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Physico-Chemical Parameters Of Saroornagar Lake In Greater Hyderabad Telangana State, India.

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ABSTRACT
The present study is about analysis of physico-chemical parameters of Saroornagar lake Hyderabad, Telangana state. Limnological studies of Saroornagar lake greater Hyderabad Telangana state were studied and analyzed during the period of two years. Variations of parameters at three different stations of the lake were observed. The parameters such as temperature, pH, TDS, Turbidity, Organic matter, Total Hardness, Calcium Hardness, Magnesium, Nitrites, Nitrates, Silicates, Sulphates, Phosphates, Chlorides, BOD, Chlorides, DO, Total solids, Suspended solids and Dissolved solids etc., of lake water were estimated. The water samples were collected from selected from selected stations and was analyzed in laboratory with using standard methods prescribed by APHA. The results indicate the most of the parameters were within the limit given by WHO, but only few parameters are not in the range. Physico-chemical parameters analysis of the lake water showed seasonal variations throughout during the study period.

KEY WORDS:- Physiological studies,Physico-chemical parameters, Saroornagar lake.

INTRODUCTION:-
Water is a miracle liquid and much more than just a human basic need. It is an essential, irreplaceable element to ensuring the continuance of life. It is a tasteless odorless liquid at standard temperature and pressure. In typical usage water refers only to its liquid form or state, but the substance also has a solid state, ice and a gaseous state water vapour or steam. Water on earth moves continually through a cycle of evaporation or transpiration, precipitation and runoff, usually reaching the sea. The hydrologic cycle refers to the continuous movement of water between the ocean, atmosphere and the land by evapo-transpiration, precipitation and run off.

Water has many distinct properties that are critical for the proliferation of life. All known forms of life depend on water. Water is vital both as a solvent in which many of the body's solutes dissolve and as an essential part of many metabolic processes within the body. Water is central to photosynthesis and respiration. It is central to acid-base neutrality and enzyme function. Water is used in agriculture for irrigation, which is a key component to produce enough food. Water is widely used in chemical reactions as a solvent or reactant and less commonly as a solute or catalyst. It is used in power generation. It is also used in many industrial processes and machines such as the steam turbine and heat exchanger.
Many lakes were formed as a result of glacial action during the Pleistocene ice sheets. In some areas as exemplified by the Great Lakes, basins were carved into bedrock by the erosive action of the advancing ice mass. Lake basins are also formed by glacial moraine deposits that dam pre existing stream valleys. Lakes also form in Calderas created by the collapse of volcanic craters. Tectonic activity in the earth's crust forms lake basins in many ways.
Lakes are transient features on the earth's surface and generally disappear in a relatively short period of geologic time by a combination of process (e.g., erosion of an outlet or climatic changes that bring drier conditions). In a process called eutrophication, a lake gradually fills with organic and inorganic sediment, becoming a swamp or bog, and eventually a meadow. (Sayyed J, A. And Bhosle, A.B., 2010, Ogbonna O., Jimoh W.L., Awagu E.F., and Bamishaiye E.I., 2011). Human activity has greatly increased the rates of eutrophication; urban and suburban land construction activities result in increased discharge of soil debris into streams draining into lakes, filling them (UNEP,1996 and Dhake R,B., Phalak R,P., Waghulde G.P.,2008).
Recent studies in this field includes Devashish Kar (2001) on Lake Sone: the biggest wetland in Assam, Somani (2002) on Kachrali and Masunda lakes of Thane city, on the ecosystems and biodiversity of Lonar crater by Jha Mohan (2003), on Papnas: a minor wetland in Tuljapur of Maharashtra by Sakhre and Joshi (2003), Sharma and Sarang (2004) on physicochemical limnology and productivity of Jaisamand lake in Udaipur of Rajasthan, Raja Lakshmi and Sreelatha (2005) on river Goutami- Godavari in Yanam of Pondicherry , Dey and Hazra (2005) on fresh water bodies of Orissa, Sulabha and Prakasham (2006) Limnological features of Thirumullavaram temple pond of Kollam municipality, Kerala., Sunil Kumar et al. (2006) on water quality Tunga of Karnataka, Hydrobiological studies by Banakar (2006) on some selected fresh water bodies of Chitradurga and its surrounding areas of Karnataka, Sanjib Kumar Das and Debajyoti Chakrabarty (2007) on the limnology of three tropical water reservoirs in eastern India,

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Suresh (2007) on some selected fresh water bodies of Chitradurga and Davangere District of Karnataka and Basavaraja (2008) on water quality characteristics of Anjanapura reservoir near Shikaripur in Shimoga District of Karnataka.
Physico chemical factors are very important to study the ecology of lakes. The main objective of the physico-chemical analysis of water is to determine the nutrient status of the lake.(Purushottam J., *et al.*, 2010) Their importance in several groups of algae has been shown by Zafar (1964a). The importance of ions in the distribution and periodicity of diatoms has been shown by Pearsall (1932).By evaluating the physico-chemical and biological characteristics of the habitat, the concentration of water pollution can be assessed. It gives an idea to plan suitable measures for adverse impact on the water bodies due to human intervention (Janardhan, 1982).
The various physical determinants are light temperature, turbidity etc. The chemical factors include the ionic composition, alkalinity, dissolved gases, dissolved organic substances etc. (Trainor,F.R., 1984). The ionic composition of lakes results from the weathering of rocks and materials in the basin. The ions, which are involved in algal nutrition, include nitrates, phosphates, sulphates and silicates. Nitrates and phosphates show great relation to algal growth. Silicates are useful for only one group of algae such as diatoms. The alkalinity is due to carbonates, bicarbonates and pH, constituting buffer system. Most of the fresh waters are slightly alkaline or alkaline in nature. The dissolved gases of oxygen and carbondioxide are the significant factors responsible for the water quality. The dissolved organic substances includes a certain amount of organic debris, some colloidal substances etc.

