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Research Paper

Comparative Review of Physicochemical Assessment of Katraj Lake, Pune

Science

KEYWORDS : katraj lake, Pune, physico-chemical parameter, water quality.

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ABSTRACT

Water is one of the most critical, scare precious and replenisable natural recourses which cannot be created. Ever increasing population, urbanization and modernization are posing problems of sewage disposal and contamination of surface waters like lakes. Hence, monitoring and conserving these important resources is essential. The present study attempts to bring an acute awareness among the people about the Katraj Lake by comparing various parameters such pH, COD, Cl, hardness, alkalinity, TDS and turbidity. In some of the parameters, it was found that there is continuous fluctuation in the water samples reading. There an increase in Cl and decrease in COD has been seen. For statistical analysis, value of mean, standard deviation and correlation were also calculated for the water quality characteristics.

1. Introduction

Water is the most important compound for the existence of human beings, animals and plants. It is the basic duty of every individual to conserve water resources (1). In order to protect the ecosystem, understanding of environmental changes is necessary. Ecological assessment helps us to conserve and manage natural resources. The physical and chemical parameters of water play a significant role in classifying and assessing water quality.

Water quality is based on the physical and chemical soluble constituents due to weathering of parent rocks and anthropogenic activities (2). Many investigations have been conducted on anthropogenic contaminants of ecosystems (3) and reported that drinking water quality is affected by the presence of different soluble salts (4).The physicochemical characteristics of water bodies have been studies by many researches from time to time (5). Ground Water is the main sources of water in many parts of India .The major problem with the ground water is that once contaminated; it is difficult to restore its quality. River and lake contributes major in ground water resources. Lakes serve as an important life support system by helping in recharging of aquifers and regulating hydrological regimes. It has becomes our prime responsibility to maintain the quality of water from such water samples from river and lakes that creates an excellent platform to the study of various Physico-chemical parameters of water namely pH, turbidity, TDS, alkalinity, hardness, phosphate content, Chemical oxygen demand (COD) and Sulphate Content (6).The present investigation reviews the physicochemical characteristics of Katraj Lake. Physicochemical data of at least three years has been studied and statistical analysis of data has been done such as standard deviation, value of mean and correlation coefficients.

2. Katraj Lake:

In 1750 Katraj Lake was built to arrange for water supply to Pune city. An earthen duct channelizes water to Pune city from the wall of Katraj Lake. This duct is about 0.75 meter wide and 2 meter high, Katraj Lake to Shaniwarwada, there are about 125 openings. At that time it is said that this water supply scheme was able to supply approx 29 lakhs liters of water per day. Katraj Lake is also a historic manmade lake situated at the bottom of hill ranges of Katraj ghat in south west part of the city which consist of intricate system of two lakes dams as canal. The water level of the lake is controlled by a unique Persian water control system. The entire system works under the action of gravity (7). Presently the lake from its three sides is covered by the zoo and snake Park. The Lake has natural inlets from different areas such as Gujar hills and suburbs. Presently it is utilized for pesiculture and recreational activities. (Figure 1)

In this present study, an attempt has been made to review and evaluate the quality of Katraj Lake water and thereby statistical analysis has been done with correlation coefficient of various physicochemical parameters. There exists strong correlations among different parameters and a combined effect of their interrelatedness indicates the water quality. Many researchers worked on the water statistical, correlation and regression technique. (8 to 17).

3. Literature Review:

Various research papers on water quality have been studied and reviewed. These papers are presented below:

S.D.Jadhav, D.G.Kanase, et al 2006 (19)has assessed the water quality of Katraj Lake at Pune, during the month of November and December 2006. The water samples were collected from two different sampling stations for the study. The analysis was carried out for the parameters like temperature, pH, dissolved oxygen (D.O.), Biochemical Oxygen Demand(B.O.D), Chemical Oxygen Demand(C.O.D), Chloride, Nitrate, Sulphate, Calcium and Magnesium. It was found that pH range (7.08 to 7.4), D.O. was varied from (5.3 to 6.5 mg/l). The BOD and COD values range from 9.9 to 10.2 mg/l. The calcium varied from 70 to 78 mg/l magnesium level varied from 76 to 79 mg/l. Hence by studying all the parameters it is found that the high value of COD and BOD and water quality of lake should be improved. Data is incorporated in the tabular study.

