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WATER QUALITY ASSESSMENT OF DALVOY LAKE WATER, MYSORE, KARNATAKA, INDIA

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Abstract: Healthy lakes indicate healthy and eco friendly life style of the people in its neighbourhood. Lakes play a pivotal role in maintaining the ecological balance. Lake water is generally used for drinking, domestic and irrigation purposes. Therefore, it should be free from the pollutants and Dalvoy Lake water is no exception as it is life line for the people of nearby four villages around it. Although, the lake is situated at the outskirts of the city of Mysore, but its water is getting mixed with urban runoff, underground drainage and sewage water from the city. This made authors curious to study its Water Quality Index (WQI) with an objective to assess the quality of water for human consumption. Thus the water quality parameters like Mg^{2+} and C^{2+} ions, pH, Total alkalinity, Total Dissolved Solids, Electrical Conductivity, hardness, etc of the lake water were studied using standard methods and WQI was calculated on the basis of Weighted Arithmetic Index.
Keywords: Dalvoy Lake, Water Quality Index, Hardness, Alkalinity, Eco friendly.

Introduction

Lakes have always remained the sources of water for agriculture, irrigation, drinking, domestic uses, industries and other related purposes. Lakes were preserved and maintained to help the man kind at the time of water crisis during long dry periods and draughts. Looking at the importance of lakes the Mysore Maharaja constructed many lakes for the benefit of his subject [8]. Dalvoy Lake was also constructed by him, which supported the life of four villages till recent times [6]. The lake is constructed in such a way that it gets water from the elevated areas during rains and storms and also as runaway water from the urban Mysore city areas. It also gets water from canal distribution system as irrigation return flow from the fields. The lake water was free from pollution till Mysore was a small town, but with the burst in population in Bangalore the neighbouring IT–capital of India, Mysore also started gaining momentum and is now expanding unexpectedly. This has led to the mushrooming of many industries which ignore the environmental issues. Hotel industry, tourism, rapid urbanization and improper drainage system all these things together are now affecting the quality of water in the Dalvoy Lake. This has led to pollution and contamination of lake water. The water which was once used by the villagers is now unsafe for use. Quick actions if

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taken by the authorities in this direction may still resolve the situation from becoming serious. Authors during the studies have found that extensive work is done on micro-organism activities in the Dalvoy lake water [13] and the physico – chemical parameters are generally ignored. However, assessing the quality of water by studying physico – chemical parameters on various water bodies is attempted by many authors [3,10,11,14,17]. A new approach to assess the quality of water using WQI with the help of mathematical equation incorporating various physico – chemical parameters is highly reliable and is studied by various authors [1,2,12,15,16]. The present study deals with a deep insight on these water quality parameters and assessment of the water quality of Dalvoy lake water through WQI. Hence, this study is quite significant and will be a great help for the lake conservation authorities.

Materials and Methods

Samples were collected from the Dalvoy Lake from different points and depths in polythene bottles as per standard procedures. The analysis was conducted within 20 days of collection of the samples. The various parameters were studied and compared with the WHO and ISI standards. Reagents were prepared using AR grade chemicals. Glass distilled water was employed for preparation of solutions. Systronics–Conductometer and Digital Systronics pH–meter were used for the determination of Conductivity and pH respectively, other parameters like Alkalinity, Total dissolved solids, Calcium and Magnesium ions, Total hardness, Temporary and Permanent hardness, etc. were studied using standard methods [7] and compared with the WHO and ISI standards [9] .

Hardness, Total Dissolved solids, Calcium, magnesium and Alkalinity were expressed in mg/L and Electrical conductivity as µs/cm. Temperature was recorded in ^{0}C.

Calculation of water quality index

WQI facilitates a single numeric value that defines overall water quality for a definite location. This is calculated on the basis of several physico – chemical parameters of the water. It describes the quality of water in terms of index number which is easy to understand and also suggests, whether the water is fit for use. In the present study it is calculated as described by [5]. Here, different water quality components are multiplied by a weighting factor and are then aggregated using simple arithmetic mean.

Calculation of Quality rating (Q_i):

Quality rating for each parameter was calculated by using the following equation

$$Q_i = \frac{(V_{actual} - V_{ideal})}{(V_{standard} - V_{ideal})} \times 100$$

Where, Q_i = Quality rating of i^{th} parameter for a total of n water quality parameters.
V_{actual} = Actual value of the water quality parameter obtained from laboratory analysis
V_{ideal} = ideal value of that quality parameter can be obtained from the standard tables.
V_{ideal} for pH = 7 and for other parameters it is equating to zero.
$V_{standard}$ = Recommended WHO standard of the water quality parameter.
Calculation of Unit weight (W_i):
Unit weight was calculated by a value inversely proportional to the recommended standard (S_i) for the corresponding parameter using the following expression

$$W_i = \frac{K}{S_i}$$

Where, W_i = Unit weight for nth parameter, S_i = Standard permissible value for nth parameter, K = proportionality constant and assumed as 1.
The overall WQI was calculated by the following equation

$$WQI = \frac{\sum W_i Q_i}{\sum W_i}$$ [Where, Q_i = quality rating, W_i = Unit weight]

