

Seasonal Variations of Water Quality Index of Osmansagar Lake in Hyderabad City– A Case Study.

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Abstract: The purity of drinking water is a major concern in the cities of developing countries. Hyderabad receives drinking water from five reservoirs namely Osmansagar, Himayathsagar, Manjira, Singur and Krishna. The present study is aimed at the variation of the physicochemical parameters of the Osmansagar Lake for a period of one year from September 2013 to August 2014. The study of water quality of Osmansagar is chosen in the paper as it is the oldest and more susceptible to the growing urbanization and industrialization owing to its close vicinity to the city. The water quality index (WQI) of the lake using the physicochemical parameters is calculated. The results showed medium water quality of the lake. Though most of the parameters studied are in accordance to the Bureau of Indian standards (BIS), the impact of urbanization and industrialization on water quality is clearly seen in the analysis. If proper measures are not taken the quality of water may deteriorate in the future affecting its potability.

Keywords: BIS standards, industrialization, physicochemical parameters, urbanization, water quality index,

I. Introduction

The three main global challenges for the twenty first century are energy, water, and air - that is, sufficient energy to ensure a reasonable standard of living, clean water to drink, and clean air to breathe. Out of these three, access to safe drinking water has become a greater challenge. The water quality of a metropolitan city like Hyderabad is greatly influenced by urbanization and industrialization. The city of Hyderabad, located in the Deccan Plateau, has a distinct physical identity characterized by huge rock formations and water bodies dotting its landscape. The city is situated in the Krishna basin. River Musi, a tributary of river Krishna, passes through the city bifurcating it as north and south Hyderabad.

Hyderabad receives drinking water from five reservoirs namely Osmansagar, Himayathsagar, Manjira, Singur and Krishna. The oldest drinking water sources are Osmansagar, built in 1920 on Musi river and Himayathsagar in 1927 on Esi river [1]. Before the two reservoirs Osmansagar and Himayathsagar were built, Hussainsagar and Mir Alam Tank (built in 1562 and 1908 respectively) supplied drinking water to the city till 1930. Over the years, the latter two got polluted and are no more used as drinking water sources [2]. The Hyderabad Metropolitan Water Supply and Sewerage Board (HMWS&SB) is a statutory authority in charge of providing and maintaining water supply and sewerage facilities in greater Hyderabad including surrounding municipalities[3]. The various drinking water sources to Hyderabad are listed in Table 1.

Table1. Sources of water to Hyderabad.

Source	Osman sagar	Himayatsagar	Manjira Phase I	Manjira Phase II	Manjira Phase III	Manjira Phase IV	Krishna Phase I&II
Year of commissioning	1920	1927	1965	1981	1991	1993	2004
River	Musi	Esi	Manjira	Manjira	Manjira	Manjira	Krishna
Reservoir	Osman sagar	Himayatsagar	Manjira Barrage	Manjira Barrage	Singur	Singur	Akkampally
Distance from Hyderabad(Km)	15	9.6	58	59	80	80	116
Designed capacity (MLD)	115	91	68	135	171	176	410
Maximum capacity supply (MLD)	40-68	40-50	68	135	171	176	261

Source: Hyderabad Metropolitan Water Supply and Sewerage Board (HMWS&SB)

A total of 1000-1040 MLD of water is supplied from these reservoirs including 115 MLD of ground water [4]. The present study is aimed at assessment of the water quality of Osmansagar. The reservoir is situated at about 20 km from Hyderabad city and is located at a latitude 17°22'30" and longitude 80°04'00". The lake is spread around 46 km² and the reservoir is around 29 km² [5]. The catchment area is 285 sq.miles. The characteristic features of Osmansagar lake is presented in Table 2.

Table2. Characteristic features of Osmansagar Lake

S.No.	Item	Description
1	Date of construction	1912-1920
2	Catchment area	285 Sq.miles (738.15Sq.Km)
3	Maximum runoff	1,05,000 Cusecs
4	Total length of the Dam	6,300 ft.
5	Total storage capacity	12,907 M.Cft
6	Area of water spread	9.57 Sq.miles (24.78 Sq.Km)
7	Maximum water level	R.L.+1810.00
8	Maximum depth of water above the bed level	104 ft.

R.L.-Reservoir length

Source: Hyderabad Metropolitan Water Supply and Sewerage Board (HMWS&SB)

The growing urbanization and industrialization is showing its effect on the water quality of Hyderabad. The loss of the water bodies due to urban sprawl is increasing at an alarming rate and is a critical factor in the lowering of water table and the resultant water crisis being faced by many localities in the city. If the trend continues, the two oldest reservoirs would dry up completely, Himayatsagar in 2036 and Osmansagar in 2040 [6]. In view of uncontrolled anthropogenic activities the water characteristics of Osmansagar Lake has deteriorated substantially. Reduced inflows coupled with organic pollution and nutrient addition resulted in increased algal activity and reduced dissolved oxygen. The remedial measures that were suggested by Venkateswara Rao et al. (1998) [7] include complete protection for forestland in the catchment, conversion of wastelands into forestlands, stoppage of transportation of water from the catchment areas, and government control on diversion structures such as check dams on various streams in the catchment. As the local water resources like rivers, lakes and groundwater are getting increasingly polluted, the highly urbanized areas are forced to seek water from greater distances and expense [8].

