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ASSESSMENT OF WATER QUALITY IN SHAMIRPET LAKE, HYDERABAD

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Abstract: Hyderabad is called the Lake City of India because of the large number of lakes located around the twin cities. However, with passing years the city has witnessed unplanned urbanization as well as an increased number of industries. The quality of the water of the Hyderabad lakes has gone down drastically due to irresponsible disposal of sewage and industrial waste into lake waters. The present work is focused on assessment of water quality of the Shamirpet lake. The lake is situated 24 km north from secunderabad. The assessment of water quality of the lake is done by analyzing the data about several parameters from the year 2016 to the year 2022. various important parameters are utilized in study such as DO, pH, Conductivity, BOD, Nitrates, Total coliforms, Fecal coliforms COD, Chlorides, sulfates, TDS, Sodium, Calcium, Magnesium, Alkalinity, and hardness. The quality of lake water is found to be unsuitable for drinking purpose according to the Bureau of Indian Standards (BIS) specifications for potable water (IS -10500: 2012). It has been found in studies that water of the lake is fairly contaminated for the existence of aquatic life. The finding of this study can be beneficial for the government to plan several strategies to prevent the further contamination. The studies can also be utilized as an input to develop the processes for cleaning of contaminated water as well as for the sustenance of a balanced aquatic ecosystem.
Keywords: Industrialization, Urbanization, water quality index parameters, aquatic life

1. Introduction

Freshwater bodies of any country hold a great importance because of several reasons. These water bodies have a great impact on ground water quality and ground water table, ground water is a major source of drinking water across the globe. Water bodies have a big role in the regulation of climate control and balancing the water cycle (Rekha Rani T.,1999)

Hyderabad is called the lake city of India because of the presence of several urban water bodies situated across the city. The capital city is geographically situated in an arid zone surrounded by land and with no perennial river. There is only one seasonal river, “Musi River.” Over a period and with the expansion of the city several lakes were built by the rulers to meet the drinking water requirements of the residents. These lakes met the purpose over a period until the rapid urbanization and industrialization led to the contamination of water bodies making the water unsuitable for drinking. (Rafi, P.M., Kusum, A.J., 2018).

Figure 1: Shamirpet Lake

Main causes of contamination of urban water bodies include irresponsible household garbage disposal and sewage disposal. disposal of dangerous industrial waste irresponsibly, agriculture runoff during flood situations. Any kind of contamination over a period of time leads to the change in morphological features as well as water quality of the lake. G.Srinivas,(2022)

1.1 Shamirpet lake location and morphological features

Shamirpet Lake is situated 24 kms north from Secunderabad. It is a man-made lake located in the Ranga Reddy district of Telangana, India.The lake was dug around 50 years ago during Nizam period. The lake is known to be constructed in the year 1796 by then Nizam of Hyderabad, Mir Mahboob Ali Khan and said to have been used as drinking water supply to the inmates of surrounding villagers during Nizam period. The lake is home to many birds as well as other wildlife. It is a popular destination for tourists and has a very picturesque ambience. the lake surrounded by the rocks all around. Lake is fed by the Musi River and is spread across an area of 5km. Shamirpet lake is declared as biodiversity heritage site by Hyderabad Urban Development Authority (HUDA) because of its natural location. Dr.A.V.Rajashekhar, J.Mahender.,(2016).

Shamirpet lake is facing many environmental issues due to water contamination. The lake water is now unsuitable for drinking and acts as a source of irrigation for nearby villages in surrounding areas. The main source of contamination of Shamirpet lake is industrial waste and untreated sewage disposal.The lake is used as a dumping well for garbage and other waste by nearby residents making its water unfit for drinking.

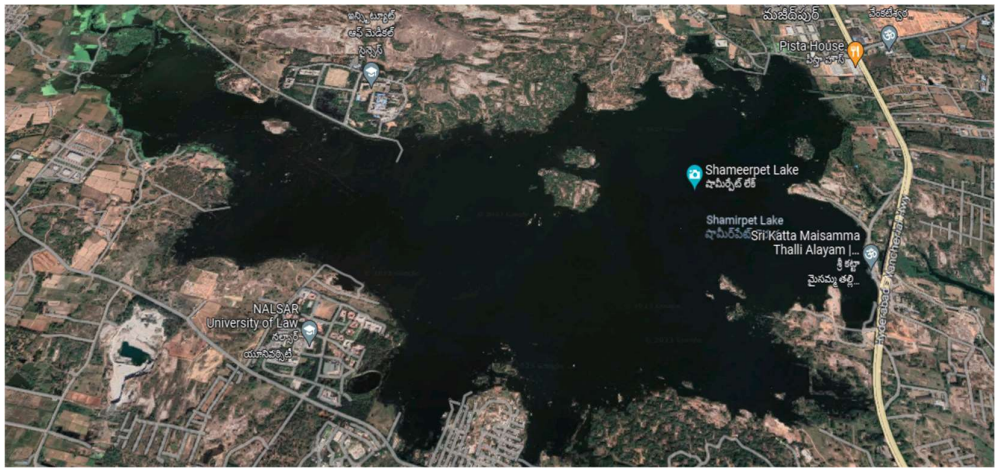

Figure 2: Shamirpet Lake (*Source: Google Maps)*

Morphological features of Shamirpet lake

The morphological features of Shamirpet lake from 1970 to 2022 has given in below figures: The area has reduced with passing years , as seen by the numbers below. The area was 4.85 sq km in 1970, and it will be 4.58 sq km in 2022. The area is reduced by 0.27 Sq Km.

