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ANALYSIS OF PHYSICO-CHEMICAL CHARACTERISTICS TO STUDY THE WATER QUALITY OF SAHEB BANDH AT PURULIA, WEST BENGAL, INDIA



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ABSTRACT:

Purulia, commonly known as “Manbhum City” is a city located on the north of the Kasai river, West Bengal state, India with an area of 6,259 km² having an average elevation of 228 metres (748 feet). Saheb bandh is a 500 acre lake in Purulia, known to have been constructed in the mid of 19th century. Saheb bandh is considered as a home for migratory birds. During migratory season, the birds fly from Baluchistan, Siberia and several other places in Europe to this place. Thus for a local birdwatchers, Saheb bandh is a popular retreat. The development of town has directly or indirectly contributed to water pollution problems. The main aim of this paper is to study the physico-chemical characteristics and Microbiological assessment of the water quality of Saheb bandh, Purulia. In this context water samples were collected in the morning (8:00 am to 9:00am) from March 2012 to

February 2013, for a period of one year. Physico-chemical analysis of the water sample such as Temperature, pH, Dissolved Oxygen, Conductivity, BOD, COD, Total alkalinity, Hardness, Sulphate, Chloride, Nitrate, Phosphate, Total Solids and Total Dissolved Solids (TDS) were estimated. In addition to this, Microbiological Assessment of water sample were also done using Most Probable Number Method (MPN). After physico-Chemical and Microbiological analysis, it was estimated that the water of Saheb Bandh is unsuitable for irrigation and drinking.

KEYWORDS : Saheb bandh, BOD, COD, MPN

INTRODUCTION:

Purulia, also known as "Manbhum City", is a city located on the north of the Kasai River, West Bengal state, India with an area of 6,259 km² was constituted in 1876. Purulia is located at 23°20'N 86°22'E 23.33°N 86.37°E. It has an average elevation of 228 metres (748 feet). Summers are hot and dry with temperatures ranging from lows of 23 °C to highs above 45 °C. Winters are dry and cool with daily temperatures ranging from 5 °C to 20 °C. Most of the rainfall occurs during the wet monsoons. Saheb Bandh is a 50 acre lake in Purulia, that is known to have been constructed in the mid of 19th century. It is said this water body was dug by convicts, at the instigation of Colonel Tingley, during the British Raj. This process was started in the year 1843 and took five years for it to be completed. Now, Saheb Bandh is also considered as a home for migratory birds. During the migratory season, birds fly from Baluchistan, Siberia and several places in Europe, to this place. Thus, for local birdwatchers, Saheb Bandh is a popular retreat. It is exposed to wind action and biotic strong stirring. Thus there is no possibility of thermal or oxygen stratification. The development of the town has directly or indirectly a number of water pollution problem. The resident surrounding this Saheb Bandh takes bath in it and cleans their clothes and utensils. These activities have subjected to a strong biotic pressure all along the periphery and have turned into a eutrophic stage. The water of the lake is declining in quality posing threat to these people. The ecological stress, particularly from human activities, deteriorates not only takes place in water quality but the aquatic life of the lake is also badly affected. The lake is undergoing rapid trophic evolution as it is under great ecological stress due to fast urbanization in its surrounding areas. It also receives huge amount of untreated sewage and solid garbage from the dense population resulting in the form of weed infestation besides obnoxious algal bloom. In the past there have been reports of limnological investigations of a number of lakes in India but no attention has been paid to assess the water quality of the Saheb Bandh. Therefore, in order to assess the ecological status of the Saheb Bandh, it becomes very important to determine the physico-chemical characteristics of the bandh.

Materials And Methods:

Water samples were collected in the morning (8.00am to 9.00am) from March, 2012 to February, 2013 for a period of one year. Subsurface sampling were done in glass stoppered sterilized container (Volume approx. 1L) at a depth of 6–7cm.

Physico-chemical analyses of water samples: Temperature and pH of water samples were measured in the field immediately after collection with the help of mercury glass thermometer and portable pH meter respectively. Other physico-chemical parameters were analyzed in the laboratory within 3 hours of collection. The turbidity was measured by a Nephelometer. Electrical conductivity was measured by Conductivity Meter. All other parameters such as dissolved oxygen (DO), biochemical oxygen demand (BOD), chemical oxygen demand (COD), total alkalinity, hardness, sulphate, chloride, nitrate, phosphate, total solids and total dissolved solids were estimated following the standard

methods as outlined in Standard methods (2002).

Observation:

Month	pH	Temperature (°C)	Turbidity (NTU)	Electrical conductivity (mS/cm)	Total solids (mg/L)	Total alkalinity (mg/L)	Hardness (mg/L)
March 2012	7.2	31.0	27	115.6	380	30	112.2
April	6.8	31.5	23	128.4	414	34	114.6
May	7.03	36.5	33	132.6	452	36	116.8
June	7.2	37.5	24	131.6	412	38	116.2
July	7.3	35.0	16	138.6	402	44	124.8
August	7.8	33.5	18	148.0	406	42	110.6
September	7.6	33.0	26	126.5	426	40	102.2
October	7.5	32.5	34	124.6	426	34	98.6
November	7.9	30.0	22	121.3	406	28	102.6
December	7.6	29.0	19	111.2	402	27	101.2
January 2013	7.5	28.0	17	114.8	398	29	104.6
February	7.2	27.0	21	112.5	408	26	112.4

Table – 1
Physico – chemical characteristics of the Saheb Bandh during March, 2012 to February, 2013.

