# Water Quality Index (W.Q.I.) of Pariyej Lake Dist. Kheda - Gujarat

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#### ABSTRACT

The present study calculates the Water Quality Index (W.Q.I.) of Pariyej Lake and assesses the impact of industries, agriculture and human activities. Physico – chemical parameters were monitored for the calculation of W.Q.I. for the rainy, winter and summer seasons. The parameters namely PH, Total hardness, TDS, Calcium, Chloride, Nitrate, Sulphate, DO and BOD values were within the permissible limits. But total alkalinities and magnesium values were exceeding the permissible limits as prescribed by Indian Standards. However, the W.Q.I. values in the present investigation were reported to be less than 75 (67.20, 68.43 and 70.37) for different season indicating that the water quality is poor and not totally safe for human consumption.

Key words: Pariyej Lake, Physico-chemical parameters, Water Quality Index, Drinking water quality.

#### INTRODUCTION

The use of fertilizers, pesticides and 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 purposes in this area. The available fresh water to man is hardly 0.3 to 0.5% of the total water available on the earth and therefore its judicious use in imperative. Lakes are one of the important water resources used for irrigation, drinking, fisheries and flood control purposes. (Adarsh kumar et al. 2006). On the other hand, lakes also provide a habitat for invertebrates, fishes and aquatic birds. Therefore scientific study needs to review strategies for conservation and better utilization of lakes. It is with this background, the present work was undertaken between Dec. 20009 to Jan. 2010.

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. 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. In general, water quality indices incorporate data from multiple water quality parameters into a mathematical equation that rates the health of a lake with number.

#### **Study Area**

Pariyej lake is big in size covers an area of about 361 ha. It is situated at a distance of about 25 km from Nadiad and comes under Kheda district. It receives rain water from surrounding area and fresh water from Mahi channel. It is located in 22° 32'N latitude and 72° 37'E longitude. Pariyej lake is old and man made reservoir. The water is used for drinking, fisheries, agriculture and domestic purposes. The study was carried out for one year period during Dec. 2009 to Jan. 2010.

Methodology :

The water sample from the lake were collected at an interval of 30 days and analysed for 11 physico – chemical parameters by following the established procedures. The parameters  $P^{H}$  and dissolved oxygen were monitored at the sampling site and other parameters like total dissolved solids, total alkalinity, total hardness, calcium, magnesium, chloride, nitrate, sulphate and biological oxygen demand were analysed in ht elaboratory as per the standard procedures of APHA (2005) and D. K. Bhoi (2004).

In this study for the calculation of water quality index eleven important parameters were chosen. The W.Q.I. has been calculated by using the standards of drinking water quality recommended by the World Health Organisation (WHO), Bureau of Indian Standards (BIS) and Indian Council for Medical Research (ICMR). The weighted arithmetic index method (Brown et. al.) has been used for the calculation of WQI of the lake. Further quality rating or sub index (qn) was calculated using the following expression.

$$qn = 100 \begin{bmatrix} Vn - V_{10} \end{bmatrix} / \begin{bmatrix} Sn - V_{10} \end{bmatrix}$$

Where,

qn = Quality rating for the n<sup>th</sup> water quality parameter.

Vn = Estimated value of the n<sup>th</sup> parameter at a given sampling station.

Sn = Standard permissible value of the n<sup>th</sup> 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<sup>H</sup> and dissolved oxygen. Calculation of quality rating for P<sup>H</sup> and DO( $V_{10} \neq 0$ ) 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<sup>th</sup> parameter. Sn = Standard value for n<sup>th</sup> 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.

#### DISCUSSION

Water quality index of the present lake is established from important various physico chemical parameters in different seasons. The values of various physico - chemical 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 lake in ·different seasons birstudy period i.e., rainy season, winter season and summer season are 67.21, 68.43 and 70.37 respectively which indicate the poor quality of water (Chatterji and Raziuddin 2002). This water quality rating study clearly shows that, the status of the water body is eutropic and it is unsuitable for the human use. 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 guality is also supported by the following physico - chemical parameters variations observed during the different seasons of the study.