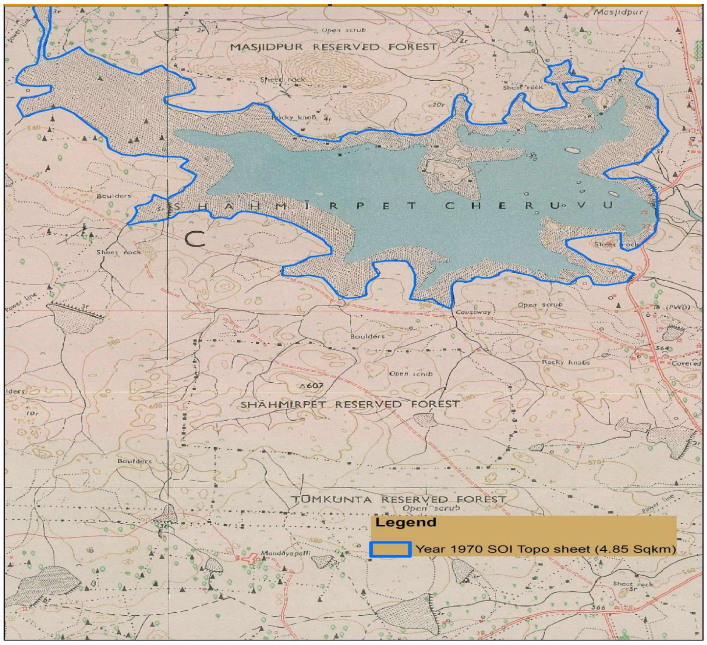

Figure 3: Shamirpet Lake as per 1970 SOI Toposheet(source:Telangana State Remote Sensing Applications Centre (TRAC) an autonomous scientific organization under Planning Department, Government of Telangana.)

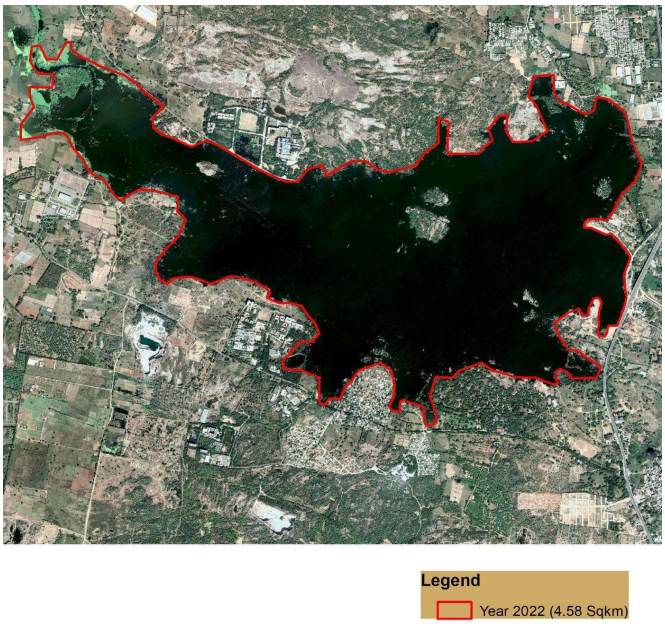

Figure 4: Shamirpet Lake as per 2022 SOI Toposheet(source:Telangana State Remote Sensing Applications Centre (TRAC) an autonomous scientific organization under Planning Department, Government of Telangana)

The following table lists the morphological characteristics of Shamirpet lake:

Table-1: Morphometric and Hydrological characteristics of Shamirpet Lake

source:Dr.A.V.Rajashekhar, J.Mahender, P.Bhavani Prasad(2016)

Location	Rangareddy Dist
Latitude	17.5917° N
Longitude	78.5822° E
Construction	1892 Surface area [ha] 276.7ha
Catchment area	[km2] 40
Water temperature	25-32 cm
Annual mean precipitation [mm]	varies 188 mm
Annual mean evaporation [mm]	150 to 250 cm
Wind [m.s.1]	8 km/h

1.2. Methodology

Various physico-chemical parameters were analyzed in Shamirpet lake, Rangareddy district, from the year 2016 to the year 2022. For analysis Monthly data of Shamirpet lake for seven years, from the year 2016 to is collected from Telangana state pollution control board (TSPCB). Yearly mean of the parameters is taken to know the average values of the selected parameters to prepare the graphs in order to show the variations over a period of seven years. The quality of water is generally analyzed by knowing the pH, temperature, dissolved oxygen, total suspended solids, total dissolved solids, electrical conductivity, total alkalinity, total hardness, and chlorides. The water quality parameters are checked according to the limits provided by(BIS, Indian Standard DRINKING WATER — SPECIFICATION (Second Revision) IS 10500 :2012 DRINKING WATER -SPECIFICATION)

Another important indicator of the lake's health is algal bloom. Shamirpet lake has been facing the problem of algal blooms for the last many years. Algal bloom is a thick layer of algae formed on the surface of water because of the presence of excessive nutrients in a water body, especially the overabundance of fertilizers which reach into lake water through agriculture runoff. Algal blooms are the main reason for decreased oxygen levels of water making it

difficult for the fish and other animals to survive. It is imperative to consider the sources of contamination for assessment of water quality of any water body . J.Mahender, K.Ramesh and A.V.Rajshekhar. (2016).