MATERIAL AND METHODS:-
Study Area:- Hyderabad city, the capital of Telangana, is located in central of it and extends over an area of 260 sq. km. The city lies in the Deccan Plateau and rises to an average height of 540 m above the sea level. The city is situated in 17^0 22' North latitude and 78^0 27' East longitudes on the banks of the river Moosi with an elevation of 536 m above mean sea level. Hyderabad has typically a hot climate with the temperature exceeding 40^0 C in the summer. Winters are however, mild and more tolerable. The maximum temperatures in summers are between 40^0 C and 43^0 C. Winter temperatures range from 14^0 C to 22^0C. The monsoon period (July to September) is warm, humid and registers rainfall of about 89 cms per annum. Hyderabad is blessed with unique landscape – spectacular rock formations, which are about 2,500 millions years old. Granite ridges and hillocks weathered into picturesque balancing forms are a part of the Deccan shield area. The city's soil type is mainly red sandy with areas of black cotton soil.
Hyderabad is famous for its shimmering lakes, there were nearly 400 beautiful water bodies in and around Hyderabad. Hyderabad has a glorious tradition of tanks built by its ruling dynasties. It owes its many lakes that stored and supplied water for drinking and irrigation to its citizens. The first source of water supply to the city was the Hussain sagar Lake, built in 1562 on the tributary of Musi. Later on Osmansagar, Himayatsagar, Mir Alam tank Durgam cheruvu, Saroornagar Lake were built.
Saroornagar Lake was constructed in late 16^{th} century during the reign of Quli Qutub Shah to provide water for irrigation to farm lands. It is located to the west of Saroornagar. It is situated at latitude of 17^0 -27'-24" and longitude of 78^0 -31' -45". The extent of water spread is about 64.02 acres. The lake has two inlet drains; one is from north side and one from east side of the lake. It is a shallow lake and the maximum depth does not exceed 3m. Scientifically speaking the lake has great aqua cultural, Ecological and Recreational potential but at the same time there is a tremendous pressure on the water body due to high land value and pollution from urbanisation. The lake basin is composed of muddy and sandy deposits and the algal blooms impart light green color to water and the lake water is much disturbed by anthropoid activities which include washing cattle, washing clothes, using detergents and cleaning of vehicles etc.
The lake is surrounded by residential colonies on all sides. It is one major water bodies lying on the outskirts of Hyderabad. It is situated to the east of the city. The lake originally occupied about 180 acres of land. However, with the onset of modern life and the subsequent pumping of sewage and waste into the lake, the submergence area has been reduced to 63 acres. To deal with this problem, the Hyderabad Urban Development Authority launched a major conservation project in 1993 to revive and beautify the lake. Under this project numerous sewage processing plants have been set up. STP of 2.5 Mld capacity is established here and it is functioning successfully since January, 2003. Three sampling stations have been identified.

Collection of water samples and their analysis
Water samples from surface were collected at all the sampling sites of the lake in polythene cans at monthly intervals for a period of two years (from May 2006 to April 2008). Water samples were collected in separate standard glass bottles for the determination of dissolved oxygen with necessary precautions. After returning to the laboratory, the samples were analysed on the same day for the various physico-chemical parameters.
The following are the standard methods employed in the analysis of the samples: the chemical analysis methods developed by the scientists are in parenthesis as given by APHA year books and names. The temperatures of the samples were recorded with the help of centigrade thermometer in the field itself. pH was recorded in the lab with a digital pH meter. Turbidity of water measured in the lab using digital nephelo turbidity meter. Carbonates, Bicarbonates, Chlorides were estimated by titrimetric method recommended by Wilcox and Hatcher (1950).

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Total hardness, Calcium hardness, Magnesium hardness, Sulphates, Phosphates, Nitrates, Silicates, Total Dissolved solids, COD and BOD estimated by the method recommended by APHA (2005). Dissolved oxygen estimated by D.O. meter and checked in the lab by Winkler's modified method (Mackereth, F.J.H., 1957).

Fig 1: SAROORNAGAR LAKE SATELLITE VIEW

Fig 2: SAROORNAGAR LAKE STATION - I

Fig 3: SAROORNAGAR LAKE STATION – II

Fig 4: SAROORNAGAR LAKE STATION – III

RESULT AND DISCUSSIONS:-

The physico chemical parameters were analysed from the lake water from different selected stations at monthly intervals. The physico chemical parameters are described in detail in ranges from lower to higher and yearly averages. In the description the summer months are from February to May, monsoon months are from June to September and winter months are from October to January. The results of various physico– chemical variables are incorporated as follows (Table-21-23).

