

Studies on the Physico-Chemical Parameters and Correlation Coefficient of Sarkhej Roza Lake, District Ahmedabad, Gujarat, India

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Abstract

This study was aimed to estimate current status of physico-chemical characteristic of Sarkhej Roza lake, District Ahmedabad, India. Monthly changes in physicochemical parameters such as water temperature, pH, turbidity, total dissolved solids, total hardness, chlorides, phosphate, nitrates, dissolved oxygen and biological oxygen demand were analyzed for a period of one year from September 2013 to August 2014. The results indicated that physico-chemical parameters of the water were within the permissible limits and can be used for domestic and irrigation. Correlation coefficient indicates showed positive and negative relationship.

Keywords: Freshwater; Physico-chemical parameter; Sarkhej roza lake; Correlation coefficient

Introduction

Wetlands are probably the earth's most important fresh water resources which provide food and habitat for many aquatic life including threatened and endangered species [1,2]. The water quality is directly related to the health of the water body [3], thus the quality of water in any ecosystem provides significant information about the available resources for supporting life in that ecosystem [4,5]. So, proper management in water quality of aquatic environment is very much essential. Human being depends on the natural resource of water for drinking, irrigation, washing and industrial purposes [6,7]. Good quality of water resources depends on a large number of physico-chemical parameters and biological characteristics. Physico-chemical properties were influence by season to season and also anthropogenic activities like agriculture, urbanization, domestic sewage etc. in the catchment area resulted in deterioration of water quality [8]. The statistical correlation has been used to develop mathematical relationship for comparison of physico-chemical parameters [9].

The purpose of the present study is to observe water quality of Sarkhej Roza lake by physico-chemical procedures and to determine the changes in water quality parameters by seasons and to find the relationship between different physico-chemical parameters.

Materials and Methods

Study area

The Sarkhej Roza Lake is the artificial lake made by Sultan Qutubuddin Ahmed Shah II between 1451 and 1458. Sarkhej was once a prominent centre of Sufi culture in the country where influential Sufi saint Gani Baksh lived. It was on the saint's suggestion that Sultan Ahmed Shah set up his capital on the banks of the Sabarmati, a few miles away from Sarkhej. Sarkhej Roza is an example of the early Islamic architectural culture of the region, which fused Islamic stylistic influences from Persia with indigenous Hindu and Jain features to form a composite "Indo-Saracenic" architectural style [10] Figure 1.

Location:

Latitude: 22°59'31.07" N

Longitude: 72°30'16.47" E

Area covered: 58,119 m²

Maintain by: Sarkej Roza Committee

Methods

Five different sites were selected for collection of samples (Figure 1). The samples were collected in sterilized polythene bottles of one liters capacity. Monitoring was done during September 2013 to August 2014 in monsoon season (July to October), winter season (November to February) and summer season (March to June). For unstable parameters like pH, temperature, Electrical Conductivity (EC) and Dissolved Oxygen (DO) were measured on the station. Samples were brought to the laboratory for analysis of other physico-chemical parameters like sodium, total alkalinity, total hardness, calcium, magnesium, chlorides, sulphate, nitrate, phosphate and Biochemical Oxygen Demand (BOD) were analyzed according to the standard methods described in the literature [11-13].

Statistical analysis

The correlation between various physico-chemical parameters of water samples were analyzed statistically conducting Pearson correlation analysis with the help of SPSS software (20.0).

Results and Discussion

Physico-chemical parameters (Mean \pm S.D) of Sarkhej Roza lake obtained during the present investigation (September 2013 to August 2014), is presented in Table 1.

Water temperature

Water temperature recorded as minimum value of 17°C and maximum of 31°C during the study period In the present investigation, minimum water temperature was obtained during winter season and maximum during summer. Water temperature shows high significant positive relationship ($p < 0.01$ level) with pH ($r = 0.608$), alkalinity

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Figure 1: Satellite image of Sarkhej Roza lake, Ahmedabad showing sampling sites denoted by dot. Source: Google map.

($r=0.971$), total hardness ($r=0.998$) and calcium ($r=0.893$) whereas electrical conductivity ($r= -0.129$), dissolved oxygen ($r= -0.596$), nitrate ($r= -0.886$), phosphate ($r= -0.682$) and biological oxygen demand ($r= -0.495$) were show negative relationship ($p<0.05$ level).

