STUDY OF WATER QUALITY INDEX OF LAKES IN AND AROUND HYDERABAD

Mr.G.Srinivas
Mahatma Gandhi Institute of Technology, Hyderabad, Telangana, India

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%

In this paper water samples from different lakes in and around Hyderabad like Himayat Sagar, Mir Alam Tank, Shamirpet Lake, Pedda Cheruvu, Kuntloor Pedda Cheruvu and Injapur Lake were selected and Water Quality Index (WQI) is calculated for all lakes to know water quality of the lakes.

KEYWORDS: Lake water, Quality Variation with WQI.

INTRODUCTION:

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%.

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.

Study area selected :

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.

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.

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.

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.

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.

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.

Kuntloor 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.

Injapur Lake:

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.

Sample collection at Himayat Sagar Lake

Sample collection at Mir Alam Tank

Sample collection at Shamirpet

Sample collection at Peddacheruvu

Sample collection at Kuntloor Pedda cheruvu

Sample collection at Injapur lake

Methodology : pH, Electrical Conductivity, TDS, Total Hardness, Calcium, Chlorides, Nitrates, Sulphates, Dissolved Oxygen and BOD values were obtained by conducting related tests on collected water samples and based on those values in different lakes Water Quality Index values for different lakes were obtained

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.

Procedure:

The calculation of the WQI was done using weighted arithmetic water quality index which was originally proposed by Horton (1965) and developed by Brown et al (1972). The weighted arithmetic water quality index (WQI) is in the following form:

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

$\mathbf{W_i}$ = Unit weight

$\mathbf{Q_i}$ = Quality rating

Where n is the number of variables or parameters, Wi is the relative weight of the i th parameter and qi is the water quality rating of the i th parameter. The unit weight (Wi) of the various water quality parameters are inversely proportional to the recommended standards for the corresponding parameters.

According to Brown et al (1972), the value of qi is calculated using the following equation:

$$Q_i = 100*[(V_i - V_{id}) / (S_i - V_{id})]$$

V_i = the observed value of the i th parameter

V_{id} = Ideal values

S_i = the standard permissible value of the i th parameter

For pH, the ideal value is 7.0 (for natural/pure water) and a permissible value is 8.5 (for polluted water). Therefore, the quality rating for pH is calculated from the following equation:

$$Q_{pH} = 100\ [(V_{pH} - 7.0) / (8.5 - 7.0)]$$

For dissolved oxygen, the ideal value is 14.6 mg/L and the standard permissible value for drinking water is 5 mg/L. Therefore, its quality rating is calculated from the following equation:

$$Q_{DO} = 100\ [(V_{DO} - 14.6) / (5.0 - 14.6)]$$

Calculation of Water Quality Index:

Himayat Sagar Lake:

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

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

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

Mir Alam Tank Lake:

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

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

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

Shamirpet Lake:

Parameters	**Observed Values (Vi)**	**Standard Values** (Si)	**Units Weights**(Wi)	**Quality Rating** (Qi)	**Wi*Qi**
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

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

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

Pedda Cheruvu:

Parameters	**Observed Values (Vi)**	**Standard Values** (Si)	**Units Weights**(Wi)	**Quality Rating** (Qi)	**W_i*Q_i**
pH	8.7	6.5-8.5	0.2190	113.33	24.81
Electrical Conductivity	1680	<250 µ-siemen/cm	0.3710	672	249.312
TDS	1091.5	<500 ppm	0.0037	218.3	0.0807
Total Hardness	414	<300 ppm	0.0062	138	0.8556
Calcium	188.5	<75 ppm	0.0250	251.33	6.283
Chlorides	211.5	<250 ppm	0.0074	84.6	0.6264
Nitrates	24.3	<45 ppm	0.0412	56.11	2.312
Sulphate	80.5	<200 ppm	0.0124	40.25	0.499

Dissolved Oxygen	2.5	5-14 ppm	0.3723	126.04	46.9
BOD	6.7	<5 ppm	0.3723	134	49.88

$\sum_{i=1}^{n}$ Wi = **1.4305** $\sum_{i=1}^{n}$ Wi ∗ Qi = **381.55**

WQI = $\left(\sum_{i=1}^{n}\frac{Wi*Qi}{Wi}\right)$*100 = **266.7**

Kuntloor Pedda Cheruvu:

Parameters	**Observed Values (Vi)**	**Standard Values** (Si)	**Units Weights**(Wi)	**Quality Rating** (Qi)	**W_i*Q_i**
pH	7.285	6.5-8.5	0.2190	19	4.161
Electrical Conductivity	1342.5	<250 µ-siemen/cm	0.3710	537	199.27
TDS	871.5	<500 ppm	0.0037	174.3	0.644
Total Hardness	405.3	<300 ppm	0.0062	135	0.837
Calcium	125.5	<75 ppm	0.0250	167.33	4.183
Chlorides	218	<250 ppm	0.0074	87.2	0.6452
Nitrates	32	<45 ppm	0.0412	71.11	2.93
Sulphate	85	<200 ppm	0.0124	42.5	0.527
Dissolved Oxygen	3.8	5-14 ppm	0.3723	112.5	41.88
BOD	5.1	<5 ppm	0.3723	102	37.97

$\sum_{i=1}^{n}$ Wi = **1.4305** $\sum_{i=1}^{n}$ Wi ∗ Qi = **293.04**

WQI = $\left(\sum_{i=1}^{n}\frac{Wi*Qi}{Wi}\right)$*100 = **204.5**

Injapur Lake:

Parameters	**Observed Values (Vi)**	**Standard Values** (Si)	**Units Weights**(Wi)	**Quality Rating** (Qi)	**W_i*Q_i**
pH	7.527	6.5-8.5	0.2190	35.133	7.7
Electrical Conductivity	1333.5	<250 µ-siemen/cm	0.3710	533.4	197.9
TDS	853.54	<500 ppm	0.0037	170.6	0.63122
Total Hardness	413.5	<300 ppm	0.0062	137.83	0.8545
Calcium	127.785	<75 ppm	0.0250	170.38	4.26
Chlorides	111.5	<250 ppm	0.0074	44.6	0.33
Nitrates	16.5	<45 ppm	0.0412	36..66	1.51
Sulphate	291	<200 ppm	0.0124	145.5	1.8
Dissolved Oxygen	5.4	5-14 ppm	0.3723	92.63	34.5
BOD	2.1	<5 ppm	0.3723	42	15.63

$\sum_{i=1}^{n} \text{Wi} = \mathbf{1.4305}$ $\sum_{i=1}^{n} \text{Wi} * \text{Qi} = \mathbf{265.11}$

$\mathbf{WQI} = \left(\sum_{i=1}^{n} \frac{Wi*Qi}{Wi}\right)*100 = \mathbf{165.8}$

Water Quality Index of Lakes :

LAKE	**WQI**	**Water Quality Status**
Himayat Sagar	94	Very Poor
Mir Alam Tank	221	Bad
Shamirpet Lake	100	Very Poor
Pedda Cheruvu	267	Bad
Kuntloor Pedda Cheruvu	205	Bad
Injapur Lake	166	Bad

Classification of water quality based on weighted arithmetic:

WQI Range	Water Quality Status	Possible Usage
0 - 25	Excellent	Drinking, Irrigation and Industrial
26 – 50	Good	Drinking, Irrigation and Industrial
51 - 75	Poor	Irrigation and Industrial
76 - 100	Very Poor	Irrigation
>101	Bad	Proper treatment before use

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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