Industrial waste disposal problem in Shamirpet lake : Industrial waste contamination is a major problem in Shamirpet lake. There are several industrial areas located near Shamirpet lake. These areas include Balanagar industrial area which include several big and small industries Kukatpally industrial area which is residential as well as commercial area with several small-scale industries. Apart from these several IT industries are in the Hitech city area as well as the financial district located near Shamirpet lake area. Apart from these with passing time a number of industries are continuously growing. Discharge of these industrial effluents contribute majorly towards the contamination of lake water Prahalad A.K.(1987).
Littering and dumping of waste is another reason for lake contamination. The lake's surroundings are often used as a dumping ground for solid waste, leading to contamination of the water. Agriculture runoff water from nearby agriculture fields brings lots of contaminants which spoil the quality of the lake and leads to the contamination of water bodies. Poor solid waste management practices are one of the reasons for the presence of lots of non-degradable waste in lakes. It has been observed that nearby residents find it easy to dump the litter near the lake Which eventually takes its way in water. Lack or inability to enforce environmental laws and regulations is a major cause which makes it easier for the people to continue to contaminate lakes. T.Vidya Sagar,(2015)

In May 2017 approximately 50000 dead fishes were found floating in shamirpet lake. Although local officials claimed that mass death was due to the heat wave and bacterial infection, environmental activists insisted that the reason was irresponsible disposal of domestic and industrial pollutants.

Figure 5: Mass Fish Deaths were reported in Shamirpet,
23 May 2017 *(Source: Deccan Chronicle)*

1.3 RESULTS:

TABLE-2: SHAMIRPET LAKE WATER QUALITY

SHAMIRPET LAKE WATER QUALITY												
Sl. No	**Parameters**	**Unit**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**Max Values**	**Permissible Limit**	**Remarks**
1	**DO**	mg/l	3.13	4.16	4.61	4.2	5.2	5.6	5.64	5.64	18	Less than the limit
2	**pH**	mg/l	7.85	8.17	7.51	7.4	7.6	7.7	7.77	8.17	6.5 - 8.5	Exceeds the limit
3	**Conductivity**	mg/l	712.00	327.08	562.83	700.1	580.0	559.0	644.18	712	400	Exceeds the limit
4	**BOD**	mg/l	4.08	2.67	4.17	3.3	2.8	2.2	2.56	4.17	216	Less than the limit
5	**Nitrates**	mg/l	6.99	3.52	1.30	0.5	1.5	1.1	1.45	6.99	10	Less than the limit
6	**Total Coliforms**	mpn/ml	361.00	611.8	106.42	44.2	71.3	158.6	83.00	611.8	0	Found to be present
7	**Fecal Coliforms**	mpn/ml	49.27	40.5	41.25	1.8	3.8	4.9	2.00	49.27	0	Found to be present
8	**COD**	mg/l	87.17	21.8	37.67	15.0	26.2	18.6	25.91	87.17	500	Less than the limit

9	**Chlorides**	mg/l	91.58	37.1	74.58	107.7	79.9	71.5	89.18	91.58	250	Less than the limit
10	**Sulphates**	mg/l	36.50	14.9	38.00	37.3	25.0	36.3	50.00	50.00	400	Less than the limit
11	**TDS**	mg/l	451.67	209.5	356.08	447.4	350.5	338.2	395.12	451.67	500	Less than the limit
12	**Sodium**	mg/l	77.33	21.0	55.17	80.1	58.0	39.8	68.00	77.33	400	Less than the limit
13	**Calcium**	mg/l	49.53	30.0	34.72	41.1	47.4	43.6	40.44	49.53	75	Less than the limit
14	**Alkalinity**	mg/l	164.83	106.3	127.67	161.7	136.8	145.9	142.27	164.83	200	Less than the limit
15	**Magnesium**	mg/l	20.63	12.3	16.03	18.2	24.2	16.2	14.82	20.63	30	Less than the limit
16	**Hardness**	mg/l	187.25	134.8	151.67	177.6	201.5	175.6	162.09	187.25	200	Less than the limit

WQI OF SHAMIRPET LAKE

Based on a variety of water quality factors, a water quality index delivers a single value (much like a grade) that indicates the total water quality at a certain location and time. An index's goal is to translate complicated data on water quality into information that the general public can

use and comprehend.The estimation of WQI was carried out by Horton's method in this work. Using the following expression, the WQI iscalculated.

WQI = Σ qn Wn / Σ Wn (1)

Where qn = quality rating of n th water quality parameter

Wn= unit weight of n th water quality parameter

Quality rating (qn)

The rating of quality is calculated using the expression provided by

qn = (Vn-V id)/ (Sn-V id) x 100 (2)

V id = ideal value (for pH = 7 and for other values it is zero and for DO it is 14.6)

Sn = Acceptable limit as given in BIS 2012 standards

Where Vn= estimated chemical value of sample

Unit Weight (Wn)

In the first step weights are assigned from 1-5 for the designated water quality parameters (Do, pH,

conductivity etc…), depend on parameters relative value in terms of overall water quality for drinking

purposes. Depending on the water quality criteria the more significant parameter is assigned with the

weightage of 5 and the less significant has given the weightage of 2 .

In the next step calculate the Unit weight (Wn) for each chemical parameter using the below equation

Wn = wi / Σwi (3)

Where Wn is unit weight of parameter

The result of Water Quality Index (WQI) parameters of Shamirpet lake data collected has given in below table:

TABLE-3: SHAMIRPET LAKE WATER QUALITY INDEX(WQI)

Year	WQI	Rating of Water Quality for Himayat Sagar Lake
2016	397.45	Unsuitable for Drinking
2017	596.1	Unsuitable for Drinking
2018	150.48	Unsuitable for Drinking
2019	96.68	Very poor
2020	117.83	Unsuitable for Drinking
2021	194.09	Unsuitable for Drinking
2022	131.02	Unsuitable for Drinking

A water quality index based on a few extremely significant factors can offer a straightforward measure of water quality. It offers the general public an idea of any water-related issues that could exist in the area.

