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Evaluation of Physico-Chemical Parameters to Assess Hussain Sagar and Saroor Nagar Lake Water Quality in Hyderabad, Telangana, India

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Abstract: *Lakes are vital resources, natural surface water course also play a crucial role in groundwater recharge and they regulate the urban climate nowadays. Sewage discharge, improper agricultural practices and urban run offs have disrupted the ecosystem .In Hyderabad there are 185 lakes in that only 10 lakes have good water quality current situation due to domestic sewage and industrial waste water discharge are mixed with lake water. For our study we have selected 2 lakes, Hussain sagar, and Saroor nagar from those 175 lakes. This paper examines the present lake water quality, Four sample stations were located around two lakes totally24 samples were collected as per standard methods and, samples have been analyzed for Physico-Chemical parameters such as pH, TH, TDS, $Ca^{2+,}$ $Mg^{2+,}$$Cl^{-}$, $HCO_{3,}$ $CO_{3,}$ DO,BOD,COD. Results obtained were compared with water quality standards, irrigation standards and compared with previous study to analyzed that parameters limits.pH is observed for Hussain sagar lake are fall within the acceptable limit, for Sarooro nagar is observed are increased.TH, TDS, $Ca^{2+,}$ $Mg^{2+,}$$Cl^{-}$, $HCO_{3,}$ CO_3 were exceeds the acceptable limits , DO,BOD and COD for 2 lakes are within the acceptable limits at present because of covid19 lockdown last year all festivals were banned.*

Keywords: Physico-Chemical, Domestic sewage, Irrigation, Hussain Sagar, Saroor Nagar.

I. INTRODUCTION

Hyderabad is the capital of southern India's Telangana state. A major center for the technology industry and home to many upscale restaurants and shops. There are 185 lakes in Hyderabad in that Hussain Sagar with an area of 450 hectares is one of the principal lakes located (78°30' E,17°30' N) between the twin cities of Hyderabad and Secunderabad, Andhra Pradesh. Nowadays lake is degrading physically and biologically due to human activities (Chandrasekhar 2007). The lakes falls under unsuitable for drinking and irrigation use. It was used as a drinking water source by the locals of Hyderabad and Secunderabad between the years of 1860 and 1930. The water body was originally built over a bund or a dam now a days come to be known as the Tank Bund. Saroor nagar lake built by the Qutub Shahis, actually changes its colour with the season, no special magical powers working here. The change in colour from green to blue-green highlights the extent of pollution in lake. While many water bodies in Hyderabad are plagued mostly by chemical, industrial and sewage contamination,

1.1 Objectives of the Study

The main objective of the study is to assess the present the state of lake water quality due to urbanization and industrialization. To present the water quality of previous and present year and its suitability for domestic and irrigation purpose.

II. MATERIALS AND METHODOLOGY

Methodologies adopted for the study are shown in Fig.1.

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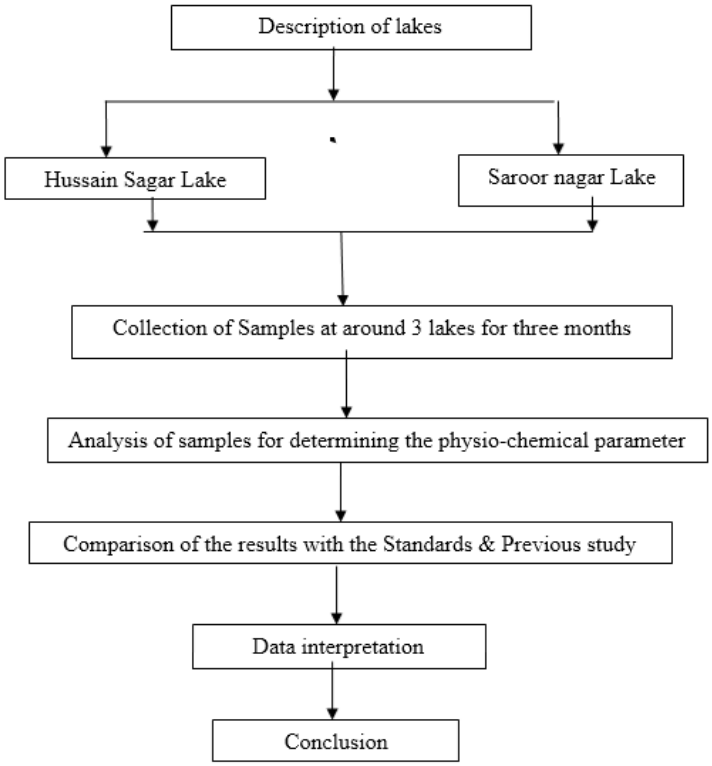

Figure 1: Flow Chart of Methodology

2.1 Description of Study Area

A. Hussain Sagar Lake (HSL)

Hussain sagar lake is heart of the world was declared by UNWTO in September 2012 because of its shape. The heart of the world logo was inaugurated by secretary during 2013. Worldwide there are 78 heart shaped lakes in that 9 similar shaped islands in globe. HSL surrounded by 3 park which attracts the tourist Hussain Sagar is also a very popular go to spot for water sport activities in Telangana, offering boating, yachting, and sailing opportunities. In addition to storm water, due to rapid residential and industrial growth in its catchment area, the lake is fed by four major drains nalas**,** which act as feeding channels.

