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Determination of Water Quality Index of Bhumel Lake, Nearby Neelkanth Mahadev Nadiad, Dist.Kheda, Gujarat, India

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ABSTRACT

Determination of Water Quality of Bhumel Lake,Nearby Neelkanth Mahadev Four different locations were selected in Bhumel Lake, It's Physico-Chemical analysis such as, pH, Total Alkalinity, Total Hardness, T.D.S, Calcium, Magnesium, Chloride, Nitrate, Sulphate, D.O during Jan.2020- Oct.2021, The present study calculate the Water Quality Index of lake and assess the impact of industries, agriculture and human activities. W.Q.I has been calculated of Bhumel Lake, District: Kheda, Gujarat (India).Total Ten Physico–Chemical parameters were monitored for the calculation of W.Q.I in Rainy, Winter and Summer seasons. The parameters namely pH, Total Alkalinity, Calcium, Magnesium, Chloride, Sulphate, were exceeding the permissible limits as prescribed by Indian Standards. However, The W.Q.I values in the present investigation were reported to be more than 70, Indicating that the Water Quality is 70.14 in Rainy and 108.32 Winter season and 195.71 in Summer season and used for drinking purpose after purification .The Pollution load is relatively lighter during Summer season which compare to the Winter and Rainy Season. Results obtained are compared in term of their highest value and lowest values among three seasons in term of 10 parameters.

KEYWORDS: *Bhumel Lake, Determination, W.Q.I, Physico–Chemical, Season, Permissible Limits*

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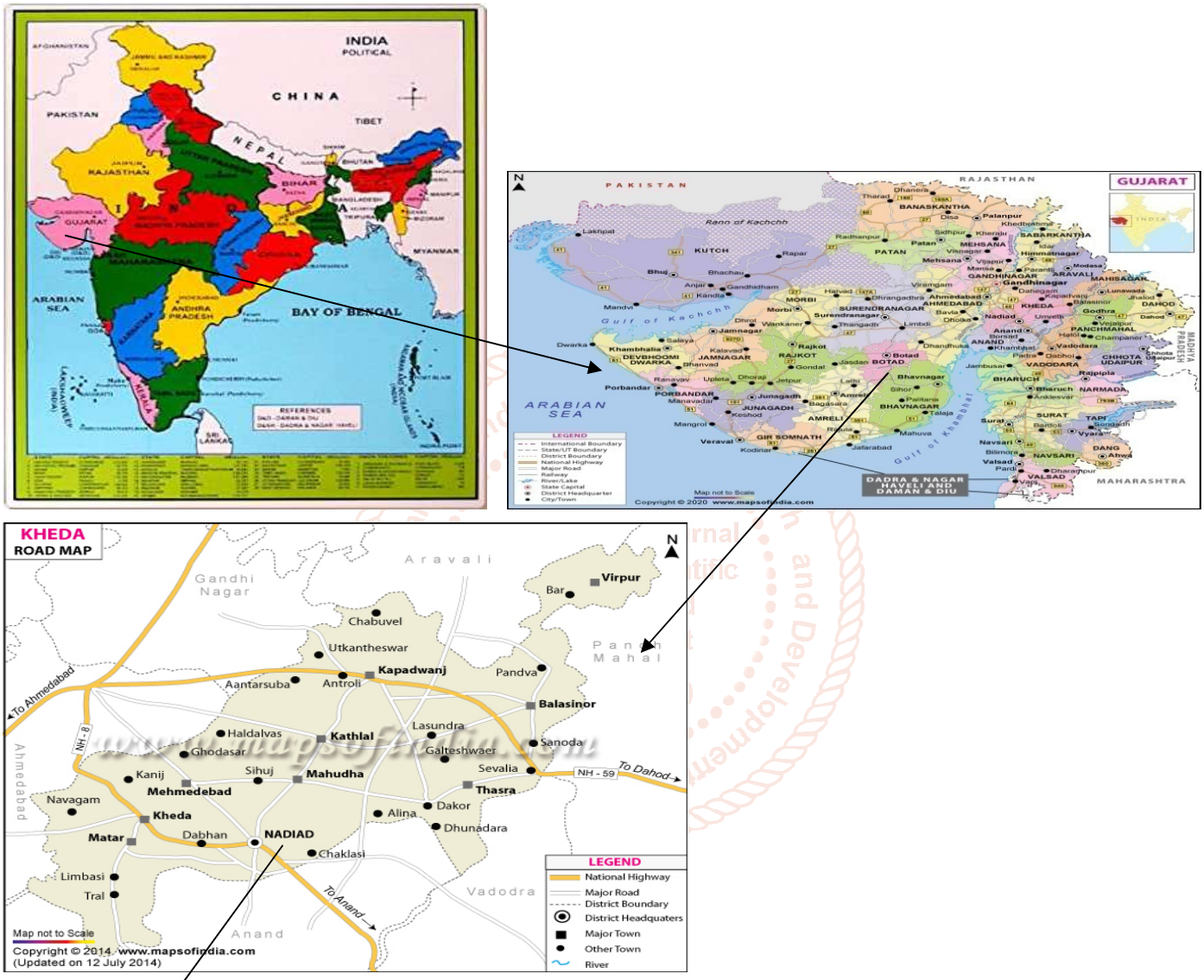
1. INTRODUCTION