The parameters of Water Quality Index (WQI) for Shamirpet lake are namely DO, pH, conductivity, BOD, nitrates, COD, TDS, hardness, magnesium, total coliforms, fecal coliforms, chlorides, sulfates, calcium, alkalinity, and sodium.

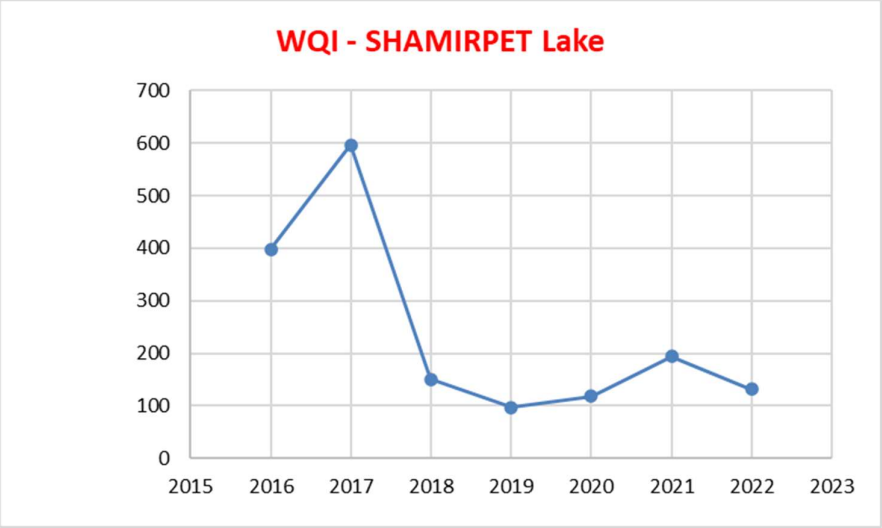

Figure 6: WQI were reported in Shamirpet

Dissolved Oxygen (DO)

Present study reveals that dissolved oxygen in Shamirpet lake is much lesser than expected limits. Dissolved oxygen in water is a very important parameter for supporting aquatic life. The present study reveals that although dissolved oxygen has increased over the years but still comes in poor category. The lowest mean oxygen recorded is during the year 2016 and it slowly increased till 2022. The lower DO is attributed to the presence of algal growth as a result of eutrophication. Dissolved oxygen is directly related to the health of aquatic life in a particular water body. The parameter has high importance in aquaculture. The lake water gets the oxygen either through photosynthesis or through the atmosphere.

A very low dissolved oxygen in 2017 can be correlated to the death of the large number of fishes in May 2017, since temperature soared in May month further reducing the oxygen carrying capacity of the lake.

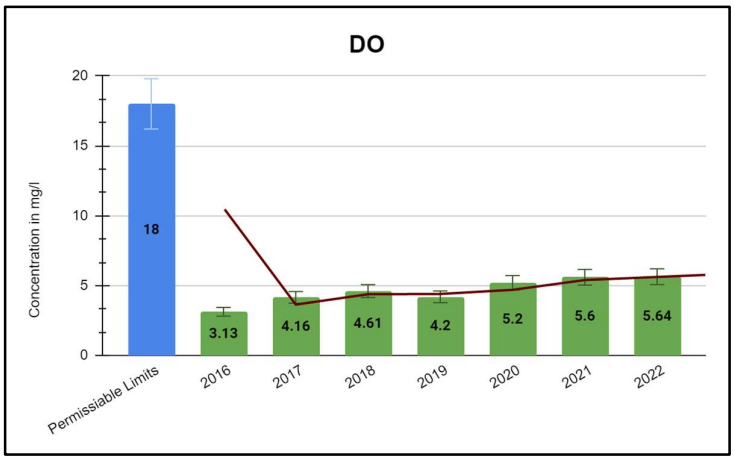

Figure 7: DO in Shamirpet Lake

pH:

The functional stability of any aquatic ecosystem depends on its buffering capacity. pH of any aquatic ecosystem has a very significant role in the survival of aquatic life. The study clearly reveals that pH values are higher than the permissible limit as given in Table1 and Fig 8 The presence of higher concentration of bicarbonates causes the lake water to turn alkaline. The maximum pH values are found to be in the year 2017.

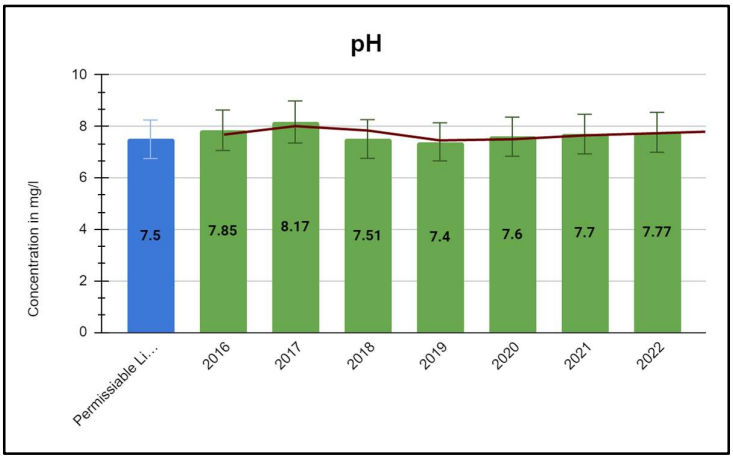

Figure 8: pH in Shamirpet Lake

Conductivity:

Conductivity Of a water body is a useful tool to understand the presence of contaminants in a water body and is used as a general measure of the water quality. Each water body generally has a relatively constant range of conductivity, which is used as a baseline for comparison with regular conductivity measurements. Significant changes in water conductivity are indicative of the discharge or some other source of pollution has entered the aquatic resource. The values of conductivity in Shamirpet lake over a period of seven years is clearly indicative of contaminants.