1. Air &Water Temperature: The air temperature of Saroornagar lake at station I ranged from 27 ^{0}C – 41 ^{0}C with an average of 32.67 ^{0}C, at station II it ranged from 28 ^{0}C – 41 ^{0}C with an average of 33.42 ^{0}C and at station III it ranged from 28 ^{0}C – 42 ^{0}C with an average of 33.96 ^{0}C. The water temperature of Saroornagar lake at station ranged between 22 ^{0}C – 34 ^{0}C with an average of 28.3 ^{0}C, at station II it ranged between 21 ^{0}C – 37 ^{0}C with an average of 28.3 ^{0}C and at station III it ranged between 22 ^{0}C – 37 ^{0}C with an average of 27.8 ^{0}C (Garg, R.K.. *et al.*,2009 and Jain, R., 2008).

Table 1: Atmospheric Temperature (^{0}C) & Water Temperature (^{0}C)- Range, Seasonal Average and Average.

Lake	**Range**	**Seasonal Average**			**Average**
Saroornagar lake		Summer	Monsoon	Winter	
Atm. Temp.	27 - 42.0	36.34	30.41	29.44	32.1
Water Temp.	22.6 – 32.8	29.54	27.73	24.44	27.2

2. pH: In the present study, pH value of Saroornagar lake at station I ranged between 7.8 - 8.5 with an average of 8.2, at station II it ranged between 8.0 - 8.5 with an average of 8.3 and at station III it ranged between 8.1- 8.6 with an average of 8.3. (Naga Sameera,2019, Anuradha, 2021)

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Table 2: pH– Range, Seasonal average and Average

Lake	Range	Seasonal Average			Average
		Summer	Monsoon	Winter	
Saroornagar lake	7.8 - 8.6	8.4	8.2	8.3	8.3

3. Dissolved Oxygen: Dissolved oxygen was present at all the stations of the two lakes. In Saroornagar lake at station I it ranged between 3.0 -12.0 mg/l with an average of 5.97 mg/l, at station II it ranged between 2.0– 9.0 mg/l with an average of 5.98 mg/l and at station III it ranged between 1.16– 10.0 mg/l with an average of 5.44 mg/l.

Table 3: Dissolved oxygen (mg/l) – Range, Seasonal average and Average

Lake	Range	Seasonal Average			Average
		Summer	Monsoon	Winter	
Saroornagar lake	1.16 - 13.00	6.44	5.27	5.67	5.79

4. Organic Matter:- The values of organic matter in Saroornagar lake at station I ranged between 20– 35.4 mg/l with an average of 30.06 mg/l, at station II ranged between 24– 37 mg/l with an average of 29.91 mg/l and at station III it ranged between 23– 36.3 mg/l with an average of 29.80 mg/l. They were maximum during summer season (31.19 mg/l).

Table 4: Organic Matter (mg/l) –Range, Seasonal average and Average

Lake	Range	Seasonal Average			Average
		Summer	Monsoon	Winter	
Saroornagar lake	20 – 37	31.19	29.29	29.42	29.97

5. Carbonates:- The values of carbonates of Saroornagar lake at station I ranged between 0 – 90 mg/l with an average of 10.50 mg/l, at station II it ranged between 0 – 96 mg/l with an average of 14 mg/l and at station III it ranged between 0 -108 mg/l with an average of 23.25 mg/l.

Table 5: Carbonates (mg/l) –Range, Seasonal average and Average

Lake	Range	Seasonal Average			Average
Saroornagar lake	0 - 108	19.00	9.5	16.25	

6. Bicarbonates:- Bicarbonates were recorded in higher proportions at all the stations of the lakes investigated. Their concentration in Saroornagar lake at station I was found to be in the range of 354 – 702 mg/l and the average being 577 mg/l, at station II 336 – 793 mg/l and the average being 565 mg/l at station II and at station III it is found to be in the range of 336 -854 mg/l and the average being 579 mg/l (Srinivas, M., *et al.,* (2018).

Table 6: Bicarbonates (mg/l) -Range, Seasonal average and Average

Lake	Range	Seasonal Average			Average
		Summer	Monsoon	Winter	
Saroornagar lake	336 – 854	637	540	545	574

7. Chlorides:- The concentration of chlorides in Saroornagar lake at station I ranged between 269.8 – 411 mg/l (average = 334 mg/l), at station II it ranged between 255.6 – 397.6 mg/l (average = 335.18 mg/l) and at station III it ranged between 269.8 – 387.6 mg/l (average = 339.47 mg/l).(Ramakrishna *et al* ., 2005 and Srinivas,D., *et al.,* 2021)

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http://www.veterinaria.org
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Table 7: Chlorides (mg/l) –Range, Seasonal average and Average

Lake	Range	Seasonal Average			Average
		Summer	Monsoon	Winter	
Saroornagar lake	255.6 – 411	355.48	331.9	321.15	336.18

8. Total Hardness:- The values of total hardness of Saroornagar lake at station I ranged from 442 – 610 mg/l (average = 522 mg/l), at station II it ranged between 424 – 600 mg/l (average = 518 mg/l) and at station III it ranged between 386 - 580 mg/l (average = 509 mg/l).

Table 8: Total Hardness (mg/l) –Range, Seasonal average and Average

Lake	Range	Seasonal Average			Average
		Summer	Monsoon	Winter	
Saroornagar lake	386 – 610	533	485	531	516

9. Calcium:- Calcium content in Saroornagar Lake at station I fluctuated between 28.05 – 144.28 mg/l with an average of 83.56 mg/l, at station II it fluctuated between 24.04 – 140.28 mg/l with an average of 80.32 mg/l and at station III it fluctuated between 16.03 – 120.24 mg/l with an average of 70.27 mg/l.