Water is most essential for existence of life on earth and is a major component for all forms of life from micro-organism to men various physico-chemical parameters have a significant role in determining the portability of Water. **[1,2]** 60 percent of our body weight is made up of water. Our bodies use water in all the cells, organs, and tissues, to help regulate body temperature and maintain other bodily functions. Because our bodies lose water through breathing, sweating, and digestion, it's crucial to rehydrate and replace water by drinking fluids and eating foods that contain water. Agricultural water is water that is used to grow fresh produce and sustain livestock. The use of agricultural water makes it possible to grow fruits and vegetables and raise livestock, which is a main part of our diet. Agricultural water is used for irrigation, pesticide, External Water is used in every cell of your body. Water travels throughout your body carrying nutrients, oxygen, and wastes to and from your cells and organs. Water keeps your body cool as part of your body's temperature regulating system. Water cushions your joints, and protects your tissues and organs from shock and damage. Water acts as a lubricant for your joints, your mouth and digestive system in saliva, and in your nose, throat, eyes, and stomach as part of mucus. Water aids in digestion and absorption of food, as well as in the removal of wastes from your body. Water also helps you maintain a healthy weight

The use of fertilizers, manure are main source of Water pollution in this area Water is one of the most important factor for every living organism on this planet Water is generally used for drinking fisheries and other domestic purpose in the in this area. Although three forth part of earth is being surrounded by water but a little portion of it can be used for drinking purpose.

Therefore we carried out studies of Physico – Chemical parameters of surface water in Gujarat state whether they are fit for drinking or some other purposes of various central areas in Gujarat state **[3].**

The major hazard in drinking Water supplies is microbial contamination which is due to agricultural land waste, domestic sewage and industrial effluent **[4]** etc. It is with their background, Water Quality Index (*W.Q.I*) provides a single number that expresses overall Water quality at a certain location and time, based on several Water quality parameters **[5,6]**. The objective of Water Quality Index is to turn complex Water quality data into information that is understandable and used by the public. A single number cannot tell the whole story of Water quality parameters that are not included in the index. However, a Water Quality Index based on some very important parameters can provide a single indicator of Water quality.



2. Methodology:

2.1. Study Area:

Bhumel Lake, Nearby Neelkanth Mahdev is located 22.6949^0 N and 72.9121^0 E, It is situated in Nadiad – Anand Road and comes under Kheda district. Bhumel Lake is an old lake.

2.2. Samples Collections:

Samples of Water were collected from four sites of the lake once every month Jan.2020- Oct.2021. One liter P.E.T. bottles were used for collection of Water samples from a depth of 30 cm. During morning hours between 8.00 – 10.00 AM. For Dissolved Oxygen measurement, a 300 ml capacity BOD bottle was used for collection of water sample and the Oxygen was fixed at the sampling site before being carried to the laboratory. The parameter pH was monitored at the sampling site and other parameters like Total Alkalinity, Total Hardness, Total Dissolved Solids, Calcium, Magnesium, Chloride, Nitrate and Sulphate were analyzed in the laboratory as per the standard procedures. APHA [2005]- **[7,8]**.

The concept of Water Quality Index was first proposed by Horton (1965). For the calculation of Water Quality Index. 10 important Physico – Chemical parameters were chosen.