Figure 2: Hydrological balance of the Hussain sagar lake
(Source: EPTRI - A Pilot Study on Hussain sagar Lake Environment, March 2015)

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Saroor nagar Lake Saroornagar lake water is 400 years old built by Qutub Shahis, it changes its colour, blue green during summer and green during winter. Due to urbanization and industrialization the lake is polluted through heavy metals and biological contamination more aquatic weeds above the water spoil the lake aesthetic appearance and there is increase in nutrient load due to human activites degrade the lakes and depletes the oxygen content.(Padmapriya2015)

Location of Sampling Stations

Four sampling stations located around Husainsagar and Saroornagar lake is given in Table .1, Similarly The surface water samples were collected around the two lakes from these 4 stations for the period of three months from Jan to Mar 2021.

Table 1: Sampling Stations around HSL

Hussain Sagar lake		Saroor Nagar Lake	
Sampling stations	**Code**	**Sampling stations**	**Code**
Front of NTR ghat	S1	Priyadarshini Park	S1
Near Boat club	S2	Pochamma temple	S2
Sanjeeh park	S3	Singareni colony	S3
Near rock garden	S4	Green park colony.	S4

Figure 2: Sampling Stations around Saroor nagar Lake

2.2 Method Adopted for Collection and Analysis of Sample

The grab sampling techniques was used to collect samples. Polyethylene bottles were used to collect samples. Before collecting the samples, the containers were rinsed thoroughly with the water being sampled, after collection of the samples, the containers were closed with air tight and transported to Teegala Krishna Reddy College of Engineering and Technology (TKRCET) Meerpet, Hyderabad for preservation and analysis, methods adopted for water quality analysis is given in Table 2. The preservations and analysis were carried out as per the standard methods (APHA 1998 and US EPASW-846).Totally, 24 no of water samples were collected to assess the water quality of fourteen physico-chemical parameters.

Table 2: Methods adopted for water quality analysis

Sl.no	Quality Parameter	Symbol	Method used
1.	pH	pH	Potentiometric (1:2.5 H2O V/V)
2.	Electrical Conductivity	EC	Conductometery (1:2.5 H2O V/V)
3.	Calcium	Ca2+	EDTA (0.05N)titrimetric
4.	Magnesium	Mg2+	EDTA (0.05 N) titrimetric
5.	Total Hardness	TH	EDTA (0.05 N) titrimetric
6.	Total dissolved solids	TDS	TDS analyser
7.	Chloride	Cl−	Titration using 0.05 N AgNO3
8.	Bicarbonate	HCO_3	Titration (with 0.01 N
9.	Dissolved oxygen	DO	Wrinklers method, Digital DO Analyser

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10.	Biological oxygen demand	BOD	Incubation
11.	Chemical oxygen demand	COD	Reflux apparatus

III. Results and Discussions

Analysis of water quality is needed before it is used for various purposes. Normally water consists many suspended, dissolved and microbiological impurities. To know the present condition of lake water 12 physicochemical parameters were analysed (pH, TS, TDS, TH, Ca, Mg, Cl, Co3, Hco3, DO,BOD, CODAll concentrations were expressed in mg/l except for pH. EC was expressed in µmhos/cm. Hussainsagar water quality around the lake at four different stations for a period of three months is presented in the Tables below All the 2 lake water quality is given in Table below, Present Scenario of Lakes are Compared with Standards and with previous study is given Table water quality criteria as per CPCB.

Table 3: Primary Water Quality Criteria by CPCB (PWQC)

