STUDY OF WATER QUALITY PARAMETERS OF LAKES IN AND AROUND HYDERABAD

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ABSTRACT

Water covers 71% of earth's surface. It is vital for all known forms of life. On earth 96.5% of planet's crust water is found in seas and oceans. Only 2.5% of this water is fresh water and 98.8% water is in the form of ice and ground water, less than 0.3% of all fresh waters is in rivers, lakes and atmosphere. Safe drinking water is essential to humans and other life forms even though it provides no calories or organic nutrients. Access to safe drinking water has improved over the last decades in almost every part of the world, but approximately one billion people still lack access to safe water and over 2.5 billion lack access to adequate sanitation. There is a clear correlation between access to safe water and gross domestic product per capita. However, some observers have estimated that by 2025 more than half of the world population will be facing water-based vulnerability. A report, issued in November 2009, suggests that by 2030, in some developing regions of the world, water demand will exceed supply by 50%

As the part of our major project we collected water samples from different lakes (Himayat Sagar, Mir Alam Tank, Shamirpet Lake, Pedda Cheruvu, Kuntloor Pedda Cheruvu and Injapur Lake). Physical, chemical, biological and Micro-Biological tests has been conducted and compared with IS standards. Water Quality Index (WQI) is calculated for all lakes to know water quality of the lakes.

I.INTRODUCTION

1.1 General:

Water, which the chamgers dictionary defined as **"**a clear, transparent colorless liquid, perfectly neutral in its reaction, and devoid of taste or smell**"** is nothing short of a life sustaining liquid and veritably a precious commodity in the contemporary development world Hydrology, a science dealing with the various movements and cycles of this precious liquid forms an integral part of civil engineering. The development of this science or water resources in particular is as old as civilization itself.

Safe drinking water is essential to humans and other lifeforms even though it provides no calories or organic nutrients. Access to safe drinking water has improved over the last decades in almost every part of the world, but approximately one billion people still lack access to safe water and over 2.5 billion lack access to adequate sanitation. However, some observers have estimated that by 2025 more than half of the world population will be facing water-based vulnerability. A report, issued in November 2009, suggests that by 2030, in some developing regions of the world, water demand will exceed supply by 50%.

1.2 Importance of water:

Water covers 71% of the Earth's surface.[1] It is vital for all known forms of life. On Earth, 96.5% of the planet's crust water is found in seas and oceans, 1.7% in groundwater, 1.7% in glaciers and the ice caps of Antarctica and Greenland, a small fraction in other large water bodies, 0.001% in the air as vapor, clouds (formed of ice and liquid water suspended in air), and precipitation. Only 2.5% of this water is freshwater, and 98.8% of that water is in ice (excepting ice in clouds) and groundwater. Less than 0.3% of all freshwater is in rivers, lakes, and the atmosphere.

Water plays an important role in the world economy. Approximately 70% of the freshwater used by humans goes to agriculture. Fishing in salt and fresh water bodies is a major source of food for many parts of the world. Much of long-distance trade of commodities (such as oil and natural gas) and manufactured products is transported by boats through seas, rivers, lakes, and canals. Large quantities of water, ice, and steam are used for cooling and heating, in industry and homes. Water is an excellent solvent for a wide variety of chemical substances; as such it is widely used in industrial processes, and in cooking and washing.

1.3 Classification of Water Resources:

Rain:

It is liquid water in the form of droplets that have condensed from atmospheric water vapor and then becomes heavy enough to fall under gravity. Rain is a major component of the water cycle and is responsible for depositing most of the fresh water on the Earth. It provides suitable conditions for many types of ecosystems, as well as water for hydroelectric power plants and crop irrigation.

Surface waters:

Surface waters include streams, rivers, lakes, reservoirs, and wetlands. The term stream is used here to represent all flowing surface water, from brooks to large rivers. Surface waters and their associated ecosystems provide habitat to many plant and animal species. Because surface waters are on the land surface, they are easily developed for use. Streams are a dynamic part of the environment and are good indicators of what is happening in a watershed. Stream flow in a watershed includes all water contributed from headwater areas, stream banks, channels, flood plains, terraces, connected lakes, ponds, wetlands, and groundwater. Because watersheds are complex systems, each tends to respond differently to natural or human activities.

Ground water:

It is the water found underground in the cracks and spaces in soil, sand and rock. It is stored in and moves slowly through geologic formations of soil, sand and rocks called aquifers. An aquifer is a geological formation or part of it, consisting of permeable material capable to store/yield significant quantities of water. In many places, groundwater discharges naturally to the surface, bubbling into natural springs or contributing to rivers and wetlands. Groundwater often plays a crucial role in sustaining rivers and streams, particularly during droughts when it becomes a valuable buffer. Many ecosystems, including some of our most iconic, depend on groundwater.

1.4 Study Area:

As the part of our major we have considered six different lakes (Himayat Sagar, Mir Alam Tank, Shamirpet Lake, Pedda Cheruvu, Kuntloor Pedda Cheruvu, Injapur Lake) and tests like physical, chemical and biological properties has been conducted. From above results we calculated Water Quality Index (WQI) for all lakes to know the quality of lakes.

Himayat Sagar:

Himayat Sagar is an artificial lake about 20 km from Hyderabad in Telangana, India. It lies parallel to a larger artificial lake Osman Sagar. The storage capacity of the reservoir is 2.9 tmc ft. The construction of reservoir on Esi a tributary of Musi River was completed in 1927, for providing drinking water source for Hyderabad and saving the city from floods, which Hyderabad suffered in 1908. It was built during the reign of the last Nizam of Hyderabad, Nizam VII and is named after his youngest son Himayat Ali Khan.