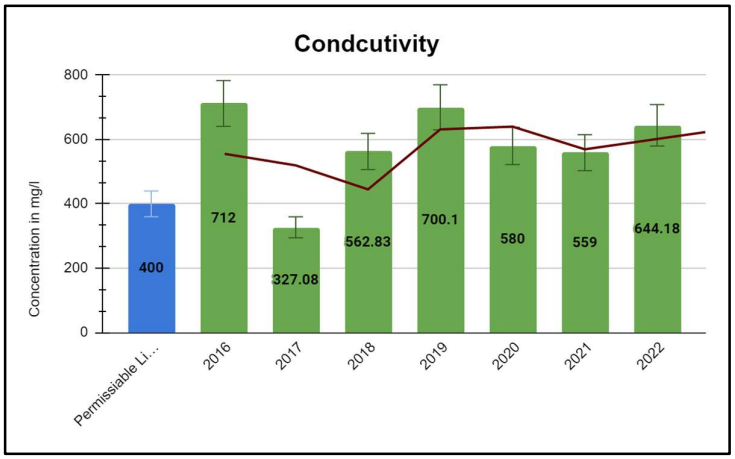

Figure 9: Conductivity in Shamirpet Lake

BOD:

Biological Oxygen Demand (BOD) is an important parameter and a very important indicator of water pollution .BOD indicates the magnitude of water pollution by the oxidizable organic matter. An increased BOD indicates increased oxidizable matter present in the lake. (HAGIWARA, K. (1979) Domestic savage, agricultural runoff and industrial effluents and the main components of oxidizable matter. The main source of organic enrichment of an aquatic ecosystem are domestic savage, agricultural runoff, and industrial effluents. Shamirpet lake BOD was found highest in the year 2018

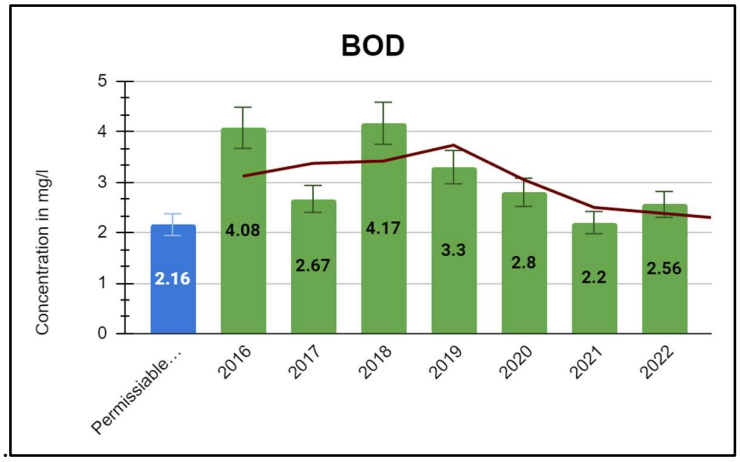

Figure 10: BOD in Shamirpet Lake

Nitrates:

Nitrates are the most important nutrients for aquatic ecosystems which are critical for the growth of plants and animals in aquatic systems. Nitrate is the highly oxidized form of nitrogen compounds commonly present in natural water, because it is produced as a result of aerobic decomposition of organic nitrogenous matter. Nitrate values of Shamirpet lake are found to be less.

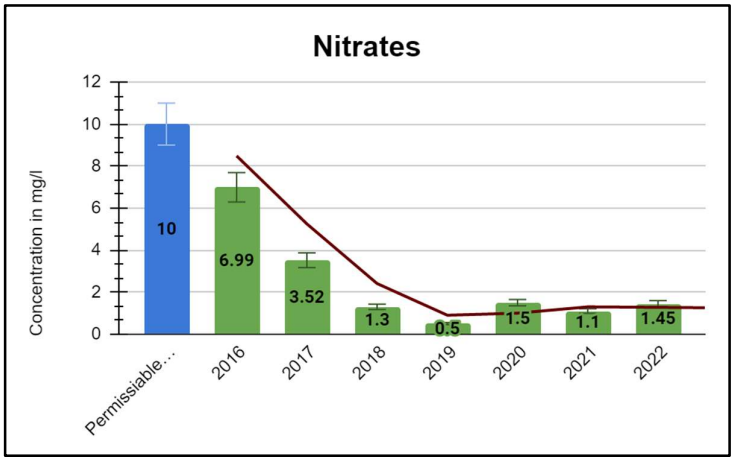

Figure 11: Nitrates in Shamirpet Lake

Total Coliforms:

Total coliform bacteria are an indicator of contamination of the water system The sources include surface runoff containing animal waste from the nearby locations Another important reason is failed septic tanks. The contamination of fresh water bodies by e coli is particularly serious. The number of coliform bacteria in 2017 were maximum in Shamirpet lake.

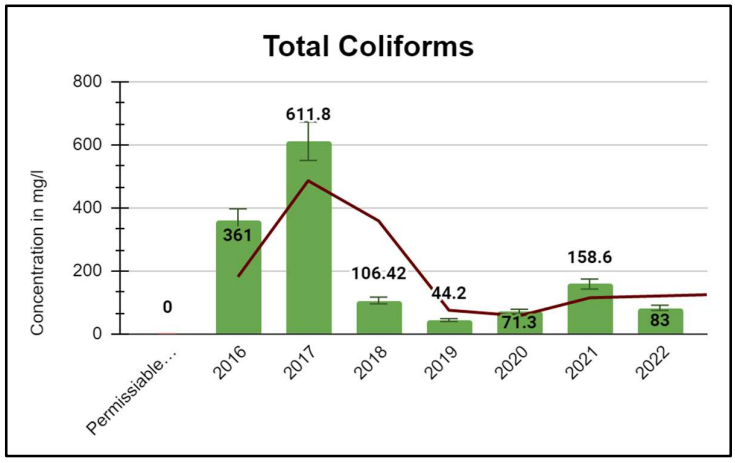

Figure 12: Total Coliforms in Shamirpet Lake

Fecal Coliforms:

The presence of fecal coliform bacteria in aquatic environments is indicative of the presence of contamination of the water body through human or animal feces. This kind of contamination can carry the disease producing bacteria and viruses. The presence of fecal contamination of water clearly indicates the potential risks involved with the exposure of such water. In 2016 and 2017 maximum number of coliform bacteria were observed in Shamirpet lake.

