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Quality Assessment of Physico- Chemical Properties of Barua Sagar Lake Jhansi Uttar Pradesh, India

Zoology

KEYWORDS : water, physico chemical parameter, barua sagar lake

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ABSTRACT

This study was aimed to estimate current status of physico-chemical characteristic of Barua sagar lake. Monthly changes in physic-chemical parameters such as water temperature, pH, total dissolved solids, dissolved oxygen, alkalinity, total hardness, calcium, magnesium, chlorides, sodium, biological oxygen demand, manganese, cadmium and lead were analyzed for during January to December from year 2014 to 2015. The results indicated that the parameters of water sample in 2014 under permissible limit except than Cd, Pb and Mn but in 2015, total hardness, Mn, Cd, Pb and Cl were out of permissible limits, due to the burden of agricultural waste and human activities.

Introduction

Water is an essential component for survival of aquatic life on planet of earth, which contains minerals and metals for the important of humans as well as for earth and aquatic life. The lakes, pond, stream is the important component for this planet's most important fresh water resources and provide innumerable benefits. The lake is man-made or artificial barriers both usually constructed across a stream channel to impound water. Some solutes are acceptable and even desirable for taste enhancement and to provide needed electrolytes. The deterioration in the water quality caused by toxicants may affect the aquatic organism which ultimately gets reflected in health problem (Malik et al., 2015). The main sources of heavy metal and pollution of the agriculture, industry and metropolitan cities and the bioaccumulation of toxic heavy metals in fish species from different aquatic systems is dependent on their foreign polluted substances (Maurya and Malik 2016). The problem of Baruwa sagar lake water quality deterioration is mainly due to human activities such as disposal of solid west and agricultural runoff which are major cause of ecological damage and pose serious health hazards (Amit et al 2012).

Study area:

Jhansi is located in the plateau of central India, an area dominated by rocky reliefs and minerals underneath the soil. Barua Sagar is a historical place located about 25 km from Jhansi in Uttar Pradesh, India. It is situated on the bank of the Betwa River, the place is named after the Barua Sagar Taal, a large lake created about 260 years ago when Raja Udit Singh of Orchha built the embankment. The beautiful temple Jarai-ka-Math, and the historic forts of Bundelkhand are nearby attractions. Area is 4.64 sq/m and altitude is 210 meters and more details shown in Table 1. Monthly water sample have been collected from 5 different point of Barua sagar lake shown in Fig 1, 2, 3, and 4.

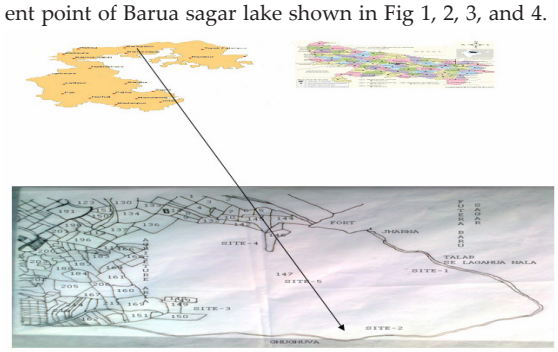

Fig 1: Sketch map showing the Barua sagar lake Jhansi



Fig 2: Barua sagar lake over flow during monsoon season



Fig 3: Human activity bank of Barua sagar Lake

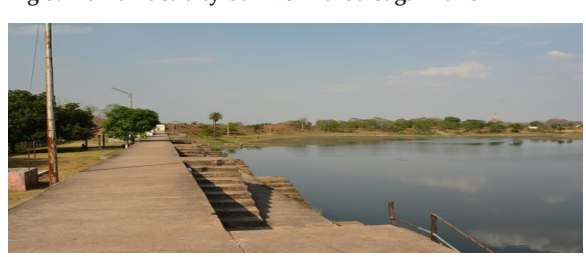

Fig 4: Barua sagar during winter season

Water samples and analysis methods

Water samples were collected at the monthly variation during 2014 to 2015. Ten samples ensure maximum representation of diverse environments of the area. For sampling, plastics bottles were used. Sampling was carried out di-

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rectly without adding any preservatives in clean bottles to avoid any contamination and brought to the laboratory. The water samples collected from different four site. Collected water samples were brought to the laboratory and stored in cold room at 1-4°C temperature in order to avoid any major chemical alteration for various physic- chemical analyses of (APHA, 1995). Guide line shown in Table 2.