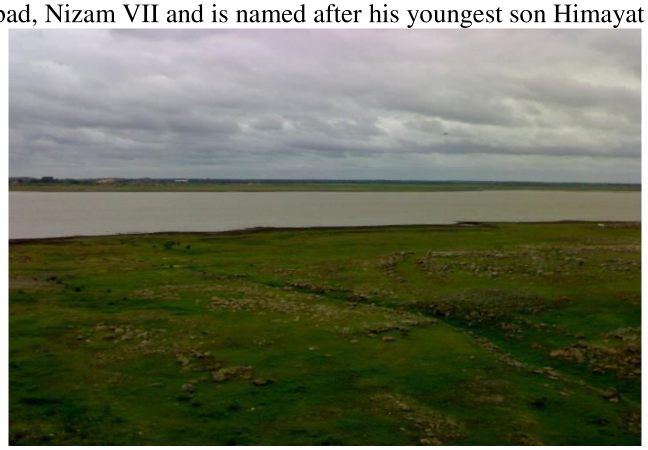


Fig 1: Himayat Sagar Lake

Mir Alam Tank:

Mir Alam Tank is a reservoir in Hyderabad, Telangana, India. It is located to the south of Musi River. It was the primary source of drinking water to Hyderabad before Osman Sagar and Himayat Sagar were built. But due to direct mixing of sewages from nearby towns, Hazardous chemical from small scale industries lead to raise in pollution levels of lakes and causing huge trouble to animals in the zoo.

Fig 2: Mir Alam Tank

Shamirpet Lake:

Shamirpet Lake is 27kms from Secunderabad is an artificial lake dug by Jagirdar of that area 50 years ago. Jawahar deer park is adjacent to the lake. Many exotic species of birds visit this lake attracting bird watchers. The water holding capacity of the lake declined from 469.25 ha in1986 to 208.65 ha in 2009 (Source: Anjal Prakash, SaciWATERs 2014). The lake acts as a source of irrigation for about 10 villages in surrounding areas. The nearby industrial waste dumps and, the residential discharges and solid wastes are polluting the water and made it unfit for portability.

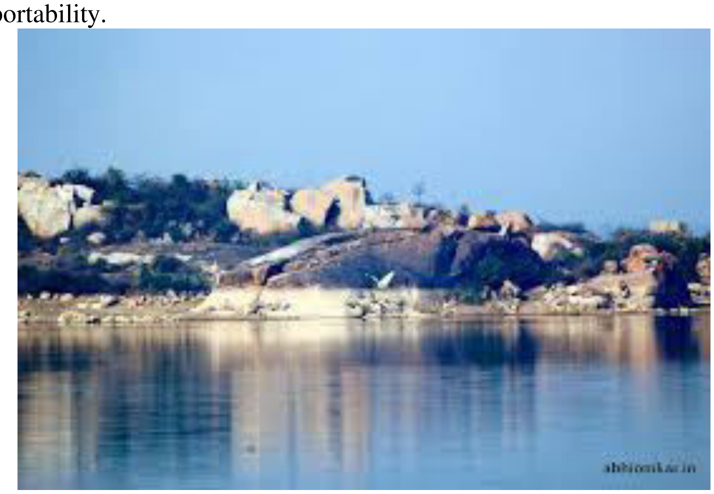


Fig 3: Shamirpet Lake

Pedda Cheruvu:

Pedda Cheruvu, also known as Ramanthapur Lake, is a lake located in Ramanthapur, Hyderabad. It is one of the largest lakes in Hyderabad. It has surface about 9 acres. The water in this lake is completed polluted because of intrusion of harmful chemicals from nearby industries.

Fig 4: Pedda Cheruvu

1.5 Various Parameters and their Importance:

Temperature:

The temperature of a body of water influences its overall quality. Water temperatures outside the "normal" range for a stream or river can cause harm to the aquatic organisms that live there. If the water temperature changes by even a few degrees, it could indicate a source of unnatural warming of the water or thermal pollution. Thermal pollution caused by human activities is one factor that can affect water temperature. Many industries use river water in their processes.

Colour:

Colour is an important measurement for aesthetic purposes affecting the appearance and taste of the water. Colour in drinking water may result from coloured organic substances or natural metallic ions such as iron, manganese and copper. Colour causing organic substances are of particular concern due to their potential for disinfection by-product formation when they are combined with chlorine.

Turbidity:

Turbidity is the clarity or haziness of water, which depends on the presence of suspended insoluble particles. Sometimes the particles are not even visible to the naked eye, but high turbidity might affect the appearance of the water. Measuring turbidity determines how much the passage of light is restricted by the suspended solid matter. In this we will be examining the value of monitoring turbidity in industrial and beverage applications. In potable water, turbidity is frequently due to the presence of oxygen or excessive amounts of calcium, which are not harmful. However, it could also be caused by suspended matter, such as mud, silt, clay or sediment.

Odor and Taste:

Consumers are entitled to a palatable water, as well as a safe water, at all times. The water must be free of any detectable taste and odor when it is used for drinking, cooking, or bathing purposes. Taste, as a specific sensory process, is very rarely a problem in public water supplies. Most 'tastes' are concerned almost entirely with odors. Undesirable odors occur frequently in many water supplies in Illinois, especially those depending upon surface waters as the source of supply. Taste and odor episodes vary in intensity, persistency, and frequency of occurrence. It is the sporadic nature of these episodes that leaves the water plant operator wondering if his treatment techniques corrected the problem or if the problem diminished through a natural course of time. Tastes and odors in water may be derived from a variety of conditions and sources. The sources can be characterized as natural and man-made with the understanding that taste and odor occurrences may develop from either one or the other, or a combination of both.

pH Value:

The pH of a solution is measured as negative logarithm of hydrogen ion concentration. At a given temperature, the intensity of the acidic or basic character of a solution is indicated by pH or hydrogen ion concentration. pH values from 0 to 7 are diminishing acidic, 7 to 14 increasingly alkaline and 7 is neutral. Measurement of pH in one of the most important and frequently used tests, as every phase of water and wastewater treatment and waste quality management is pH dependent. The pH of natural water usually lies in the range of 4 to 9 and mostly it is slightly basic because of the presence of bicarbonates and carbonates of alkali and alkaline earth metals.

