

Evaluation of Water Quality Index of Pallecheruvu Surroundings

¹S.Ramanarayan, ²A.Manjunath, ³C.Jenifa Latha, ⁴K.V.R. Satya Sai, ⁵A.S.Kanagalakshmi

^{1,3}Associate Professor, Department of Civil Engineering, Aurora's Scientific Technological Research Academy, Hyderabad, India

²Assistant Professor, Department of Civil Engineering, MVSR Engineering College, Nadargul, Hyderabad, India

⁴Research Scholar, Department of Civil Engineering, Jawaharlal Nehru Technological University, Anantapuramu, India

⁵ Professor, Department of Civil Engineering, Panimalar College of Engineering, Poonamalle, Chennai, Tamil Nadu, India

ramanarayan.s@gmail.com, manjunath.aluru@gmail.com, jenifalatha@gmail.com, kvr.satya.sai@gmail.com, askv26@gmail.com

Abstract— Water Quality Index is a concept for classification of water for different purposes and to find suitability for human consumption and industry. An effort has been made to know the ground water quality by usage of water quality index in and around Pallecheruvu lake of Bandlaguda area of South Hyderabad. 15 groundwater samples were collected from bore wells along with 4 surface water samples from the surrounding regions of Pallecheruvu Lake during the pre-Monsoon in the year 2017. This was done by collecting the 15 groundwater samples and subjecting them to a detailed physico-chemical analysis by using standard methods of analysis. From the data obtained aforesaid, the water quality index was calculated by following the method developed by Tiwari and Mishra. Water quality index rating was carried out to quantify overall ground water quality status of the area. For calculating the index, the following 8 characteristics have been considered like pH, Chlorides (mg/l), Acidity, Alkalinity, Total dissolved Solids, Electrical Conductivity, Turbidity. The range of WQI values is from 7.18 to 11.70. The average value of water quality index of the samples was found in the value of 8.05 in pre-monsoon season. Post monsoon concentrations are diluted after monsoon effect. The results of the present study are very encouraging and reflect the healthy status of the lake. After analysis of WQI, all the samples indicate that water of all locations is acceptable for direct consumption and is within the permissible limit. Also, on carefully examining the data, it was concluded that most of the water quality parameters were below the desired limit as prescribed by BIS, making the water safe for consumption by man.

keywords- *Ground Water, Water Quality Index, Physico-Chemical Analysis, Tiwari And Mishra, Hyderabad*

I. INTRODUCTION

The main source of drinking water is ground water. It can be said that one third of the world's population uses groundwater for purpose of drinking and today more than 50 percent of the population of the world is dependent upon groundwater for living. For all water development projects, water quality is a very significant parameter as it controls all aspects of water use-by humans, by animals, by crops, and even by industry. To determine the welfare of the

society, water quality is a major factor. A regular and periodic monitoring of water bodies with required number of characteristics as well as the quality of water not only prevents outbreak of disease and occurrence of other ill-health problems but also checks the water from further contamination and there by protects it. Water Quality Index (WQI) is one of the most suitable rating which reflect a combined influence of contributing factors on the quality of water for any water supply system. That's why the present work deals with WQI of drinking water collected from different locations of Bandlaguda area, Telangana, India. This Index is devised by Horton and modified by Tiwari and Mishra (1985).

II. STUDY AREA AND PROBLEM STATEMENT

Pallecheruvu is located in the southern part of the Hyderabad city, covering an area of about 16.8 hectares. The present study is undertaken to evaluate the quality of surface water and ground water of Pallecheruvu Lake. The assessment of groundwater quality is made through calculating the water quality parameters such as pH, turbidity, chlorides, Hardness etc.

III. MATERIALS AND METHODS

Totally, 19 water samples were collected and each sample was designated as S1 to S19. The sample locations are taken by using handheld GPS receiver (table 1). Among 19 samples, the 15 water samples were taken from bore wells and 4 samples from surface water of lake. These samples were analysed for different parameters such as pH, Chlorides (mg/l), Acidity, Alkalinity, Total dissolved Solids, Electrical Conductivity, Turbidity by following standard methods (APHA, 1998). Therefore the purpose is to study the Physico-chemical characteristics in order to understand the water quality. The samples were collected downstream of the lake.

