Water Quality Index of Hemavathi River Water, Tumkur, Karnataka, India

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Abstract: - **The present study was carried out to assess the water quality of River Hemavathi using Water Quality Index. Water quality index (WQI) is a unique technique to depict the overall water quality status in a single term. The various water quality parameters like calcium and magnesium ions, pH, alkalinity, Total Dissolved Solids, Electrical Conductivity, hardness are studied to calculate the WQI for Hemavathi river water which were collected near a village Gubbi at two different points. Sample S_1 was collected from the populated area of the village and Sample S_2 was collected from one km upstream. The sums of these are substituted in the formula and the WQI is obtained. This made authors to study its Water Quality Index (WQI) of Hemavathi river water with an objective to assess the quality of water for drinking and demostic purposes.**

Key Words: **Water Quality Index, pH, Alkalinity, Hardness, Electrical Conductivity**

I. INTRODUCTION

Rivers are essential resource because they transport water, provide habitat and enable transportation. Rivers provide important nutrients for living beings and also support economic activities. The chemical composition of the water has great impact on the ecology of water for living beings. All human civilizations developed near river banks to fulfil their necessity of water, to quench their thirst and for the food resources such as Farming, Fishing and Irrigation. During their growing need for Agriculture, people started using chemical fertilizers, pesticides, insecticides etc to get better yields, forgetting that this may lead to serious problems to the quality of water. Many authors have so far studied the quality of water of different rivers [1] – [20]. So this is a sincere effort from the author to study the various physico – Chemical parameters like Temperature, pH, Electrical Conductivity, Total dissolved solids, Total hardness, Alkalinity, Calcium and Magnesium ions of the water of River Hemavathi a major tributary of river Kaveri near Gubbi Taluk, where villagers use its water mainly for demostic purposes and irrigation.

II. MATERIALS AND METHODS

Samples were collected from two different places in the village as per standard procedure. Sample-1 (S_1) from the populated locality of the village and Sample-2 (S_2) from one km up the river from the village .The Physical and Chemical parameters such as Calcium and Magnesium ions, Alkalinity, Total dissolved solids, Total hardness, Electrical Conductivity,

pH were studied using standard methods [21] and the results were compared with WHO and ISI standards [22]. AR grade chemicals and double distilled water were used to prepare the reagents. Systronics – Conductometer and Digital Systronics pH – meter were used for the determination of Conductivity and pH respectively. The WHO and ISI standards are listed in table 1.

III. CALCULATION OF WATER QUALITY INDEX

WQI is a simple convenient method to assess the quality of water. WQI gives a single numeric value to define water quality in a simple way. This is calculated on the basis of several physico – chemical parameters of the water. The quality of water is obtained in terms of index number which is easy to understand and also to assess the quality of water [23]. 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 ith 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,
For the sake of simplicity, K is assumed as 1,

The overall WQI was calculated by using the following equation

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

Where, Q_i = quality rating, W_i = Unit weight

IV. RESULTS AND DISCUSSION

The water quality of Hemavathi river water was studied and analysed. The results obtained in the study are tabulated in the table 2.

A. Temperature

A variation in temperature of water affects the chemical and biochemical reactions. The temperature of the water samples was found to be 23^0C for both the samples. Table 2.

B. pH

pH is defined as the negative logarithm of hydrogen ion concentration. The pH of potable water is between 7 and 8. pH of water is affected by hydrolysis of salts of strong bases and weak acids vice versa. Dissolved gases like carbon dioxide, Hydrogen sulphide, ammonia etc also affect the pH. It was reported as 7.1 for both the samples S_1 and S_2 which is well within the permissible limits. Table 2, Fig 1.

C. Alkalinity

Alkalinity of water is the capacity to neutralize the acids and it is due to the presence of bicarbonates, carbonates and hydroxide ions. Alkalinity in water is due to rocks and soils, animal and plant activities, discharge of industrial wastes etc. It was found to be 140 mg/L for both S_1 and S_2 samples which is little higher than the standard limits. Table 2, Fig 1.

D. Electrical Conductivity

Electrical conductivity is the capacity of water to conduct electrical current and it is due to the presence of dissolved salts and minerals in the water. The electrical conductivity was found to be 190 μs/cm and 196 μs/cm for samples S_1 and S_2 respectively which is well within the permissible limit. Table 2, Fig 2.

E. Total hardness

Hardness of water is due to the presence of calcium and magnesium of bicarbonate, chloride and sulphate. Hardness is expressed in terms of $CaCO_3$ equivalents. Total hardness was reported as 156 mg/L and 160 mg/L for samples S_1 and S_2 respectively which is well within the ISI standard but little higher according to WHO standard. Table 2, Fig 1.

F. Calcium and Magnesium ions

Excess of calcium and magnesium ions dissolved in water leads to various kinds of deadly diseases like stone formation, cancer etc. due to their deposition in the soft tissues of living bodies. Presence of Calcium ions was found to be 100 mg/L and 108 mg/L for S_1 and S_2 samples respectively, which is higher according to standard limit. Magnesium ions was found to be 56 mg/L and 52 mg/L for samples S_1 and S_2 samples respectively which is well within the WHO standard but little higher according to ISI standard. Table 2, Fig 1.

