

Assessment of Water Quality Index in Lower Manair Dam, Karimnagar district, Telangana

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Abstract: In the present study, water quality of surface water has been assessed in terms of water quality index (WQI) in Manair dam, Karimnagar district of Telangana. Ten parameters have been selected; they are pH, total alkalinity, chlorides, total hardness, calcium, magnesium, nitrates, sulphates, total dissolved solids and dissolved oxygen. Three sampling stations were selected for the collection of water samples. The samples were analyzed on the same day in the laboratory for different physico-chemical parameters following the standard methods (1). Based on the results obtained, all the physico-chemical parameters are well below the permissible limits as prescribed by Indian standards. The WQI show that overall stations in Manair dam in Karimnagar district, qualify in the 'Good' category and it is fit as such for domestic and irrigation purpose.

Keywords: Water Quality Index, Surface Water and Manair Dam.

I. INTRODUCTION

WQI indicates the quality of water in terms of index number which represents overall quality of water for any intended use. It is defined as a rating reflecting the composite influence of different water quality parameters were taken into consideration for the calculation of water quality index (WQI). The indices are among the most effective ways to communicate the information on water quality trends to the general public or to the policy makers and in water quality management. In formulation of water quality index the relative importance of various parameters depends on intended use of water. Mostly it is done from the point of view of its suitability for human consumption.

Water quality index (WQI) provides information about water quality in a single value. WQI is commonly used for the detection and evaluation of water pollution and may be defined as a reflection of composite influence of different quality parameters on the overall quality of water (6). WQI indices are broadly classified in two types; they are physico-chemical and biological indices. The physico-chemical indices are based on the values of various physico-chemical parameters in a water sample, while biological indices are derived from the biological information (9). Here prompt and reliable attempt has been made to calculate the water quality index of the study area based on physico-chemical data (10, 14, 11,7, 13 and 8).

II. STUDY AREA

Lower Manair Dam Situated at Karimnagar District. Lower Manair Dam Works will start in 1974 and ending in 1985. In Manair Dam area at Kakatiya Canal 146.00 km to 234 km. Lower Manair Dam Water will go up to 2,62,326 ac s. The Dam is constructed across the Manair River at 18°24' N latitude and 79° 20' E longitude in Karimnagar District at Km.146 of Kakatiya Canal. Lower Manair Dam is a balancing

reservoir built across the river Manair a tributary of Godavari at Karimnagar. It is having a storage capacity of 24 TMC. The water is used for drinking, agriculture and supports fish culture.

III. MATERIAL AND METHODS

Three sampling stations were selected for the collection of water samples. Station-I is situated right side of the lake. The water samples from the surface were collected at all the sampling stations in 2L polythene containers at monthly intervals for a period of 2 years from June 2013 to August 2015. The samples were analyzed on the same day in the laboratory for different physico-chemical parameters following the standard methods (1).

Water quality index provides information on a rating scale from zero to hundred. Higher value of water WQI indicates poor quality of water and lower value shows good water quality. The computed WQI values are classified into six types; "excellent water" to "water unsuitable for drinking" is given Table: 6 (2). The water quality parameters are selected based on its direct involvement in deteriorating of surface water quality for human consumption.

Calculation:

During the present study, the standards for the drinking water, recommended by BIS are considered for the computation of surface water quality rating (qi) and unit weights (Wi), for the purpose of calculate WQI. Ten parameters have been selected; they are pH, total alkalinity, chlorides, total hardness, calcium, magnesium, nitrates, sulphates, total dissolved solids and dissolved oxygen. The standard values of surface water quality parameters, their corresponding ideal values and unit weights are given in table: 1.

For computing WQI three steps involved. In the first step, each of the all parameters has been assigned a weight (wi) according to its relative importance in the overall quality of

surface water for drinking purposes. The maximum weight of 5 has been assigned to the parameters nitrates, dissolved oxygen and total dissolved solids due to its major importance in surface water quality assessment at present study. In the second step, the relative weight (W_i) is computed from the following equation.

Calculation of WQI was carried out in this work by Arithmetic method. The WQI is calculated by using the expression given in equation.

$$W_i = w_i / \sum_{i=1}^n w_i$$

Where, ' W_i ' is the relative weight, ' w_i ' is the weight of each parameter and ' n ' is the number of parameters. Calculated relative weight (W_i) values of each parameter are also given in Table: 15.