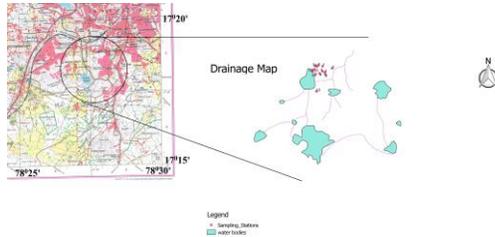


Fig.1. Location map

TABLE I. GPS Values of sample locations

Sample	Type	Lat	long	Station
S1	Bore well	17°18.966'	78°27.372'	Ambedkar statue
S2	Bore well	17°18.952'	78°27.402'	pride OS function hall
S3	Bore well	17°18.929'	78°27.621'	White palace
S4	Bore well	17°18.868'	78°27.518'	Evergreen function hall
S5	Bore well	17°18.885'	78°27.485'	Modern Motors
S6	Bore well	17°18.968'	78°27.422'	Kailash Dal industry
S7	Bore well	17°18.958'	78°27.485'	GMR parking
S8	Bore well	17°18.840'	78°27.523'	Amar Boys Hostel
S9	Bore well	17°18.854'	78°27.442'	Rose garden
S10	Bore well	17°18.915'	78°27.366'	ZAS motors
S11	Bore well	17°18.897'	78°27.345'	Resident building-1
S12	Bore well	17°18.881'	78°27.342'	Resident Building-2
S13	Bore well	17°18.895'	78°27.334'	Resident building-3
S14	Bore well	17°18.844'	78°27.386'	Pallecheruvu Temple
S15	Bore well	17°18.600'	78°27.397'	Aurora College
S16	Surface water	17°18.788'	78°27.387'	Pallecheruvu centre
S17	Surface water	17°18.703'	78°27.409'	Pallecheurvuv corner
S18	Surface water	17°18.844'	78°27.386'	Pallecheurvuv corner
S19	Surface water	17°18.307'	78°27.200'	Pallechuruvu corner

IV. WATER QUALITY INDEX ESTIMATION

Water Quality Index (WQI) is defined as a value that reflects the combined influence of different water quality characteristics on the overall quality of water. Horton (1965) was among the first to give an idea of the concept of indices to represent water quality. The WQI has been calculated to evaluate the groundwater quality of the study area for purpose of drinking. The BIS code for drinking purposes is considered for the calculation of WQI. To calculate WQI, six parameters such as: pH, TDS, turbidity, acidity, alkalinity, chlorides have been used. To calculate WQI the following four steps are to be adhered.

A. Step-I

- Every 1 parameter out of the 6 parameters is allotted a weight (wi) according to their relative significance in the overall water quality for purpose of drinking.
- A maximum weight 5 was allotted to parameters such as chlorides due to their major importance in water quality assessment (srinivasamoorthy et al., 2008).
- Rest of the parameters were allotted a value of weight in between 1 to 5 that depends on their importance in the overall water quality for purpose of drinking.

B. Step-II

The relative weight (w) is calculated by using a weighted arithmetic index method given underneath (Brown et al., 1972; Horton, 1965; Tiwari and manzoor, 1988) in the steps that follow.

$$W_i = \frac{W_i}{\sum_{i=1}^n W_i}$$

Where, W_i is the relative weight and w is the weight of each parameter and n is the number of parameter.

TABLE II. WHO Standards ,Weight, relative weight of each parameter

Parameters	Indian Standard	Weight (w _i)	Relative Weight
pH	6.5-8.5	4	0.1739
Total dissolved solids	500 mg/lit	4	0.1739
Turbidity	1 NTU	3	0.1304
Chlorides	250 mg/lit	3	0.1304
Conductivity	3000 μmhos/cm	3	0.1304
Alkalinity	200 mg/lit	3	0.1304
Acidity	200 mg/lit	3	0.1304

C. Step-III

A quality rating scale (Qi) for each parameter is allotted by division of its concentration in each sample of water by its respective standard according to the guidelines of BIS code and then afterwards multiplied by 100.

$$Q_i = \frac{C_i}{S_i} * 100$$

where Q_i is the quality rating, C_i is the concentration of each chemical characteristic in each water sample in mg/l and S_i is the drinking water standard for each chemical characteristic in mg/lit according to the guidelines of BIS code.