Table 9: Calcium (mg/l) - Range, Seasonal average and Average

Lake	Range	Seasonal Average			Average
		Summer	Monsoon	Winter	
Saroornagar lake	16.03 - 144.28	81.46	68.87	83.83	78.05

10. Magnesium:- The values of magnesium in Saroornagar lake at station I oscillated between 79.96 – 130.47 mg/l with an average of 107.11 mg/l, at station II it oscillated between 71.18 – 121.98 mg/l with an average of 106.91 mg/l and at station III it oscillated between 69.23 – 128.33 mg/l with an average of 107.04 mg/l.

Table 10: Magnesium (mg/l) –Range, Seasonal average and Average

Lake	Range	Seasonal Average			Average
		Summer	Monsoon	Winter	
Saroornagar lake	69.23 - 130.47	110.37	101.53	109.16	107.02

11. Silicates:- The values of silicates in Saroornagar Lake at station I oscillated between 0.16 – 1.32 mg/l with an average of 0.41 mg/l, at station II it oscillated between 0.12 – 1.13 mg/l with an average of 0.39 mg/l and at station III it oscillated between 0.1 – 1.5 mg/l with an average of 0.38 mg/l.

Table 11: Silicates (mg/l) –Range, Seasonal average and Average

Lake	Range	Seasonal Average			Average
		Summer	Monsoon	Winter	
Saroornagar lake	0.1 - 1.5	0.49	0.45	0.25	0.40

12. Phosphates.:- The concentration of phosphates was found to be in the range of 0.10 – 1.79 mg/l at all the stations of Saroornagar lake. At station I it ranged between 0.1 – 1.30 mg/l (average = 0.40 mg/l), at station II it ranged between 0.12 – 1.79 mg/l (average = 0.41 mg/l) and at station III it ranged between 0.16 – 0.96 mg/l (average = 0.39 mg/l).

Table 12: Phosphates (mg/l) –Range, Seasonal average and Average

Lake	Range	Seasonal Average			Average
		Summer	Monsoon	Winter	
Saroornagar lake	0.10 - 1.79	0.20	0.44	0.33	0.32

13. Sulphates:- The values of sulphates in Saroornagar lake at station I was found to be in the range of 50 – 180 mg/l with an average of 96.50 mg/l, at station II it was found to be in the range of 50 – 175 mg/l with an average of 91.79 mg/l and at station III it was found to be in the range of 55 - 145 mg/l with an average of 92.29 mg/l.

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http://www.veterinaria.org
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Table 13: Sulphates (mg/l) –Range, Seasonal average and Average

Lake	Range	Seasonal Average			Average
		Summer	Monsoon	Winter	
Saroornagar lake	50 -180	33.33	68.25	77.63	93.07

14. Nitrates:- Nitrates content at station I was found to be in the range of 0.15 – 0.34 mg/l (average = 0.22 mg/l), at station II it was found to be in the range of 0.13 – 0.37 mg/l (average = 0.21 mg/l) and at station III it was found to be in the range of 0.1 – 0.4 mg/l (average = 0.21 mg/l).

Table 14: Nitrates (mg/l) –Range, Seasonal average and Average

Lake	Range	Seasonal Average			Average
		Summer	Monsoon	Winter	
Saroornagar lake	0.1 - 0.4	0.25	0.19	0.21	0.22

15. Nitrites:- The content of nitrites in Saroornagar lake was found to be in the range of 0.11 – 1.76 mg/l with an average of 0.79 mg/l at station I, 0.13 – 1.77 mg/l with an average of 0.69 mg/l at station II and 0.14 – 1.99 mg/l with an average of 0.60 mg/l at station III.

Table 15: Nitrites (mg/l) –Range, Seasonal average and Average

Lake	Range	Seasonal Average			Average
		Summer	Monsoon	Winter	
Saroornagar lake	0.11 - 1.99	0.93	0.60	0.57	0.70

16. Total Solids:- The values of total solids in Saroornagar lake at station I range between 873 – 1347 mg/l (average = 1164 mg/l), at station II it range between 988 – 1527 mg/l (average = 1213 mg/l) and at station III it range between 878 – 1614 mg/l (average = 1207 mg/l). The maximum values were recorded during rainy season and minimum during winter season.

Table 16: Total Solids (mg/l) –Range, Seasonal average and Average

Lake	Range	Seasonal Average			Average
		Summer	Monsoon	Winter	
Saroornagar lake	873 – 1614	1195	1280	1108	1194

17. Total Suspended Solids:- The values of total suspended solids in Saroornagar lake at station I ranged between 28 – 125 mg/l with an average 59 mg/l, at station II it ranged between 27 – 117 mg/l with an average of 55 mg/l and at station III it ranged between 23 – 130 mg/l with an average of 57 mg/l.

Table 17: Total Suspended Solids (mg/l) –Range, Seasonal average and Average

Lake	Range	Seasonal Average			Average
		Summer	Monsoon	Winter	
Saroornagar lake	23 – 130	59	62	50	57

18. Total Dissolved Solids:- The values of total dissolved solids in Saroornagar lake at station I oscillated between 840 – 1249 mg/l (average = 1104 mg/l), at station II it oscillated between 912 – 1311 mg/l (average =1159 mg/l) and at station III it oscillated between 855 – 1274 mg/l (average =1132 mg/l).