Conductivity:

Conductivity is the capacity of water to carry an electrical current and varies both with number and types of ions in the solutions, which in turn is related to the concentration of ionized substances in the water. Most dissolved inorganic substances in water are in the ionized form and hence contribute to conductance.

Total Dissolved Solids:

Total dissolved solids (TDS) is defined as all inorganic and organic substances contained in water that can pass through a 2 micron filter. In general, TDS is the sum of the cations and anions in water. Ions and ionic compounds making up TDS usually include carbonate, bicarbonate, chloride, fluoride, sulfate, phosphate, nitrate, calcium, magnesium, sodium, and potassium, but any ion that is present will contribute to the total. The organic ions include pollutants, herbicides, and hydrocarbons. In addition, soil organic matter compounds such as humic acids are also included in TDS. Total dissolved solids is a non-specific, quantitative measure of the amount of dissolved inorganic chemicals but does not tell us anything about its nature. TDS is not considered a primary pollutant with any associated health effects in human drinking water standards, but it is rather used as an indication of aesthetic characteristics of drinking water.

Hardness:

Water hardness is the traditional measure of the capacity of water to react with soap, hard water requiring considerably more soap to produce a lather. Hard water often produces a noticeable deposit of precipitate (e.g. insoluble metals, soaps or salts) in containers, including "bathtub ring". It is not caused by a single substance but by a variety of dissolved polyvalent metallic ions, predominantly calcium and magnesium cations, although other cations (e.g. aluminum, barium, iron, manganese, strontium and zinc) also contribute. Hardness is most commonly expressed as milligrams of calcium carbonate equivalent per liter. Water containing calcium carbonate at concentrations below 60 mg/l is generally considered as soft; 60–120 mg/l, moderately hard; 120–180 mg/l, hard; and more than 180 mg/l, very hard (McGowan, 2000).

Calcium and Magnesium:

Calcium ions solved in water form deposits in pipes and boilers and when the water is hard, that is, when it contains too much calcium or magnesium. This can be avoided with the water_softeners. In the industry, metallic calcium is separated from the melted calcium chloride by electrolysis. This is obtained by treatment of carbonated_minerals with chlorhydric acid, or like a sub product of the carbonates Solvay process. In contact with air, calcium develops an oxide and nitride coating, which protects it from further corrosion. It burns in the air at a high temperature to produce nitride.

Alkalinity:

The Water Quality Association defines alkalinity as the quantitative capacity of water to neutralize an acid; that is, the measure of how much acid can be added to a liquid without causing a significant change in pH. Alkalinity is often confused with pH as water with a pH above 7 is commonly referred to as alkaline. Alkalinity is not the same as pH because water does not have to be strongly basic (pH above 7) to have a high alkalinity level. Alkalinity is related to pH, because higher levels of alkalinity are useful in stabilizing the pH level.

Nitrates:

Nitrate and nitrite are naturally occurring ions that are part of the nitrogen cycle. The nitrate ion (NO_3^-) is the stable form of combined nitrogen for oxygenated systems. Although chemically unreactive, it can be reduced by microbial action. The nitrite ion (NO_2^-) contains nitrogen in a relatively unstable oxidation state. Chemical and biological processes can further reduce nitrite to various compounds or oxidize it to nitrate. Unlike temperature and dissolved oxygen, the presence of nitrates usually does not have a direct effect on aquatic insects or fish.

Total Phosphates:

Phosphorus occurs naturally in rocks and other mineral deposits. During the natural process of weathering, the rocks gradually release the phosphorus as phosphate ions which are soluble in water and the mineralize phosphate compounds breakdown. Phosphates PO_4^{-3} are formed from this element.

Chlorides:

Chloride content in water can be an indication of the human impact on local water supplies. Chloride (Cl) can be found naturally in water supplies (lakes, streams, rivers, etc.) but it is also present in sewage. If a water supply normally contains little chloride, then the presence of higher levels can be an indication of human activity (pollution, recreational activity, land development, etc.). Chlorides are widely distributed in nature as salts of sodium (NaCl), potassium (KCl), and calcium ($CaCl_2$). Chloride increases the electrical conductivity of water and thus increases its corrosivity.

Iron:

Iron can be a troublesome chemical in water supplies. Making up at least 5 percent of the earth's crust, iron is one of the earth's most plentiful resources. Rainwater as it infiltrates the soil and underlying geologic formations dissolves iron, causing it to seep into aquifers that serve as sources of groundwater for wells. Iron is mainly present in water in two forms: either the soluble ferrous iron or the insoluble ferric iron.

Fluorides:

Fluoride is a naturally occurring element, abundant in the Earth's crust. It is not essential for growth and development of humans or other organisms. Most fluorine occurs as insoluble fluorides, but there is some ionized fluoride in soil and groundwater. There are large differences in the amount of fluoride found naturally in water supplies.

Sulfates:

Sulfate is second to bicarbonate as the major anion in hard water reservoirs. Sulfates (SO_4^{--}) can be naturally occurring or the result of municipal or industrial discharges. When naturally occurring, they are often the result of the breakdown of leaves that fall into a stream, of water passing through rock or soil containing gypsum and other common minerals, or of atmospheric deposition.

Sodium:

Sodium compounds naturally end up in water. As was mentioned earlier, sodium stems from rocks and soils. Not only seas, but also rivers and lakes contain significant amounts of sodium. Concentrations however are much lower, depending on geological conditions and wastewater contamination. Sodium compounds serve many different industrial purposes, and may also end up in water from industries.

