ASSESSMENT OF WATER QUALITY PARAMETRS FOR GOVERDHAN SAGAR LAKE OF UDAIPUR, RAJASTHAN

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Abstract - *The current research work was conducted to find out the water quality status of Goverdhan Sagar Lake of Udaipur (Rajasthan). An attempt has been made to assess the current physico-chemical and biological status of the lake. The physico-chemical and biological parameters of the lake have been studied at three locations for a period of six months from October'19 to March'20 and June'20. Physico-chemical parameters of lake were found to be moderate throughout the study period as compared to the Drinking water standards. The average water quality parameters of the lake during the study period were found to be, Temperature 28.6 ^0C, Colour and odour disagreeable, pH 9.0, EC 735 ppm, BOD 3.8 ppm, COD 42.3 ppm, DO 5.3 ppm, nitrogen content 7.1 ppm, Alkalinity 245.9 ppm, Total hardness 30.9 ppm, Calcium hardness 7.9 ppm, Magnesium hardness 23.0 ppm, Chloride content 161.7 ppm, Fluoride content 0.5 ppm, MPN coliform 350 MPN/100ml.*

Key Words: Goverdhan Sagar Lake, Water Quality, Pollution, Physico-Chemical Parameters, Biological Status

1. INTRODUCTION:

Water is found everywhere on Earth, from the polar ice caps to steamy geysers and wherever water flows on this planet, you can be sure to find life. Human realised that water is essential for the survival and hence early civilizations started near great rivers –e.g. Tigris and Euphrates in Mesopotamia, Nile in Egypt, Indus in India and Huang ho in China (Bairwa, 2008). Our earth surface has 71% of water and 29% land. Out of total water on earth 96.5% is in ocean which is salty and not useful for drinking, growing crops. Only 2.5% water is fresh water in which nearly 70% locked up in ice and rest is in the ground. Only 1.3 % fresh water is present on surface, mostly in lake and about 1% is salty water is in ground (Shiklomanov, 1993).

India accounts for about 2.45 percent of world's surface area, 4 percent of the world's water resources and about 16 percent of world's population. The total water available from precipitation in the country in a year is about 4000 cubic km. The availability from surface water and replenishable groundwater is 1,869 cubic km. Out of this only 60 percent can be put to beneficial uses. Thus, the total utilisable water resources in country are only 1,122 cubic km.

Central Pollution Control Board of India estimates that 75-80% of water pollution by volume is from domestic sewerage, while untreated sewerage flowing into water bodies including rivers have almost doubled in recent years. Inadequate sanitation facilities and waste water policy framework are primary reason responsible for the groundwater and surface water pollution in the country (Dey, 2015).

Aquatic life depends on the Physico-chemical and Biological characteristics of water and Industrialization, urbanization and discharge from human activities can produce undesirable change in Physico-chemical and Biological characteristics of water. As Udaipur is blessed with the good number of lakes and it is also known as 'The city of lake'. Every year numbers of tourist come from all around the world to visit Udaipur city and the lakes of Udaipur are the major source of drinking water. Therefore, it is important to asses and monitors the water quality of the lakes and its significant values provided information about the problems related with public health.

The objective of present paper is to investigate the Physico-Chemical and Biological parameters of water for Goverdhan Sagar Lake. Scope of this study is to check the compliance of selected parameters with the permissible limit recommended under various standards.

2. METHODOLOGY:

2.1 Study Area:

Goverdhan Sagar Lake is located 2.5 km away from the south-west of Udaipur at 74⁰42' E Longitude and 24⁰34' N latitude. It has an overall length of 1.97 km, covering a total water spread area of 30.81 hectares. The lake is rain-fed and receives water from Pichhola Lake via the connecting canal. The catchment area is approximately 2.56 square meters. The capacity at maximum lake level is 9 million cubic metres. The deeper position of the lake lies towards the north-east which has a steep slope, while the field and farmland lie towards the south-west (Mehta, 2009).

The details of morphometric features of the Goverdhan Sagar Lake are given in Table-1.

Table -1: Morphomitric features of Goverdhan Sagar Lake

Latitude	24°32'N
Longitude	73°41'E
Altitude	582 m (MSL)

Average rainfall	670 mm
Water spread area	Over 17.97 ha.
Weed choked marginal area	Over 12.83 ha.
Total area	30.81 ha.
Catchment area	2.56 sq.km.
Maximum depth (Zm)	25 ft.
Maximum length (L)	1.97 km
Maximum width (bx)	0.72 km
km Length of shoreline (L)	3888.8 m
Capacity of F.T.L.	9 million cubic meter
Type of dam	Masonry
District	Udaipur
Accesses	2.5 km away from Udaipur.