Designated-Best-Use	Class of water	Criteria
Drinking Water Source without conventional treatment but after disinfection	A	Total Coliforms Organism MPN/100ml shall be 50 or less
		pH between 6.5 and 8.5
		Dissolved Oxygen 6mg/l or more
		Biochemical Oxygen Demand 5 days 20C 2mg/l or less
Outdoor bathing (Organised)	B	Total Coliforms Organism MPN/100ml shall be 500 or less pH between 6.5 and 8.5 Dissolved Oxygen 5mg/l or more
		Biochemical Oxygen Demand 5 days 20C 3mg/l or less
Drinking water source after conventional treatment and disinfection	C	Total Coliforms Organism MPN/100ml shall be 5000 or less pH between 6 to 9 Dissolved Oxygen 4mg/l or more
		Biochemical Oxygen Demand 5 days 20C 3mg/l or less
Propagation of Wild life and Fisheries	D	pH between 6.5 to 8.5 Dissolved Oxygen 4mg/l or more
		Free Ammonia (as N) 1.2 mg/l or less
Irrigation, Industrial Cooling, Controlled Waste disposal	E	pH between 6.0 to 8.5
		Electrical Conductivity at 25C micro mhos/cm Max.2250
		Sodium absorption Ratio Max. 26
		Boron Max. 2mg/l
	Below-E	Not Meeting A, B, C, D & E Criteria

Table 4: Hussain SagarLake Water Quality 2018-2021

Sl. No	Parameters	Units	Permissible Limits	2018	2019	2020	2021
1	Temperature	°C	12-25	34	35	35	38.3
2	PH	-	6.5-8.5	9	8	8	9.7
3	Total Solids	Mg/l	5000	3335	3356	3356	4967
4	Total dissolved Solids	Mg/l	5000	2585	2658	2658	4290
5	Total Hardness	Mg/l	50	745	765	765	827
6	Calcium	Mg/l	100	196	178	178	198
7	Magnesium	Mg/l	125-350	75	69	69	99
8	Chlorides	Mg/l	250	598	595	565	689

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9	Carbonates	Mg/l	250	32	30	30	35
10	Bicarbonates	Mg/l	50	765	721	721	778
11	Dissolved Oxygen	Mg/l	1	0.85	0.9	0.9	0.9
12	BOD	Mg/l	500-1000	299	321	321	498
13	COD	Mg/l	500-1000	257	266	266	399

Table 5: Saroor Nagar Lake Water Quality 2018-2021

Parameters	Units	Permissible Limits	2018	2019	2020	2021
Temperature	°C	12-25	34	35	35	38.3
PH	-	6.5-8.5	9	8	8	9.27
Total Solids	Mg/l	5000	3335	3356	3356	4380
Total dissolved Solids	Mg/l	5000	2585	2658	2658	4290
Total Hardness	Mg/l	50	745	765	765	718
Calcium	Mg/l	100	196	178	178	160
Magnesium	Mg/l	125-350	75	69	69	69
Chlorides	Mg/l	250	598	595	565	581
Carbonates	Mg/l	250	32	30	30	35
Bicarbonates	Mg/l	50	765	721	721	720
Dissolved Oxygen	Mg/l	1	0.85	0.9	0.9	0.9
BOD	Mg/l	500-1000	299	321	321	498
COD	Mg/l	500-1000	257	266	266	399

Table 6: Comparison of Three lakes water quality with BIS

Sl. No	Parameters	Units	Permissible Limits	Hussain Sagar Lake	Saroor Nagar Lake	Meerpet Lake	Remarks
1	Temperature	°C	12-25	38.3	38.3	37	Exceeds the limit
2	PH	-	6.5-8.5	9.7	9.27	10.5	Exceeds the limit
3	Total Solids	Mg/l	5000	4967	4380	5210	Within the limit
4	Total Dissolved Solids	Mg/l	5000	4290	4290	4878	Within the limit
5	Total Hardness	Mg/l	50	827	718	912	Exceeds the limit
6	Calcium	Mg/l	100	198	160	199	Exceeds the limit
7	Magnesium	Mg/l	125-350	99	69	19	Within the limit
8	Chlorides	Mg/l	250	689	581	899	Exceeds the limit
9	Carbonates	Mg/l	250	35	35	47	Within the limit
10	Bicarbonates	Mg/l	50	778	720	949	Exceeds the limit
11	Dissolved Oxygen	Mg/l	1	0.9	0.9	1	Within the limit
12	BOD	Mg/l	500-1000	498	498	755	Within the limit
13	COD	Mg/l	500-1000	399	399	566	Within the limit

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3.1 Water Quality Analysis

A. Temperature (T)

Temperature is very important indicator for water quality and provides information in many types of geophysical equilibrium. From the study it was observed that the temperature of the water samples in 2021 is 38.3°C for Husain sagar lake and 38.3°C for Sarrornagar lake When compared with previous study temperature and compared with BIS were observed as increased for all three.

B. pH

The pH of water is a very important indication of its quality and provides important information in many types of geochemical equilibrium or solubility calculation From the study it was observed that pH of the water samples is 8 for Hussainsagar lake, 7 for & Sarrornagar lake, when it is compared with previous study pH is observed for Hussainsagar lake are fall within the acceptable limit, for Sarooronagar is observed are increased. The acceptable limit of pH is 6.5-8.5 (IS 10500:2012 guidelines for drinking water).