D. Step-IV

The SI_i is first found for each parameter, which is then used to compute the WQI as shown in equation below:

$$SI_i = W_i * Q_i$$

Where SI_i is the sub index of i^{th} parameter and Q_i is the rating based on concentration of i^{th} parameter. The overall water quality index (WQI) was computed by summing up together each of the sub index values of each samples of groundwater as below:

$$WQ_i = \sum SI_i$$

TABLE III. Results of Water Quality Index

Sample Station	pH		Chloride(mg/l)		Acidity		Alkalinity		TDS		EC		Turbidity		WQI
	Qi	SIi	Qi	SIi	Qi	SIi	Qi	SIi	Qi	SIi	Qi	SIi	Qi	SIi	
1	0.93	0.16	0.76	0.10	4.55	0.59	4.60	0.60	0.68	0.12	3.33	0.43	0.45	0.06	7.24
2	0.93	0.16	0.77	0.10	4.51	0.59	4.58	0.60	0.88	0.15	3.33	0.43	0.43	0.06	7.22
3	0.93	0.16	0.77	0.10	4.51	0.59	4.57	0.60	0.36	0.06	3.33	0.43	0.43	0.06	7.10
4	0.93	0.16	0.78	0.10	4.50	0.59	4.57	0.60	0.82	0.14	6.67	0.87	0.43	0.06	11.53
5	0.93	0.16	0.77	0.10	4.51	0.59	4.55	0.59	0.76	0.13	3.33	0.43	0.41	0.05	7.15
6	0.93	0.16	0.77	0.10	4.51	0.59	4.56	0.59	0.56	0.10	3.33	0.43	0.42	0.05	7.11
7	0.93	0.16	0.77	0.10	4.51	0.59	4.56	0.59	1.26	0.22	3.33	0.43	0.43	0.06	7.34
8	0.93	0.16	0.78	0.10	4.52	0.59	4.57	0.60	0.38	0.07	3.33	0.43	0.42	0.05	7.10
9	0.93	0.16	0.77	0.10	4.51	0.59	4.56	0.59	1.28	0.22	6.67	0.87	0.43	0.06	11.70
10	0.93	0.16	0.77	0.10	4.51	0.59	4.56	0.59	0.28	0.05	3.33	0.43	0.43	0.06	7.07
11	0.93	0.16	0.77	0.10	4.51	0.59	4.56	0.59	0.48	0.08	3.33	0.43	0.42	0.05	7.10
12	0.93	0.16	0.78	0.10	4.50	0.59	4.57	0.60	0.62	0.11	3.33	0.43	0.42	0.05	7.13
13	0.93	0.16	0.77	0.10	4.51	0.59	4.56	0.59	0.58	0.10	3.33	0.43	0.42	0.05	7.12
14	0.93	0.16	0.76	0.10	4.55	0.59	4.60	0.60	0.88	0.15	6.67	0.87	0.45	0.06	11.64
15	0.93	0.16	0.77	0.10	4.50	0.59	4.56	0.59	0.84	0.15	3.33	0.43	0.45	0.06	7.18
Average WQI															8.05

V. RESULTS AND DISCUSSIONS

The variation in physico-chemical characteristics of the surface water, and bore well water of the lake have been summarized in the tables 4. Monitoring lakes requires many different parameters to be sampled. The parameters analyzed in this assessment include:

A. *pH*: The pH of a solution is the negative logarithm of Hydronium ion concentration in moles/litre. According to Bureau of Indian Standard(BIS),the permissible limit of pH in drinking water is within 6.5 – 8.5 The value of pH in all samples of water is within the permissible range. The value of pH in groundwater samples of the study area ranges from 6.98 – 7.83.

B. *Total dissolved solids*: Solids is the material suspended or dissolved in water or wastewater. Solids affects water quality severely in a number of ways. Waters with high number of dissolved solids generally are at poor waters. The value of TDS of the study area ranges from 140 - 700 mg/l in ground water samples. 21% of samples were above the standard limit of 500 mg/l as prescribed by BIS.