K.C.Khare and M.S.Jhadhav 2007,(7) have studied and asses the water quality of Katraj Lake Pune (Maharashtra,India). Table1, 2 and Graph 1&2. The research paper discusses about

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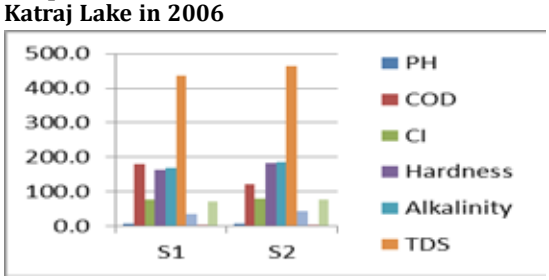
the analysis of the water quality and suggests the means to improve through eco remediation measures. Water quality analysis was done, for pre-monsoon and post monsoon season. The choice of sampling stations was influenced by the various uses of the water and their location, relative magnitude and importance. Lake sampling is normally carried out from a boat. Water analysis was done for the parameters like, pH, dissolved Oxygen(D.O.), Biochemical oxygen Demand (BOD), Chemical Oxygen Demand (COD), Total dissolved Solids(TDS), Chloride, Sulphate, Nitrate, Calcium, Magnesium and hardness for testing the suitability for drinking, agriculture purposes. The temperature of water was found to be in the range between 24°C to 28° C in the pre-monsoon (2006) and post-monsoon (2007) respectively. pH was recorded 7.3 to 8.45, dissolved Oxygen varied from 4.3 to 5.7 mg/l during the study biochemical Oxygen demand was recorded in the range 68 to 78 mg/l. The chloride ranged from 76.01 to 82.03 mg/l, total hardness ranged from 162.00 to 298.00 mg/l, total alkalinity ranged from 170.00 to 239.00 mg/l, total dissolved solid ranged from 390.00 to 465 mg/l, turbidity ranged from 28 to 42 NTU. It was concluded that surface water quality of the Katraj Lake is surely degraded due to the pollution from surrounding areas directly entering the waters.

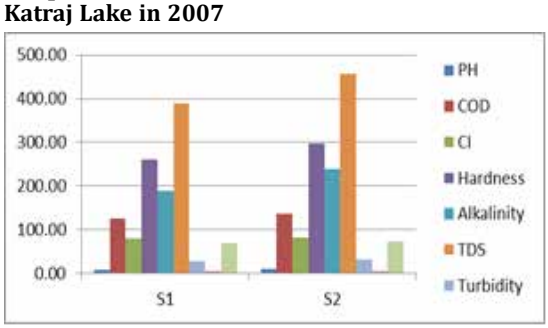
Table 1 Water Parameters values in 2006 of katraj lake and their statistical analysis data.

Katraj lake							
Year of monitoring	2006	2006	Mean	Median	Standard deviation	Minimum	Maximum
PH	7.3	7.1	7.2	7.2	0.1	7.1	7.3
COD	180.0	120.0	147.0	150.0	42.4	120.0	180.0
CI	76.0	80.0	78.0	78.0	2.8	76.0	80.0
Hardness	162.0	182.0	171.7	172.0	14.1	162.0	182.0
Alkalinity	170.0	186.0	177.8	178.0	11.3	170.0	186.0
TDS	435.0	465.0	449.7	450.0	21.2	435.0	465.0
Turbidity	36.0	42.0	38.9	39.0	4.2	36.0	42.0
D.O	5.4	4.3	4.8	4.9	0.8	4.3	5.4
BOD	70.0	78.0	73.9	74.0	5.7	70.0	78.0

