Volume : 3 | Issue : 4 | April 2014 • ISSN No 2277 - 8179

Research Paper

An Assessment of Lake Water Quality Index of Manipu Lake of District Ahmedabad, Gujarat

Zoology

KEYWORDS : Manipur Lake, Physico-chemical parameters, Water quality

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ABSTRACT

The present study was intended to calculate Water Quality Index (WQI) of Manipur Lake, District Ahmedabad. This paper deals with the study on the influence of environmental parameters on the water quality of water body. Water Quality Index, indicating the water quality in terms of index number, offers a useful presentation of overall quality of water for public or for any intended use as well as in the pollution abatement programmes and in water quality management. In this study Water Quality Index was determined on the basis of various physico-chemical parameters like pH, Electric conductivity, Total Dissolved Solids, Alkalinity, Total hardness, Ca hardness, Mg hardness, Nitrate, Phosphate, Sulphate, Chloride, Dissolved oxygen, Biological Oxygen Demand.

INTRODUCTION:

Water quality index provides a single number that express overall water quality at a certain location and time, based on several water quality parameters. The objective of water quality index is to turn complex water quality data into information that is useful for public. A single number cannot tell the whole story of water quality there are many other water quality parameters that are not included in the index. However a water quality index based on some very important parameters can provide a simple indicator of water quality. In general, water quality indices incorporate data from multiple water quality parameters into a mathematical equation that rates the health of a water body with number.

STUDY AREA:

Manipur Lake is located at the western side of the village. It is natural Water body. Rain water enters from the surroundings into the lake. One portion of the lake is covered by local people who are engaged in washing clothes and discharge soap water into the lake. Manipur lake covers an area of 71832 Sq.m., peripheral area of the lake is 949 m. and depth is 19 feet. Its Latitude and Longitude are 23^0 02' 07.13" N and 72 ^{0} 25' 26.37" E respectively, and 146 feet above sea level.

MATERIALS AND METHODS:

The water sample from the water body were collected early in the morning at an interval of 30 days and analyzed for 12 physico-chemical parameters by following the established procedure. The parameters pH, electrical conductivity and dissolved oxygen were monitored at the sampling site and other parameters like TDS, alkalinity, total hardness, calcium, magnesium, chloride, nitrate, sulphate and BOD were analysed in the laboratory as per the slandered methods of APHA (1995). During study period WQI has been calculated by using the standards of drinking water quality recommended by the World Health Organization (WHO), Bureau of Indian Standards (BIS) and Indian Council of Medical Research (ICMR). The weighted arithmetic index method (Brown et. al., 1972) has been used for the calculation of WQI of the water body. Further, quality rating or sub index (q_n) was calculated by following expression.

$$\mathbf{q_n = 100[V_n - V_{10}] / [S_n - V_{10}]}$$

(Let there be *n* water quality parameters and quality rating or sub index (q_n) corresponding to n^{th} parameter is a number reflecting the relative of this parameter in polluted water with respect to its standard permissible value.)

Where:

$\mathbf{q_n}$ = Quality rating for the n^{th} water quality parameter.

$\mathbf{V_n}$ = Estimated value of the n^{th} water quality parameters of collected sample.

$\mathbf{S_n}$ = Standard permissible value of the n^{th} water quality parameter

$\mathbf{V_{10}}$ = Ideal value of the n^{th} water quality parameter in pure water. (i.e. 0 for all other parameters except the parameter pH and Dissolved oxygen (7 and 14.6mg/L respectively.)

Unit weight was calculated by a value inversely proportional to the recommended standard value S_n of the corresponding parameter.

$$\mathbf{W_n = K / S_n}$$

Where:

$\mathbf{W_n}$ = Unit weight for n^{th} water quality parameter.

$\mathbf{S_n}$ = Standard permissible value of the n^{th} water quality parameter.

K = Constant for proportionality.

The overall Water Quality Index was calculated by aggregating the quality rating with the unit weight linearly.

$$\mathbf{WQI = \Sigma\, q_n\, W_n / \Sigma\, W_n}$$

Table 1. Water Quality Index (WQI) and status of water quality, Chatterji et. al., (2002).

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

Table 2. Drinking water standards recommending agencies and unit weights.