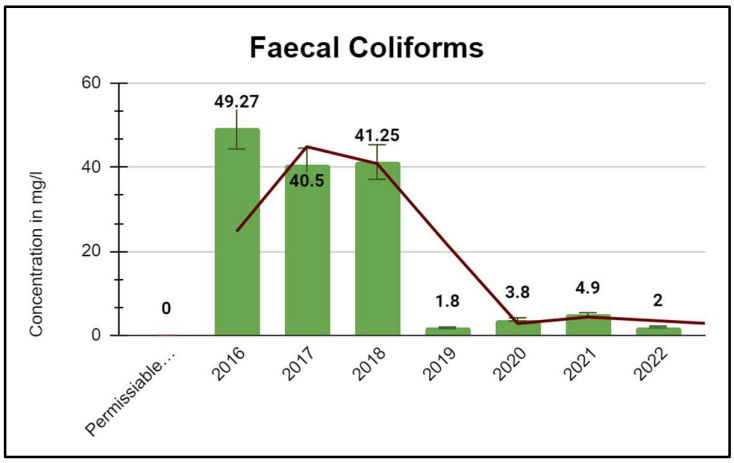

Figure 13: Faecal Coliforms in Shamirpet Lake

COD:

The requirement for oxygen may also increase in the presence of non-biological waste. Chemical oxygen demand, or COD, includes all substances other than organic matter that increase oxygen need. As a result, the COD value always exceeds the BOD value. The COD value has decreased over a period in Shamirpet lake.

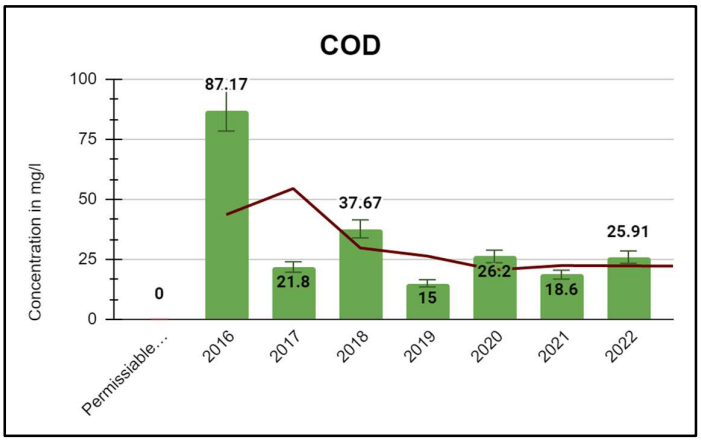

Figure 14: COD in Shamirpet Lake

Chlorides:

High amounts of chloride are toxic to aquatic organisms such as fish and amphibians. Chloride in streams, lakes and wetlands harms aquatic ecosystems and can change the whole ecosystem structure. sources of chloride in water bodies are fertilizers as well poor wastewater management. The values of chloride ranged between 37 mg/l to 91 mg /l.

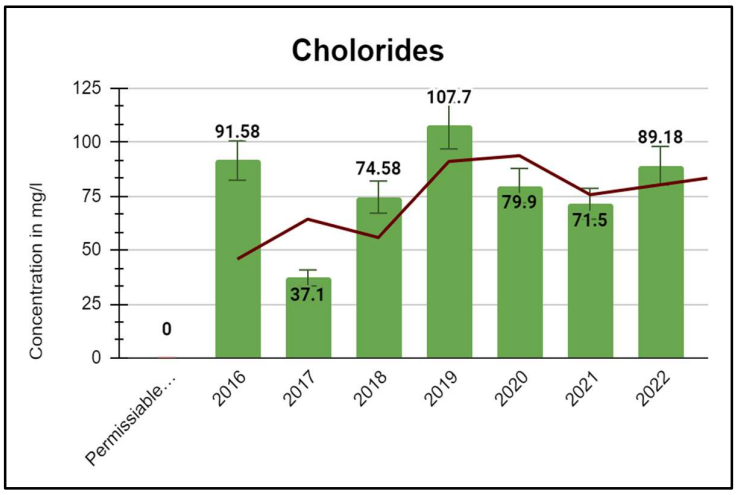

Figure 15: Chlorides in Shamirpet Lake

Sulfate:

Sulfates are a natural or synthetic byproduct of sewage or industrial pollutants. Anthropogenic sources of sulfate are sewage infiltration, fertilizers, synthetic detergents, industrial wastewater and mining drainage,.(Man K., Ma Z.M., Xu X.J.2014, Liu C.Q., Lang Y.C., Satake H., Wu J., Li S.L. 2008, Otero N., Canals À., Soler A. 20070. The diversity of sulfate sources and its effects on the ecological. In Shamirpet lake the sulfate maximum value is in 2022.

