The International Journal of Engineering and Science (IJES)
|| Volume || 8 || Issue || 3 Series I|| Pages || PP 19-24 || 2019 ||
ISSN (e): 2319 – 1813 ISSN (p): 23-19 – 1805

Physico-chemical Properties of Moulvi Bandh, Ambikapur, Sargujawith reference to Water Quality

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----------***ABSTRACT:***----------
This study was carried out to assess the water quality of Moulvi Bandh on the basis of Physico-chemical Properties of Ambikapur City, Sarguja, Chhattisgarh. Various parameters including Temperature, pH, EC (Electrical Conductivity), TDS (Total Dissolved Solids), TSS (Total Suspended Solids), TS (Total Solids),Acidity, DO (Dissolved Oxygen), and Free CO_2. The results were calculated and compared with water quality standards given by WHO, BIS and EPA guidelines (Environmental Protection Agency). The overall water quality index value of Moulvi Bandh is 57.60 which show that the Bandh is moderately polluted. The water can be used for irrigation and household purposes.

Keywords: *Physico-chemical Parameters, Water Quality, Water Quality Index (WQI).*

Date of Submission: 20-02-2019 Date of acceptance: 08-03-2019

I. INTRODUCTION:

The water is one of the essential resources on earth. No creature, as well as personalities, animals, plants or insects, can live without water. Water is one amongst precious gift by the character of humanity and that we should love and put it aside for our future generation still as a result of water could be a scarce resource and it's going to fill over time or as a result of overuse. The human body is 70% made up of water and our earth's surface consists of 75% of water and below the surface of the land, there's a saturated layer which is known as the water table. If there's no water on earth there's no life. Water plays a big role in the field of agriculture. Agriculture is not possible while not water and if there would be no agriculture there would be nothing to eat. Irrigation is done with the help of water. Water ensures the proper growth of the plant. Water is employed for varied domestic uses like for laundry garments, bathing, change of state etc. Water is also used in balancing the ecosystem. Water is employed in industries like industry, fertilizers, chemicals, cement, paper, etc. in immense quantities for, cleaning, air-con, cooling, generation of power, fire protection etc. Water is also used in generating electricity. Water is a vital supply of fish, wildlife, and recreation. Recreational activities such as swimming, boating etc. are just possible because of water. As per (Guojun et al., 2016) surface water pollution has a significant effect on the infant mortality rate in China. Based on the parameters concentrations and therefore the land uses impacts, it was concluded that domestic and agricultural waste strongly influenced the variation and the quality of ponds in the area (Ayeni et al., 2013). Various methods are available to analyze the water quality data that changes depending on informational goals, the type of samples, and the size of the sampling area. WQI is calculated consistent with the quality of surface water for human consumption. WQI index is a numeric expression used to transform a large number of variables data into a single number, which represents the water quality level (Sanchez E. et al., 2007). In the earlier research work, it is observed that the pH value ranged between 7.47– 8.50, Electrical conductivity ranges between 200 -1230 (µs/cm) and Total Dissolved solids range between 104 – 390 mg/L. (Kumari Komal and Upadhay Manish, 2013). The objectives behind the study were to develop an overall picture of the pond water quality using WQI, assessment of pond water quality and suitability of pond water for different purposes.

II. STUDY AREA:

The present investigation was carried out to evaluate the status of surface water quality of Moulvi Bandh of Ambikapur. Ambikapur is additionally the divisional headquarters of Surguja Division that consists of the 5 districts of Surguja, Korea, Balrampur, Surajpur and Jashpur. Ambikapur is located at 23°12′ N 83°2′ E. It has an average elevation of 623 meters (2078 feet). The climate of the district is characterized by a hot summer and well - distributed precipitation throughout the monsoon season. With its general monsoonal character, the region in step with thornthwait's classification falls within the Tropical Thermal belt.

