

Water Quality Assessment of Kukkarahalli Lake Water Mysore, Karnataka, India

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Abstract - Lakes are important part of urban ecosystem and play a vital role in maintaining ecological balance. Lake water is used for many purposes such as drinking, irrigation, domestic purposes, and industrial. But the polluted water generated by the industries and homes which are not properly treated gets cycled back into lakes, resulting in the pollution of lakes. Kukkarahalli Lake water is no more exception. The present study deals with the determination of water quality index on the basis of Weighted Arithmetic Index by studying various water quality parameters like pH, Electrical Conductivity, Total hardness, Magnesium and Calcium ions, Total alkalinity, Total Dissolved Solids, etc. to assess the water quality for drinking and domestic purposes.

Key Words: Alkalinity, Hardness, Kukkarahalli Lake, Standard methods, Water Quality Index

1. INTRODUCTION

Lakes are a valuable source of water for drinking, domestic uses, agriculture, industries etc. Lakes are used for recreation, swimming, boating, and fishing etc. Lakes support and regulate the services of soil formation, groundwater recharge, biodiversity and flood protection. Lakes were preserved and protected to help the man kind during water crisis. Looking at the importance of lakes, Kukkarahalli lake was constructed by Mummadi Krishnaraja Wodeyar, (1794–1868) of the Mysore Dynasty in the year 1864, to provide water for irrigation for the land outside the city. This lake has seen the rise of great writers, poets and musicians doing their finest work on its shores [1]. It was also a big attraction to bird watchers. Due to increased sewage dumping, industrial wastes and excessive land encroachments have resulted into the blockage of water flow leading to the eutrophication of lake. This had an adverse effect on birds visiting the lake and their number is greatly reduced. Tourism, rapid urbanization and improper drainage system are now affecting the water quality of Kukkarahalli lake leading to the pollution and contamination of lake water. A new approach was made to assess water quality using WQI technique. WQI is mathematical equation incorporating the various physico – chemical parameters are highly reliable, convenient and are studied by various authors [2 - 14]. The present study deals with water quality

parameters and assessment of the water quality of Kukkarahalli lake water through WQI. Hence, this study will be a great help for the lake conservation authorities.

2. MATERIALS AND METHODS

Samples were collected from Kukkarahalli Lake as per the standard procedures. The Physico – chemical parameters like pH, Electrical Conductivity, Alkalinity, Total dissolved solids, Calcium and Magnesium ions, Hardness were studied and analyzed. AR grade chemicals were used for analysis. Glass distilled water was used for the preparation of the reagents. pH and Electrical Conductivity were determined using Digital Systronics pH – meter and Systronics – Conductometer respectively. Temperature of the samples was recorded at their sampling points. Standards methods were used for the determination of various parameters [15]. The experimental results obtained were then compared with WHO and ISI standards [16] Table 1. Hardness, Calcium ions, magnesium ions, Total Dissolved solids and Alkalinity were expressed in mg/L and Electrical conductivity as $\mu\text{s}/\text{cm}$. Temperature was recorded in $^{\circ}\text{C}$.

3. WEIGHTED ARITHMETIC WATER QUALITY INDEX METHOD

Water Quality Index is a simple and convenient method expresses the water quality according to the degree of purity. It is calculated by using the various physico – chemical parameters. This method is widely used by the scientist's community and the calculation of WQI was made by using the following equation [17]:

$$WQI = \frac{\sum W_i Q_i}{\sum W_i}$$

Where, Q_i = quality rating, W_i = Unit weight

The quality rating scale (Q_i) for each parameter is calculated by using the expression:

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

Where, V_{actual} is estimated concentration of ith parameter in the analyzed water

V_{ideal} is the ideal value of this parameter in pure water

$V_{\text{ideal}} = 0$ (except pH = 7.0 and DO = 14.6 mg/l)

$V_{standard}$ is recommended standard value of i th parameter
The unit weight (W_i) for each water quality parameter is calculated by using the following formula

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

Where, S_i = Standard permissible value for n th parameter
 K = proportionality constant,
For the sake of simplicity, K is assumed as 1.