(Source: Mishara et al.,2016)

2.2 Sampling station

For present study, the following three sampling station was selected in Goverdhan Sagar Lake for the collection of water sample:

1) Near Goverdhan sagar pal side (Eastern shore of lake)
2) Near Smart city park (Western shore of lake)
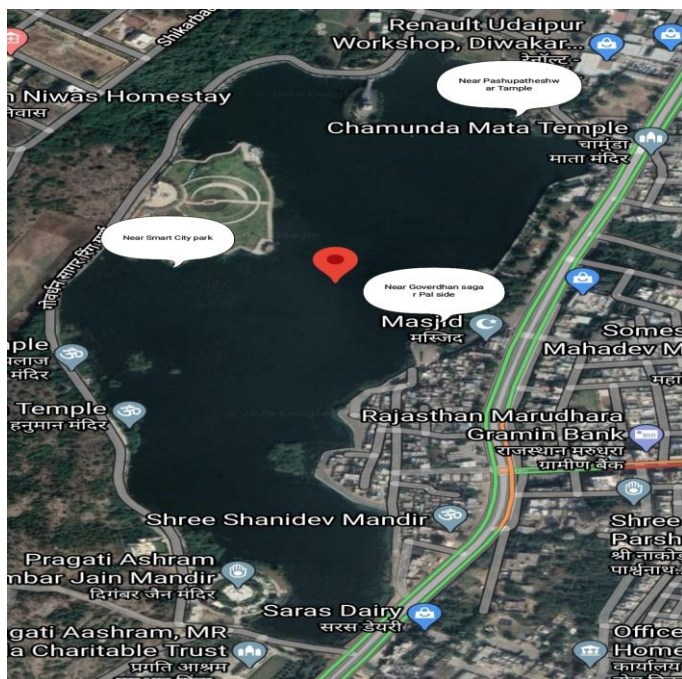3) Near Pashupatheshwar Temple (Northern shore of lake)

Figure 2.1 Location of sampling Station

2.3 Sampling Method and Collection

Grab or Catch sampling method is used for the present study. A grab sample is an individual sample collected without compositing or adding other samples (NEERI, 2011).

During the study period, sample was collected from all three sampling stations manually using grab method of sampling.

2.4 Testing

The water quality of Goverdhan Sagar Lake was analysed using standard methods as mentioned in the Manual on Water and Wastewater analysis (NEERI, 2011; Trivedy & Goel, 1984; and APHA, 2005).

In this study, Physico-Chemical parameters like water temperature, pH, TDS, BOD, COD, DO, Total alkalinity, Total nitrogen content, Total hardness, Calcium Hardness, Magnesium Hardness, Fluoride Content and Biological Parameter like MPN Coliform were analysed using standard method mentioned in the manual. These parameters give a brief knowledge about water quality and pollution status of Goverdhan Sagar Lake.

3. RESULT & DISCUSSION:

Table -2: Average water quality parameters of Goverdhan Sagar Lake

S. No.	Parameters	Average value
1	Temperature	27.3^0C - 30.2^0C
2	pH	8.4 - 9.4
3	EC	772 – 839mS/cm
4	TDS	509 – 550 ppm
5	BOD	3- 4.13 ppm
6	COD	20.4- 47.84 ppm
7	DO	4.70- 6.20 ppm
8	Total nitrogen content	7 - 7.3 ppm
9	Alkalinity	200 - 280 ppm
10	Total hardness	28-32.9 ppm
11	Calcium hardness	6.6 -9.8 ppm
12	Magnesium hardness	20.4-24.2 ppm
13	Chloride content	149.9-170.4 ppm
14	Fluoride content	0.416-0.578 ppm
15	MPN Coliform	350.0 MPN/100ml

❖ *Temperature*

Temperature plays an important in influencing the characteristics of water. When temperature gets high it reduces the solubility characteristic of water which in turn affects the quality of water and shows the level of contamination/pollution. In present study the water temperature were recorded with care as per the sampling procedure and it was found between 27.3^0C - 30.2^0C at all three sampling stations (See Table 2). Mishara *et al.* (2016) also observed an average water temperature of 28.57^0C for Goverdhan Sagar Lake. A similar range of water temperature is commonly found to prevail in water bodies of arid and semi-arid regions of Rajasthan (Sarang, 2001; Rajkumar, 2005; and Balai, 2007). However, in some typical areas of arid and semi-arid regions the surface water temperature showed a wide annual fluctuation as per the investigations conducted by Rawat (2002) and Balai (2007). These findings are very much in consonance with the findings of past research.

