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Assessment of Water Quality of Ameenpur Lake: The Biodiversity Heritage Site of India

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ABSTRACT

Across the world, the various water bodies are being exposed to different forms of environmental degradation and deterioration caused due to population explosion, urbanization and development in the industrial sector. Another factor affecting the quality of water is the aggregations of producers of the water ecosystem i.e., the phytoplankton, macro algae and occasionally colourless heterotrophic protists which can discolour the water giving rise to foam. Due to this, there is decrease in Dissolved Oxygen (DO) level which ultimately affects the ecological balance of the water and eventually leads to eutrophication in water bodies. The present paper deals with water quality of Ameenpur Lake, Hyderabad, Sangareddy, Telangana, India, the first urban lake to be declared as a Biodiversity Heritage Site. The water quality assessment is made through Dissolved Oxygen (DO), Biochemical Oxygen Demand (BOD) and Chemical Oxygen Demand (COD).

Key words : Ameenpur Lake, Biodiversity Heritage Site, Water Quality, Dissolved Oxygen, Biochemical Oxygen Demand, Chemical Oxygen Demand.

Introduction

Water - the main source of life and one of the most important natural resource of the ecosystem (Lingaswamy and Praveen Raj Saxena, 2016). It is the needed natural resources for the entire living organism for various metabolic activities. About 73% of earth is covered with marine (97%) and freshwater (3%) which is present in different forms like ponds, lakes, rivers, swamps, marshes, sea, oceans and glaciers etc. In the freshwater bodies the lakes play a very important role in urban ecosystem. As they perform significant environmental, social and economic functions, like groundwater recharge, a drinking water source, effecting ground water quality and ground water table, in controlling floods, influence microclimatic conditions, enhance the aesthetic value, supporting biodiversity and livelihoods etc. It also plays a tremendous role in maintaining environmental sustainability regardless of them being man-made or natural, fresh water or brackish.

Factors influencing lake water quality is the quantity of dissolved oxygen in the water column. The guideline for the minimum instantaneous DO concentration for aquatic life is 5 mg/l (BC Ministry of Environment, 1997). The major inputs of dissolved oxygen to lakes are the atmospheric oxygen which gets diffused into the water and photosynthetic activity by aquatic plants and algae. Dissolved

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oxygen (DO) levels are important for the survival of aquatic organisms. When deeper waters no longer mix with surface waters, due to stratification, concentrations of DO can decrease. This occurs as a result of decomposition of organic materials.

In the present study, the assessment of the water quality of the Biodiversity Heritage Site of India namely Ameenpur Lake was done using Dissolved Oxygen (DO), Biochemical Oxygen Demand (BOD) and Chemical Oxygen Demand (COD). Ameenpur Lake is one of the important lakes in the Hyderabad city. In 2016, it was declared as a Biodiversity Heritage Site (BHS) and the only urban lake to be declared as BHS. The BHS are areas that are distinctive, ecologically fragile terrestrial, coastal or inland water ecosystems having rich biodiversity. It has one or many components like rich endemism, having rare and threatened species, richness of wild as well as domesticated species or intra-specific categories, keystone species, species of evolutionary significance, past pre-eminence of biological components represented by fossil beds and having significant cultural, ethical or aesthetic values and are important for the maintenance of cultural diversity, with or without a long history of human association with them.

Several industries from Bollarum industrial area, agricultural runoff activities of catchment area, sewage water drainages from surrounding households, temples on all three sides of the lake and waste from certain religious activities find their ways to the lake and affect its water quality. These activities have a clear impact on the lake water quality. BOD and COD are globally used in water quality parameters for the evaluation of organic contaminant pollution in water environment as well as in monitoring, design, and modeling of wastewater systems (Drolc et al., 2003; Dubber and Gray, 2010; Jingsheng et al., 2006; Aoki et al., 2004). Also widely used to evaluate organic pollutants in water systems as well as the efficiency of wastewater treatment plants (Jaewoong Lee et al., 2016).

Materials and Methodology

Study Area

Ameenpur Lake (17° 31.198'N, 78° 19.524'E) situated in Ameenapur Mandal, Sangareddy District, Telangana State of India is 27 km away from the Hyderabad City. It is covering an area of 93.15 acres (0.38 Sq. km) (Sy.No-231- Shikam Land) (Sailu *et al.*,



Fig. 1. Sample Location Points

2016). A Biodiversity assessment in the year 2017 has reported that the lake was a home to 8 species of mammals, 166 birds, 45 herpetofauna (12 amphibians and 34 reptiles), 9 species of fish, and 143 invertebrates (26 aquatic beetles, 41 butterflies, 18 odonates, 25 arachnids, and 33 other invertebrates – (Sailu *et al.*, 2016).

Water samples were collected from the lake in eight different locations (Table 1 and Fig.1) which cover throughout the lake. Water samples were collected in the month of May 2019 in the morning hours in 250 ml BOD bottles for DO and BOD analysis and in 500 ml plastic bottles for COD analysis. Before collecting the samples, the bottles were rinsed thoroughly with the water being sampled and after the collection of samples, they were closed tight and transported to laboratory for analysis.

