikehoronye and Ngoddy, 1985), Water can be obtained from a number of sources, among which are; streams, lakes, rivers, ponds, spring and wells (Linsely and Frazini 1979; kolade 1982). Unfortunately, clean, pure and safe water only exist briefly in nature and immediately polluted by prevailing environmental factor and human activities.

Table 1. Showing the variation of physico-chemical parameters in Upper Lake, Bhopal during Monsoon 2011.

S.No.	Parameters	S1	S2	S3	S4	S5
1	Air temperature °c	27	30	31	34	34
2	water temperature °c	22	23	24	23	23.5
3	Transparency cm	24	34	39	54	58
4	Ph	9.5	9	9	9	8.5
5	TDS	150	140	140	130	120
6	Conductivity mhos	260	210	200	200	190
7	DO mg/l	8.8	9.6	12	10.8	12.8
8	Free Co ₂ mg/l	194	Ab	Ab	218	Ab
9	Chloride mg/l	31.99	34.99	48.99	27.99	24.99
10	Total Alkalinity mg/l	18	42	58	22	24
11	Total Hardness mg/l	120	110	106	110	88
12	Calcium hardness mg/l	99.1	97.1	82.5	84	71.8
13	Mg. hardness mg/l	18.66	11.07	18.2	14.64	11.8
14	Nitrate mg/l	3.9	4.3	4.1	1.2	1.1
15	Orthophosphate mg/l	0.09	0.06	0.08	0.04	0.01

Table 2. Showing the variation of physico-chemical parameters in Upper Lake, Bhopal during Post Monsoon 2011.

S. No.	Parameters	S1	S2	S3	S4	S5
1	Air temperature °c	23	24	23	25	23
2	water temperature °c	18.5	18.5	18	18.5	18
3	Transparency m	35	28	29	34	52
4	pH	9.5	9	8	9.5	8.5
5	TDS	110	120	110	110	100
6	Conductivity mhos	220	240	220	200	240
7	DO mg/l	8.5	7.5	8.5	9.8	10.8
8	Free co ₂ mg/l	Ab	Ab	Ab	Ab	Ab

9	Chloride mg/l	22.99	44.99	41.99	36.99	25.99
10	Total Alkalinity mg/l	72	66	82	72	96
11	Total Hardness mg/l	120	130	116	100	90
12	Calcium hardness mg/l	100.2	109.8	100.4	85.1	78.8
13	Mg. hardness mg/l	18.5	17.13	12.07	11.07	9.8
14	Nitrate mg/l	5.5	4	4.4	4.2	2.1
15	Orthophosphate mg/l	0.09	0.08	0.05	0.03	0.02

Table 3. Showing the variation of physico-chemical parameters in Upper Lake, Bhopal during Winter 2012.

S.No.	Parameters	S1	S2	S3	S4	S5
1	Air temperature °c	21	22	23	24	24
2	water temperature °c	18	18.5	18	19	18.5
3	Transparency m	36	40	49	50	58
4	pH	8	8	8.5	9	8.5
5	TDS	140	150	120	120	110
6	Conductivity mhos	210	230	240	200	200
7	DO mg/l	5.8	4.6	6	7.8	8.8
8	Free CO ₂ mg/l	ab	14	Ab	ab	18
9	Chloride mg/l	23.99	21.92	20.99	19.66	15.92
10	Total Alkalinity mg/l	100	96	86	86	48
11	Total Hardness mg/l	110	84	130	72	58
12	Calcium hardness mg/l	107.1	96.6	110.9	81.9	45.5
13	Mg. hardness mg/l	16.3	12.95	16.52	14.61	9.71
14	Nitrate mg/l	3.5	5.3	1.5	1.2	1.1
15	Orthophosphate mg/l	0.10	0.08	0.03	0.02	0.02

Table 4. Showing the variation of physico-chemical parameters in Upper Lake, Bhopal during Summer 2012.

S. No	Parameters	Site 1	Site 2	Site 3	Site 4	Site 5
1	Air temperature °c	35	36.5	37	38.5	40
2	water temperature °c	24	24.5	24.5	25	25
3	Transparency m	34	32	39	54	63
4	Ph	7.5	8	8.5	8.9	9
5	TDS	160	150	140	140	110
6	Conductivity mhos	210	210	100	220	200
7	DO mg/l	5.8	6.6	6.8	8.2	10.6
8	Free co ₂ mg/l	Ab	16	Ab	ab	20
9	Chloride mg/l	24.15	25.16	28.3	26.3	18.31
10	Total Alkalinity mg/l	110	112	100	98	65
11	Total Hardness mg/l	122	125	136	88	65
12	Calcium hardness mg/l	104	108	118	75	49.12
13	Mg. hardness mg/l	17.3	15.6	12.31	11.4	10.9
14	Nitrate mg/l	4.9	3.3	3.1	2.2	0.51
15	Orthophosphate mg/l	0.09	0.06	0.08	0.08	0.02

IV. CONCLUSION-

The present study reveals that the assessment of water quality deterioration is due to various reasons and Upper Lake is of a better quality, although there is a need of continuous monitoring in order to maintain the drinking water. The water quality of Upper Lake is evaluated which is one of the major potable water source of Bhopal city. Better water quality was found in winter season than summer. Extent of pollution that has occurred due to urbanization, anthropogenic activities; increased human interventions in the water bodies have been ascertained.

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