W.Q.I has been calculated by using the standards of drinking water quality recommended by the World Health Organization (*WHO*) – 1992 **[9]**, Bureau of Indian Standards (*BIS*) - 1993 and Indian Council for Medical Research (*ICMR*) - 1975. The weighted arithmetic index method (Brown et. al.) has been used for the calculation of *W.Q.I* of the lake. Further quality rating or sub index (qn) was calculated using the following expression.

$$qn = 100\left[Vn - V_{10}\right] \Big/ \left[Sn - V_{10}\right]$$

Where, qn = Quality rating for the n^{th} water quality parameter.
Vn = Estimated value of the n^{th} parameter at a given sampling station.
Sn = Standard permissible value of the n^{th} parameter.
V_{10} = Ideal value of nth parameter in a pure water.

Ideal value in most cases $V_{10} = 0$ except in certain parameters like P^H and Dissolved Oxygen. Calculation of quality rating for P^H and $DO\left(V_{10} \neq 0\right)$ is 7.0 and 14.6 mg/L respectively.

Unit weight was calculated by a value inversely proportional to the recommended standard values Sn of the corresponding parameters.
Wn = K / Sn.

Where, Wn = Unit weight for the n^{th} parameter.
Sn = Standard value for n^{th} parameter.
K = Constant for proportionality.

The overall Water Quality Index (*W.Q.I*) was calculated by aggregating the quality rating with the unit weight linearly. $\therefore W.Q.I. = \sum qnWn \Big/ \sum Wn$

Table 1 Water Quality Index (W.Q.I.) and status of water quality (Chatterji and Raziuddin 2002)

Water Quality Index	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	Unfit for drinking

Table 2 Method used for Physico-Chemical analysis of water (All values except pH is in mg/L.)

Parameter (Unit)	Method
pH	pH Probe
Total Alkalinity	Volumetric
Total Hardness	Volumetric
T.D.S.	Gravimetric

Calcium	Volumetric
Magnesium	Volumetric
Chloride	Volumetric
Nitrate	Colorimetric
Sulphate	Volumetric
D.O.	Volumetric

Table – 3 Drinking water standards recommending agencies and unit weight. (All values except pH is in mg/L.)

Parameter	Standards	Recommended Agency	Unit Weight
pH	6.5 - 8.5	ICMR / BIS	0.2190
Total Alkalinity	120	ICMR	0.0155
Total Hardness	300	ICMR / BIS	0.0062
T.D.S.	500	ICMR / BIS	0.0037
Calcium	75	ICMR / BIS	0.025
Magnesium	30	ICMR / BIS	0.062
Chloride	250	ICMR	0.0074
Nitrate	45	ICMR / BIS	0.0413
Sulphate	150	ICMR / BIS	0.0124
D.O.	5	ICMR / BIS	0.723

Table 4 Seasonal variations of the Physico – Chemical parameters of the Bhumel Lake (All values except P^H is in mg/L.)

Parameter	Seasons		
	Rainy Season	Winter Season	Summer Season
pH	7.93	8.89	9.27
Total Alkalinity	164.75	191.4	434
Total Hardness	158.25	211.7	404
T.D.S.	391.75	675.25	852
Calcium	14.25	58.5	119.25
Magnesium	25	65	101.5
Chloride	59.25	101.25	240
Nitrate	20.08	19.5	28
Sulphate	6.25	9.75	18.25
D.O.	7.4	4.97	4.015
Water Quality Index	**70.14**	**108.32**	**195.71**

Table 5 Calculation of Water Quality Index in Rainy Season

Parameter	Observed Values (Vn)	Standard Values (Sn)	Unit Weight (Wn)	Quality Rating (Qn)	WnQn
pH	7.93	6.5 - 8.5	0.2190	62	13.57
Total Alkalinity	164.75	120	0.0155	137.29	2.127
Total Hardness	158.25	300	0.0062	52.75	0.3270
T.D.S.	391.75	500	0.0037	78.35	0.2898
Calcium	14.25	75	0.025	19	0.475
Magnesium	25	30	0.062	83.33	5.166
Chloride	59.25	250	0.0074	23.7	0.175
Nitrate	20.08	45	0.0413	44.62	1.842
Sulphate	6.25	150	0.0124	4.16	0.051
D.O.	7.4	5	0.723	75	54.22
			$\sum Wn = 1.155$	$\sum Qn = 580.2$	$\sum WnQn = 78.242$
Water Quality Index $= \sum WnQn / \sum Wn = 78.242/1.1155 = 70.14$					