Table 18: Total Dissolved Solids (mg/l) –Range, Seasonal average and Average

Lake	Range	Seasonal Average			Average
		Summer	Monsoon	Winter	
Saroornagar lake	840 – 1311	1142	1196	1057	1132

19. Biological Oxygen Demand:- The biological oxygen demand in Saroornagar lake ranged between 10 -20 mg/l (average =15.33 mg/l) at station I, 28 – 49 mg/l (average = 35.96 mg/l) at station II and 17 – 32 mg/l (average = 25.38

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Vol 25, No.1 (2024)
http://www.veterinaria.org
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mg/l) at station III. During the summer lowest values of dissolved oxygen may be due to high temperature and low solubility of oxygen in water consequently affecting the BOD. Further, the dissolved oxygen content of water was low in summer because of its enhanced utilization by microorganisms in the decomposition of organic matter (Naik *et al.*,2012)

Table 19: Biological Oxygen Demand (mg/l) –Range, Seasonal average and Average

Lake	**Range**	**Seasonal Average**			**Average**
		Summer	Monsoon	Winter	
Saroornagar lake	10.0 - 49.0	26.6	25.7	24.4	25.6

20. Chemical Oxygen Demand:- In Saroornagar lake it ranged between 38 – 124 mg/l with an average of 74.8 mg/l at station I, 96 – 157 mg/l with an average of 134.1 mg/l at station II and 74 – 124 mg/l
with an average of 104.5 mg/l at station III.

Table 20: Chemical Oxygen Demand (mg/l) –Range, Seasonal average and Average

Lake	**Range**	**Seasonal Average**			**Average**
		Summer	Monsoon	Winter	
Saroornagar lake	38 – 157	110.5	106.4	96.5	104.5

TABLE – 21 COMPARISONS OF THE PRESENT DATA WITH ISI AND WHO STANDARDS. (Expressed in mg/l except pH)

Parameters	Saroornagar lake			ISI	WHO
	I	II	III		
pH	7.9	8.2	8.1	6.5 - 8.5	7.0 - 8.5
Cl	334	335	339	-	200
D.O.	6.0	6.0	5.4	6.0	3.0
T.H	523	518	509	300	100
Ca	84	80	70	200.0	75.0
Mg	107	107	107	100.6	30 – 150
PO_4	0.16	0.32	0.35	-	-
NO_3	0.22	0.21	0.21	20.0	10.0
T.S.	1164	1214	1207	500	-

REDVET - Revista electrónica de Veterinaria - ISSN 1695-7504
Vol 25, No.1 (2024)
http://www.veterinaria.org
Article Received: 10/05/2024 Revised: 22/05/2024 Accepted: 03/06/2024