Month	Dissolved oxygen (mg/L)	BOD (mg/L)	COD (mg/L)	Sulphate (mg/L)	Chloride (mg/L)	Nitrate (mg/L)	Phosphate (mg/L)
March 2012	6.2	2.36	56.2	12.68	31.6	0.86	0.16
April	5.8	2.16	52.4	9.45	34.6	0.82	0.21
May	4.6	2.1	50.5	16.6	37.4	0.68	0.34
June	3.2	2.3	48.4	14.55	42.6	0.96	0.42
July	3.6	2.6	48.6	16.14	46.5	1.32	0.52
August	4.6	2.8	46.0	11.67	38.2	1.86	0.56
September	5.2	2.6	52.8	14.62	3705	1.76	0.58
October	5.6	3.2	56.2	16.34	32.2	1.46	0.62
November	5.8	3.8	56.0	14.28	28.4	0.92	0.38
December	5.4	4.2	54.4	16.35	32.6	0.78	0.26
January 2013	6.5	4.2	56.8	17.48	32.6	0.87	0.18
February	7.6	4.0	52.2	19.45	34.2	0.94	0.14

Result and discussion:

The physico-chemical characteristics of the Saheb Bandh during the period of study were presented in Table 1.

The pH recorded (ranges between 6.8 and 7.9) during the present study was indicative of the alkaline nature of water.

The water temperature fluctuated between 27.0 C and 37.50 C. The surface water temperature is one of the most significant parameters which control inborn physical qualities of water. The summer

temperature (May- Jul) was always above the winter temperature (Jan-Feb) due to lack of sunlight.

Water transparency is an important factor that controls the energy relationship at different trophic levels. It is essentially a function of reflection of light from the surface and is influenced by the absorption characteristics of both of water and of its dissolved and particulate matter (Stepane, 1959). The turbidity ranged between 16 NTU and 34 NTU which was well above the WHO (1992) standards. The maximum and minimum turbidity values were noted during October and July respectively. The sewage influx and settleable solids have a tremendous effect on the aquatic environment by increasing the turbidity which in turn decreases productivity and photosynthesis (Bartsch, 1960).

Electrical conductivity values ranged from 112.5 to 148 mS/cm with its maximum value during August. The annual mean conductivity value was thus above eutrophic levels of 200 μ S/cm (Olson, 1950). Increased electrical conductivity is regarded as pollution indicator in shallow lakes (Das et al., 2006).

Dissolved oxygen (DO) is one of the most reliable parameters in assessing the trophic status and the magnitude of eutrophication in an aquatic ecosystem (Edmondson, 1966). Its concentration was generally low and ranged from 3.2 mg/L to 7.6 mg/L. The lowest value was recorded during summer (June) and highest value during winter (February). The low level of DO is again indicative of polluted nature of water body. Such low level of oxygen was also noted in other lakes (Iqbal et al., 2006).

The BOD value of the lake throughout the year of survey fluctuated between 2.1 mg/L and 4.2 mg/L with highest and lowest values during December - January and May respectively. However, high BOD value (89- 99mg/L) was noted in the Bellandur lake water of Bangalore which may be due to absorption of pollutants by aquatic flora in lake system (Chandrasekhar et al., 2003).

On the other hand, Chemical oxygen demand (COD) value ranged from 48.4 mg/L to 56.8mg/L. The highest and lowest values were noted in the month of January, 2013 and June, 2012 respectively. The hardness value was found to be very high with minimum value of 98.6 mg/L during October and maximum of 124.8 mg/L during July. The salts of calcium and magnesium usually account for most of the hardness.

High amount total solids (TS) were noted during the period of survey. The TS concentration varied between 380 mg/L and 452 mg/L. The maximum value was noted during May while the minimum during March.

The alkalinity of water is mainly due to bicarbonates. The value ranged between a minimum of 26 mg/L during February, 2013 and maximum of 44 mg/L during July, 2012. The lower values might be attributed to the utilization of carbon dioxide by autotrophs and therefore precipitation of calcium as calcium carbonate (Otsuki and Wetzel, 1972).

According to Zafar, 1964, chloride can be considered as one of the basic parameters of classifying lakes polluted by sewage into different categories. The chlorides value oscillated between 28.4 mg/L and 42.6 mg/L. The high chloride content might be attributed to the presence of large amount of organic matter of both allochthonous and autochthonous origin (Pandit, 1999). High chloride content of water indicates organic pollution of animal origin also (Thresh et al., 1994). The sulfate concentration fluctuated between 9.45 mg/L and 19.45 mg/L throughout the period of survey. The sulfate concentration reached its peak during February while the minimum value was noted during April.

The phosphate value varied from 0.14 to 0.58 mg/L Highest concentration of phosphate was noted in the month of September with lowest value during February. The US Environmental protection agency (1976) suggested that 0.08 ppm of phosphate is the critical level for the occurrence of eutrophication in lakes and reservoirs.

The nitrate content of lake water fluctuated between 0.68 and 1.86 mg/L. The nitrate content, however, ranged from 2.02 to 15.22 ppm in Sahapura Lake, Bhopal (Kataria et al., 1996).

CONCLUSION:

The water of Saheb Bandh hence was unsuitable for irrigation and drinking. The water is completely unfit for human use. Growing urbanization around this lake is likely to degrade water quality which could be a threat to public health in future. The values so assessed clearly indicated the extent of pollution.

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