Table – 6 Calculation of Water Quality Index in Winter Season

Parameter	Observed Values (Vn)	Standard Values (Sn)	Unit Weight (Wn)	Quality Rating (Qn)	WnQn
P^H	8.89	6.5 - 8.5	0.2190	126	27.59
Total Alkalinity	191.4	120	0.0155	159.5	2.472
Total Hardness	211.7	300	0.0062	70.56	0.43
T.D.S.	675.25	500	0.0037	135.05	0.499
Calcium	58.5	75	0.025	78	1.95
Magnesium	65	30	0.062	216.6	13.43
Chloride	101.25	250	0.0074	40.5	0.2997
Nitrate	19.5	45	0.0413	43.33	1.789
Sulphate	9.75	150	0.0124	6.5	0.0806
D.O.	4.97	5	0.723	100.31	72.3
			$\sum Wn = 1.1155$	$\sum Qn = 976.41$	$\sum WnQn = 120.84$
Water Quality Index $= \sum WnQn / \sum Wn$ **= 120.84/1.1153=108.32**					

Table – 7 Calculation of Water Quality Index in Summer Season

Parameter	Observed Values (Vn)	Standard Values (Sn)	Unit Weight (Wn)	Quality Rating (Qn)	Wn Qn
P^H	9.27	6.5 - 8.5	0.2190	150	32.85
Total Alkalinity	434	120	0.0155	361.66	5.605
Total Hardness	404	300	0.0062	134.6	0.834
T.D.S.	852	500	0.0037	170.4	0.630
Calcium	119.25	75	0.025	159	3.97
Magnesium	101.5	30	0.062	338.33	20.97
Chloride	240	250	0.0074	96	71.04
Nitrate	28	45	0.0413	62.22	2.56
Sulphate	18.25	150	0.0124	12.16	0.150
D.O.	4.015	5	0.723	110.26	79.717
			$\sum Wn = 1.155$	$\sum Qn = 1594.69$	$\sum WnQn = 218.32$
Water Quality Index $= \sum WnQn / \sum Wn = 218.32 / 1.155 = 195.71$					

3. Summary and Discussion:

The Physico-Chemical parameters of Water quality were analyzed using standard methods given in APHA, et al (2005). The values of various Physico – Chemical parameters for calculation of Water Quality Index are presented in Table: 4. While season wise Water Quality Index calculations are depicted in the Table 5, 6 and 7. The Water Quality Index of Rainy season, Winter season and Summer season are 70.14, 108.32 and 195.71 respectively. Which indicate that the Water quality is Poor to unfit for drinking used for human consumption after purification system (Chatterji and Raziuddin 2002)- **[9].** It is also observed that the pollution load is relatively higher during Summer season when compared to the Winter and Rainy season. The above water quality is also supported by the following Physico – Chemical parameters variations observed during the different seasons of the study.

3.1. pH

pH is a measurement of the acidic or basic Quality of water**[10,11]**. The average pH values of the lake water was 7.93 mg/L during rainy season, 8.89 mg/L during winter season and 9.27 mg/L during summer season. The P^H of water was relatively high in the Summer season and low in Rainy and Winter season. However, when the average values for three seasons are taken into account that the water body was slightly alkaline**[12].** Swaranalatha and Narasingrao [1993]- **[13].** The P^H values of water samples of present study ranged from 7 to 9 of Bhumel Lake. These values are within the prescribed limit of standards (WHO – 2002).

3.2. Total Alkalinity

Alkalinity value greater than 178 mg/L is desirable for domestic use APHA (2005). The observed average value of total alkalinity was 164.75 mg/L during Rainy season,191.4 mg/L during Winter

season and 434 mg/L during summer season. Total alkalinity values in our observations indicated that the water was hard. Higher values of alkalinity registered during Summer season, lower during Rainy season. D. K. Bhoi et. al. (2011) also reported similar findings in the study of Pariyej lake.**[14]**

3.3. TOTAL HARDNESS:

The observed average Total Hardness value was 158.25 mg/L during rainy season, 211.7 mg/L during winter season and 404 mg/L during Summer can be attributed to low water level and high rate of evaporation of water and addition of Calcium and Magnesium salt. Mohanta and Patra (2000) stated that addition of sewage, detergents and large scale human use might be the cause of elevation of hardness**[15,16].** Elisha Lake water was moderately hard but the value of hardness in Summer were up to permissible limits. Hardness below 300 mg/L is considered potable but beyond this limit produces gastrointestinal irritation (ICMR 1975).

