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Research Article

WATER QUALITY INDEX OF ALISAGAR LAKE, NIZAMABAD DISTRICT, TELANGANA

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ABSTRACT

The present paper aims at determining the Water Quality Index (WQI) of Alisagar lake, Nizamabad district in Telangana, India. Which is 13 km from Nizamabad and 2 km off the Nizamabad-Basar road. It Coordinates 18°56′24″N 78°06′06″E. Water samples from the surface were collected at three sampling stations at monthly intervals for a period of 2 years (June-2014 to May-2016). The samples were analysed for ten physico-chemical parameters as per the standard procedures of APHA, (2005). pH, alkalinity, chlorides, DO, total hardness, calcium, magnesium, nitrates, sulphates and total dissolved solids for evaluating Water Quality Index. Station wise Water Quality Index calculations were carried out and the result of the present investigation exhibited the Water Quality Index values 64.35, 67.26 and 69.83 at station I, II and III respectively. The water quality rating study clearly shows that, the status of the water body is oligotrophic and it is suitable for the human consumption.

INTRODUCTION

Fresh water has been of little importance to human beings and other organisms of the environment for sustenance of life and maintaining the balance of the nature. Lentic water bodies are becoming very important resources throughout the world because of the primary concern of man were thought to be for meeting his basic requirements (Krishan *et al*., 2016). A water quality index was developed in order to integrate the composite influence of various physical, chemical and biological parameters measured by the Bureau of Reclamation. This index depends upon weights of parameters which were selected on the basis of a policy of land use in the area as well as considering nature and the amount of the polluted material and pattern of the water quality (Puri, *et al*., 2011). Using these rating curves and associated weightings, arithmetic water quality indices were calculated and on this basis the spatial distribution of water with different qualities was defined for the study area. The water quality index system, which was used for the first time in Iran, also served as a satisfactory means of unambiguous communication between experts and the public (Bharti and Katyal, 2011, Kankal *et al*., 2012 and Hossain *et al*., 2013).

WQI indicates the quality of water in terms of index number which represents overall quality of water for any intended use (Ravikumar *et al*., 2013 and Srinivas *et al*., 2017). 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 (Walsh and Wheeler, 2012). 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 (Yogendra and Puttaiah, 2008).

MATERIAL AND METHODS

Alisagar reservoir is located in Nizamabad district in Telangana, India. Which it is 13 km from Nizamabad and 2 km off the Nizamabad-Basar road. It Coordinates 18°56′24″N 78°06′06″E. In the year 1931, the Alisagar reservoir was built by the order of the Nizam of Hyderabad. Later in the year 1985, the deer park was established with an aim to offer a safe haven to several species of deer. A natural habitat was created for the deer. Dense vegetation can be witnessed in this region.
Water samples from the surface were collected at all sampling stations in polythene containers (2 Liters Capacity) at monthly intervals for a period of 2 years (June-2014 to May-2016). The samples were analysed for ten physico-chemical parameters as

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per the standard procedures of APHA (2005). pH, alkalinity, chlorides, dissolved oxygen, total hardness, calcium, magnesium, total dissolved solids and sulphates were the parameters considered for the calculation of Water Quality Index.

WQI Calculation

Based on their relative importance in the overall quality of water for drinking purposes and considerable effects on primary health each of the chemical parameters was assigned a weight (*wi*) (Table: 1).

5 was the maximum weight assigned to the parameters which are important in maintaining water quality and have prominent effect on water quality. The parameters which exhibit considerably low harmful effects were assigned a weight of 2. Computing the relative weight (*Wi*) of each parameter Eq. 1 (Table: 1). Present the weight (*wi*) and calculated relative weight (*Wi*) values for each parameter. The concentration of each parameter was divided by its respective standard according to the guidelines laid down by BIS (1998) for computing a quality rating scale (*qi*).This result was multiplied by 100 using Eq. 2. For WQI computation, the water quality sub-index *(SIi)* for each chemical parameter is first determined, which is then used to determine the WQI as per the Eqs.3 and 4 (Chaterjee and Raziuddin, 2002).

The concentration of each parameter was divided by its respective standard according to the guidelines laid down by BIS (1998) for computing a quality rating scale (*qi*). This result was multiplied by 100 using Eq. 2. For WQI computation, the water quality sub-index (*SIi*) for each chemical parameter is first determined, which is then used to determine the WQI as per the Eqs. 3 and 4.

$$W\,i = w_i \Big/ \sum_{n=1}^{n} Wi = 1 \quad (1)$$

Where Wi is the relative weight, wi is the weight of each parameter and n is the number of parameters.

$$q_i = (Ci|Si)100 \quad (2)$$

Where qi = quality rating, Ci = concentration of each chemical parameter in each water sample in mg/L, Si = Indian drinking water standard (BIS, 1998) for each chemical parameter in mg/L except for pH.

$$SI = Wiqi \quad (3)$$

$$WQI = \sum_{i=1}^{n} SIi \quad (4)$$

Where SI_i is the sub-index of i^{th} parameter; qi is the rating based on concentration of i^{th} parameter and n is the number of parameters.

RESULTS AND DISCUSSION

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 (Gupta *et al*., 2009 and John Mohammad *et al*., 2015).