In the third step, a quality rating scale (q_i) for each parameter is assigned by dividing its concentration in each surface water sample by its respective standard according to the guidelines laid down by the BIS and the result multiply by 100.

$$Q_i = C_i / S_i * 100$$

Where q_i is the quality rating, C_i is the concentration of each chemical parameter in each water sample in mg/L; S_i is the Indian drinking water quality standard for each chemical parameter in mg/L according to the guidelines of the BIS.

For computing the WQI, the SI is determined for each chemical parameter, which is then used to determine the WQI as per the following equation.

$$S_{i_i} = W_i * q_i$$
$$WQI = S_{i_i}$$

Where S_{i_i} is the sub index of i^{th} parameter, q_i is the rating based on the concentration of i^{th} parameter.

Results and Discussion:

The range of pH is 8.0 to 8.8 at all the three stations. The pH values are indicating alkaline nature of water. The average values of carbonates are 31.38 mg/L, 25.31 mg/L and 33.74 mg/L at station I, station-II and station-III respectively. The average values of total hardness were 157 mg/L at station-I, 206 mg/L at station-II and 173 mg/L at station-III respectively. The concentration of calcium is 48.65 mg/L at station-I, 44.97 mg/L at station-II and 42.85 mg/L at station-III. The average values of magnesium are 25.43 mg/L, 39.29 mg/L and 31.59 mg/L at station I, station-II and station-III respectively. The average values of nitrates were 2.30 mg/L at station-I, 1.75 mg/L at station-II and 1.79 mg/L at station-III. The concentration of total dissolved 261.70 mg/L at station-I, 307.50 mg/L at station-II and 340.70 mg/L at station-III respectively. The concentration of dissolved oxygen is 9.3 mg/L at station-I, 9.5 mg/L at station-II and 10.3 mg/L at station-III respectively.

In the present study, considering ten selected physico-chemical parameters the water quality index was calculated for three stations and tabulated in the tables: 2 - 4. The results of water quality index employing ten parameters showed 65.74, 70.76 and 70.42 at station -I, station-II and station-III respectively.

The status of water corresponding to the WQI is categorized into five types which are given in table 6. From the table, different sampling stations are calculated as per the procedure described earlier. The water quality index values are given in table: 5. Based on the results obtained, all the physico-

chemical parameters are well below the permissible limits as prescribed by Indian standards.

From the foregoing observations, the physico-chemical parameters indicate high dissolved oxygen, low BOD and nitrate concentrations indicates the oligotrophic status of the water body. A relatively lower concentration of chlorides and sulphates also indicate the water is suitable for domestic use (3 and 12). Hence, application of water quality index technique for the overall assessment of the water quality of a water body is useful tool.

However, the WQI values (65.74 - 70.76) calculated for the different samples indicate that the water is safe for human consumption. The values of WQI in the present investigation were reported to be less than 75, indicating that the water is suitable for human consumption. It is evident that the surface water samples of the lake are falling under excellent category and it is suitable for domestic, irrigation and industrial purpose.

WQI analysis showed that the water is in good condition for drinking purpose. Physico-chemical data analyzed in the Manair dam indicates that the dam is at present free from pollution and the quality of water is good. Hence, it can be safely used for different purpose such as drinking, domestic and agriculture purposes.

IV. CONCLUSION

WQI has been computed based on ten different quality parameters viz. pH, total alkalinity, chlorides, total hardness, calcium, magnesium, nitrates, sulphates, total dissolved solids and dissolved oxygen to assess the suitability of surface water for drinking purposes in Karimnagar district. The WQI show that overall stations in Manair dam in Karimnagar district, qualify in the 'Good' category and it is fit as such for domestic and irrigation purpose. The water needs 'Filtration and disinfection' treatment and then can be used for the drinking purpose. The reason of slightly low values of WQI may be the higher values of bicarbonates. Continuous monitoring of surface water is required by establishing a planned monitoring network in the study area for regular assessment of the WQI which will be useful in proper management of the water resources.