Electrical conductivity

The electrical conductivity of Sarkhej Roza Lake ranges from the 3.13 to 4.89 Ω/cm (Table 1). The maximum EC was reported during monsoon season 4.89 Ω/cm and the minimum was reported during winter 3.13 Ω/cm . Electrical conductivity shows high significant positive relationship ($p<0.01$ level) with turbidity ($r=0.968$), total dissolved solids ($r=0.997$), pH ($r=0.709$), sodium ($r=0.97$) and phosphate ($r=0.814$) whereas calcium ($r= -0.562$), magnesium ($r= -0.998$), dissolved oxygen ($r= -0.719$), chloride ($r= -0.995$) and biological oxygen demand ($r= -0.798$) were show negative relationship ($p<0.05$ level).

Turbidity

The turbidity value of the Sarkhej Roza Lake was noted between 11 to 18 NTU (Table 1). The maximum turbidity was reported in monsoon season 18 NTU and minimum turbidity was found during winter 11 NTU. Turbidity shows high significant positive relationship ($p<0.01$ level) with total dissolved solids ($r=0.984$), pH ($r=0.709$), sodium ($r=0.978$) and phosphate ($r=0.814$) whereas magnesium ($r= -0.953$), dissolved oxygen ($r= -0.87$), chloride ($r= -0.939$), nitrate ($r= -0.568$) and biological oxygen demand ($r= -0.798$) were show negative relationship ($p<0.05$ level).

Total Dissolved Solids (TDS)

Total dissolved solids recorded from the Sarkhej Roza Lake ranges between 1489 to 1842 mg/L. The maximum TDS in monsoon season 1842 mg/L and TDS values lower during winter season 1489 mg/L. Total dissolved solids shows high significant positive relationship ($p<0.01$ level) with pH ($r= 0.759$), sodium ($r= 0.986$) and phosphate ($r= 0.768$) whereas calcium ($r= -0.499$), magnesium ($r= -0.991$), dissolved

oxygen ($r= -0.697$), chloride ($r= -0.985$) and biological oxygen demand ($r= -0.84$) were show negative relationship ($p<0.05$ level).

pH

The pH values of samples collecting from the Sarkhej Roza Lake range from 7.5 – 8.7 which showed acidic water whole year (Table 1). The maximum pH noted during monsoon 8.7 and minimum pH observed during winter 8.2. pH shows high significant positive relationship ($p<0.01$ level) with alkalinity ($r=0.779$), total hardness ($r=0.654$) and sodium ($r=0.858$) whereas magnesium ($r= -0.668$), dissolved oxygen ($r= -0.985$), chloride ($r= -0.636$), nitrate ($r= -0.906$) and biological oxygen demand ($r= -0.991$) were show negative relationship ($p<0.05$ level).

Alkalinity

Alkalinity value ranged between 179-223 mg/L for Sarkhej Roza Lake (Table 1). The maximum value of alkalinity was reported during summer 274 mg/L and minimum alkalinity was during winter season 194 mg/L. Alkalinity shows high significant positive relationship ($p<0.01$ level) with total hardness ($r=0.984$) and calcium ($r=0.76$) whereas dissolved oxygen ($r= -0.77$), nitrate ($r= -0.971$) and biological oxygen demand ($r= -0.687$) were show negative relationship ($p<0.05$ level).

Total hardness

Total Hardness of water collected from the Sarkhej Roza Lake ranges between 246 to 320 mg/L (Table 1). The maximum amount of total hardness in the water was recorded during summer season 320 mg/L and the minimum amount of total hardness was recorded during winter season 246 mg/L. Total hardness shows high significant positive relationship ($p<0.01$ level) with calcium ($r=0.76$) whereas dissolved oxygen ($r= -0.642$), nitrate ($r= -0.912$), phosphate ($r= -0.637$) and biological oxygen demand ($r= -0.545$) were show negative relationship ($p<0.05$ level).

Average with standard error values of physico-chemical parameters at Sarkhej Lake (2013-14)					W.H.O. standards for drinking water (Annual Max.) in 1998
Sr. No.	Parameters	Year 2013-14			
		Monsoon	Winter	Summer	
1	Temperature (°C)	20 ± 1.63	17 ± 0.74	31 ± 0.87	30-32
2	Electrical conductivity (Ω/cm)	4.89 ± 0.45	3.13 ± 0.47	3.48 ± 0.69	500
3	Turbidity (NTU)	18 ± 0.33	11 ± 0.16	14 ± 0.15	5
4	Total Dissolve Solid (mg/L)	1842 ± 79.14	1489 ± 0.42	1584 ± 57.63	259-500
5	pH	8.7 ± 0.07	7.5 ± 0.13	8.6 ± 0.42	6.5-8.5
6	Alkalinity (mg/L)	198 ± 7.32	179 ± 3.8	223 ± 3.42	100
7	Total Hardness (mg/L)	266 ± 3.88	246 ± 7.64	320 ± 7.13	200
8	Calcium (mg/L)	43 ± 1.36	54 ± 6.47	84 ± 3.47	75
9	Magnesium (mg/L)	31 ± 1.65	38 ± 5.69	37 ± 0.93	150
10	Dissolved Oxygen (mg/L)	3.36 ± 0.84	5.17 ± .39	3.54 ± 0.47	7.5
11	Chloride (mg/L)	49 ± 0.69	79 ± 5.47	76 ± 4.13	200
12	Sodium (mg/L)	59 ± 0.69	40 ± 3.23	48 ± 2.52	200
13	Nitrate (mg/L)	8.22 ± 0.72	9.01 ± 0.53	7.78 ± 0.84	11
14	Phosphate (mg/L)	0.77 ± 0.15	0.48 ± 0.38	0.27 ± 0.23	0.5
15	Biochemical Oxygen Demand (mg/L)	1.21 ± 0.24	1.80 ± 0.98	1.34 ± 0.77	6.9