SR. NO.	PARAMETERS	STANDERED VALUES	RECOMMENEDED AGENCY	UNIT WEIGHT
1	pH	6.5-8.5	ICMR/BIS	0.219
2	EC	300	ICMR	0.371
3	TDS	500	ICMR/BIS	0.0037
4	Alkalinity	120	ICMR	0.0155
5	Total hardness	300	ICMR/BIS	0.0062

Volume : 3 | Issue : 4 | April 2014 • ISSN No 2277 - 8179

6	Mg hardness	30	ICMR/BIS	0.061
7	Ca hardness	75	ICMR/BIS	0.025
8	Nitrate	45	ICMR/BIS	0.0412
9	DO	5	ICMR/BIS	0.3723
10	BOD	5	ICMR	0.3723
11	Sulphate	150	ICMR/BIS	0.01236
12	Chloride	250	ICMR	0.0074
All values except pH and Electrical Conductivity are in mg./L				

RESULT AND DISCUSSION:

Table 3. Seasonal variation in the physico-chemical parameters of Manipur Lake.

SR. NO.	PARAMETERS	MONSOON SEASON	WINTER SEASON	SUMMER SEASON
1	pH	7.75	7.88	8.5
2	EC	0.44	0.41	0.47
3	TDS	295	290	315
4	Alkalinity	127.5	170	142
5	Total hardness	117.5	107.5	115
6	Mg hardness	13.42	10.73	12.2
7	Ca hardness	35	32	26
8	Nitrate	2.28	2.29	2.29
9	DO	7.31	10.15	12.28
10	BOD	2	2.25	3.75
11	Sulphate	18.44	28.63	29.19
12	Chloride	58.75	51.25	75
Water Quality Index		40.21	35.36	43.18

Table 4. Calculation of Water Quality Index in Monsoon season.

SR. NO.	PARAM-ETERS	OB-SERVED VALUE (Vn)	STAND-ERED VALUES (Sn)	IDE-AL VAL-UE (V_{10})	UNIT WEIGHT (Wn)	QUAL-IYT RATING (Qn)	WnQn
1	pH	7.75	6.5-8.5	7	0.219	50.00	10.95
2	EC	0.44	300	0	0.371	0.15	0.05
3	TDS	295	500	0	0.0037	59.00	0.22
4	Alkalinity	127.5	120	0	0.0155	106.25	1.65
5	Total hardness	117.5	300	0	0.0062	39.17	0.24
6	Mg hardness	13.42	30	0	0.061	44.73	2.73
7	Ca hardness	35	75	0	0.025	46.67	1.17
8	Nitrate	2.28	45	0	0.0412	5.07	0.21
9	DO	7.31	5	14.6	0.3723	75.94	28.27
10	BOD	2	5	0	0.3723	40.00	14.89
11	Sulphate	18.44	150	0	0.01236	12.29	0.15
12	Chloride	58.75	250	0	0.0074	23.50	0.17
					∑Wn= 1.51	∑Qn= 502.76	∑WnQn= 60.71
WaterQuality Index = ∑WnQn/∑Wn = 40.21							

Table 5. Calculation of Water Quality Index in Winter season.

SR. NO.	PARAM-ETERS	OB-SERVED VALUE (Vn)	STAND-ERED VALUES (Sn)	IDE-AL VAL-UE (V_{10})	UNIT WEIGHT (Wn)	QUALIYT RATING (Qn)	WnQn
1	pH	7.88	6.5-8.5	7	0.219	58.67	12.85
2	EC	0.41	300	0	0.371	0.14	0.05
3	TDS	290	500	0	0.0037	58.00	0.21
4	Alkalinity	170	120	0	0.0155	141.67	2.20
5	Total hardness	107.5	300	0	0.0062	35.83	0.22
6	Mg hardness	10.73	30	0	0.061	35.77	2.18
7	Ca hardness	32	75	0	0.025	42.67	1.07
8	Nitrate	2.29	45	0	0.0412	5.09	0.21
9	DO	10.15	5	14.6	0.3723	46.35	17.26
10	BOD	2.25	5	0	0.3723	45.00	16.75
11	Sulphate	28.63	150	0	0.01236	19.09	0.24
12	Chloride	51.25	250	0	0.0074	20.50	0.15
					∑Wn= 1.51	∑Qn= 508.77	∑WnQn= 53.39
WaterQuality Index = ∑WnQn/∑Wn = 35.36							

Table 6. Calculation of Water Quality Index in Summer season.