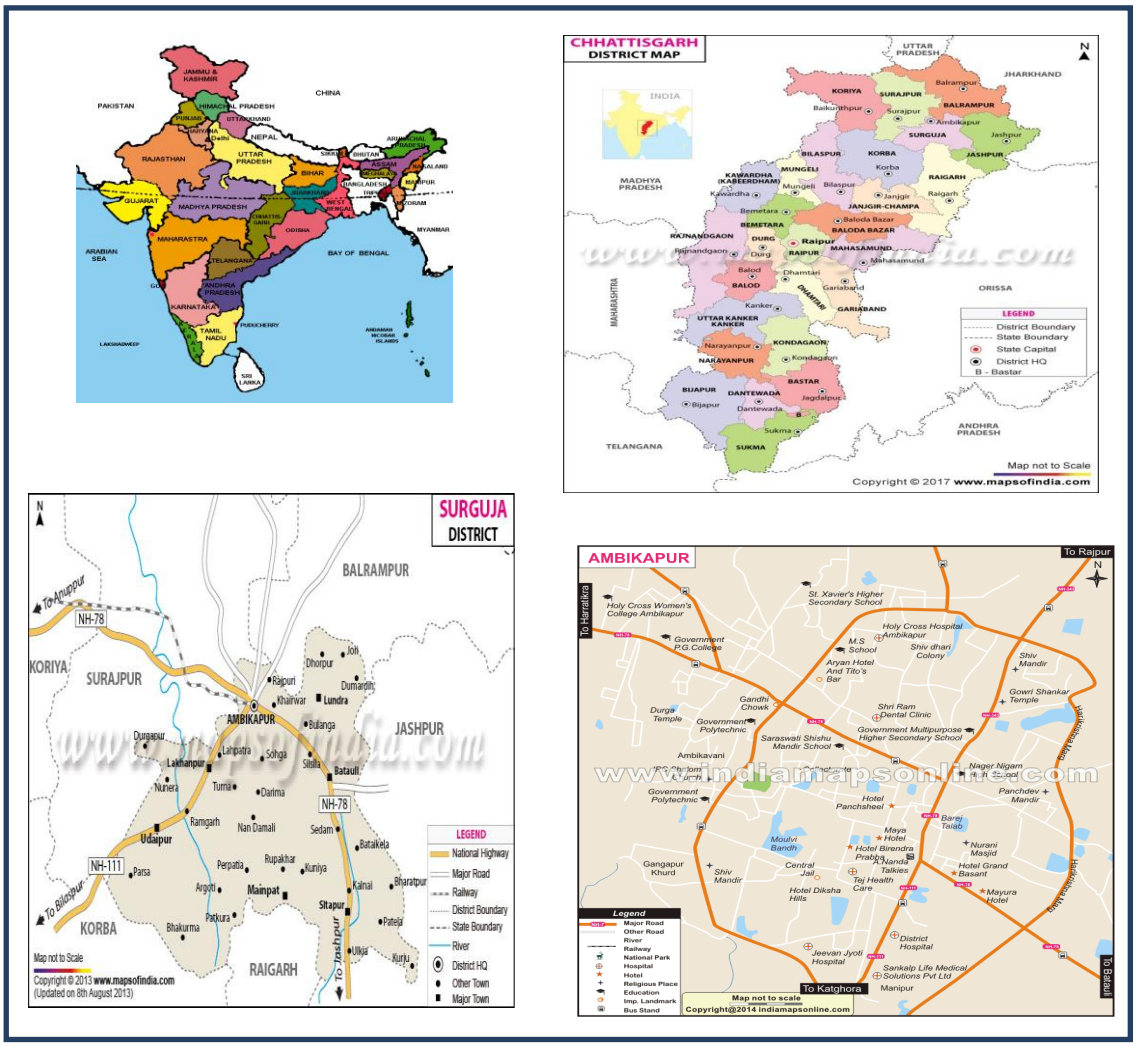

Fig 1: Map of Study Area

III. MATERIALS AND METHODS:

The water samples were collected from three different directions of Moulvi Bandh of Ambikapur, Sarguja, Chhattisgarh in the winter season. The sampling and analysis of various Physico-chemical attributes were done by following the standard procedures as detailed in APHA (1998). The experimental results were compared to the permissible limit of drinking and irrigation water quality standard (BIS (as per IS 2296), WHO (2014), EPA (1970)). In this study, for the calculation of water quality index, nine important parameters were considered (Temperature, pH, EC, TDS, TSS, TS, DO, Acidity and Free CO2). The weighted arithmetic index method (Brown et. al., 1970) has been used for the calculation of WQI of the water body. Further, quality rating or sub-index (qn) was calculated using the following expression –

$$q_n = 100[V_n - V_{io}] / [S_n - V_{io}]$$

Where,

V_n=Estimated value of the nth parameter at a given sampling station.