3. RESULTS AND DISCUSSION

The water quality of Kukkarahalli lake water was studied and analysed. The results are compared with WHO and ISI standards tabulated in table 1.

3.1 Temperature

Temperature of water is an important parameter because it affects chemical and bio-chemical reactions. The increase in temperature of water leads to the increase in chemical reactions in water reduces the solubility of gases and amplifies the tastes and odours. The temperature of the water for samples S_1 and S_2 were recorded as $27^{\circ}C$. Table 2.

3.2 pH

pH is defined as the negative logarithm of hydrogen ion concentration. The ideal pH of natural water is between 6 and 8. Variations in pH of water are mainly due to hydrolysis of salts of weak acids and strong bases or vice versa. pH of water is also affected by the dissolved gases such as carbon dioxide, Hydrogen sulphide, ammonia etc. The pH of S_1 and S_2 were found to be 6.9 and 6.8 respectively which is well within the ISI standard but slightly less compared to WHO standards. Table 2, Fig 1.

3.3 Alkalinity

Alkalinity of water is defined as its quantitative capacity to neutralize acids. The bicarbonates, carbonates and hydroxides present in water decreases the H^+ ions and increase the pH of the water. The alkalinity of the samples S_1 and S_2 were found to be 320 mg/L and 310 mg/L respectively, showed very high according to WHO and ISI standards which could be alarming. Table 2, Fig 1

3.4 Electrical Conductivity

Conductivity of water is a measure of current carrying capacity. Increased in conductivity is due to the concentration of dissolved inorganic solids like chloride, nitrate, sulphate, phosphate, sodium, magnesium, calcium, iron and aluminium ions. The Electrical Conductivity for the samples S_1 and S_2 were found to be 600 $\mu s/cm$ and 590 $\mu s/cm$, within the tolerance limits of the standard values. Table 2, Fig 1.

3.5 Total hardness

Total hardness of water is caused by presence of calcium and magnesium of bicarbonates, chlorides and sulphates. Hardness is expressed in terms of $CaCO_3$ equivalents. Total Hardness of water for the samples S_1 and S_2 were found to be 204 mg/L and 200 mg/L respectively which is higher according to the WHO standard but was within the tolerance limit of ISI standards. Table 2, Fig 1.

3.6 Calcium ions and Magnesium ions

The presence of calcium and magnesium ions causes hardness. Excess of Calcium and Magnesium ions lead to the various kinds of diseases such as stone formation, cancer etc. The presence of Calcium ions for the samples S_1 and S_2 were found to be 130 mg/L and 141 mg/L respectively which are very high according to both the standards. Magnesium ions for the samples S_1 and S_2 were found to be 74 mg/L and 59 mg/L respectively, shows higher according to said standards. Table 2, Fig 1.

3.7 Total Dissolved Solids

The sum of all the chemical ions that are dissolved in the water is called Total Dissolved Solids. The amount of Total Dissolved Solids for the samples S_1 and S_2 were found to be 700 mg/L and 681 mg/L respectively which was well within the permissible range of ISI standards but higher according to WHO standards. Table 2, Fig 1.

Table I: Water Quality Parameters and Their WHO & ISI Standards

Parameters	Method	WHO Standards	ISI Standards
Temp.	Thermometric	-----	-----
pH	pH metery	7.0 – 8.0	6.5 – 8.5
Electrical Conductivity	Conductometry	1400	-----
Total Dissolved Solid	Filtration Method	1000	500
Total Hardness	EDTA titration	100	300
Calcium ions	EDTA titration	75	75
Magnesium ions	EDTA titration	150	30
Alkalinity	Titration Method	120	200

Table 2: Water Quality Parameters of Kukkarahalli lake water

Parameters	Method	Samples	
		S ₁	S ₂
Temp.		27°C	27°C
pH	Thermometric	6.9	6.8
Electrical Conductivity	pH metery	600	590
Total Dissolved Solid	Conductometry	700	681
Total Hardness	Filtration Method	204	200
Calcium ions	EDTA titration	130	141
Magnesium ions	EDTA titration	74	59
Alkalinity	EDTA titration	320	310
	Titration Method		