Graph 1Comparation of various parameters of Katraj Lake in 2006



Graph21Comparation of various parameters of Katraj Lake in 2007



Nazneen J.Shaikh, Alim A. Sayed, Khan E.M.,2013(20) has studied the physicochemical parameters of Katraj lake water namely pH, turbidity, Total dissolved Solids(TDS), hardness, alkalinity, phosphate content, Chloride contents, Biochemical oxygen Demand (BOD), Chemical Oxygen Demand (COD), Sulphate content. Six samples have collected abbreviated symbols namely S1 to S6 are given between February 2011 to July 2011(Table3 and Graph3). pH values of water samples varied between 6.45 to 8.12, turbidity ranges between 6.32 NTU.

Table 2 Water Parameters values in 2007 of katraj Lake and their statistical analysis data.

Katraj lake								
Year of monitoring	units	2007	2007	Mean (2007)	Median	Standard deviation	Minimum	Maximum
PH	mg/l	8.45	9.05	8.7	8.75	0.424264	8.45	9.05
COD	mg/l	126	136	130.9	131.00	7.071068	126.00	136.00
CI	mg/l	79	82	80.6	80.66	2.326381	79.01	82.30
Hardness	mg/l	260	298	278.4	279.00	26.87006	260.00	298.00
Alkalinity	mg/l	189	239	212.5	214.00	35.35534	189.00	239.00
TDS	mg/l	390	456	421.7	423.00	46.66905	390.00	456.00
Turbidity	NTU	28	32	29.9	30.00	2.828427	28.00	32.00
D.O	mg/l	5.80	4.80	5.3	5.30	0.707107	4.80	5.80
BOD	mg/l	68	74	70.9	71.00	4.242641	68.00	74.00

Table 3 Water Parameters values in 2011 of katraj Lake and their statistical analysis data.

Katraj lake,2011							
Year of monitoring	units	2011	2011	2011	2011	2011	2011
		S1	S2	S3	S4	S5	S6
PH	mg/l	7.74	8.12	6.60	6.61	6.65	6.45
COD	mg/l	2.86	1.70	6.00	2.40	2.12	1.86
CI	mg/l	67.40	16.12	31.03	46.50	185.8	354.85
SO4	mg/l	82.26	246.90	197.40	189.2	164.5	246.78
Hardness	mg/l	46.80	62.34	47.10	56.40	103.4	94
Alkalinity	mg/l	310.00	260.00	230.00	220.00	160	200
TDS	mg/l	600.00	140.00	170.00	230.00	400	300
Turbidity	NTU	21.00	25.00	8.00	7.00	32	6

Table 4 Statistical Analysis.in 2011of katraj Lake

Katraj lake,2011				
Mean	Median	Standard deviation	Minimum	Maximum
7.0	6.6	0.7	6.5	8.1
2.6	2.3	1.6	1.7	6.0
68.5	57.0	131.4	16.1	354.9
177.0	193.3	61.2	82.3	246.9
65.0	59.4	24.4	46.8	103.4
225.2	225.0	51.4	160.0	310.0
270.8	265.0	171.5	140.0	600.0
13.3	14.5	11.0	6.0	32.0

TDS from 140-600mg/l, alkalinity, ranges from 160-310 mg/liters, hardness values from 46.8 to 103.4 mg/liters, phosphate ranges from 82.2 mg/l to 246.9 mg/liters, chloride16.124 mg/l to 354.85 mg/l, COD values between 1.7 to 2.86 mg/liters.It was concluded that water quality standard vary significantly due to different environmental conditions of ecosystem. And katraj natural inlets has increased turbidity, Chloride contents, Total dissolved Solids(TDS) increased due to effluents of nearby industries and other parameters phos-

phate and Chemical Oxygen Demand (COD) are in the limit of Indian and WHO standards.

Table 5 Comparative review of the data from 2006 to 2011.