Potassium:

Potassium is an essential element in humans and is seldom, if ever, found in drinking water at levels that could be a concern for healthy humans. It occurs widely in the environment, including all natural waters. It can also occur in drinking-water as a consequence of the use of potassium permanganate as an oxidant in water treatment. In some countries, potassium chloride is being used in ion exchange for household water softening in place of, or mixed with, sodium chloride, so potassium ions would exchange with calcium and magnesium ions.

Dissolved Oxygen:

Oxygen is critical for the animals that live in the water. Just as land-based organisms need oxygen to live, so do aquatic animals. The more oxygen dissolved in water; usually the better it is for aquatic life. You typically have the greatest diversity in waters with high levels of dissolved oxygen. Oxygen comes into water through two processes. The first is photosynthesis. Plants and algae in the water produce oxygen during the daytime. Those same plants consume oxygen during the night. If there are many plants in the water, oxygen levels may increase as the day goes on and plants are photosynthesizing more. Oxygen also enters the water directly from the atmosphere. Tumbling water mixes and dissolves atmospheric oxygen. Waterfalls and rapids tend to increase the amount of oxygen in water. Reduced DO levels in stream water may be because the water is too warm. The increased molecular activity of the warm water pushes the oxygen molecules out of the spaces between the moving water molecules.

Biochemical Oxygen Demand:

Biochemical oxygen demand or BOD is a chemical procedure for determining the amount of dissolved oxygen needed by aerobic biological organisms in a body of water to break down organic material present in a given water sample at certain temperature over a specific time period. It is not a precise quantitative test, although it is widely used as an indication of the organic quality of water. It is most commonly expressed in milligrams of oxygen consumed per liter of sample during 5 days (BOD_5) of incubation at 20°C and is often used as a robust surrogate of the degree of organic pollution of water. BOD directly affects the amount of dissolved oxygen in rivers and streams. The rate of oxygen consumption is affected by a number of variables: temperature, pH, the presence of certain kinds of microorganisms, and the type of organic and inorganic material in the water. The greater the BOD, the more rapidly oxygen is depleted in the stream.

Coliforms:

Coliform bacteria are present in the environment and feces of all warm-blooded animals and humans. Coliform bacteria are unlikely to cause illness. However, their presence in drinking water indicates that disease-causing organisms (pathogens) could be in the water system. Most pathogens that can contaminate water supplies come from the feces of humans or animals. Testing drinking water for all possible pathogens is complex, time-consuming, and expensive.

II.LITERATURE REVIEW

Ramachandraiah, Chigurupati Vedakumar, through their study on Hyderabad's Water Issues and the Musi River Need for Integrated Solutions. This paper brings out clearly that as the city of Hyderabad has grown in size and is emerging as a global megacity, its water resources have been neglected to the detriment of long-term water security of the people. Non-implementation of the environmental laws relating to the protection of water resources and haphazard planning and growth of the city have exerted tremendous pressure on the city's water resources: Musi river, Osmansagar, Himayathsagar, and innumerable water bodies that were built by its early rulers. With the old sources declining and the demand for water growing, the city is drawing water from longer distances.

The Musi River has been reduced to a sewer drain carrying the domestic and industrial waste generated in Hyderabad city. This has had an adverse impact on the river ecology and the villages in the downstream of the river. Even today, the government's approach to the conservation of Musi is piece-meal in nature and not integrated. The future water security of Hyderabad city lies in an integrated management of the entire catchment area of the Musi River and a number of water bodies that are still existing in and around the city.

Laith Hemed Kamel Al Hachami and Praveen Raj Saxena through their study on Seasonal Variations of Water Quality Index of Osmansagar Lake in Hyderabad City– A Case Study they have concluded that, Both the surface waters and ground waters around Osmansagar lake are slightly hard to alkaline in nature. All the parameters of water samples fall within the permissible levels as compared to WHO: 2006 drinking water standards except for few samples. The different indices for evaluation of waters for its suitability for irrigation such as Sodium Adsorption Ratio (SAR), USSL, RSC, Na% and PI were also calculated. According to Sodium Adsorption Ratio (SAR) all the water samples (GW&SW) fall in low sodium class (S1) denoting little (or) no hazard. According to USSL diagram, 93% of water samples (GW&SW) fall in C3S1 indicating high salinity and low sodium class. Na% indicates that all the water samples (GW&SW) fall under the good category. Residual Sodium Carbonate (RSC) indicates that majority of the samples fall in good category. According to Permeability Index (PI) all the water samples are suitable for irrigation. Hence it can be concluded that Osmanasagar lake waters and ground waters in and around Osmansagar are well suitable for drinking and irrigation purpose exceptionally for few samples.

III.METHODOLOGY

3.1 Sample Collections from lakes:

Rinse the sample container 3 times with the corresponding lake water before it is filled. Leave a small air space in the bottle to allow mixing of sample at the time of analysis. Label the sample container properly. The sample code and the sampling date should be clearly marked. Water is collected through standards procedure given by American Public Health Association (APHA), 2005[9]. Water samples are collected 2 meters from surface of water at different random location.

3.1.1 Himayat Sagar:

About four samples were collected from different location using water sample collector which helps to collect water 2 meters below from surface level of water. For given samples physical, chemical and biological parameters has been tested to known the water quality of lake.

3.1.2 Mir Alam Tank:

About five samples were collected because of availability of boat facility for this lake. Samples were collected at five different locations which were randomly selected about 2 meters below form surface level. Then samples are tested for physical, chemical and biological properties.

3.1.3 Shamirpet Lake:

About five samples were collected because of availability of boat facility for this lake. Samples were collected at five different locations which were randomly selected about 2 meters below form surface level. Then samples are tested for physical, chemical and biological properties.