II. Methodology

The water samples from the study area (Osmansagar Lake) are analyzed for the physicochemical characteristics for a period of one year from August 2013- September 2014. The analysis was carried out for three seasons at different locations using standard procedures recommended by American Public Health Association (APHA), 2005[9]. To provide a comprehensive but easy to use tool in the assessment and evaluation of water quality, the concept of water quality index (WQI) has been developed [10]. WQI provides "ranking of water quality" with a single number that express overall water quality based on several parameters. Water quality index is calculated for Osmansagar using the protocol of National Sanitation Foundation (1970). It is determined on the basis of nine important parameters viz., pH, temperature, turbidity, total solids, nitrate, phosphates, dissolved oxygen, biochemical oxygen demand and faecal coliforms. The average values of the samples at different locations for all the nine parameters are compared to the corresponding standard curves provided by the National Sanitation Foundation (NSF) Brown et al. (1970) [11] and a numerical value or "Q-value" is obtained. Thus, water quality index is obtained after the Q- value is multiplied by a "weighting factor" based on the importance of the particular test in water quality. The values range from 0-100 and the streams are classified from very bad to excellent. The quality of the water based on the WQI values is shown in Table 3.

Table3. Water Quality Index Legend

Range	Quality
90-100	Excellent
70-90	Good
50-70	Medium
25-50	Bad
Below 25	Very bad

III. Results And Discussions

The mean values of physico-chemical parameters for winter, summer and rainy seasons for the calculation of water quality index are presented in the Table 4.

Table 4. Water Quality Index for Osmansagar Lake (Season wise).

S.No	Parameters	Winter			Summer			Rainy		
		Avg.	Q value	WQI	Avg.	Q value	WQI	Avg.	Q value	WQI
1	pH	7.92	86	9.46	7.6	92	10.1	7.72	91	10
2	Temperature (°C)	24.7	16	1.6	28.2	12	1.2	26.5	14	1.4
3	Turbidity(NTU)	14.5	68	5.44	22.2	59	4.72	53	37	2.96
4	Total solids(mg/L)	2.9	80	5.6	9.3	82	5.74	2.22	80	5.6
5	DO (mg/L)	5.8	40	6.8	4.4	19	3.23	6.2	49	8.33
6	BOD (mg/L)	2.6	69	7.59	2.55	70	7.7	8.7	39	4.29
7	Total phosphates(mg/L)	0.08	97	9.7	0.12	95	9.5	0.11	96	9.6
8	Nitrates (mg/L)	1.02	96	9.6	2.07	95	9.5	1.57	96	9.6
9	Faecal Coliforms (CFU/100ml)	760	25	4	111	43	6.88	205	37	5.92
WQI				59.79		58.51		57.71		

The water quality index for winter, summer and rainy seasons are 59.79, 58.51, and 57.71 respectively. The WQI values for all the seasons indicate medium water quality of the lake, where in comparatively water quality is better in winter and poorer in rainy season than in summer. The deterioration of water quality in rainy season can be attributed to the growth of the algal vegetation and dissolution of various nutrients in the lake water. The overall water quality of the Osmansagar Lake by taking the average of the three seasons is presented in Table 5.

Table5. Overall Water Quality Index of Osmansagar Lake.

S. No	Parameters	Seasonal Average	Observed Q-value	Unit weight	WQI= Observed Q value X unit weight
1	pH	7.76	90	0.11	9.9
2	Temperature (°C)	26.5	14	0.10	1.4
3	Turbidity(NTU)	29.9	53	0.08	4.24
4	Total solids(mg/L)	4.8	80	0.07	5.6
5	DO (mg/L)	5.5	30	0.17	5.1
6	BOD (mg/L)	4.61	58	0.11	6.38
7	Total phosphates(mg/L)	0.106	96	0.10	9.6
8	Nitrates (mg/L)	1.55	95	0.10	9.5
9	Faecal Coliforms (CFU/100ml)	358.6	32	0.16	5.12
Water Quality Index					52.84

IV. Conclusion

Rapid urbanization and industrialization has led to unchecked proliferation of hazardous industries in and around Hyderabad. Unchecked and unregulated distribution and management of urban resources especially green areas & water bodies with large scale urban sprawl have all made Hyderabad an unmanaged polluting city. The area surrounding the Osmansagar Lake has ample possibilities of organic pollution, heavy metals and pesticides contamination from various sources viz., domestic waste water, agriculture/horticulture runoff, laboratory waste from educational institutes, solid waste disposal, vegetation in the lake and human activities. The presence of nutrients in the lake has increased the algal growth resulting in unacceptable levels of colour and odour. As a result, the water quality index of the lake is lowered to 52.84 indicating a medium water quality. The government should strictly implement GO-111(1996), which was issued to prohibit all types of activities in the catchment area of the lake leading to deterioration in water quality. If stringent measures are not taken in the future the water from the lake may not be fit for drinking, adding stress to the prevalent water crisis in Hyderabad city.

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