S_n =Standard permissible value of the nth parameter. V_{io} = Ideal value of nth parameter in pure water.

(i.e. 0 for all other parameters except the parameter pH and Dissolved oxygen (7.0 and 14.6 mg/L respectively). Unit weight was calculated by a value inversely proportional to the recommended standard value $S_n$of the corresponding parameter.

$$W_n = K / S_n$$

W_n= unit weight for the n^{th}parameters.
S_n= Standard value for n^{th}parameters
K= Constant for proportionality.

The overall Water Quality Index was calculated by aggregating the quality rating with the unit weight linearly.

$$\mathbf{WQI = \Sigma\, q_n . W_n / \Sigma\, W_n}$$

Water quality Index Level	**Water quality status**
0-25	Excellent water quality
26-50	Good water quality
51-75	Poor water quality
76-100	Very Poor water quality
>100	Unsuitable for drinking

Table 1: Water Quality Index (WQI) and status of water quality given by Chatterji and Raziuddin, 2002 (K. Yogendra and E.T. Puttaiah , 2008)

The quality rating scale for each parameter was calculated by dividing its concentration in each water sample by its respective standards and multiplied the results by 100. (Table-1)

IV. RESULT AND DISCUSSION:

Temperature:

Under the aquatic system, temperature plays a crucial role in the regulation of the environment (Dwivedi B. K et al., 2002). It affects the physical and chemical properties of water and additionally affects the aquatic vegetation, organisms, and their biological activities. The temperature of the water body influences its overall quality. In a longtime system, the water temperature controls the speed of all chemical reactions and affects fish growth, breeding and immunity. Immoderate temperature changes can be inevitable to fish. (Patil P. N. et al., 2012). During the present study, the water temperature ranges from 26ºC to 29ºC across the three different sampling sites. There is significant variation in temperature among all the sites. The maximum (atmosphere temperature) is 28 ^{0}C at site III and minimum 26 ^{0}C at the site I and maximum (water temperature) is 28 ^{0}C at site III and minimum 26 ^{0}C at the site I. Choudary et al., study the ponds of Sasaram, Bihar observed the temperature range varies from 23^{0}C to 27^{0}C. The water temperature is lower during the sampling time which might be attributed towards the seasonal influence of ambient temperature.

pH:

It is the most vital factor in deciding the corrosive nature of water. Lower the pH scale price higher is that the corrosive nature of water. (Patil P. N. et al., 2012) pH is a measure of acidity or alkalinity of water. pH is an important limiting factor for aquatic life as well as for domestic uses. The permissible limit of pH scale in drinkable is inside 6.5 – 8.5 consistent with Bureau of Indian normal ((BIS (as per IS 2296)). During the present investigation, it was found that the water is slightly acidic in nature. The pH value of the water sample ranged between 6.2 to 6.6 at three sites of Moulvi Bandh. The acidic nature of the water sample may be due to anthropogenic activities and sewage effluent.

Electrical conductivity:

Electrical conductivity (EC) is the propensity of an aqueous solution to conduct the electric current. Electrical Conductivity is a useful parameter to evaluate water purity (Acharya et al., 2008). The standard desirable limit of EC in drinking water is prescribed as 1000 µs/cm (BIS (as per IS 2296)). In the present study, electrical conductivity ranges from 635 µs/cm to 655 µs/cm which is much below than the prescribed standard limit. The values show less mineral deposition in Bandh Water (Salam S. M. A et al.,2012). Shrivastava and Kanungo in 2013 reported that the EC ranged between 115.11µs/cm -212.13 µs/cm in Surguja, Chhattisgarh.

Total Dissolved Solids:

Diffused or suspended matter in water coined as solids. Solids may affect the water quality adversely in a number of ways. This factor is used for determining the taste of water (G Dhanaji et al., 2016). The observed total dissolved solids in sample water of Moulvi Bandh ranges up to 1 mg/L. Total dissolved solids (TDS) typify mainly the various kinds of minerals present in water. The permissible value recommended for TDS is 500 mg/L (BIS (as per IS 2296)). The results show that the water quality of Moulvi Bandh is suitable for irrigation, fish culturing etc. (Salam S. M. A et al., 2012). Shrivastava and Kanungo in 2013 reported that the TDS range between 152.12- 265.97 mg/L.