Table 1: Parameters analyzed methods used

Parameters	Methods
Temperatue	Thermameter
pH	Digital Kit (NPC361D)
Total Dissolved Solid	Digital Kit (NPC361D)
Dissolved Oxygen	Digital Kit (NPC361D)
Chloride	Titration Methods
Alkalinity	Titration Methods
Total Hardness	Titration Methods
Calcium, Magnesium & sodium	Titration Methods
Cadmium & lead	Atomic absorption spectrophotometer (AAS)
BOD	BOD incubator

Resultsanddiscussion

pH

The water tend to be more alkaline due to the increasing of pH, if the possesses more carbonates and less alkaline when possesses large quantities of calcium, bicarbonates and CO2 (Sarwar and Wazir, 1991). However, it is more often governed by the photosynthetic activities of producers in lakes (George, 1961). The hydrogen ion concentration (pH) of water is considered as an index of environmental conditions. In present study, the pH values varied from 7.3 to 8.5 and mean value 7.52±0.62 during year 2014 and 7.4 to 9.1 and average values 8.29±0.54 during 2015, which indicate the slightly polluted for human health shown in Table3 and 4. This is generally the normal range of pH in fresh water bodies very less contaminated by alkaline wastes. High pH was observed in month of august due to the weathering of rock.

Temperature

The present study Barua sagar lake water temperature ranged from 15.2°C to 28.3 °C and mean value 21.36±4.44 0C during 2014 and 17.2 to 28.7 and mean value 24.54±3.11 °C during 2015 shown in Table 3 & 4. Meteorological conditions such as trade winds, sunshine durations and absorption of the solar radiation by the shallow reservoir water body might be responsible for the monthly variations and significant differences seen between the seasons.

Table 2: Physico chemical characteristics of Barua sagar lake 2014

Parameters	Jan	Feb	March	April	May	June	July	Aug	Sept	Octo	Nov	Dec	Average±sd
pH	7.8	7.3	7.5	7.7	8.2	8.5	7.4	7.5	7.4	5.9	7.8	7.3	7.52±0.62
Temp	15.2	16.5	17.8	20.6	24.3	28.3	27.2	27.3	18.25	19.35	21.54	20.14	21.36±4.44
TDS (mg/l)	215	230	235	255	273	354	235	309	312	212	234	254	259.83±44.03
DO (mg/l)	6.25	6.3	5.4	5.2	5.1	5.3	6.5	6.5	6.7	7.5	7.9	8.4	6.42±1.08
TA (mg/l)	61.25	69.5	75.8	88.8	111.1	97.5	100.5	98.25	89.54	95.01	105.6	98.58	90.95±14.95
TH (mg/l)	201.2	208.6	209.6	218.2	236.8	252.3	250.51	270.36	238.21	254.24	245.3	155.85	228.43±31.32
Ca^{++}(mg/l)	21.24	24.5	26.8	35.5	36.2	34.7	32.01	35.51	36.5	38.54	39.54	38.21	33.27±5.93
Mg^{++}(mg/l)	48.47	51.2	56.6	62.6	65.6	69.5	51.24	55.62	56.89	54.9	51.41	45.21	55.77±7.13
Cl^{-}(mg/l)	41.32	44.3	47.5	50.5	52.4	56.2	48.24	45.35	54.31	56.21	59.24	64.12	51.64±6.69
Na (mg/l)	21.36	26.32	23.12	29.35	15.68	28.21	27.54	31.24	25.47	54.32	35.12	34.78	29.37±9.57
BOD (mg/l)	5.02	6.34	5.54	6.32	5.14	6.25	5.35	7.54	6.35	5.65	6.21	7.54	6.10±0.82
Mn (mg/l)	134.2	150.21	154.32	168.21	167.68	157.32	147.32	120.32	100.21	98.21	95.21	98.21	132.61±28.72
Cd (mg/l)	0.84	0.59	0.55	0.62	0.32	0.84	0.68	0.45	1.02	0.93	0.89	0.47	0.68±0.21
Pb (mg/l)	1.54	0.66	0.85	0.57	1.95	2.32	2.45	1.65	3.85	2.96	3.54	3.47	2.15±1.14