Table-21

PHYSICO-CHEMICAL PARAMETERS

SAROOR NAGAR LAKE STATION – 1

Month & Year	A. T	W. T	pH	D.O.	O.M.	CO_3	HCO_3^-	Cl^-	T.H.	Ca^{2+}	Mg^{2+}	SiO_2	PO_4^{3-}	SO_4^{2-}	NO_3^{2-}	NO_2^-	T.S	S.S	D.S.	BOD	COD
May'06	40	32	8.5	4	32	0	683.2	383.4	442	60.12	93.17	1.32	0.12	180	0.19	1.39	1210	125	1085	20	89
Jun'06	33	31	8.3	13	35.4	0	646.6	369.2	570	35.27	130.47	0.422	0.13	90	0.26	0.53	1250	65	1185	18	98
Jul'06	30	27	7.8	6	27	0	488	326.6	500	64.12	106.35	0.66	0.67	65	0.2	0.36	1300	62	1238	18	96
Aug'06	32	26	8.2	6	28	0	427	269.8	480	40.08	107.34	0.67	0.69	75	0.17	0.26	1280	64	1216	10	40
Sep'06	32	29	7.9	4	32	0	549	284	480	60.12	102.45	0.71	0.12	85	0.21	0.29	1200	38	1162	11	47
Oct'06	30	27	8.3	2.4	27	60	353.8	298.2	520	116.23	98.51	0.35	0.28	70	0.2	1.48	873	33	840	14	58
Nov'06	29	27	8.2	4.4	29	0	610	333.7	530	32.06	121.49	0.26	0.23	65	0.25	0.3	878	30	848	14	64
Dec'06	28	24	8.5	3	31	0	671	326.6	560	76.15	118.05	0.31	0.25	60	0.24	0.3	1211	112	1099	14	65
Jan'07	30	26	8.4	10.5	29.5	0	549	355	480	28.05	110.27	0.29	0.25	96	0.34	0.56	1284	65	1219	18	98
Feb'07	32	28	8.3	12	30.5	90	427	333.7	550	90.58	112.09	0.3	0.23	100	0.28	0.29	1242	59	1183	17	96
Mar'07	35	32	8.5	6	27	0	671	355	530	104.2	103.8	0.4	0.23	165	0.27	0.38	1312	78	1234	16	81
Apr'07	40	33	8.3	3	32	0	701.5	369.2	520	64.12	111.23	1.18	0.25	180	0.29	1.76	1327	82	1245	24	124
1st year Average	**32.58**	**28.50**	**8.27**	**6.19**	**30.03**	**12.50**	**564.76**	**333.70**	**513.50**	**64.26**	**109.60**	**0.57**	**0.00**	**102.58**	**0.24**	**0.66**	**1197.25**	**67.75**	**1129.50**	**16.17**	**79.67**
May'07	39	34	8.5	8	35	0	671	383.4	580	80.16	121.96	0.37	0.26	170	0.27	1.48	1273	63	1210	20	98
Jun'07	33	30	8.2	5	31	12	518.5	411.8	530	104.2	103.89	0.51	0.58	65	0.17	0.71	1347	98	1249	20	104
Jul'07	31	29	8.4	3	30	60	549	397.6	520	72.14	109.27	0.5	0.17	60	0.17	0.69	1150	40	1110	16	88
Aug'07	32	29	7.8	7	25	0	640.5	312.4	460	132.26	79.96	0.16	0.17	55	0.21	1.07	1210	108	1102	11	48
Sep'07	33	28	7.9	4	32	0	549	298.2	460	96.19	88.76	0.16	0.43	60	0.16	0.92	1250	64	1186	13	56
Oct'07	30	27	8.4	5	20	0	579.5	291.1	480	84.16	96.58	0.16	0.64	50	0.19	0.66	1120	40	1080	14	63
Nov'07	31	28	8.3	4.8	33	0	579.5	319.5	530	144.28	94.11	0.24	0.57	80	0.18	0.9	978	35	943	14	68
Dec'07	27	22	8.1	6	32	30	366	312.4	560	136.27	103.39	0.18	0.3	90	0.18	0.63	1100	39	1061	12	55
Jan'08	29	23	8.2	7	30	0	670	333.7	530	84.16	108.78	0.17	0.32	90	0.17	0.11	1158	44	1114	11	47
Feb'08	32	25	8.3	6.2	31	0	640.5	298.2	540	60.12	117.09	0.2	0.13	85	0.15	1.17	1071	33	1038	10	38
Mar'o8	36	30	8.2	8.6	28	0	640.5	312.4	610	120.24	119.5	0.18	0.1	130	0.3	1.1	943	28	915	18	98
Apr'08	40	34	8.4	4.4	34	0	670	340.8	580	120.24	112.18	0.2	0.15	150	0.26	1.7	970	30	940	15	76
2nd year Average	**32.75**	**28.25**	**8.23**	**5.75**	**30.08**	**8.50**	**589.50**	**334.29**	**531.67**	**102.87**	**104.62**	**0.25**	**0.32**	**90.42**	**0.20**	**0.93**	**1130.83**	**51.83**	**1079.00**	**14.50**	**69.92**
Average	**32.66**	**28.38**	**8.25**	**5.97**	**30.03**	**10.50**	**577.13**	**334.00**	**522.58**	**83.56**	**107.11**	**0.41**	**0.16**	**96.50**	**0.22**	**0.79**	**1164.04**	**59.79**	**1104.25**	**15.33**	**74.79**

A.T : Air Temperature ; W.T : Water Temperature, D.O. Dissolved Oxygen; O.M: Organic Matter; CO_3: Carbonates, HCO_3 : Bicarbonates, Cl^-: Chlorides, T.H: Total hardness; Ca^{2+}: Calcium; Mg^{2+} : Magnesium, SiO_2: Silicates; PO_4^{3-}: Phosphates; SO_4^{2-}: Sulphates; NO_3^{2-} : Nitrates; NO^{2-} : Nitrites , T.S.: Total Solids, S.S. Suspended Solids; D.S. DissolvedSolids; BOD: Biological Oxygen Demand; COD: Chemical Oxygen Demand