Table 1: Average with standard error values of physico-chemical parameters of Sarkhej Roza lake.

Calcium

The analysis of calcium revealed a range of between 43 to 84 (Table 1). The maximum amount of calcium recorded in water during summer season 84 mg/L and the minimum amount of calcium in water was recorded during monsoon season 43 mg/L. Calcium shows high significant positive relationship ($p < 0.01$ level) with magnesium ($r = 0.608$) and chloride ($r = 0.64$) whereas nitrate ($r = -0.583$) and phosphate ($r = -0.938$) were show negative relationship ($p < 0.05$ level).

Magnesium

The amount of magnesium recorded in the water ranges between 31 to 38 mg/L (Table 1). The maximum amount of magnesium in the water was recorded during winter season 38 mg/L where as the minimum value was recorded during monsoon season 31 mg/L. Magnesium shows high significant positive relationship ($p < 0.01$ level) with dissolved oxygen ($r = 0.679$), chloride ($r = 0.999$) and biological oxygen demand ($r = 0.763$) whereas nitrate ($r = -0.955$) and phosphate ($r = -0.845$) were show negative relationship ($p < 0.05$ level).

Dissolve oxygen

The amount of dissolved oxygen recorded in the water ranges between 3.36 to 5.17 mg/L (Table 1). The maximum amount of dissolved oxygen recorded during winter season 5.17 mg/L whereas the minimum dissolved recorded during monsoon season 3.36. Dissolved oxygen shows high significant positive relationship ($p < 0.01$ level) with chloride ($r = 0.648$), nitrate ($r = 0.9$) and biological oxygen demand ($r = 0.993$) whereas sodium ($r = -0.866$) was show negative relationship ($p < 0.05$ level).

Chloride

Chloride concentration in Sarkhej Roza Lake lies between 49 to 79 mg/L (Table 1). The maximum chloride reported in winter season 89 mg/L and the minimum value of chloride recorded during monsoon season 49 mg/L. Chloride shows high significant positive relationship ($p < 0.01$ level) with biological oxygen demand ($r = 0.735$) whereas sodium ($r = -0.942$) and phosphate ($r = -0.867$) were show negative relationship ($p < 0.05$ level).

Sodium

The amount of sodium recorded in the water of Sarkhej Roza

Lake ranges between 40 to 59 mg/L (Table 1). The maximum amount of sodium was recorded during monsoon season 59 mg/L and the minimum amount was recorded during winter season 40 mg/L. Sodium shows high significant positive relationship ($p < 0.01$ level) with phosphate ($r = 0.649$) whereas nitrate ($r = -0.561$) and biological oxygen demand ($r = -0.92$) were show negative relationship ($p < 0.05$ level).

Nitrate

The amount of Nitrate recorded in the water of Sarkhej Roza Lake ranges between 7.78 to 9.01 mg/L (Table 1). The maximum amount of nitrate was recorded during winter season 9.01 and the minimum amount of nitrate in water was recorded during summer season 7.5 mg/L. Nitrate shows high significant positive relationship ($p < 0.01$ level) with biological oxygen demand ($r = 0.841$).

Phosphate

Phosphate recorded in the water of Sarkhej Roza Lake ranges between 0.27 to 0.77 mg/L (Table 1). The maximum amount of phosphate recorded during monsoon season 0.77 mg/L and the minimum amount phosphate was recorded during summer season 0.27 mg/L.

Biochemical Oxygen Demand (BOD)

The biochemical oxygen demand (BOD) reported from Sarkhej Roza Lake was ranges from 1.21 to 1.80 mg/L (Table 1). The maximum demand of oxygen in the water was recorded during winter season 1.80 mg/L and the minimum demand was recorded during monsoon season 1.21 mg/L.