Table 3: Physico chemical characteristics of Barua sagar lake 2015

Parameters	Jan	Feb	March	April	May	June	July	Aug	Sept	Octo	Nov	Dec	Average±sd
pH	7.4	7.5	7.8	7.9	8.5	8.6	8.3	9.1	8.4	8.9	8.8	8.3	8.29±0.54
Temp	17.2	18.5	19.8	22.6	24.9	25.7	24.2	27.3	20.25	20.35	22.54	20.14	24.54±3.11
TDS (mg/l)	350	321	354	451	373	394	335	349	332	326	338	254	348.04±46.67
DO (mg/l)	5.25	5.54	5.24	5.41	6.13	6.24	4.58.5	4.25	4.79	6.54	5.91	6.44	5.61±0.71
TA (mg/l)	75.35	68.54	78.83	98.8	110.15	105.5	109.53	89.25	140.54	104.12	109.69	91.89	98.51±19.49
TH (mg/l)	211.22	218.7	224.6	215.5	257.8	345.3	324.55	3.8.36	341.21	324.24	340.3	215.85	274.47±59.64
Ca^{++}(mg/l)	25.14	23.5	24.8	38.5	37.25	37.75	34.42	36.55	37.55	40.1	48.54	50.54	36.22±8.53
Mg^{++}(mg/l)	51.44	55.25	52.63	65.64	62.63	64.51	51.21	59.18	61.81	57.94	62.48	64.57	59.1±5.32
Cl^{-}(mg/l)	45.32	48.35	54.55	56.1	57.5	55.91	64.24	84.47	69.37	69.58	71.35	69.58	62.19±11.79
Na (mg/l)	34.36	86.32	54.10	54.34	67.19	35.54	35.48	56.45	35.54	68.35	62.45	69.71	54.98±16.91
BOD (mg/l)	5.87	6.48	4.75	6.58	5.45	6.57	5.48	7.48	6.35	6.78	5.75	4.24	5.98±0.91
Mn (mg/l)	145.2	210.21	164.52	154.	169.18	231.32	214.34	220.39	190.58	198.57	157.29	198.27	187.7±28.87
Cd (mg/l)	1.65	1.74	1.39	2.12	1.32	2.41	2.41	2.19	1.74	2.39	2.89	2.47	2.06±0.48
Pb (mg/l)	2.54	3.36	5.85	5.57	4.95	3.32	3.45	4.65	5.85	6.96	5.54	4.47	4.70±1.32

Table 4: The correlation coefficient of physic-chemical parameters during 2014

	pH	Temp	TDS	DO	TA	TH	Ca	Mg	Cl	Na	BOD	Mn	Cd	Pb
pH	1													
Temp	0.36488	1												
TDS	0.531616	0.600185	1											
DO	-0.5366	-0.18364	-0.31472	1										
TA	0.107736	0.734944	0.368721	0.189941	1									
TH	-0.00657	0.599888	0.360133	-0.21969	0.420578	1								
Ca	-0.13774	0.473249	0.344737	0.384695	0.878198	0.312938	1							

Mg	0.470263	0.477821	0.640163	-0.75332	0.325188	0.483732	0.238506	1						
Cl	-0.09099	0.184293	0.202383	0.538572	0.651279	-0.14782	0.809282	0.034599	1					
Na	-0.77272	-0.01078	-0.24234	0.635482	0.217807	0.182606	0.495722	-0.24451	0.460413	1				
BOD	-0.05872	0.200769	0.420454	0.426916	0.223114	-0.13875	0.422632	-0.17553	0.366659	0.283371	1			
Mn	0.531772	0.209143	0.117434	-0.90891	-0.17252	0.01906	-0.44411	0.580521	-0.50442	-0.62638	-0.40886	1		
Cd	-0.24237	-0.24513	-0.00352	0.278102	-0.18296	0.267643	0.064669	-0.06492	0.157647	0.394329	-0.20238	-0.46758	1	
Pb	-0.191	0.142	0.179306	0.704267	0.53527	0.101477	0.648287	-0.22632	0.741001	0.392929	0.198741	-0.78615	0.474623	1