Results and Discussion

Temperature: Temperature was noted at the time of sampling. It is an important parameter that affects solubility and conductivity of minerals in water. It was found to be 20^0C for both the samples.

pH: pH suggests acidity or alkalinity in a given solution. The ideal pH for potable water is described in the range of 7 to 8 by WHO and 6.5 to 8.5 by ISI standards. In the present study the pH was well within the limits of the said standards. It was reported as 7.5 for S_1 and 7.7 for S_2. (Table 1, Fig 1).

Alkalinity: The acid neutralizing capacity of water is termed as alkalinity. The presence of carbonates, bicarbonates and hydroxides makes the water alkaline. The present study shows a very high alkalinity in the water samples, 560 mg/L in S_1 and 565 mg/L in S_2, which is highly undesirable for both domestic and industrial uses. (Table 1, Fig 1).

Electrical Conductivity: Electrical conductivity suggests the current carrying capacity of water. It is due to the presence of dissolved salts and minerals in the water. Conductivity of water depends upon temperature, concentration and mobility of the ions. The Electrical Conductivity was found to be 960 µs/cm and 980 µs/cm respectively for S_1 and S_2, which is though within the permissible range but is reasonably high for consumption and other uses. (Table 1, Fig 1).

Total hardness: Hardness is that property of water which prevents lathering of water with soap solution. Hardness is of two types temporary and permanent. Total hardness is a sum of temporary hardness and permanent hardness present in the water. The presence of bivalent ions of Ca^{2+} and Mg^{2+} are responsible for hardness in the water. The bicarbonates of Ca^{2+} and Mg^{2+} ions are responsible for temporary hardness where as chlorides and sulphates impart permanent hardness to the water. Total hardness was reported as 315 mg/L and 320 mg/L for samples S_1 and S_2 respectively, which is very high compared to WHO and ISI standards. Temporary hardness was 294 mg/L for S_1 and 300 mg/L S_2, whereas Permanent hardness was reported as 21mg/L and 20 mg/L for S_1 and S_2 samples respectively. This suggests that the hardness present in water is mainly the temporary hardness. (Table 1, Fig 1).

Calcium and Magnesium ions: Ca^{2+} and Mg^{2+} ions if present in excess get deposited in the soft tissues of the living bodies leading to various kinds of chronic diseases. Presence of Ca^{2+} and Mg^{2+} ions was found to be very high compared to drinking water standards. It was reported 189 mg/L and 190 mg/L for Ca^{2+} ions and 126 mg/L and 128 mg/L for Mg^{2+} ions in samples S_1 and S_2 respectively. Table 1, Fig 1.

Total Dissolved Solids: The sum of all the dissolved chemical species in the water is termed as Total Dissolved Solids. The amount of Total Dissolved Solids was reported as 602 mg/L for S_1 and 605 mg/L for S_2which is within the safe limits of WHO but high according to ISI standards. (Table1, Fig 1).

Table 1: Results obtained, methods employed and WHO & ISI Standards

Parameters	Method	WHO Standards	ISI Standards	S_1	S_2
Temperature	Thermometric	-----	-----	20^0C	20^0C
pH	pH metery	7.0 – 8.0	6.5 – 8.5	7.5	7.7
Electrical Conductivity	Conductometry	1400	-------	960	980
Total Dissolved Solid	Filtration Method	1000	500	602	605
Total Hardness	EDTA titration	100	300	315	320
Temporary hardness	EDTA titration	-----	-----	294	300
Permanent hardness	EDTA titration	-----	------	21	20
Calcium	EDTA titration	75	75	189	190
Magnesium	EDTA titration	150	30	126	128
Alkalinity	Titrimetric	120	120	560	565

Table 2: Calculation of WQI for S_1 sample

Parameters	Observed values	Standard values	Unit Weight (W_i)	Quality rating (Q_i)	Weighted values (W_iQ_i)
pH	7.5	8.5	0.11764	33.333	3.9215
Electrical Conductivity	960	300	0.00333	320	1.06656
Total Dissolved Solid	602	500	0.002	120.4	0.2408
Total Hardness	315	300	0.00333	105	0.349965
Calcium	189	75	0.01333	252	3.35916
Magnesium	126	30	0.03333	420	13.9986
Alkalinity	560	120	0.00833	466.66	3.8886
			$\sum W_i$ = 0.181306		$\sum W_iQ_i$= 26.825185
Water Quality Index (WQI) = $\sum W_iQ_i / \sum W_i$ = 147.9553					