❖ *Hydrogen-ion concentration (pH)*

pH is an important factor of freshwater bodies deciding fish health as well as the productivity of water. Slightly alkaline pH has been considered as most suitable for fish culture while pH above 9 is unsuitable (Swingle, 1967; Jhingran, 1977). In present study, the pH of lake water was found between 8.4 - 9.4 at all three sampling stations (See Table 2). The pH of Goverdhan sagar lake was found to be alkaline which is suitable for supporting good aquatic productivity but if the average value increases beyond recorded values then it will not suitable for aquatic productivity. Mishara *et al.*, 2016) reported an average pH of 7.18 for Goverdhan Sagar Lake earlier. Such alkaline pH for lakes has also been found in other research work (Dangi and Sharma, 2017).

❖ *Electrical conductivity (EC)*

The electrical conductivity represent total ionic load in water due to dissolved substance. In present study the EC of water was recorded between 772 – 839 mS/cm at all three sampling stations (See Table 2). This observation is supported by the study of Sarang (2001) where the similar range of EC values were found in the Jaisamand lake Udaipur, Rajkumar (2005) found values of EC 630 mS/cm in the Daya reservoir.

❖ *Total dissolved solids (TDS)*

Indian Standards prescribed the desirable limit of TDS as 500 ppm in drinking water; presence of excess TDS may cause gastrointestinal irritation when consumed. TDS analysis also has great involvement in the control of biological and physical waste water treatment processes (Thirupathaiah *et al.*, 2012). In present study, the TDS content of lake water sample was recorded slightly above the permissible limit i.e. 509 – 550 ppm at all three sampling stations (See Table 2). Rajkumar (2005) found values of TDS 406.21ppm in the Daya reservoir, Dangi and Sharma (2017) found TDS 230.4 ppm - 428.8 ppm of Picchola lake.

❖ *Dissolved Oxygen (DO)*

Dissolved oxygen is the most critical water quality variable in aquatic ecosystem. It is of primary importance both as regulator of metabolism of plant and animal communities and as an indicator of water condition. In present study the values of DO were recorded with care as per the sampling procedure and it was found between 4.70 - 6.20 ppm at all three sampling stations (See Table 2). Mishara *et al.* (2016) observed DO content as 3.80 ppm -7.80 ppm for Goverdhan Sagar Lake.

❖ *Chemical Oxygen Demand (COD)*

COD gives a measure of organic strength of domestic and industrial wastes. The higher value of COD indicates the presence of undesirable organic matter, demanding investigation of the cause before the water is pronounced potable. In present study the values of COD were recorded with care as per the sampling procedure and it was found between 20.4 - 47.84 ppm at all three sampling stations (See Table 2). COD has indicating the pollution level due to oxidisable organic matter present in water.

❖ *Bio-chemical oxygen demand (BOD)*

BOD is a measure of quantity of oxygen required by bacteria and other micro-organisms under aerobic condition in order to biochemically degrade and transform organic matter present in the water body. High BOD is considered as a limiting factor for the living organisms, it is an indirect indicator of organic pollution of water body. In present study the values of BOD were recorded with care as per the sampling procedure and it was found between 3 - 4.13 ppm at all three sampling stations (See Table 2). Similar readings were also observed in other lakes of Rajasthan region (Rawal *et al.*, 2014; Choubisa and Dubey, 2017).

❖ *Alkalinity*

Natural water bodies show a wide range of fluctuation in total alkalinity values depending upon the location, season, plankton population and nature of bottom deposits. It is a measure of buffering capacity of the water and is important for aquatic life in a fresh water system because it acting as a stabilizer for pH. In present study the Alkalinity of water was found between 200 - 280 ppm at all three sampling stations (See Table 2). Mishra *et al.* (2012) also found the similar value of alkalinity for Goverdhan Sagar Lake. Higher range Alkalinity was reported in different water bodies of Udaipur by Rajkumar (2005) & Balai (2007). Alkalinity above 40 ppm has been considered as good sign of productivity, further total alkalinity above 60 ppm are indication of nutrient rich condition, which is good for the production of fish food organisms.