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TABLE -22

PHYSICO-CHEMICAL PARAMETERS

SAROOR NAGAR LAKE STATION – 2

Month & Year	A. T	W. T	pH	D.O.	O.M.	CO_3	HCO_3^-	Cl^-	T.H.	Ca^{2+}	Mg^{2+}	SiO_2	PO_4^{3-}	SO_4^{2-}	NO_3^{2-}	NO_2^-	T.S	S.S	D.S.	BOD	COD
May'06	41	37	8.5	3	30	0	658.8	383.5	424	36.87	94.45	1.13	0.13	125	0.13	1.77	1000	88	912	28	140
Jun'06	38	27	8.4	4	32.8	0	640.5	355	500	35.27	113.39	0.43	0.15	90	0.37	0.43	1216	96	1120	33	128
Jul'06	33	26	8.4	8	28	0	549	312.4	540	40.08	121.98	0.81	0.62	68	0.18	0.47	1200	48	1152	42	157
Aug'06	31	29	8.3	8	25	0	488	255.6	460	24.04	106.37	0.69	0.76	60	0.18	0.5	1260	58	1202	39	144
Sep'06	30	27	8.2	3	30.5	0	549	298.2	440	60.12	92.69	0.66	0.12	55	0.18	0.6	1180	47	1133	31	110
Oct'06	31	28	8.1	2	28	72	396.5	305.3	500	84.16	101.46	0.41	0.22	50	0.18	1.61	988	33	955	37	134
Nov'06	30	26	8.3	8	26	0	610	333.7	530	36.07	120.5	0.32	0.21	60	0.25	0.3	1165	117	1048	29	110
Dec'06	29	24	8.4	7	25	0	610	319.5	580	88.17	120	0.28	0.24	65	0.26	0.35	1260	48	1212	32	98
Jan'07	28	25	8.5	4	26	0	518.5	355	520	64.12	111.23	0.28	0.21	110	0.25	0.37	1129	33	1096	37	123
Feb'07	30	28	8.0	6	25	60	427	355	560	80.16	117.08	0.29	0.24	130	0.3	0.29	1290	61	1229	28	96
Mar'07	35	31	8.1	6	28	96	427	369.2	570	100.2	114.63	0.35	0.24	160	0.28	0.3	1307	60	1247	39	128
Apr'07	39	35	8.3	3	33	0	671	397.6	500	64.12	106.35	0.95	0.33	175	0.28	0.35	1264	33	1273	49	168
1st year Average	**32.92**	**28.58**	**8.29**	**5.17**	**28.11**	**19.00**	**545.44**	**336.67**	**510.33**	**59.45**	**110.01**	**0.55**	**0.29**	**95.67**	**0.24**	**0.61**	**1188.25**	**60.17**	**1131.58**	**35.33**	**128.00**
May'07	41	36	8.5	9	37	0	610	397.6	600	104.2	120.97	0.41	0.22	120	0.33	0.96	1278	55	1223	38	136
Jun'07	36	30	8.4	4	30	30	518.5	397.6	490	72.14	101.95	0.43	0.31	55	0.14	0.67	1378	67	1311	34	138
Jul'07	35	29	8.4	6	28	60	488	383.4	500	52.14	109.28	0.45	0.26	60	0.15	0.66	1325	58	1267	42	155
Aug'07	32	27	8.3	7	24	0	683.2	312.4	420	128.25	71.18	0.12	0.15	65	0.3	0.95	1300	52	1248	38	145
Sep'07	33	28	8.5	3	30	0	518.5	312.4	440	92.18	84.86	0.15	0.85	80	0.14	0.81	1250	42	1208	39	149
Oct'07	30	28	8.4	6	33	0	579.5	305.3	530	140.28	95.09	0.15	0.65	50	0.18	0.69	1120	35	1085	45	159
Nov'07	31	26	8.2	8	35.5	0	549	305.3	500	112.22	94.61	0.12	0.63	85	0.16	0.7	1020	27	993	31	116
Dec'07	30	23	8.3	7	35	18	335.5	326.6	540	140.28	97.53	0.17	0.29	85	0.15	0.65	1200	45	1155	34	135
Jan'08	29	21	8.5	7.5	31	0	640.5	312.4	580	92.18	119.02	0.19	0.3	90	0.16	0.13	1131	75	1056	37	140
Feb'08	33	26	8.4	7	32	0	670	340.8	560	48.09	124.9	0.18	0.17	85	0.147	0.73	1096	44	1052	29	144
Mar'08	36	31	8.5	9	30	0	793	326.6	560	128.25	105.34	0.27	0.2	135	0.21	0.64	1242	51	1191	37	135
Apr'08	41	33	8.4	8	35	0	640.5	284	600	104.2	120.97	0.18	0.13	145	0.25	1.7	1527	61	1466	35	130
2nd Year Average	**33.92**	**28.17**	**8.40**	**6.79**	**31.71**	**9.00**	**585.52**	**333.70**	**526.67**	**101.20**	**103.81**	**0.24**	**0.35**	**87.92**	**0.19**	**0.77**	**1238.92**	**51.00**	**1187.92**	**36.58**	**140.17**
2 Years Average	**33.42**	**28.38**	**8.35**	**5.98**	**29.91**	**14.00**	**565.48**	**335.18**	**518.50**	**80.32**	**106.91**	**0.39**	**0.32**	**91.79**	**0.21**	**0.69**	**1213.58**	**55.58**	**1159.75**	**35.96**	**134.08**

A.T : Air Temperature ; W.T : Water Temperature, D.O. Dissolved Oxygen; O.M: Organic Matter; CO_3: Carbonates, HCO_3 : Bicarbonates, Cl^-: Chlorides, T.H: Total hardness; Ca^{2+}: Calcium; Mg^{2+} : Magnesium, SiO_2: Silicates; PO_4^{3-}: Phosphates; SO_4^{2-}: Sulphates; NO_3^{2-} : Nitrates; NO^{2-} : Nitrites , T.S.: Total Solids, S.S. Suspended Solids; D.S. DissolvedSolids; BOD: Biological Oxygen Demand; COD: Chemical Oxygen Demand

TABLE -23

PHYSICO-CHEMICAL PARAMETERS

SAROOR NAGAR LAKE STATION – 3

Month & Year	A. T	W. T	pH	D.O.	O.M.	CO_3	HCO_3^-	Cl^-	T.H.	Ca^{2+}	Mg^{2+}	SiO_2	PO_4^{3-}	SO_4^{2-}	NO_3^{2-}	NO_2^-	T.S	S.S	D.S.	BOD	COD
May'06	42	37	8.5	1.6	36	0	610	387.6	386	16.03	90.27	1.5	0.16	120	0.19	1.29	1200	130	1184	24	106
Jun'06	37	29	8.1	4.4	36.3	0	683.2	355	530	39.27	119.7	0.42	0.17	88	0.19	0.45	1280	116	1204	18	82
Jul'06	31	26	8.3	2	28	0	549	326.6	520	28.05	120.03	0.61	0.55	59	0.19	0.47	1614	44	1156	30	112
Aug'06	35	28	8.3	6	25	0	427	269.8	480	24.04	111.25	0.67	0.77	62	0.16	0.44	1420	65	1215	26	108
Sep'06	34	27	8.2	4	30	0	518.5	284	400	116.23	69.23	0.65	0.13	67	0.17	0.58	1200	38	1162	25	104
Oct'06	33	26	8.1	3	31	90	335.5	298.2	510	36.07	115.63	0.38	0.2	90	0.21	0.36	878	23	855	23	102
Nov'06	32	25	8.3	3	26	90	640.5	305.3	550	24.04	128.33	0.32	0.15	67	0.25	0.3	1211	113	1098	32	116
Dec'06	30	23	8.2	7	30	0	640.5	347.9	580	72.14	123.91	0.3	0.25	89	0.27	0.31	1260	48	1212	28	110
Jan'07	29	25	8.3	6	23.5	0	488	355	520	36.07	118.07	0.3	0.21	87	0.29	0.32	1284	35	1249	25	96
Feb'07	30	27	8.1	4	27	108	396.5	355	550	108.21	107.79	0.3	0.28	125	0.29	0.3	1242	55	1187	23	102
Mar'07	36	31	8.5	8	23	102	549	355	580	96.12	118.06	0.31	0.25	132	0.29	0.32	1312	67	1245	32	110
Apr'07	40	34	8.6	7	32	0	671	369.2	420	56.11	88.78	0.67	0.2	145	0.3	0.32	1327	54	1273	34	128