Table 3: Calculation of WQI for S_2 sample

Parameters	Observed values	Standard values	Unit Weight (W_i)	Quality rating (Q_i)	Weighted values (W_iQ_i)
pH	7.7	8.5	0.117647	46.6666	5.49018
Electrical Conductivity	980	300	0.003333	326.6666	1.08877
Total Dissolved Solid	605	500	0.002	121.0	0.242
Total Hardness	320	300	0.003333	106.6666	0.35551
Calcium	190	75	0.01333	253.3333	3.37693
Magnesium	128	30	0.03333	426.6666	14.2207
Alkalinity	565	120	0.008333	470.8333	3.92345
			$\sum W_i$ = 0.181306		$\sum W_iQ_i$ = 28.69754
Water Quality Index (WQI) = $\sum W_iQ_i / \sum W_i$ = 158.28235					

Table 4: Water Qaulity Index (WQI) status of water quality [4]

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

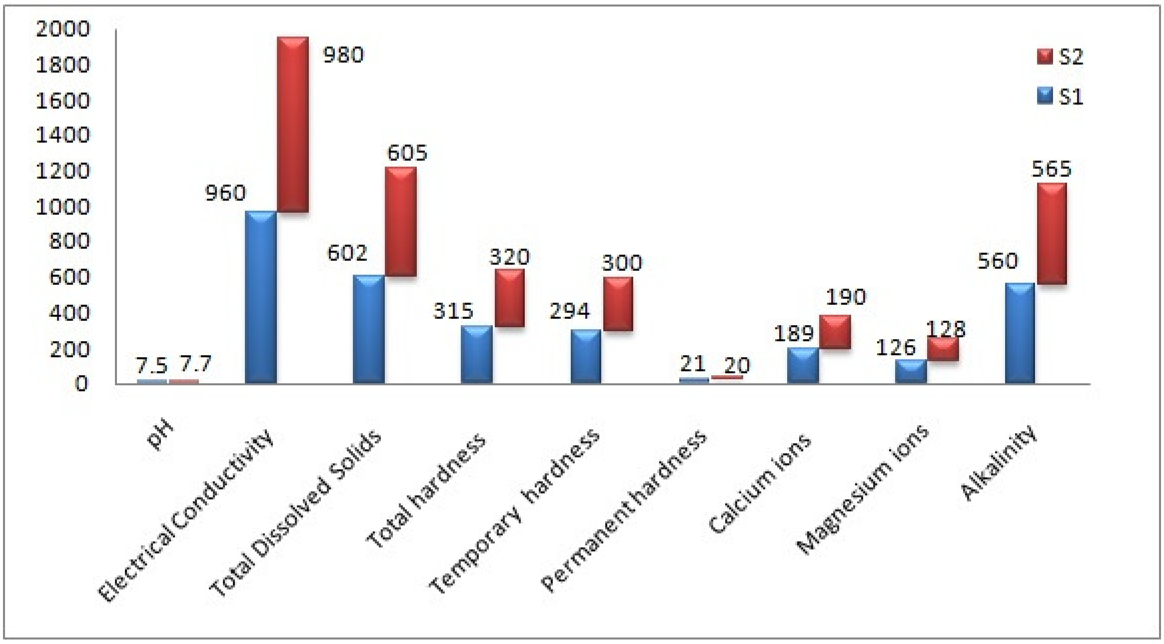

Fig 1: Graphical representation of physico – chemical parameters of Dalvoy Lake water

Conclusion

The present study suggests that the lake water contains very high bicarbonate hardness. The concentrations of Ca^{2+} and Mg^{2+} ions, electrical conductivity and alkalinity were also found to be exceptionally high. The WQI which was calculated for samples was found to be 147 and 158 for the sample S_1 and $S_{2,}$ respectively (Table 2 and 3). Thus the results obtained by the above analysis states that the quality of water is extremely poor [4] (Table 4). These results obtained also support the hypothesis that water quality of lakes around cities is getting deteriorated, mainly due to run-off and sewage water from the cities. As the surrounding villagers are dependent on the lake water for their day to day activities it should be made free from the said impurities before some serious health issues are reported. Irrigation with highly alkaline water is another disadvantage that can spoil the soil texture and will lead to the destruction of the crops. The surrounding Mandya district which is also known as sugar city due to high yield of sugarcane will also be affected adversely due to soil deterioration. Also, the hard water if used in the sugar industries for crystallization of sugar will produce poor and low quality sugar. Other industries will also have the same fate. Looking at the seriousness of the matter the authors suggest to raise a boundary fitted with natural filters around the lake that will prevent the lake water from getting contaminated and also keep a check on the illegal trespassing and misuse of lake water. Sewage water from the city should be diverted properly to the treatment plants such that it should not get mixed up with the lake water. The backflow irrigation water also should be treated to remove fertilizers and pesticides before it getting mixed with the lake water as the chemicals in them will harm both aquatic and human life. Most importantly, the villagers should be educated to keep their surroundings clean and also to use clean and purified water for domestic and drinking purposes. They should be prohibited to bathe and wash clothes in the lake water.

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