3.1.4 Pedda Cheruvu:

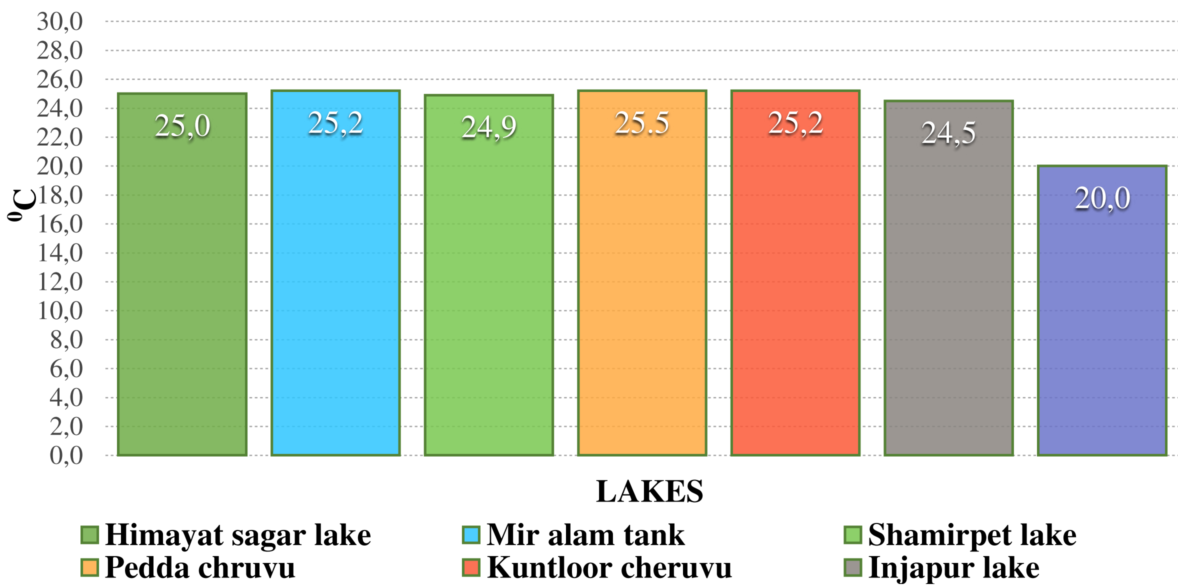
About four samples were collected from different location using water sample collector which helps to collect water 2 meters below from surface level of water. For given samples physical, chemical and biological parameters has been tested to known the water quality of lake.

IV. RESULTS AND DISCUSSION

Temperature:

Table 4: Observed Average Temperature values of Lakes.

S.NO	LAKE	Average Value	Permissible Limit (IS 10500)
1	Himayat Sagar	25^0C	10 – 20^0C
2	Mir Alam Tank	25.2^0C	10 – 20^0C
3	Shamirpet Lake	24.9^0C	10 – 20^0C
4	Pedda Cheruvu	25.5^0C	10 – 20^0C
5	Kuntloor Pedda Cheruvu	25.2^0C	10 – 20^0C
6	Injapur Lake	24.5^0C	10 – 20^0C

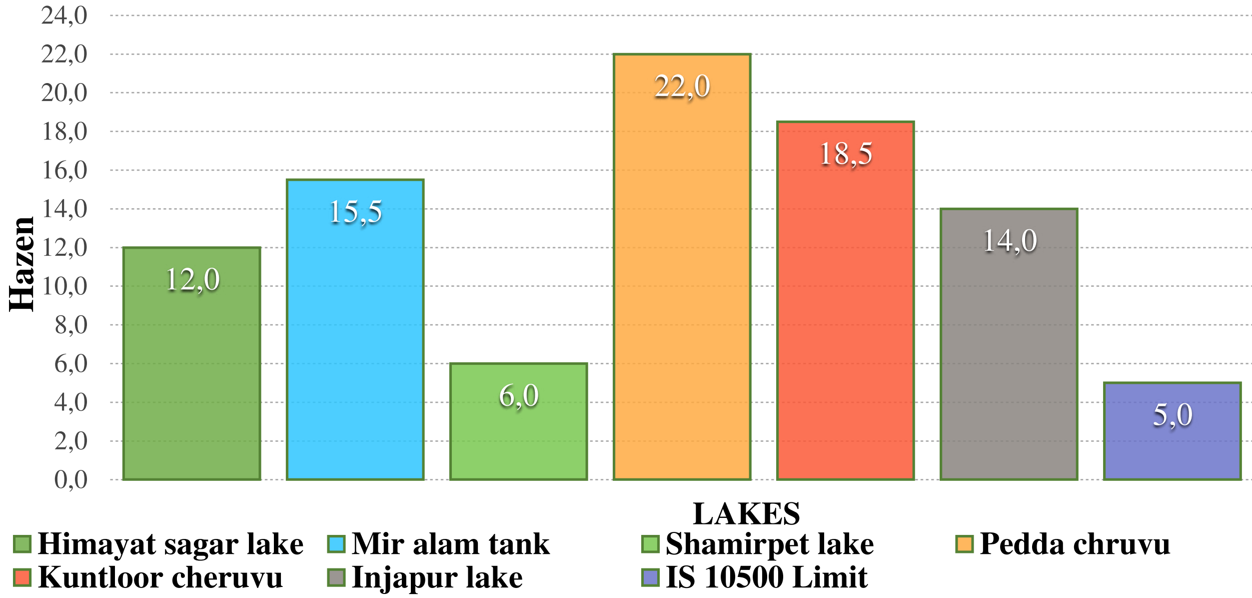


Graph 1: Variation in Temperature of different Lakes.