Table 1. Sample Location Points

Sample No.	Latitude	Longitude Elev	vation (m)
S1	17;31;27.48 N	78;20;12.53 E	557
S2	17;31;30.91 N	78;19;48.41 E	557
S3	17;31;13.20 N	78;19;55.03 E	558
S4	17°31′18.6"N	78°19′54.1"E	560
S5	17;31;12.05 N	78;19;42.61 E	558
S6	17° 31' 21'' N	78;19;32.88 E	560
S7	17;31;27.37 N	78;19;31.41 E	520
S8	17;31;30.16 N	78;19;38.22 E	534

Methodology

Dissolved Oxygen analysis was carried out by using IS: 3025 Part 38 1989 RA-2003, Biochemical Oxygen Demand (BOD) analysis by using IS: 3025 Part 44 1993. RA-2014 and Chemical oxygen Demand (COD) analysis was carried out by using IS: 3025 Part 58 2006, RA-2017.

Results and Discussion

Central pollution Control Board (CPCB) has ascribed certain water quality standards for Inland water and according to these values, the lake water can be classified in five groups as mentioned in Table 5.

Dissolved Oxygen (DO)

Oxygen in water is measured in its dissolved form as dissolved oxygen (DO). If the amount of oxygen consumed is more than that is produced, then the

Table 2. Results of DO, BOD and COD (All are in mg/l)

Parameter/	DO	BOD	COD
Sample No.			
1	3.1	75	220
2	3	70	210
3	2.7	110	310
4	2.9	100	280
5	3	80	230
6	3.1	80	220
7	2.7	90	260
8	3	80	240
Min	2.7	70	210
Max	3.1	110	310
Avg	2.93	85.62	246.25

 Table 3. Central Pollution Control Board (CPCB) water quality standards

Parameter	CPCB Standards		
	A(Excellent)	B(Desirable)	C(Acceptable)
DO	>90%	>80%	>60%
BOD	<2	<3	<6

 Table 4.
 Classification of Lake based on Adakole *et al.*

 (1998)

Parameter	Unpolluted	Moderately Polluted	Heavily Polluted
BOD	<1.0 mg/l	2-9 mg/l	>10.0 mg/l

level of dissolved oxygen declines. The level of DO fluctuates seasonally and also over a period of 24 hours. It varies with water temperature and altitude.

In the present study, dissolved oxygen was found to be in the range of 2.3 mg/l to 3.1 mg/l with an average of 2.81 mg/l (Table 2). This can be attributed to the addition of oxidisable organic matter from the effluents, biodegradation and decay of vegetation at higher temperature thereby taking oxygen from water. DO Concentrations below 2mg/l may cause fish mortality and below 5 mg/l may affect the functions and survival of biological communities. Water with inadequate DO may be considered as a wastewater. The DO values obtained in the present study are less compared to ICMR standards, i.e. >5 mg/l.

Biochemical Oxygen Demand (BOD)

BOD is a measure of the dissolved oxygen utilized by the microorganisms for the oxidation of reduced substances in water and wastes. It has a direct affect

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Table 5. Designated Best Use Classification of Surface water (Source: CPCB, 1978)

Designated best use	Quality Class	Primary Water Quality Criteria
Drinking Water Source without	А	DO 6 mg/l or moreBOD 2 mg/l or less
conventional treatment but after Disinfection		
Outdoor bathing (Organized)	В	DO 5 mg/l or moreBOD 3 mg/l or less
Drinking water source after conventional	С	DO 4 mg/l or more BOD 3 mg/l or less
treatment and disinfection		
Propagation of Wild life and Fisheries	D	DO 4 mg/l or more
Irrigation, Industrial Cooling, Controlled	E	-
Waste disposal		



Fig. 2. Spatial Distribution Map of Dissolved Oxygen

on the amount of dissolved oxygen in water bodies. More oxygen is depleted, when the levels of BOD is more. Meaning lesser oxygen will be available to the aquatic forms. Similar conditions can be seen when the BOD is high and DO is less, causing stress, suffocation and death to the aquatic organisms.

In the present study, the Biochemical oxygen demand (BOD) was found to be in the range of 70 mg/ l to 135 mg/l with an average of 94.55 mg/l (Table 2). The high levels of BOD can indicate the presences of organic pollutants. The BOD values obtained in the present study, exceed the ICMR standards i.e. 5.0 mg/l. According to Adakole *et al.* (1998) classification, this lake falls under Heavily Polluted category (>10 mg/l).

Chemical Oxygen Demand (COD)

COD is a measure of the oxygen required for the oxidation of all the substance including non-biodegradable substances present in water. To determine the level of pollution in the water, COD can be a reliable parameter. The level of COD in water increases with increasing concentration of organic matter.



Fig. 3. Spatial Distribution Map of Biological Dissolved Oxygen



Fig. 4. Spatial Distribution Map of Chemical Dissolved Oxygen

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The maximum permissible value of COD is 10 mg/L for drinking water (A. K. De, 1985). In the present study, chemical oxygen demand (COD) value was found to be in the range of 210 mg/l to 380 mg/l with an average of 272.73 mg/l (Table 2).

Conclusion

The assessment of water quality of Ameenpur lake based on DO, BOD and COD, reveals that the lake water is polluted. The DO values are less compared to the permissible limits recommended by the CPCB and ICMR. The BOD and COD values were found to be higher than the permissible limits of CPCB and ICMR. The decrease in the DO values and increase in BOD and COD values may be due to the discharge of industrial effluents, agricultural runoff and domestic sewage. Decrease in DO will affect the survival of all aquatic organisms not only fishes but also invertebrates such as crabs, zooplanktons etc. which can indirectly affect the biodiversity too. Therefore it is important to maintain the quality of water.

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Conflict of Interest

The author declares no conflict of interest in publishing the paper.

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