G. Total Dissolved Solids

Total Dissolved Solids is the sum of all the dissolved chemical species present in the water. The amount of Total Dissolved Solids was reported as 202 mg/L for S_1 and 210 mg/L for S_2 samples which is well within the permissible limit. Table 2, Fig 1.

TABLE 1
WATER QUALITY PARAMETERS AND THEIR WHO & ISI STANDARDS.

Parameters	Method	WHO Standards	ISI Standards
Temperature	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	EDTA titration	75	75
Magnesium	EDTA titration	150	30
Alkalinity	Titration Method	120	120

TABLE 2
WATER QUALITY PARAMETERS OF HEMAVATHI RIVER WATER

Parameters	Method	S_1	S_2
Temperature	Thermometric	23^0C	23^0C
pH	pH metery	7.1	7.1
Electrical Conductivity	Conductometry	190	196
Total Dissolved Solid	Filtration Method	202	210
Total Hardness	EDTA titration	156	160
Calcium	EDTA titration	100	108
Magnesium	EDTA titration	56	52
Alkalinity	Titration Method	140	140

TABLE 3
WATER QAULITY INDEX (WQI) STATUS OF WATER QUALITY [24]

Water Quality Index Level	Water Quality Status	51 – 75	Poor water quality
0 – 25	Excellent water quality	76 – 100	Very poor water quality
26 – 50	Good water quality	> 100	Unsuitable for drinking

Table 4
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	7.1	8.5	0.1176	6.6666	0.7843
Electrical Conductively ($\mu s/cm$)	190	300	0.0033	63.333	0.2110
Total Dissolved Solid (mg/L)	202	500	0.002	40.40	0.0808
Total Hardness (mg/L)	156	300	0.0033	52.0	0.1733
Calcium (mg/L)	100	75	0.0133	133.3333	1.7773
Magnesium (mg/L)	56	30	0.0333	186.6666	6.2215
Alkalinity (mg/L)	140	120	0.0083	116.6666	0.9721
			$\sum W_i = 0.1813$		$\sum W_iQ_i = 10.2204$
Water Quality Index (WQI) = $\sum W_iQ_i / \sum W_i = 56.3732$					

Table 5
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	7.1	8.5	0.117647	6.6666	0.7843
Electrical Conductivity ($\mu s/cm$)	196	300	0.003333	65.3333	0.2177
Total Dissolved Solid (mg/L)	210	500	0.002	42.0	0.084
Total Hardness (mg/L)	160	300	0.003333	53.3333	0.17775
Calcium (mg/L)	108	75	0.01333	144.0	1.91952
Magnesium (mg/L)	52	30	0.03333	173.3333	5.7771
Alkalinity (mg/L)	140	120	0.008333	116.6666	0.9721
			$\sum W_i = 0.181306$		$\sum W_iQ_i = 9.92927$
Water Quality Index (WQI) = $\sum W_iQ_i / \sum W_i = 54.767$					
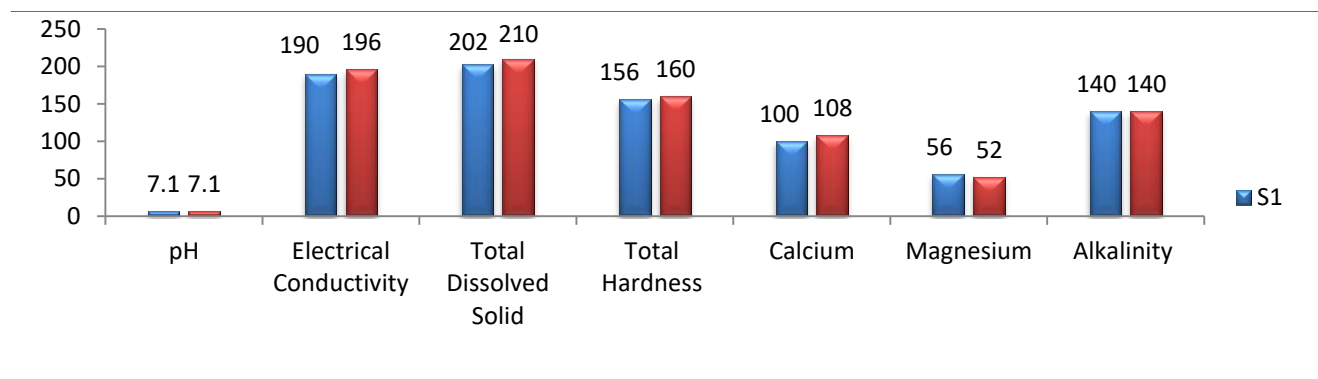
Fig 1 Graphical representation of physico – chemical parameters of Hemavathi river water

V.   CONCLUSION

The Water Quality Index was calculated for the samples (Tables 4 and 5) and was found to be 56.3732 and 54.767 for S_1 and S_2 respectively. The present study conducted on the Hemavathi River water reveals that the water quality is poor (Table 3) [24]. Hemavathi River water is a source for drinking, irrigation and demostic purposes. Before consuming the water by the people, the water should be free from impurities, hence the water should be subjected to treatment.

ACKNOWLEDGEMENT

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