Colour:

Table 5: Observed Average Hazen units of Lakes.

S.NO	LAKE	Average (Hazen units)	Permissible Limit (IS 10500)
1	Himayat Sagar	12.0	<5 Hazen
2	Mir Alam Tank	15.5	<5 Hazen
3	Shamirpet Lake	6.0	<5 Hazen
4	Pedda Cheruvu	22	<5 Hazen
5	Kuntloor Pedda Cheruvu	18.5	<5 Hazen
6	Injapur Lake	14	<5 Hazen

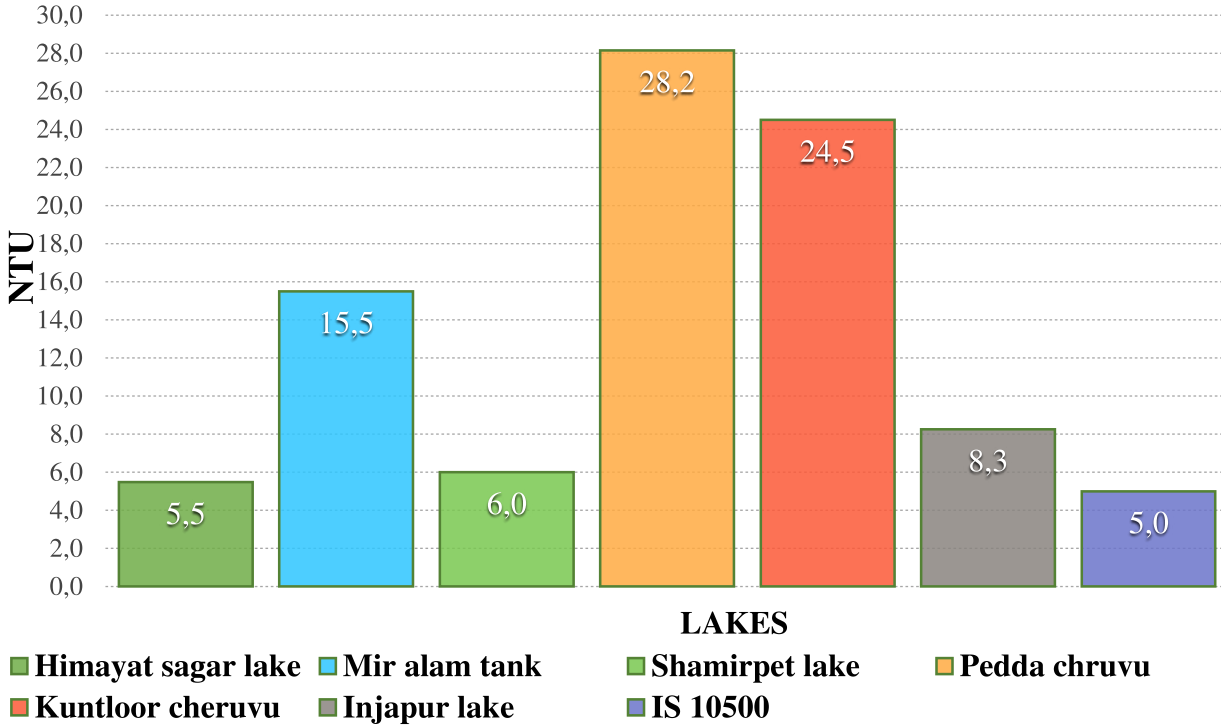


Graph 2: Variation in Colour of Different Lakes.

Turbidity:

Table 6: Observed Average Turbidity values of Lakes.

S.NO	**LAKE**	**Average** (NTU)	**Permissible Limit (IS 10500)**
1	Himayat Sagar	5.475	<5 NTU
2	Mir Alam Tank	15.5	<5 NTU
3	Shamirpet Lake	6.0	<5 NTU
4	Pedda Cheruvu	28.15	<5 NTU
5	Kuntloor Pedda Cheruvu	24.5	<5 NTU
6	Injapur Lake	8.25	<5 NTU

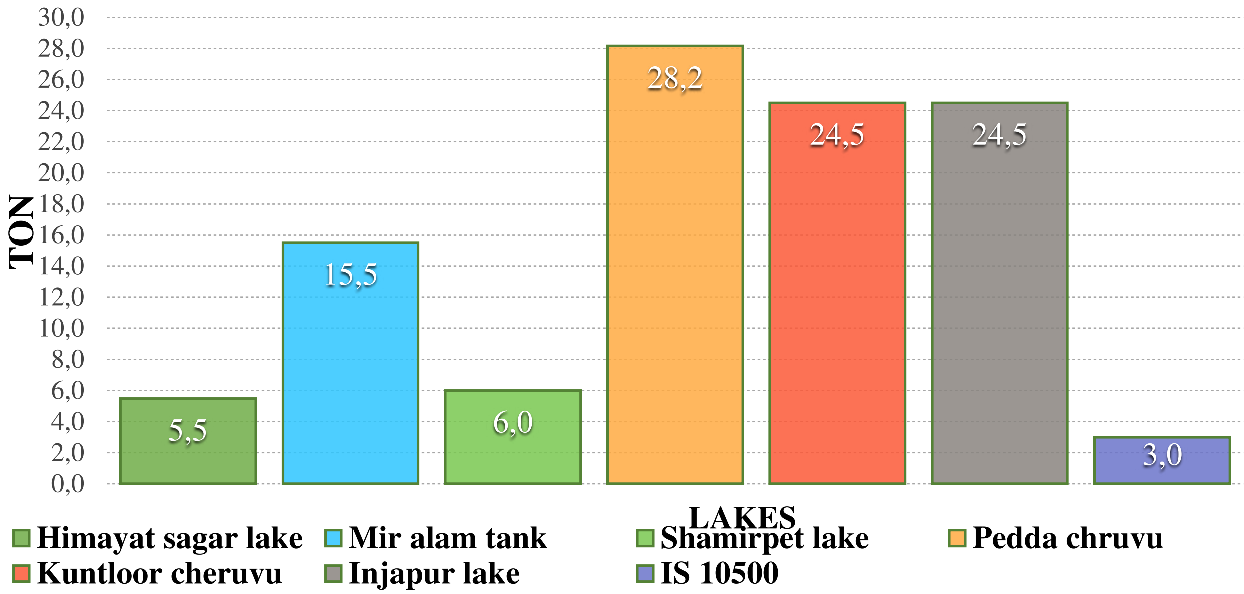


Graph 3: Variation in Turbidity of Different Lakes

Odor and Taste:

Table 7: Observed Average TON units of Lakes.