Table 5: The correlation coefficient of physic-chemical parameters during 2015

	pH	Temp	TDS	DO	TA	TH	Ca	Mg	Cl	Na	BOD	Mn	Cd	Pb
pH	1													
Temp	0.704286	1												
TDS	-0.08813	0.369787	1											
DO	0.104858	-0.17717	-0.14598	1										
TA	0.555331	0.346896	0.084849	-0.01265	1									
TH	0.837832	0.645208	-0.00043	-0.25373	0.584644	1								
Ca	0.676356	0.351473	-0.2211	0.423553	0.537678	0.350068	1							
Mg	0.447506	0.389613	0.218407	0.449167	0.457142	0.157053	0.735855	1						
Cl	0.85542	0.511901	-0.31448	-0.19432	0.445177	0.71989	0.649664	0.319328	1					
Na	0.017617	-0.16034	-0.31492	0.437416	-0.39227	-0.31107	0.117058	0.169826	0.057055	1				
BOD	0.320936	0.338764	0.438313	-0.28907	0.099781	0.530534	-0.14194	0.111789	0.227045	-0.06607	1			
Mn	0.419742	0.444753	-0.27302	-0.07379	0.098241	0.531405	0.075895	0.048291	0.361166	0.017889	0.324453	1		
Cd	0.542835	0.296898	-0.18353	0.216251	0.227698	0.4836	0.713093	0.330896	0.530446	-0.0069	0.124255	0.310995	1	
Pb	0.452667	0.017757	0.047735	0.194965	0.421795	0.200505	0.383016	0.326348	0.464433	0.267667	0.054225	-0.22414	0.065672	1

Total Dissolved Solids (TDS):
Total dissolved solids was found ranging from 212 to 309 mg/l, mean value 259.83±44.03 mg/l during 2014 and 254 to 394 mg/l and mean value was found 348.04±46.67 mg/l during 2015 in different month shown in Table 3 & 4. Similar findings have been reported by Rao et al 2003, Kirubavathy et al 2005, Garg et al 2006.

Dissolved Oxygen
Dissolved oxygen is an important indicator of water quality, ecological status, productivity and health of lakes. This is due to its importance as a respiratory gas, and its use in biological and chemical reactions. The DO ranging from 5.10 to 8.40 mg/l and mean value was found 6.42±1.08 mg/l during 2014 and 4.25 to 6.54 mg/l and mean value was measured 5.61±0.71 mg/l was recorded in 2015 shown in Table 3 & 4.

Alkalinity
The total alkalinity of the reservoir is a reflection of its carbonates and bicarbonate profiles (Wetzel, 2001) with the likelihood of silicates and phosphates contribution. The value of alkalinities varied from 61.25 to 111.10 mg/l and mean value 90.95±14.95 mg/l during 2014 and 75.35 to140.54 mg/l mean value 98.51±19.49 mh/l during 2015 shown in Table 3 & 4.

Total hardness (TH)
In the present study total hardness ranged from 155.85 to 270.36 mg/l and 228.43±31.32 mg/l during 2014 and 211.22 mg/l to 383.6 mg/l and mean value 274.47±59.64 mg/l in 2015 in different months shown in Table 3 & 4. These high values may be due to the addition of calcium and magnesium salts.

Calcium
Presence of calcium and magnesium makes the water hard. Calcium cation (Ca+) and calcium salts are among the most commonly encountered substances in water, arising mostly from dissolution of minerals. In the present study, concentration of calcium content of water samples varied from 21.24 mg/l to 39.54 mean value 33.27±5.93 mg/l during 2014 and 23.50 to 50.45 and mean value 36.22±8.53 mg/l during 2015 shown in Table 3 & 4.