In the present study the correlation coefficient (r) between every parameter pairs in computed by taking the average values as shown in Table 1. Correlation coefficient (r) between any two parameters, x and y is calculated for parameter such as water temperature, pH, turbidity, total dissolved solids, total hardness, chloride, phosphate, nitrate, dissolved oxygen and biological oxygen demand of the Sarkhej Roza lake. The degree of line association between any two of the water quality parameters as measured by the simple correlation coefficient (r) is presented in Table 2.

The comparison of various physico-chemical parameters deduced from Sarkhej Roza lake, Gujarat allowed us to study the pollution status

Correlation Coefficient (r) of various physico-chemical parameters studied from Sarkhej Roza Lake															
	Tem	EC	Tur	TDS	pH	Alk	TH	Ca	Mg	DO	Cl	NA	NO ₃	PO ₄	BOD
Tem	1	-0.129	0.122	-0.056	0.608	0.971	0.998	0.893	0.185	-0.596	0.226	0.114	-0.886	-0.682	-0.495
EC	-0.129	1	0.968	0.997	0.709	0.11	-0.07	-0.562	-0.998	-0.719	-0.995	0.97	-0.345	0.814	-0.798
Tur	0.122	0.968	1	0.984	0.862	0.355	0.181	-0.338	-0.953	-0.87	-0.939	0.978	-0.568	0.643	-0.923
TDS	-0.056	0.997	0.984	1	0.759	0.183	0.004	-0.499	-0.991	-0.769	-0.985	0.986	-0.413	0.768	-0.84
pH	0.608	0.709	0.862	0.759	1	0.779	0.654	0.185	-0.668	-0.985	-0.636	0.858	-0.906	0.167	-0.991
Alkal	0.971	0.11	0.355	0.183	0.779	1	0.984	0.76	-0.054	-0.77	-0.012	0.347	-0.971	-0.488	-0.687
TH	0.998	-0.07	0.181	0.004	0.654	0.984	1	0.865	0.127	-0.642	0.168	0.173	-0.912	-0.637	-0.545
Ca	0.893	-0.562	-0.338	-0.499	0.185	0.76	0.865	1	0.608	-0.17	0.64	-0.346	-0.583	-0.938	-0.05
Mg	0.185	-0.998	-0.953	-0.991	-0.668	-0.054	0.127	0.608	1	0.679	0.999	-0.955	0.291	-0.845	0.763
DO	-0.596	-0.719	-0.87	-0.769	-0.985	-0.77	-0.642	-0.17	0.679	1	0.648	-0.866	0.9	-0.181	0.993
Cl	0.226	-0.995	-0.939	-0.985	-0.636	-0.012	0.168	0.64	0.999	0.648	1	-0.942	0.251	-0.867	0.735
Na	0.114	0.97	0.978	0.986	0.858	0.347	0.173	-0.346	-0.955	-0.866	-0.942	1	-0.561	0.649	-0.92
NO ₃	-0.886	-0.345	-0.568	-0.413	-0.906	-0.971	-0.912	-0.583	0.291	0.9	0.251	-0.561	1	0.265	0.841
PO ₄	-0.682	0.814	0.643	0.768	0.167	-0.488	-0.637	-0.938	-0.845	-0.181	-0.867	0.649	0.265	1	-0.299
BOD	-0.495	-0.798	-0.923	-0.84	-0.991	-0.687	-0.545	-0.05	0.763	0.993	0.735	-0.92	0.841	-0.299	1

Table 2: Correlation Coefficient (r) of various physico-chemical parameters studied from Sarkhej Roza Lake.

of this water body. Quantities such as turbidity, total dissolved solids, alkalinity, pH, hardness and phosphate contents are significantly high. The comparison of estimated quantities from other lakes in Ahmedabad like Chandola lake [14], Nikol lake [15], Chandlodia lake [16] and Ghuma lake [17] with the presented data revealed the content of turbidity, total dissolved solids, alkalinity, total hardness, magnesium, sodium, nitrate and phosphate is high during the winter and summer season as compared to Chandola lake, Chandlodia lake and Ghuma lake whereas turbidity, pH, alkalinity, total hardness, calcium, magnesium, chloride, nitrate and phosphate are less in Nikol lake.

Conclusion

Fluctuations in various physico-chemical parameters were observed during monsoon, winter and summer seasons. The study shows that the water of Sarkhej Roza lake exhibits high concentration of turbidity, total dissolved solids, alkalinity, total hardness, calcium and phosphate due to addition of detergents and soap by washing clothes surround the lake which directly released into the lake and also evaporation of water which make the water more concentrated during summer season. Other physico-chemical parameters were within desirable limits suggest by WHO [12]. The correlation coefficient indicates positive and negative correlation of physico-chemical parameters with each other. This study may be helpful in sustainable management of the lake.

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