❖ *Hardness*

Klein (1956) and Sawyer (1960) classified water on the basis of hardness as:

Water Type	Harness
Soft water	upto 75 ppm
Moderately hard	75 to 150 ppm
Hard water	150 to 300 ppm
Very hard water	above 300 ppm

Hardness of water hinders the lather forming action and also responsible for scaling in the water carrying systems. The quantity of total hardness, calcium hardness and magnesium hardness for Goverdhan Sagar Lake were found as 28 - 32.9 ppm, 6.6 - 9.8 ppm, and 20.4 - 24.2 ppm respectively (See Table 2). These values of hardness indicated that the water of Goverdhan Sagar Lake can be considered as soft water as per the classification explained above.

❖ *Chloride content*

Chloride in water is derived from natural mineral deposit, agriculture or irrigation discharge and industrial water. Presence of chloride content in high quantity indicated pollution of water due to sewage or industrial water. In present study, chloride content of the water was found between 149.9 - 170.4 ppm at all three sampling stations (See

Table 2). Choudhary and Ahi (2015) recorded 55.27 - 134.86 ppm of chloride content for Sagar Lake.

❖ *Fluoride content*

Fluoride content upto 1 ppm will helps to prevent dental cavities and during formation of permanent teeth it combines chemically with tooth enamel, resulting in harder, stronger teeth that are more resistant to decay and excess value of fluoride cause bone fluorisis and other skeleton abnormalities. In present study the Fluoride content of water were found between 0.416-0.578 ppm at all three sampling stations (See Table 2). Very less fluoride content also affects bone density, so for healthy bones an adequate quantity of fluoride is essential.

❖ *Total Nitrogen content*

In the ecosystem of lake the major input of nitrogen is through run off, but this may also be contributed from the decomposition of nitrogenous matter and its further oxidation (Goldman and Horne, 1993). Nitrogen is essential for many photosynthetic autotrophs. Presence of Nitrogen in water indicates presence of organic matter. Nitrogen present in water on four forms which are as: Free ammonia; Indicates recent pollution, Organic ammonia; Indicates quantity of nitrogen before decomposition has started, Nitrite (NO_2^-); Indicates partly decomposed condition, Nitrate (NO_3^-); Indicates old pollution (fully oxidised). In the present study the total nitrogen content varied from 7 - 7.3 ppm in Goverdhan Sagar Lake. Mishra *et al.* (2012) found nitrate-nitrogen as 0.46 mg/l for Goverdhan Sagar Lake.

❖ *MPN Coliform*

Coliform bacteria are described and grouped, based on their common origin or characteristics such as Escherichia coli (E. Coli), as well as other type of coliforms bacteria that are naturally found in polluted water. The presence of faecal coliform bacteria in aquatic environment indicates that the water has been contaminated with the faecal material of man or other animals. The presence of coliform which themselves are harmless aerobic lactose fermented organisms but their presence or absence indicates the presence and absence of pathogenic bacteria. Coliform are (B-coli, E-coli) important harmless aerobic microorganisms which are found residing in the intestine of all warm blooded animals and excreted with their faces. These bacteria live longer in water than pathogenic bacteria. Hence if coliforms are absent pathogens would be absent. Colifoem indicate the degree of pollution and their high density shows the difference between clean and polluted waters (Ray and Hill, 1978). Coliform will be used as indicator of pollution in water due to the potential for introducing pathogens and other pollutants along with these bacteria (McMath et al. 1999, Perkins and Hunter, 2000). In the present study, MPN Coliform was found only in the month of June and the value was recorded as 350 MPN/100 ml (Table 2). MPN value shows high pollution level of the water present in Goverdhan Sagar Lake, which in turn makes it unfit for human consumption.

4. CONCLUSION

Goverdhan Sagar Lake is nutrient rich and alkaline water body. The water quality indicated that the water of lake is suitable for the fishery purpose. The bacterial load of lake water is very high as the values of bio-chemical oxygen demand, Chemical oxygen demand and MPN show its high pollution status and the water of lake is highly contaminated. If the similar condition continue for the longer period, lake may soon become ecological inactive. However, water of the lake was not found suitable for drinking and domestic uses. Suitable restoration program should be initiated for the sustainable use of lake.

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