For better understanding of the variation also, Table 4 explains water quality classification based on WQI criteria for different ranges of WQI values.

In the present study pH value remains alkaline throughout the study period and it ranged from 8.2 to 8.8 at all the stations. Bicarbonates during the study period's minimum value were 212.06 mg/L and maximum was 288.36 mg/L. The values of chlorides range from 102.20 mg/L to 189.26 mg/L. In the Lake, the amount of dissolved oxygen recorded between 5.8 mg/L to 13.2 mg/L. Total hardness of the lake, is in between 134 mg/L to 220 mg/L. In the lake Magnesium content ranges between 23.92 to 28.7 mg/L. Sulphates were maximum 38.32 mg/L and minimum in 32.32 mg/L.

The average analytic results of each parameter during the period of investigation are summarized table 2a-2c. Station wise Water Quality Index calculations are depicted in the Table 2a, 2b and 2c. The result of the present investigation exhibited the Water Quality Index values 64.35, 67.26 and 69.83 at station I, II and III respectively. From these results the average water quality index of the lake was found to be 67.14 (Table: 3).

From the foregoing observations, the physico-chemical parameters indicate high dissolved oxygen, low nitrate concentrations indicates the oligotrophic nature of the water body. A relatively lower concentration of chlorides and sulphates also indicate the water is suitable for domestic use. Hence, application of water quality index technique for the overall assessment of the water quality of a water body is useful tool. It can safely be considered that the values of WQI in the present investigation were reported to be less than 75, indicating that the water is suitable for human consumption.

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 2a 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	8.47	8.5	3	0.090909	99.6471	9.058
2	Alkalinity	281.57	200	2	0.060606	140.785	8.532
3	Chlorides	134.89	250	3	0.090909	53.956	4.905
4	Total Hardness	156.73	300	3	0.090909	52.2433	4.749
5	Calcium	55.37	75	2	0.060606	73.8267	4.474
6	Magnesium	26.22	30	2	0.060606	87.4	5.296
7	Nitrate	0.68	45	5	0.151515	1.51111	0.228
8	Sulphate	38.32	200	3	0.090909	19.16	1.741
9	Total Dissolved Solids	264.4	1000	5	0.151515	26.44	4.006
10	Dissolved Oxygen	8.46	6	5	0.151515	141	21.363
				$\sum wi = 33$	$\sum Wi = 1$		$\sum SI = 64.357$

Table 2b 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	8.5	8.5	3	0.090909	100	9.090
2	Alkalinity	283.6	200	2	0.060606	141.8	8.593
3	Chlorides	137.59	250	3	0.090909	55.036	5.003
4	Total Hardness	184.2	300	3	0.090909	61.4	5.581
5	Calcium	45.91	75	2	0.060606	61.213	3.709
6	Magnesium	23.92	30	2	0.060606	79.733	4.832
7	Nitrate	0.71	45	5	0.151515	1.577	0.239
8	Sulphate	35.77	200	3	0.090909	17.885	1.625
9	Total Dissolved Solids	310.36	1000	5	0.151515	31.036	4.702
10	Dissolved Oxygen	9.46	6	5	0.151515	157.666	23.888
				$\sum wi = 33$	$\sum Wi = 1$		$\sum SI$ =67.268

Table 2c 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	8.51	8.5	3	0.090909	100.117	9.101
2	Alkalinity	290	200	2	0.060606	145	8.787
3	Chlorides	149.75	250	3	0.090909	59.9	5.445
4	Total Hardness	178.96	300	3	0.090909	59.653	5.423
5	Calcium	43.8	75	2	0.060606	58.4	3.539
6	Magnesium	27.3	30	2	0.060606	91	5.515
7	Nitrate	0.82	45	5	0.151515	1.822	0.276
8	Sulphate	32.32	200	3	0.090909	16.16	1.469
9	Total Dissolved Solids	343.2	1000	5	0.151515	34.32	5.2
10	Dissolved Oxygen	9.95	6	5	0.151515	165.833	25.126
				$\sum wi = 33$	$\sum Wi = 1$		$\sum SI$ =69.883

Table 3 Average water quality status of Alisagar during 2014 - 2016

S.NO	Station	WQI	Status
1	Station-I	64.35	Good
2	Station-II	67.26	Good
3	Station-III	69.83	Good

Table 4 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.

CONCLUSIONS

The present analysis reveals that the physico-chemical parameters, alkalinity, chlorides, BOD, total hardness, calcium, magnesium, sulphates and total dissolved solids are in low concentration at all the stations and all the physico-chemical parameters were less than the BIS (1998) permissible limits. Alisagar lake is free from pollution and representing oligotrophic nature.

The permissible WQI for human consumption is up to 100. It is clear from the table: 4 WQI for Alisagar lake is suitable for drinking purpose. Application of Water Quality Index (WQI) in this study has been found useful in assessing the overall quality of water and to get rid of judgment on quality of the water. This method appears to be more systematic and gives comparative evaluation of the water quality of sampling stations.

In the present investigation physico-chemical and water quality index data analyzed indicates that the water is oligotrophic. Hence it can be used safely for different purposes, such as drinking, domestic and irrigation purposes.

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