3.4. TOTAL DISSOLVED SOLIDS:

The total Dissolved solids in water of Bhumel Lake was 391.75 mg/L during rainy season, 675.25 mg/L during winter season and 852 mg/L during Summer season. Gupta and Singh (2000) also reported high concentration of TDS in the Damodar river due to mixing of sewage and industrial water. Gray N. F. (2005) reported that the hardness in the water is due to the Dissolved minerals from sedimentary rocks, seepage and run-off. Detergents and soaps also aggravate the situation – Ahluwalia V. K. (2008)-**[17,18]**

3.5. CALCIUM:

The observed average value of Calcium was 14.25 during rainy season, 58.5 mg/L during winter season and 119.25 mg/L during Summer season. The quantities of Calcium in natural water depend upon the type fo rocks. Small concentration of Calcium is reducing corrosion in water pipes- D. K. Bhoi et al., (2011)-**[19].**

3.6. MAGNESIUM:

The observed average value of Magnesium was 25 mg/L during Rainy season, 65 mg/L during Winter season and 101.5 mg/L during Summer season. Magnesium hardness particularly associated with the Sulphate ion has laxative effect on persons unaccustomed to it. (Khursid 1998)-**.** The recorded increase in Ca and Mg concentration during pre monsoon may be the effect of bacterial decomposition. Jaybhaye and Madlapure (2005) reported high values of Calcium and Magnesium in Parola dam, Dist. Hingoli, Maharashtra.

3.7. Chloride:

Chloride occurs in all types of natural waters. The high concentration of Chloride is considered to be an indication of pollution due to high organic waste of animal origin (Singh, 1995). The observed Chloride value was 59.25 mg/L during rainy season, 101.25 mg/L during winter season and 240 mg/L in summer season. The higher values of Chloride recorded in Summer season. Similar results were also reported by D.K.Bhoi et al., (2011) from Pariyej lake, Kheda district, Gujarat. The high values may be attributed to low water levels during Summer season- **[20,21].**

3.8. Nitrate:

The Nitrate ranged from 20.08 mg/L during rainy season, 19.5 mg/L during winter season and 28 mg/L during summer season during. According to Jhingram and Sugunan (1990) the water with the 0.2 to 0.5 ppm of Nitrate is of high productive reservoirs, upto 0.2 ppm Nitrate is medium productive reservoirs and in low productive reservoirs, the Nitrates are negligible. According to the above classification present reservoir belongs to high productive nature.**[16,17]**

3.9. Sulphate:

Sulphate ion does not effect the taste of water if present in low concentration. The observed average value of Sulphate was 6.25 mg/L during rainy season, 9.75 mg/L during winter season and 18.25 mg/L during summer season.[18,19] The Sulphate value in Bhumel Lake water was found within the acceptable limit of 150 mg/L.

4. Dissolved Oxygen (D.O):

Dissolved Oxygen (D.O.) is important to the health of aquatic ecosystem because all aquatic organisms need Oxygen to survive**. [20,21]** The average Dissolved Oxygen (D.O.) was 7.4 mg/L during rainy season, 4.97 mg/L during winter season and 4.015 mg/L during summer season. The maximum Dissolved Oxygen in the water of Bhumel lake was recorded in rainy season. Thereafter it started declining gradually and in summer reached the lowest concentration**.[22,23]** The maximum DO in rainy season may be due to low atmospheric temperature and minimum D.O. was recorded in Summer season may be due to high metabolic rate of organism similar result was also reported by munawar [1970] – and Bhoi et al. [2005] – **[27,28]**

5. Conclusion:

The W.Q.I. values in the present investigation of Bhumel Lake in rainy season, winter season and summer season are 70.14, 108.35, 195.71 and respectively. Which indicate that the water quality is Poor to unfit for drinking.

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