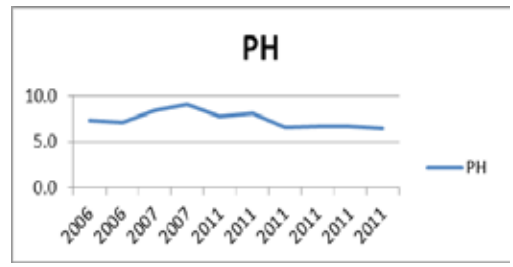
Katraj lake										
Year of monitoring	2006	2006	2007	2007	2011	2011	2011	2011	2011	2011
PH	7.3	7.1	8.5	9.1	7.7	8.1	6.6	6.6	6.7	6.5
COD	180.0	120.0	126.0	136.0	2.9	1.7	6.0	2.4	2.1	1.9
Cl	76.0	80.0	79.0	82.3	67.4	16.1	31.0	46.5	185.8	354.9
Hardness	162.0	182.0	260.0	298.0	46.8	62.3	47.1	56.4	103.4	94.0
Alkalinity	170.0	186.0	189.0	239.0	310.0	260.0	230.0	220.0	160.0	200.0
TDS	435.0	465.0	390.0	456.0	600.0	140.0	170.0	230.0	400.0	300.0
Turbidity	36.0	42.0	28.0	32.0	21.0	25.0	8.0	7.0	32.0	6.0
D.O	5.4	4.3	5.8	4.8						
BOD	70.0	78.0	68.0	74.0						

Table 6 Comparative review of the statistical analysis data with various standards from 2006 to 2011.

					ICMR		EU	WHO
					DL	MPL	STANDARDS	STANDARDS
MEAN	Median	Standard deviation	Minimum	Maximum				
7.4	7.2	0.9	6.5	9.1	7.0 - 8.5	6.5-9.2	≥6.5and ≤9.5	6.9-8.5
12.6	4.4	72.8	1.7	180.0	–	–	–	
72.6	77.5	99.8	16.1	354.9	200	1000	250	200-600
194.3	193.3	78.6	82.3	354.9				200-250
105.6	98.7	91.1	46.8	298.0				100-500
212.3	210.0	45.5	160.0	310.0				
327.5	395.0	145.7	140.0	600.0	500	1500 - 3000	–	500-1500
19.4	26.5	12.9	6.0	42.0	–			
5.0	5.1	0.7	4.3	5.8	–	–	–	
72.4	72.0	4.4	68.0	78.0	–	–	–	

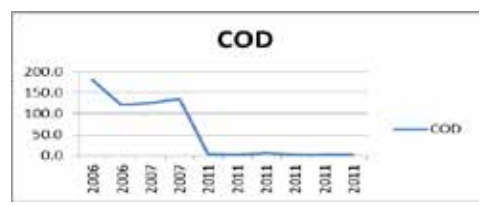
pH: pH is considered as an important ecological factor and provide an important piece of information in many types of geochemical equilibrium or solubility calculations (21), the pH value of drinking water is an important index of acidity or alkalinity. Generally, pH values of ground water are fluctuating in the range of 3 to 10 (22).pH values of water samples from 2006 to 2011 was analyzed by different researchers lies in the range of 6.5 to 9.1(Graph 4), it was noted highest 2007. Mean value is 7.4 and standard deviation 0.9. All the samples were in maximum permissible limit of pH suggested by ICMR and also well within the EU standards of pH.

Graph 4 pH Data



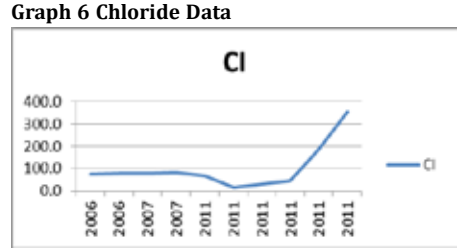
COD: COD values varied from 1.7 mg/l to 180 mg/l (Graph 5). The high values indicate that the lake water was rich with respect to untreated sewage and dissolved organic compounds. In 2006, COD values was highest 180mg/l and latter in 2011, the COD value almost reaches to minimum, means in course of time the lake water become clean by governmental measures.