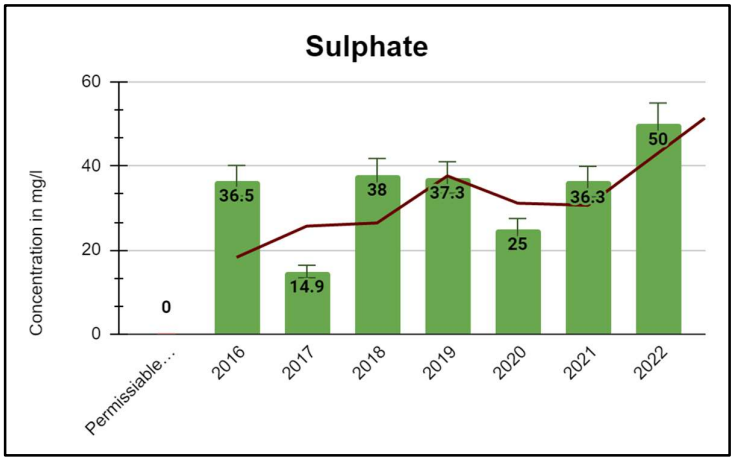

Figure 16: Sulfate in Shamirpet Lake

TDS:

Total Dissolved Solids (mg/L) are important parameters for determining the quality of water. The turbid nature of the water body reflects the concentration and composition of its total dissolved solids in water. The underwater environment, color and transparency of the water body is also dependent upon the nature, size, shape, color, density and dispersion of the suspended particles. The TDS values ranged from 209.5 to 451.67. In Shamirpet lake TDS values were maximum in 2016.

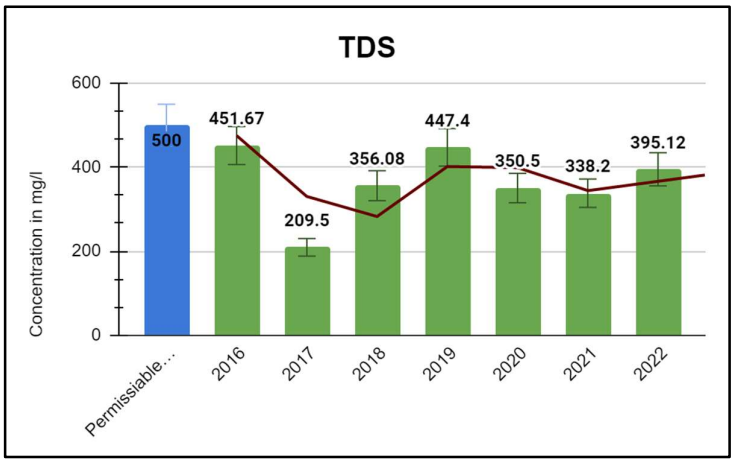

Figure 17: TDS in Shamirpet Lake

Sodium:

Compounds containing sodium naturally end up in water, Many rivers and lakes contain significant amounts of salt contamination. Most of the sodium contamination of fresh water bodies happens because of the industrial effluents discharged in lakes irresponsibly. Shamirpet lake showed significant level of sodium contamination.

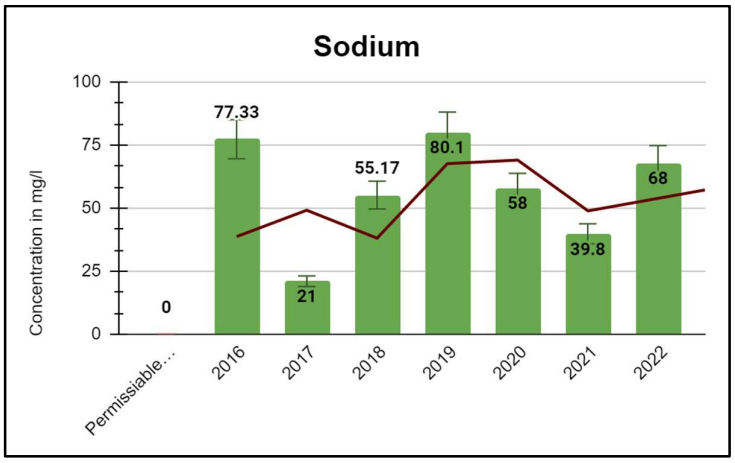

Figure 18: Sodium in Shamirpet Lake

Calcium:

The calcium content in Shamirpet Lake has fluctuated between 30 mg/l and 50 mg/l, which is lower than the permissible limits Calcium content of the lake has a significant role to play in water hardness. It is an important component in the exoskeleton of molluscs and crustaceans.

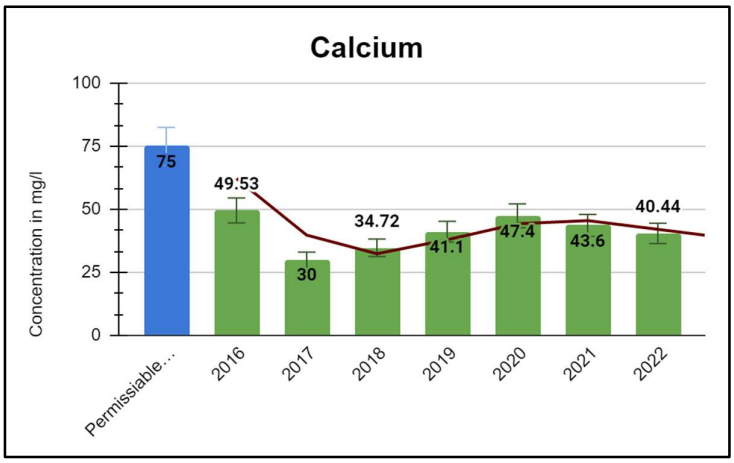

Figure 19: Calcium in Shamirpet Lake

Alkalinity:

According to the Water Quality Association, alkalinity is the amount of acid that can be given to a liquid without significantly changing its pH. It is also known as the water's quantitative ability to neutralize acids. Higher amounts of alkalinity help to maintain the pH level; hence alkalinity and pH are connected. In the past 7 years, the alkalinity value has ranged from 106.3 mg/l to 164.83 mg/l, above the allowable limit.