C. Total Solids (TS)

From the study it was observed that the total solids in 2021 for Hussainsagar lake is 4967 mg/l, Saroornagar lake is 4380mg/l and Meerpet lake is 5210 mg/l when compared with previous study TS is observed for Hussiansagar lake and sarrornagarlake exceeds the permissible limit .

D. Total Dissolved Solids (TDS)

In natural water, dissolved solids are increase when compared with previous study TDS is observed for are increased are composed mainly of carbonates, bicarbonates, chlorides, sulphates, phosphates, nitrates, calcium, magnesium, sodium, potassium, iron and manganese From the study it was observed that the total dissolved solids in 2021 for Hussainsagar lake is 4290 mg/l, and Sarrornagar lake is 4290 mg/l. when compared with previous study TDS is observed all lakes exceeds the permissible limit, The acceptable limit of TDS is 500 mg/lit (IS 10500:2012).

E. Total Hardness (TH)

Total Hardness includes sulphates, chlorides of calcium and magnesium. In most natural waters the predominant ions are those of bicarbonates associated mainly with calcium, to a lesser degree with Magnesium, and still less with sodium and potassium. The acceptable limit of TH is 200 mg/lit (IS 10500:2012). In the study area total hardness of the water samples ranges from 245-395 mg/lit with an average of 281 mg/l. From the study it was observed that the total hardness in 2021 for Hussainsagar lake is 827 mg/l & Saroornagar lake is 718 mg/l, when compared with previous study TH is observed all lakes exceeds the permissible limit, All samples (100%) exceeding the acceptable limit.

F. Calcium ($Ca2^{+}$)

Calcium is found abundantly in all-natural water. The higher concentration of Calcium may be due to sewage coming from the surrounding residential areas. The acceptable limit of Ca^{2+} is 75 mg/lit (IS 10500:2012). In the study area calcium concentration of the water samples in 2021 for Hussainsagar lake is 198 mg/l and Saroornagar lake is 160 mg/l when compared with previous study $Ca2^{+}$ is observed all lakes exceeds the permissible limit,

G. Magnesium (Mg2+)

Magnesium is often associated with calcium in all kinds of waters, but its concentration remains generally lower than the calcium The acceptable limit of Mg^{2+} is 30 mg/l (IS 10500:2012). From the study it was observed that the Magnesium in 2021 for the Hussainsagar lake is 99 mg/l, for Saroornagar lake is 69 mg/l, when compared with previous study Mg2+ is observed all lakes exceeds the permissible limit,

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H. Chlorides (Cl^-)

The salts of sodium, potassium and calcium contribute chlorides in water. The acceptable limit of is 250 mg/lit (IS 10500:2012).From the study it was observed that the Chlorides in 2021 for the Hussainsagar lake is689 mg/l , for Saroornagar lake is 589 mg/l, when compared with previous study Cl + is observed all lakes exceeds the permissible limit,

I. Carbonates

From the study it was observed that the Carbonates in 2021 for the Hussainsagar lake is 35 mg/l, for Saroornagar lake is 35 mg/l. when compared with previous study **.**Carbonates is observed all lakes exceeds the permissible limit,

J. Bicarbonates

From the study it was observed that the Bicarbonates in 2021 for the Hussainsagar lake is 778 mg/l, for Saroornagar lake is 720 mg/l, when compared with previous study **.**Bicarbonates is observed all lakes exceeds the permissible limit,

K. Dissolved Oxygen

From the study it was observed that the Dissolved oxygenin 2021 for the Hussainsagar lake is 0.9 mg/l, for Saroornagar lake is 1 mg/l, when compared with previous study DOis observed with in the acceptable limits

L. Biological Oxygen Demand

From the study it was observed that the Biological oxygen Demand in 2021 for the Hussainsagar lake is 498mg/l, for Saroornagar lake is 498mg/l. when compared with previous study BOD is observed increasedwhen compared with previous study BODis observed exceeds the acceptable limits

M. Chemical Oxygen Demand

From the study it was observed that the Chemical Oxygen Demand in 2021 for the Hussainsagar lake is 399mg/l, for Saroornagar lake is 399mg/l, when compared with previous study COD is observed for hussiansagar lake are within the acceptable limit, when compared with previous study COD is observed for all lakes are with in the acceptable limits

IV. CONCLUSION

For our present study from 2 lakes 24 water samples were analyzed forTemperature, pH, Total solids, Total dissolved solids, Total hardness, Calcium hardness, Magnesium, Chlorides, Carbonates, Bicarbonates, Dissolved oxygen (DO), Biological oxygen demand(BOD) and Chemical oxygen demand(COD). All concentrations were expressed in mg/l except for pH. EC was expressed in µmhos/cm. The lake water quality shows variation in physico chemical characteristics compare with permissible limit.

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