S.NO	LAKE	**Average** (TON)	**Permissible Limit (IS 10500)**
1	Himayat Sagar	5.475	<3 TON
2	Mir Alam Tank	15.5	<3 TON
3	Shamirpet Lake	6.0	<3 TON
4	Pedda Cheruvu	28.15	<3 TON
5	Kuntloor Pedda Cheruvu	24.5	<3 TON
6	Injapur Lake	8.25	<3 TON

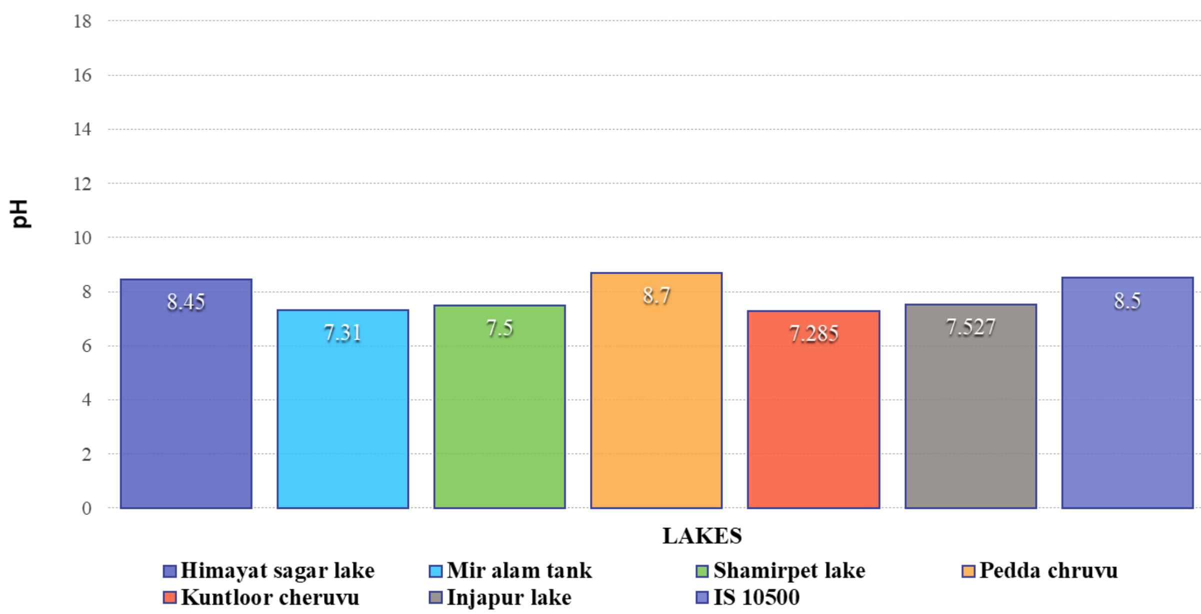


Graph 4: Variation in Odour and Taste of Different Lakes.

pH:

Table 8: Observed Average pH of Lakes.

S.NO	LAKE	Average	Permissible Limit (IS 10500)
1	Himayat Sagar	8.45	6.5-8.5
2	Mir Alam Tank	7.31	6.5-8.5
3	Shamirpet Lake	7.5	6.5-8.5
4	Pedda Cheruvu	8.7	6.5-8.5
5	Kuntloor Pedda Cheruvu	7.285	6.5-8.5
6	Injapur Lake	7.527	6.5-8.5



Graph 5: Variation in pH of Different Lakes.

4.1 Water Quality Index (WQI):

A water quality index provides a single number (like a grade) that expresses overall water quality at a certain location and time based on several water quality parameters. The objective of an index is to turn complex water quality data into information that is understandable and useable by the public. This type of index is similar to the index developed for air quality that shows if it's a red or blue air quality day. The use of an index to "grade" water quality is a controversial issue among water quality scientists. A single number cannot tell the whole story of water quality; there are many other water quality parameters that are not included in the index. The index presented here is not specifically aimed at human health or aquatic life regulations. However, a water index based on some very important parameters can provide a simple indicator of water quality. It gives the public a general idea the possible problems with the water in the region.

Samples were assessed for ten physio-chemical parameters namely pH, Electrical Conductivity, Total Dissolved Solid, Total Hardness, Nitrates, Sulphate, Chlorides, Calcium, Dissolved Oxygen and Biochemical Oxygen Demand. The calculation of the WQI was done using weighted arithmetic index method.

Calculation of Water Quality Index:

Himayat Sagar Lake:

Table : Calculation of Water Quality Index of Himayat Sagar.