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Vol 25, No.1 (2024)
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1st year Average	**34.08**	**28.17**	**8.29**	**4.67**	**28.98**	**32.50**	**542.39**	**334.05**	**502.17**	**54.37**	**109.25**	**0.54**	**0.28**	**94.25**	**0.23**	**0.46**	**1269.00**	**65.67**	**1170.00**	**26.67**	**106.33**
May'07	41	33	8.5	10	35	0	640.5	397.6	530	72.14	111.71	0.38	0.22	132	0.39	1.99	1273	64	1209	31	116
Jun'07	35	28	8.2	6	33	48	488	397.6	500	104.2	96.57	0.5	0.35	55	0.13	0.76	1356	82	1274	28	124
Jul'07	36	27	8.2	3	25	90	427	369.2	520	52.1	114.16	0.19	0.62	77	0.15	0.74	1284	60	1224	26	112
Aug'07	33	28	8.3	6	26	0	549	340.2	440	88.17	85.84	0.15	0.82	86	0.15	0.24	1280	45	1235	22	88
Sep'07	34	27	8.2	4	31	0	518.5	326.6	460	92.18	89.74	0.1	0.91	56	0.13	0.69	1200	35	1165	26	120
Oct'07	32	25	8.3	3.6	32	0	610	305.3	510	88.17	102.92	0.17	0.51	76	0.18	0.94	1120	40	1080	20	84
Nov'07	31	24	8.4	6	30	0	671	312.4	530	120.24	99.98	0.15	0.53	80	0.16	0.74	878	23	855	24	104
Dec'07	30	23	8.2	8	33	30	366	326.6	560	120.24	107.3	0.19	0.29	83	0.18	0.69	1210	47	1163	17	74
Jan'08	28	22	8.3	7	29.5	0	701.5	326.6	520	56.11	113.18	0.24	0.22	95	0.18	0.14	1158	83	1075	23	98
Feb'08	32	27	8.4	4	34	0	823.5	340.8	520	56.11	113.18	0.21	0.16	85	0.27	0.83	1071	57	1014	20	86
Mar'08	35	31	8.5	8	29	0	854	355	520	88.17	105.36	0.27	0.17	110	0.17	0.64	943	27	916	24	102
Apr'08	39	33	8.5	9	33	0	732	340.8	580	96.19	118.04	0.25	0.2	122	0.25	0.58	970	30	940	28	124
2nd Year Average	**33.83**	**27.33**	**8.33**	**6.22**	**30.88**	**14.00**	**615.08**	**344.89**	**515.83**	**86.17**	**104.83**	**0.23**	**0.42**	**88.08**	**0.20**	**0.75**	**1145.25**	**49.42**	**1095.83**	**24.08**	**102.67**
2 Years Average	**33.96**	**27.75**	**8.31**	**5.44**	**29.93**	**23.25**	**578.74**	**339.47**	**509.00**	**70.27**	**107.04**	**0.38**	**0.35**	**91.17**	**0.21**	**0.60**	**1207.13**	**57.54**	**1132.92**	**25.38**	**104.50**

A.T : Air Temperature ; W.T : Water Temperature, D.O. Dissolved Oxygen; O.M: Organic Matter; CO_3: Carbonates, HCO_3 : Bicarbonates, Cl^-: Chlorides, T.H: Total hardness; Ca^{2+}: Calcium; Mg^{2+} : Magnesium, SiO_2: Silicates; PO_4^{3-}: Phosphates; SO_4^{2-}: Sulphates; NO_3^{2-} : Nitrates; NO^{2-} : Nitrites , T.S.: Total Solids, S.S. Suspended Solids; D.S. DissolvedSolids; BOD: Biological Oxygen Demand; COD: Chemical Oxygen Demand

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CONCLUSION:-

In the present study low concentrations of dissolved oxygen and high concentration of organic matter, chlorides, total hardness, phosphates indicate that the lakes are polluted with higher quantities by sewage and domestic wastes. Chlorides, bicarbonates, total hardness, total solids, organic matter, nitrates, nitrites, phosphates were ranging high throughout the period of investigation. The physico-chemical parameters show seasonal fluctuations. The average values of the important physico-chemical variables of the lake studied are compared with ISI, WHO standards to assess the trophic status of the lakes.

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