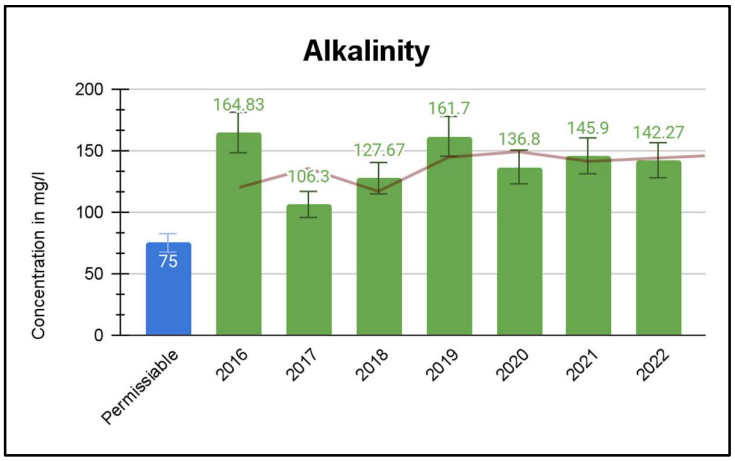

Figure 20: Alkalinity in Shamirpet Lake

Magnesium:

Magnesium (mg/l) Magnesium is another dominant cation in natural Waters. It reaches to lakes through leaching of rocks in the catchment area. It is a vital component of chlorophyll; In Shamirpet lake magnesium is found to be less than the permissible limit of 30 mg/l (International Journal of Applied Biology and Pharmaceutical Technology Page: 165 Available online at www.ijabpt.com Mahender et al Copyrights@2016, ISSN: 0976-4550.)

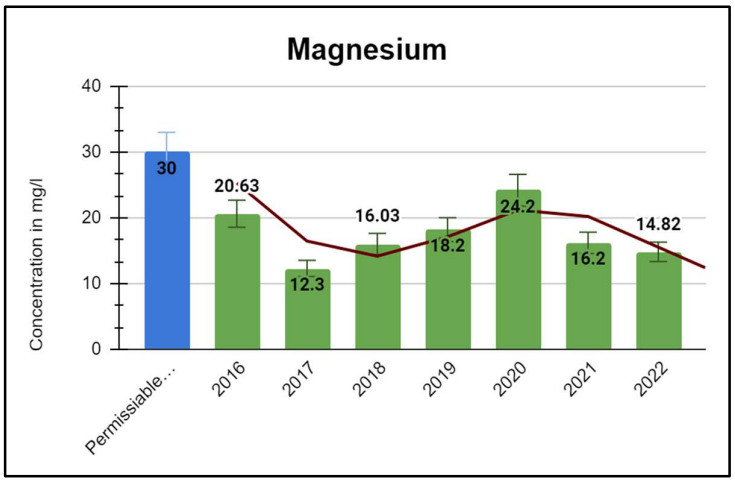

Figure 21: Magnesium in Shamirpet Lake,

Hardness:

Hardness is a conventional indicator of a water's capacity to react with soap, it is caused by many dissolved polyvalent metallic ions, mostly calcium and magnesium cations. The permissible value of hardness is 200 mg/generally hard water is considered less toxic for aquatic life as some of the toxins can form insoluble precipitants and settle down. In Shamirpet, the hardness of water was least during the year 2017.

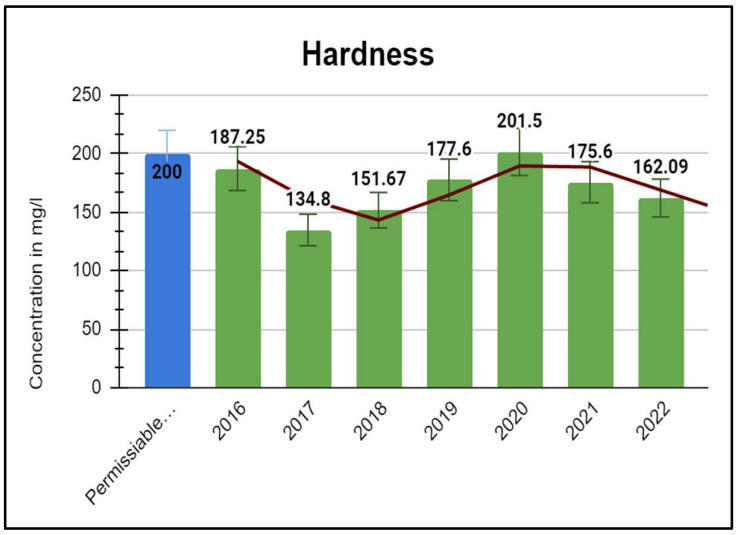

Figure 22: Hardness in Shamirpet Lake

Conclusion

The water quality of Shamirpet lake, located in the suburb of Hyderabad, India, is quite deteriorated. The lake water is unfit for drinking and cannot support a healthy aquatic ecosystem. Very less dissolved oxygen and high Biological Oxygen Demand clearly indicate a risk for aquatic life .Presence of coliform bacteria indicate the presence of untreated sewage in Shamirpet water .the various parameters observed from the year 2016 to 2022 clearly indicate that lake health has not improved substantially to support healthy aquatic life. In this regard, regular monitoring is required to avoid the further contamination of the lakes. Further, it is recommended to use certain bioremediation techniques to improve the water quality,

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