Parameters	**Observed Values** (Vi)	**Standard Values** (Si)	**Units Weights**(Wi)	**Quality Rating** (Qi)	W_i*Q_i
pH	8.45	6.5-8.5	0.2190	96.66	21.17
Electrical Conductivity	331.5	<250 µ-siemen/cm	0.3710	132.6	49.19
TDS	212.5	<500 ppm	0.0037	42.5	0.15725
Total Hardness	129	<300 ppm	0.0062	43	0.2666
Calcium	67	<75 ppm	0.0250	89.33	2.233
Chlorides	40.5	<250 ppm	0.0074	16.2	0.11988
Nitrates	14.5	<45 ppm	0.0412	32.22	1.327
Sulphate	25.5	<200 ppm	0.0124	12.75	0.1581
Dissolved Oxygen	5.5	5-14 ppm	0.3723	94.79	35.29
BOD	3.3	<5 ppm	0.3723	84	24.57

$\sum_{i=1}^{n}$ Wi = **1.4305** $\sum_{i=1}^{n}$ Wi $*$ Qi = **134.48**

WQI = $\left(\sum_{i=1}^{n} \frac{Wi*Qi}{Wi}\right)$*100 = **94**

Mir Alam Tank Lake:

Table 32: Calculation of Water Quality Index of Mir Alam Tank.

Parameters	**Observed Values** (Vi)	**Standard Values** (Si)	**Units Weights**(Wi)	**Quality Rating** (Qi)	W_i*Q_i
pH	7.31	6.5-8.5	0.2190	20.6	4.5114
Electrical Conductivity	1480	<250 µ-siemen/cm	0.3710	592	219.63
TDS	962	<500 ppm	0.0037	192.4	0.7118
Total Hardness	422.25	<300 ppm	0.0062	140.75	0.8726
Calcium	112	<75 ppm	0.0250	149.33	3.733
Chlorides	219	<250 ppm	0.0074	87.6	0.648
Nitrates	24.5	<45 ppm	0.0412	54.5	2.24128
Sulphate	71.5	<200 ppm	0.0124	35.75	0.4433
Dissolved Oxygen	3.5	5-14 ppm	0.3723	115.62	43.15
BOD	3.5	<5 ppm	0.3723	110	26.061

$\sum_{i=1}^{n}$ Wi = **1.4305** $\sum_{i=1}^{n}$ Wi $*$ Qi = **302**

WQI = $\left(\sum_{i=1}^{n} \frac{Wi*Qi}{Wi}\right)$*100 = **211**

Shamirpet Lake:

Table : Calculation of Water Quality Index of Shamirpet Lake.

Parameters	**Observed Values** (Vi)	**Standard Values** (Si)	**Units Weights**(Wi)	**Quality Rating** (Qi)	W_i*Q_i
pH	7.5	6.5-8.5	0.2190	33.33	7.96
Electrical Conductivity	513	<250 µ-siemen/cm	0.3710	205.2	76
TDS	356.25	<500 ppm	0.0037	71.2	0.263
Total Hardness	153.3	<300 ppm	0.0062	51	0.3162
Calcium	46	<75 ppm	0.0250	61.33	1.533
Chlorides	60	<250 ppm	0.0074	24	0.1776
Nitrates	16	<45 ppm	0.0412	35.55	1.4646
Sulphate	56	<200 ppm	0.0124	28	0.3472
Dissolved Oxygen	4	5-14 ppm	0.3723	110.4	41.12
BOD	3.4	<5 ppm	0.3723	43.2	16.083

$\sum_{i=1}^{n} \text{Wi} = \mathbf{1.4305}$ $\quad\quad \sum_{i=1}^{n} \text{Wi} * \text{Qi} = \mathbf{143.86}$

$$\textbf{WQI} = \left(\sum_{i=1}^{n} \frac{Wi*Qi}{Wi}\right)*100 = \mathbf{100.2}$$

V.CONCLUSIONS

1) Water Quality Index (**WQI**) of Himayat Sagar Lake is **94**. Water quality is frequently impaired; conditions often depart from desirable levels. Therefore water quality in this lake is **very poor**. Thus this water can be used for Irrigation directly. From the above results we can clearly notice that physical parameters are not satisfactory. Therefore by proper filtration and disinfection water can be treated and used as potable water.

2) Water Quality Index (**WQI**) of Mir Alam Tank is **221**. Water quality is almost always impaired; conditions usually depart from desirable levels. Therefore water quality in this lake is **bad**. Thus this water can be used for irrigation when no other source is available. From above results we can clearly notice that physical, chemical and biological parameters are not within the limits. So intensive treatment is required for treating of water**.**

3) Water Quality Index (**WQI**) of Shamirpet Lake is **100**. Water quality is frequently impaired; conditions often depart from desirable levels. Therefore water quality in this lake is **Very poor**. Thus this water can be used for Irrigation directly. From the above results we can clearly notice that physical and biological properties are not satisfactory. Therefore by proper filtration and disinfection water can be treated and used as potable water.

4) Water Quality Index (**WQI**) of this Pedda Cheruvu Lake is **267.** Water quality is frequently impaired; conditions often depart from desirable levels. Therefore water quality in this lake is **bad**. This Lake water is not aesthetically pleasing for irrigation purposes. From above results we can notice that physical, chemical, and biological parameters are very high range values then standards. Highly polluted lake. Costly treatment procedure required for treating of water.

5) Water Quality Index (**WQI**) of this Kuntloor Cheruvu Lake is **205**. Water quality is frequently impaired; conditions often depart from desirable levels. Therefore water quality in this lake is **bad.** Thus this water can be used for irrigation when no other source is available. From above results we can notice that physical, chemical, and biological parameters are having very high values then standards. This is a polluted lake. Costly treatment procedure required for treating of water.

6) Water Quality Index (**WQI**) of this Injapur Lake is **165**. Water quality is frequently impaired; conditions often depart from desirable levels. Therefore water quality in this lake is **bad**. Thus this water can be used for irrigation if no other source is available. From the above results we can notice that physical and chemical properties are slightly higher because of dumping of Lord Ganesh idols into the lake which leads to pollution in the lake. So intensive treatment is required for treating of water.

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