SR. NO.	PARAM-ETERS	OB-SERVED VALUE (Vn)	STAND-ERED VALUES (Sn)	IDEAL VALUE (V_{10})	UNIT WEIGHT (Wn)	QUALI-YT RAT-ING (Qn)	WnQn
1	pH	8.5	6.5-8.5	7	0.219	100.00	21.90
2	EC	0.47	300	0	0.371	0.16	0.06
3	TDS	315	500	0	0.0037	63.00	0.23
4	Alkalinity	142	120	0	0.0155	118.33	1.83
5	Total hard-ness	115	300	0	0.0062	38.33	0.24
6	Mg hard-ness	12.2	30	0	0.061	40.67	2.48
7	Ca hard-ness	26	75	0	0.025	34.67	0.87
8	Nitrate	2.29	45	0	0.0412	5.09	0.21
9	DO	12.28	5	14.6	0.3723	24.17	9.00
10	BOD	3.75	5	0	0.3723	75.00	27.92
11	Sulphate	29.19	150	0	0.01236	19.46	0.24
12	Chloride	75	250	0	0.0074	30.00	0.22
					∑Wn= 1.51	∑Qn= 548.87	∑Wn Qn= 65.20
WaterQuality Index = ∑WnQn/ ∑Wn = 43.18							

Water quality Index of the present water body is established from important various physicochemical parameters in different seasons. The values of various physicochemical parameters for calculation of water quality index are presented in Table 3. Season wise Water Quality Index calculations are depicted in the Table 4, 5 and 6. The Water Quality Index obtained for the water body in different seasons of study period i.e., rainy season, winter season and summer season are 40.21, 35.36 and43.18 respectively, which indicate the poor quality of water (Chatterji and Raziuddin 2002).

The above water quality is also supported by the following physicochemical parameters variations observed during the different seasons of the study. Among all the physicochemical param-

eters selected for the Water Quality Index calculations, pH is an important parameter which determines the suitability of water for various purposes. In the present study pH ranged between 7.75 to 8.50. In many of the collections the pH remained exactly neutral. However, when the average values for three seasons are taken into account the water body was found to be slightly alkaline. Ambasht (1971), Shardendu and Ambasht (1988), Swarnalatha and Sinha (1995) have also made similar observations in their studies on different waterbodies. Electrical Conductivity was very low and total dissolved solids were found to be very high. Season wise it is found to be high during summer season.

Chloride is one of the most important parameter in assessing the water quality. Munawar (1970) is of the opinion that higher concentrations of chlorides indicate higher degree of organic pollution. In the present study the concentration of chloride fluctuated between 58.75 mg/L to 75 mg/L. seasonally, chloride was found to be high during summer season and low during winter season.

The concentration of dissolved oxygen regulates the distribution of flora and fauna. The present investigation indicated that the concentration of dissolved oxygen fluctuated between 7.31mg/L and 12.28mg/L seasonally; the concentration of dissolved oxygen was more during summer and least during monsoon. The dissolved oxygen (DO) is some time referred to as measure of the pulse of an aquatic ecosystem. The optimum range of dissolved oxygen in natural waters is 4 to 6 mg/L (Jayasree, 2002).

Bio-chemical oxygen demand is a parameter to assess the organic load in a water body. The increased levels of BOD indicated the nature of chemical pollution. Many researchers have recorded higher BOD values in polluted water. The average BOD was 2.00 mg/L during rainy season, 2.25 mg/L during winter season and 3.75 mg/L during summer season. The BOD values obtained in the present study are within the ICMR standards. Seasonally, it was high during summer (Chatterjee 1992).

CONCLUTION:

All parameters were in the permissible limits but only Alkalinity exceeding the permissible limits as prescribed by Indian standards. However, the WQI values in the present investigation were reported 40.21 in monsoon season 35.36 in winter season 43.18 in summer season and overall WQI value was 39.58. Above results were less than 50 (table 1) for different season indicating that the water quality is good and utilize for agriculture, but not totally safe for human consumption.

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