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 $P^{H}$  is one of the most important factors that server as an index for the pollution. The average  $P^{H}$  values of the lake water was 7.2 during rainy season, 7.7 during winter season and 8.0 during summer season. The  $P^{H}$  of water was relatively high in the summer season and low in monsoon and winter season. However, when the average values for three seasons are taken into account the water body was found to be slightly alkaline. Swarnalatha and Mazasingcerao (1993) and sinha (1995). The alkaline nature of water was a characteristic throughout the study period with slight seasonal variation at the lake. In the present investigation  $P^{H}$  values were within the ICMR standards (7.8 – 8.5)

## T.D.S.

The total dissolved solids in water of Pariyej lake was266 mg/L during rainy season, 250 mg/L during winter season and 237.5 mg/L during summer season. The concentration is high during rainy season, which may be due to addition of solids from run off water, sewage and industrial effluents to the lake. Gupta and Singh (2000) also reported high concentration of TDS in the Damodar river due to mixing of sewage and industrial water.

#### **Total Alkalinity**

Alkalinity value less than 100 mg/L is desirable for domestic use. According to USPHA the maximum permissible limit is 120 mg/L. The observed average value of total alkalinity was 110 mg/L during rainy season, 115 mg/L during winter season and 136 mg/L in summer season. Total alkalinity values in our observations indicated that the water was hard. Higher values of alkalinity registered during summer might be due to the presence of excess of free  $CO_2$  product as a result of decomposition process coupled with the mixing of sewage and domestic waste. The low alkalinity during rainy season may be due to dilution. Jain et. al (1996) also reported similar finding in the study of the Halali Reservoir.

## **Total Hardness**

The observed average total hardness value was 154 mg/L during rainy season, 162 mg/L during winter season and 170 mg/L during summer season, Higher values of hardness during summer can be attributed to low water level and high rate of evaporation of water and addition of calcium an d magnesium salts. Mohanta and Patru (2000) stated that addition of sewage, detergents and large scale human use might be the cause of elevation of hardness.

Kannan (1991) has classified water on the basis of hardness values in the following manner, 0 – 60 mg/L soft, 61 – 120 mg/L Moderately hard, 121 – 160 mg/L. hard and greater than as 180 mg/ L very hard. Pariyej lake water was moderately hard but the hardness values were in permissible limits. Hardness below 300 mg/L is considered potable but beyond this limit produces gastrointestinal irritation, (ICMR, 1975).

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: Drinking Water standards recommending agencies and unit weight (All values except P<sup>H</sup> is in mg/L.)

	Standards	Recommended Agency	Unit Weight
P <sup>H</sup>	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	ICR / 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.	5.0	ICMR / BIS	0723
B.O.D.	5.0	ICMR	0.3723

## Calcium & Magnesium

The observed average value of calcium was 36 mg/L during rainy season, 41 mg/L during winter season and 47 mg/L during summer season. The quantities of calcium in natural water depend upon the type of rocks. Small concentration of calcium is reducing corrosion in water pipes. While the observed average value of magnesium was 26 mg/L during rainy season, 29.5 mg/L during winter season and 33 mg/L during summer season. Magnesium hardness particularly associated with

the sulphate ion has laxative effect on persons un accustomed to it (Khursid, 1998).

## 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). Chloride value obtained in the study was 29.6 mg/ L during rainy season, 33.3 mg/L during winter season and 43.5 mg/L in summer season. The

Table 3: Seasonal variations of the physico -che	emical parameters
of the Water body (All values except P <sup>H</sup> i	s in mg/L.)

	Rainy Season	Winter Season	Summer Season
P <sup>H</sup>	7.7	7.7	8.0
Total Alkalinity	110	115	136
Total Hardness	154	152	170
T.D.S.	266	250	237.5
Calcium	36	41	47
Magnesium	26	29.5	33
Chloride	29.6	33.3	43.5
Nitrate	16	∑rmultin /22	27
Sulphate	14	<u>∑18</u> <sup>2</sup>	23.4
D.O.	5.9	5.4	4.9
B.O.D.	4.3	3.9	3.6

#### Table 4: Calculation of water quality index in Rainy season

	Observed Values (Vn)	Standard Values(Sn)	Unit Weight (Wn)	Quality Rating(Qn)	WnQn
P <sup>H</sup>	7.2	6.5 – 8.5	0.2188	2.35	0.514
Total Alkalinity	110	120	0.0155	91.66	1.42
Total Hardness	154	300	0.0062	51.33	0.318
T.D.S.	266	500	0.0037	5.32	0.196
Calcium	36	75	1.025	48	1.2
Magnesium	26	30	0.061	86.66	5.28
Chloride	29.6	250	0.0074	11.84	0.087
Nitrate	16	45	0.0413	35.55	1.46
Sulphate	14	150	0.124	9.33	0.115
D.O.	5.9	05	0.372	90.62	33.71
B.O.D.	4.3	05	0.372	86	31.99
			$\sum Wn = 1.135$	518.66	=76.29

chloride in Pariyej lake water was found within the acceptable limit of 250 mg/L. In natural surface water the concentration of chloride was normally low.