Total Suspended Solids:

TSS indicates water clarity i.e. transparency. Total suspended solids in the body of water show a higher concentration of bacteria, nutrients, pesticides, and metals in water (Sheila, 2007). The total suspended solids in sample water of Moulvi Bandh ranged between 9 mg/L to 12 mg/L which is much below the prescribed limit of BIS (as per IS 2296) 500 mg/L. The low value of TSS shows less contamination of minerals in the water. (S Sasikala et al., 2015)

Acidity:

Acidity is the effect of the presence of numerous constituents, including dissolved carbon dioxide, dissolved multivalent metal ions, strong mineral acids such as sulfuric, nitric, and hydrochloric acids, and weak organic acids such as acetic acid. The acidity of the water sample is its quantitative capacity to neutralize a strong base to a designated pH. It is a sum of all titrate bases. From the results, it appears that acidity of the water sample ranged between 8 to 16 mg/L as $CaCO_3$. The maximum value was recorded in site II (16 mg/L) and minimum 8 mg/L at the site I & Site III respectively.

Dissolved Oxygen:

Dissolved oxygen is an important tool for water quality, ecological status, and productivity of a water body. DO draw into the water by diffusion from the atmosphere, aeration of the water as it tumbles over falls and rapids, and as a waste product of photosynthesis. During the study, the dissolved oxygen of the water sample ranges between 4 to 7 mg/L of the water sample. The standard value for DO is 5 mg/L. The range of dissolved oxygen recorded 4.8 mg/L – 8.2 mg/L shows the water to be of good quality and will support fish production (Alam M.J.B et al., 2007). The optimum level of DO helps in proper growth of the aquatic life living in the Bandh. (Mustapha M. K., 2008).

Free Carbon dioxide (CO_2):

Carbon dioxide (CO_2) is present in water supplies in the form of dissolved gas. Typically, surface waters contain less than 10 mg/L free carbon dioxide while ground waters may have much higher concentrations. Dissolved CO_2 in water forms carbonic acid, which lowers pH. From the observation, it appears that free CO_2 ranges between 2 to 5 mg/L of the water sample. The outcome of my research states that the sites having higher DO, the same site has lower Free CO_2 level and where the value of DO is lower, the Free CO_2 level is higher.

Parameters	**Site I**	**Site II**	**Site III**
Temperature ^oC	26 ± 2.64	28 ± 1.73	28 ± 1.73
pH	6.54 ± 1.152	6.29 ± 1.46	6.48 ± 1.03
EC (µs)	652 ± 32.07	648 ± 20.29	637 ± 19.97
TDS (mg/L)	0.000570 ± 0.000121	0.000547 ± 0.000137	0.000567 ± 0.000160
TSS (mg/L)	9 ± 2.64	11 ± 2.64	11.6 ± 0.62
TS (mg/L)	9.00057 ± 2.64	11.00054 ± 2.64	11.60056 ± 0.62
Acidity (mg/L)	8 ± 1.732	16 ± 2.64	8 ± 1.732
DO (mg/L)	5.22 ± 0.104	4.63 ± 0.461	6.87 ± 0.350
Free CO_2 (mg/L)	2.2 ± 0.624	2.64 ± 0.216	4.4 ± 0.121

Table 2: Physico-chemical characteristics of water samples of three different sites of Moulvi Bandh

V. CONCLUSION:

This study was undertaken to define the quality of water samples with special reference to physicochemical properties to decide its Water Quality Index, for the assessment of pond water quality of the Moulvi Bandh of Ambikapur, Sarguja, Chhattisgarh. For assessing the suitability of drinking water, the water quality data of the analyzed samples were compared with the prescribed drinking water standard of BIS 1991 (as per IS 2296), WHO and EPA guidelines have been considered for the calculation of WQI. The overall water quality index value of Moulvi Bandh is 57.60 which show that the Bandh is moderately polluted. The study can offer the requisite information for the authority to protect and conserve these small water bodies.

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Avinash Pratap Gupta" Physico-chemical Properties of Moulvi Bandh, Ambikapur, Sarguja with reference to Water Quality"The International Journal of Engineering and Science (IJES), 8.3 (2019): 19-24