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Table: 1 The weight and relative weight of each of the physico - chemical parameters used for WQI determination

S.No	Parameters	BIS Desirable limits	Weight (wi)	Relative weight (Wi)
1	pH	8.5	3	0.083
2	Alkalinity	200	2	0.055
3	Chlorides	250	3	0.083
4	Total Hardness	300	3	0.083
5	Calcium	75	2	0.055
6	Magnesium	30	2	0.055
7	Nitrate	45	5	0.138
8	Sulphate	200	3	0.083
9	Total Dissolved Solids	1000	5	0.138
10	Dissolved Oxygen	6	6	0.138

Table: 2 Water Quality Index (WQI) Calculation at Station-I

S.NO	Parameters	Concentration of each parameter(Ci)	BIS Desirable limit (Si)	Weight (wi)	Relative Weight (Wi)	qi	SI (Wiqi)
1	pH	8.37	8.3	3	0.090909	100.8434	9.167579
2	Alkalinity	291.95	200	2	0.060606	145.975	8.84697
3	Chlorides	128.94	250	3	0.090909	51.576	4.688727
4	Total Hardness	157	300	3	0.090909	52.33333	4.757576
5	Calcium	48.65	75	2	0.060606	64.86667	3.931313
6	Magnesium	25.43	30	2	0.060606	84.76667	5.137374
7	Nitrate	0.7	45	5	0.151515	1.555556	0.23569
8	Sulphate	34.3	200	3	0.090909	17.15	1.559091
9	Total Dissolved Solids	260	1000	5	0.151515	26	3.939394
10	Dissolved Oxygen	9.3	6	5	0.151515	155	23.48485

				$\sum w_i = 33$	$\sum W_i = 1$		$\sum SI = 65.74856$
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Table: 3 Water Quality Index (WQI) Calculation at Station-II

S.NO	Parameters	Concentration of each parameter(Ci)	BIS Desirable limit (Si)	Weight (wi)	Relative Weight (Wi)	qi	SI (Wiqi)
1	pH	8.2	8.5	3	0.090909	96.47059	8.770053
2	Alkalinity	284.54	200	2	0.060606	142.27	8.622424
3	Chlorides	134.68	250	3	0.090909	53.872	4.897455
4	Total Hardness	206	300	3	0.090909	68.66667	6.242424
5	Calcium	44.97	75	2	0.060606	59.96	3.633939
6	Magnesium	39.29	30	2	0.060606	130.9667	7.937374
7	Nitrate	0.78	45	5	0.151515	1.733333	0.262626
8	Sulphate	35	200	3	0.090909	17.5	1.590909
9	Total Dissolved Solids	318	1000	5	0.151515	31.8	4.818182
10	Dissolved Oxygen	9.5	6	5	0.151515	158.3333	23.9899
				$\sum w_i = 33$	$\sum W_i = 1$		$\sum SI = 70.76529$

Table: 4 Water Quality Index (WQI) Calculation at Station-III

S.NO	Parameters	Concentration of each parameter(Ci)	BIS Desirable limit (Si)	Weight (wi)	Relative Weight (Wi)	qi	SI (Wiqi)
1	pH	8.4	8.5	3	0.090909	98.82353	8.983957
2	Alkalinity	280.73	200	2	0.060606	140.365	8.50697
3	Chlorides	136.86	250	3	0.090909	54.744	4.976727
4	Total Hardness	173	300	3	0.090909	57.66667	5.242424
5	Calcium	42.85	75	2	0.060606	57.13333	3.462626
6	Magnesium	31.59	30	2	0.060606	105.3	6.381818
7	Nitrate	0.79	45	5	0.151515	1.755556	0.265993
8	Sulphate	34	200	3	0.090909	17	1.545455
9	Total Dissolved Solids	333	1000	5	0.151515	33.3	5.045455
10	Dissolved Oxygen	10.3	6	5	0.151515	171.6667	26.0101
				$\sum w_i = 33$	$\sum W_i = 1$		$\sum SI = 70.42153$

Table: 5 Average water quality status of Lower Manair Dam during 2013 - 2015

S.NO	Station	WQI	Status
1	Station-I	65.74	Good
2	Station-II	70.76	Good
3	Station-III	70.42	Good

Table: 6 WQI and corresponding water quality status

S.NO	WQI	Status	Possible Usages
1	0-50	Excellent	Drinking, irrigation and industrial
2	50-100	Good	Domestic, irrigation and industrial
3	100-200	Poor	Irrigation
4	200-300	Very poor	Restricted use for irrigation
5	>300	Unfit for drinking	Proper treatment required before use.