Graph 5 COD Data



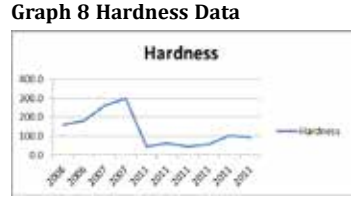
Chloride: Domestic sewage, agrochemicals and chlorine rich effluents can contribute for high chlorine content in water. Chloride content in the study samples lies between 16.1-354.9 mg/l (Graph 6). According to EU maximum permissible limit of 250 mg/l (24), high content of chloride is due to invasion of domestic waters and disposals by human activities. Maximum chloride content is found in 2011 samples. And it lies within MPL (ICMR) limit

Graph 6 Chloride Data



Hardness: Hardness of water samples lies in the range of 46.8 to 298.0 mg/l (Graph 8). Basically calcium, magnesium, barium strontium etc. are responsible for the total hardness of water. Hardness plays role in heart disease in human. Hardness above approximately 200 mg/l may causes scales in the pipes and distribution systems (25). If we see the graphs of total hardness, in 2007 the lake hardness was at higher level, later on the hardness of water decreases. The hardness is increase during monsoon period because of dissolution of rocks (26).

Graph 8 Hardness Data



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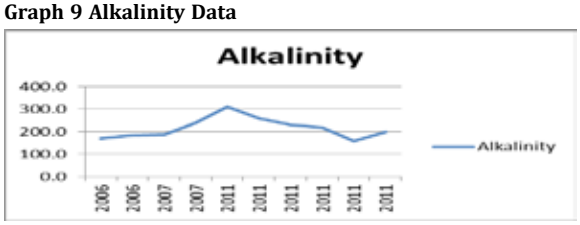
Alkalinity: The total alkalinity ranges from 160-310 mg/l. (Graph 9). The highest value of alkalinity was seen in 2011, the high value of alkalinity due to the large scale execration of human excreted directly into the lake. There is not much decrease is seen in the alkalinity from2006 to 2011.Excessive alkalinity may causes eye irritation in human and Chlorsis in plants (27).

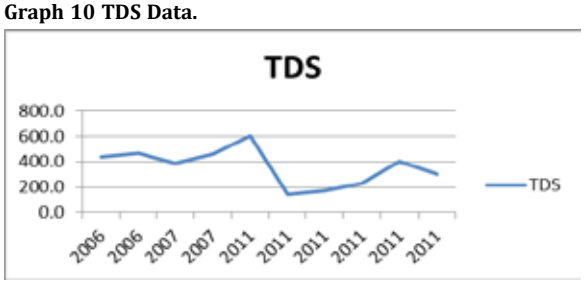
Graph 9 Alkalinity Data



TDS: The total dissolved solid ranged from 140.00 to 600 mg/l. (Graph 10) TDS is within permissible limit of WHO. This variation is because of a pollutant which comes along with the effluents of the nearly industries and inlets.

Turbidity: turbidity is a measure of murkiness of water. High value of turbidity indicates presence of many suspended particles in it. In all the samples from 2006-2011 the lake water contain high turbidity. The range of turbidity is 6.0 to 42.0 NTU means water is highly turbid.

Graph 10 TDS Data.



4. Conclusion: In the present investigation, an attempt has been made to assess water quality from 2006-2011 with reference to physicochemical parameters .In some of the parameters pH, Alkalinity, TDS, Turbidity there is continuous fluctuation in the water samples reading .But we can see the major increase in chloride in 2011. Due to domestic sewage, agrochemicals and chloride rich effluents can contribute for chlorine content in water.

And decrease in COD in 2011 means there is decrease in organic matter content of water samples. Some water samples may contain substances that are difficult to oxidize.

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