Table 3: Calculation of WQI for S₁ sample

Parameters	Observed values	Standard values	Unit Weight (W _i)	Quality rating (Q _i)	Weighted values (W _i Q _i)
pH	6.9	8.5	0.1176	6.666	0.7843
Electrical Conductivity	600	300	0.0033	200	0.666
Total Dissolved Solid	700	500	0.002	140	0.28
Total Hardness	204	300	0.0033	68	0.2264
Calcium ions	130	75	0.0133	173.33	2.3105
Magnesium ions	74	30	0.0333	246.66	8.2140
Alkalinity	320	120	0.0083	266.66	2.2213

			$\sum W_i = 0.1813$		$\sum W_i Q_i = 14.7025$
Water Quality Index (WQI) = $\sum W_i Q_i / \sum W_i = 81.0948$					

Table 4: Calculation of WQI for S₂ sample

Parameters	Observed values	Standard values	Unit Weight (W _i)	Quality rating (Q _i)	Weighted values (W _i Q _i)
pH	6.8	8.5	0.1176	13.333	1.5686
Electrical Conductivity	590	300	0.0033	196.666	0.6438
Total Dissolved Solid	681	500	0.002	136.2	0.2724
Total Hardness	200	300	0.0033	66.666	0.222
Calcium ions	141	75	0.0133	188	2.5060
Magnesium ions	59	30	0.0333	196.666	6.5490
Alkalinity ions	310	120	0.0083	258.33	2.1519
			$\sum W_i = 0.1813$		$\sum W_i Q_i = 13.913$
Water Quality Index (WQI) = $\sum W_i Q_i / \sum W_i = 76.7440$					

Table 5: water Quality Index (WQI) status of water quality [18]

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

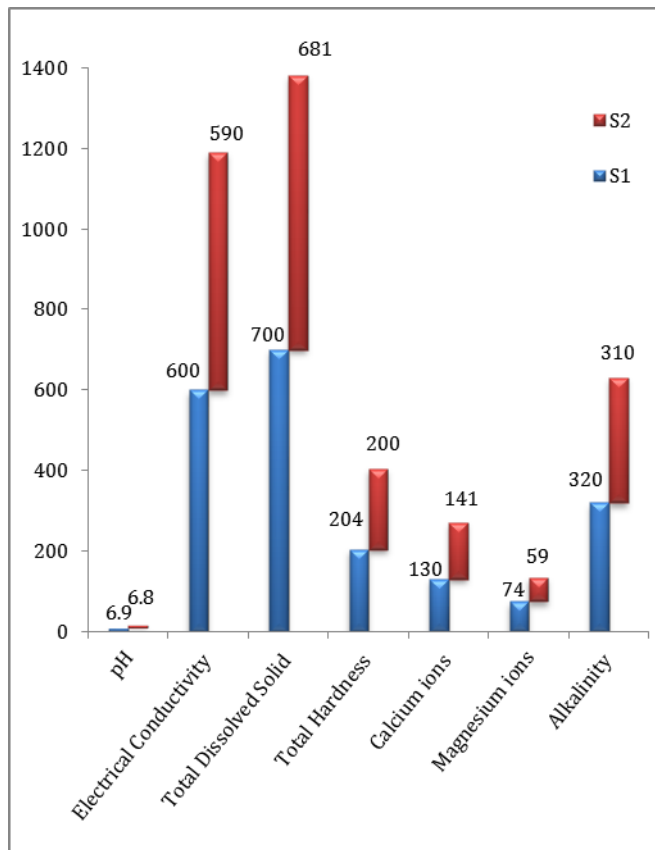


Fig. 1: Graphical representation of physico – chemical parameters of Kukkarahalli lake water

4. CONCLUSION

The present study conducted on the Kukkarahalli lake water reveals that the water quality is very poor (Table 5) [18]. The Water Quality Index for all samples was calculated (Tables 3 and 4) and was found to be 81.09 and 76.74 for the samples S₁ and S₂ respectively. The reason for this may be the inflow of the sewage water and industrial wastes into the lake water which makes the lake water highly polluted. Also, the consumption of its water for any kind of use without treatment should be immediately prohibited. To stop the inflow and mixing of the dirty water in the lake water, Barricades and filters should be fitted throughout the circumference of the lake.

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