Magnesium
Magnesium concentration can be extremely high in certain closed saline lakes. Natural sources contribute more magnesium to the environment than all anthropogenic sources. The magnesium concentrations varies between 45.21 to 69.5 mg/l and mean value 55.77±7.13 mg/l during 2014 and 51.21 to 65.64 mg/l and mean value was measured 59.10±5.32 mg/l during 2015 shown in Table 3 & 4.

Chloride
Chloride is not harmful to humans but high concentration of chloride increase the corrosive property of water. The chloride content of studied water samples were out of permissible limit prescribed by BIS. The chloride range between 41.32 to 59.24 mg/l and mean value 51.64±6.69 mg/l during 2014 and 45.32 to 69.58 mg/l and average value was found 62.19±11.79 mg/l recorded during 2015 respectively shown in Table 3 & 4.

Sodium
Sodium is one of the important cation occurring naturally. Sodium concentration in irrigation water and soil is of great interest as high sodium contents makes soil hard to plough and unsuitable for seedling emergence (Maurya et al 2011). The present study was observed that 21.36 to 54.32 mg/l and mean value 29.37±9.57 mg/l was found during 2014 and 34.36 to 86.32 mg/l and mean value 54.98±16.91 mg/l during 2015 shown in Table 3 & 4.

BOD
BOD is a measure of the amount of oxygen removed from aquatic environments by aerobic microorganisms during the breakdown of organic substances in lake water (Radojevic and Bashkin, 1999). The resent study was observed that BOD concentration range between 5.02 to 7.54 mg/l and mean value was found 6.73±0.87 mg/l during 2014, the concentration 4.24 to 6.78 mg/l and mean value 6.98±0.91 mg/l recorded in 2015 shown in Table 3 & 4.

Manganese
Manganese can be adsorbed onto soil; the extent of adsorp-

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tion depends on the organic content and cation exchange capacity of the soil. The biomagnifications in food chains is not expected to be very significant (Abbasi et al 1998). The present study was measured 95.21 to 168.21 mg/l and mean value 132.61±28.72 during 2014 and 145.20 to 220.39 mg/l mean value was measured 187.7±28.87 mg/l in 2015 shown in Table 3 & 4.

Cadmium

Metals are generally precipitated at alkaline pH in the form of insoluble oxides and carbonates. It has been proved that lethality increases of living animals and decrease oxygen concentration in river ecosystem (Malik and Maurya 2016). The concentration of cadmium range between 0.32 to 0.65 mg/l and mean value was found 0.46±0.11 during 2014 and 1.32 to 2.89 mg/l and mean value 2.06±0.48 mg/l found during 2015 shown in Table 3 & 4.

Lead

One probable source of lead pollution in the lake is the leaching from soils that are found next to busy highways into the water system (USEPA, 2003). The concentrations of lead measured between 0.57 to 3.54 mg/l and mean value 2.15±1.14 mg/l during 2014 and 2.54 to 6.96 mg/l and mean value was found 4.70±1.32 was found in during 2015 shown in Table 3 & 4.

Correlation coefficient

The correlation coefficient was indicated that high correlation in between Calcium & total alkalinity, chloride & calcium during 2014 shown in Table 5, and total hardness & pH, chlorine and pH was highly correlated during 2015 shown in Table 6. The other parameters indicated less correlation otherwise negative correlation.

Conclusion

The present study indicated that the Baruwa sagar lake is slightly polluted for the different agricultural waste and human activities. More variation of selected parameters in the present study was fluctuated during 2014 to 2015. The data indicated that lead is unlikely to be present in source water unless a specific source of contamination exists. However, lead has long been used in the plumbing materials and solder that are in contact with drinking water as it is transported from its source into homes. The results indicate that the Barua sagae lake water quality deterioration day bay day due to the increasing of agricultural and organic waste during the study period. The cadmium and lead were out of permissible limit according to WHO. Dissolved oxygen is an important aquatic parameter, whose presence is vital to aquatic fauna. It plays crucial role in life processes of animals. Dissolved oxygen concentrate was 5.5 mg/l throughout the year. The present study indicated that the Barua sagar lake suitable for production for fish culture agricultural purposes and after treatment suitable for drinking purposes.

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