## Nitrate

Nitrate is the most important nutrient in an ecosystem. Generally water bodies polluted by

organic matter exhibit higher values of nitrate. Nitrate value obtained in the study was 16 mg/L during rainy season, 22 mg/L during winter season and 27 mg/L during summer season. In the present study water samples of all the seasons showed low concentration of nitrate well below permissible levels as per the standards.

	Observed Values (Vn)	Standard Values(Sn)	Unit Weight (Wn)	Quality Rating(Qn)	WnQn
P <sup>H</sup>	7.7	6.5 - 8.5	0.2188	8.23	1.80
Total Alkalinity	115	120	0.0155	95.83	1.48
Total Hardness	162	300	0.0062	54	0.334
T.D.S.	250	500	0.0037	50	0.185
Calcium	41	75	0.025	54.66	1.36
Magnesium	29.5	30	0.061	98.33	5.99
Chloride	33.3	250	0.0074	13.32	0.098
Nitrate	22	45	0.0413	48.88	2.018
Sulphate	18	150	0.0124	12	0.148
D.O.	5.4	05	0.372	108	35.26
B.O.D.	3.9	05	0.372	78	29.01
			∑wn <sup>1</sup> =135	621.25	=77.01

	Table 5:	Calculation	of w	ater o	quality	index	in	Winter	season
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Water Quality Index

68.73

## Table 6: Calculation of water quality index in Summer season

	Observed Values (Vn)	Standard Values(Sn)	Unit Weight (Wn)	Quality Rating(Qn)	WnQn
P <sup>H</sup>	8	6.5 - 8.5	0.2188	11.76	2.57
Total Alkalinity	136	120	0.0155	1113.33	1.75
Total Hardness	170	300	0.0062	586.66	0.351
T.D.S.	237.5	5200	0.0037	47.5	0.175
Calcium	47	75	1.0258	62.66	1.56
Magnesium	33	30	0.061	110	6.71
Chloride	43.5	250	0.0074	17.4	0.128
Nitrate	27	145	0.0413	60	2.47
Sulphate	23.4	150	0.0124	15.6	.0193
D.O.	4.9	05	0.372	100	37.2
B.O.D.	3.6	05	0.372	72	26.78
			1.135	666.91	=79.88

Water Quality Index





#### Sulphate

Sulphate ion does not effect the taste of water if present in low concentration. The sulphate ion concentration in 14 mg/L during rainy season, 18 mg/L during winter season and 23.4 mg/L during summer season. The sulphate in Pariyej lake water was found within the acceptable limit of 150 mg/L.

## DO

The average dissolved oxygen was 5.9 mg/ L during rainy season, 5.4 mg/L during winter season and 4.9 mg/L during summer season. The maximum dissolved oxygen in the water of Pariyej lake was recorded in rainy season. Thereafter it started declining gradually and in summer reached the lowest concentration. This can be attributed to addition of effluents containing oxidizable organic matter and consequent biodegradation and decay of vegetation at higher temperature leading to consumption of oxygen from water.

Concentration below 5 mg/L may adversely affect the functioning and survival of biological communities and below 2 mg/L may lead to fish mortality. Water without adequate DO may be considered waste water. Presence of DO in water may be due to direct diffusion from air and photosynthetic activity of autotrophs. (Shanthi et al. 2002). The DO values obtained in the present study are slightly increased compared to ICMR standards.

#### BOD

BOD is the measurement of the amount of biologically oxidizable organic matter present in the waste. The increased levels of BOD indicated the nature of chemical pollution. The average BOD was 4.3 mg/L during rainy season, 3.9 mg/L during winter season and 3.6 mg/L during summer season. The BOD values obtained in the present study are within the ICMR standards.

#### CONCLUSION

Some of the samples have Total alkalinity and Magnesium values exceeding the permissible limits as prescribed by Indian standards. However, the WQI values in the present investigation are reported to be less than 75 (67.201, 68.43 and 70.37) for different season indicating that the water quality is poor and not totally safe for human consumption.

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