C. *Electrical Conductivity*: The values of EC ranged from 0.1 and 0.2(siemens/cm).

D. *Chloride*: The Chloride concentration in the study area ranges from 152 – 162 mg/l. 250 mg/l is the permissible limit of chloride. 100% of samples were within the standard limit prescribed by BIS.

E. *Total Alkalinity*: The values of alkalinity at stations range from 910-927 mg/l. 100% samples were found above the standard limit of 200 mg/l as prescribed by BIS. Water with high alkalinity is said to be “hard.” Calcium carbonate causes alkalinity. CaCO₃ comes from rocks such as limestone or can be leached from dolomite and calcite in the soil. Water gets bitter taste with increase in alkalinity.

F. *Turbidity*: The turbidity for all the water samples is below the BIS Standard limit of 1.0 NTU. Out of 19 samples,the highest value of turbidity obtained is 0.45 NTU. Turbidity in water causes loss in clarity.

G. The profile of water quality parameters is presented below.

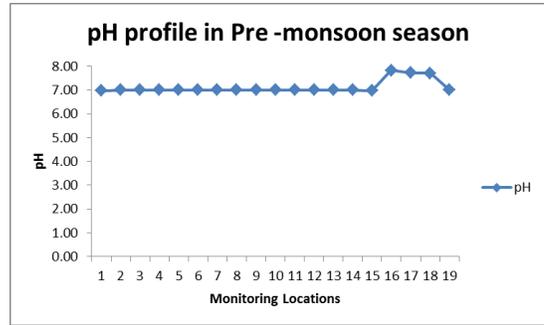


Fig.2.pH profile

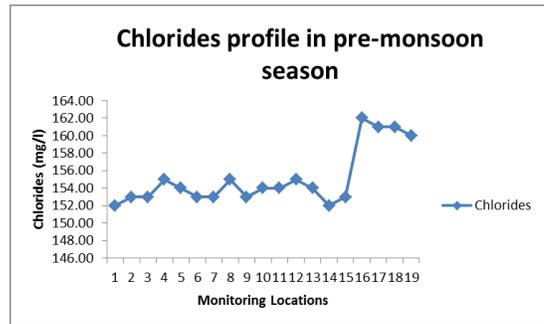


Fig.3.Chlorides profile

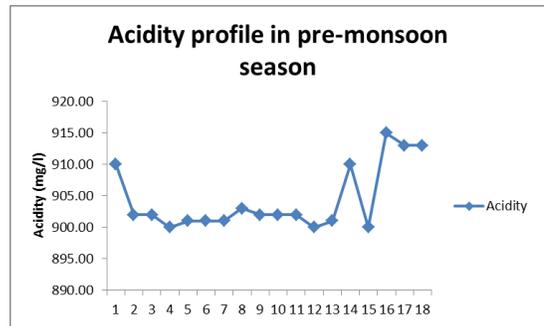


Fig.4. Chlorides profile

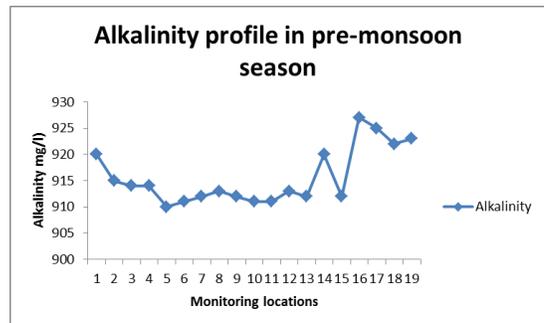


Fig.5. Alkalinity Profile

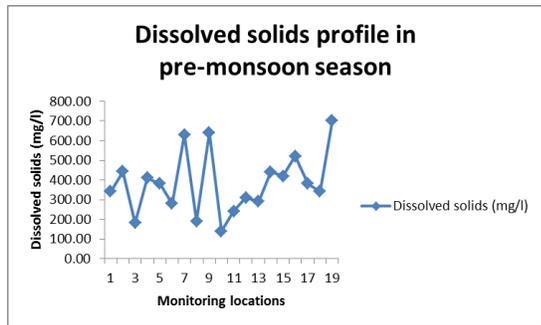


Fig.6.Dissolved solids profile

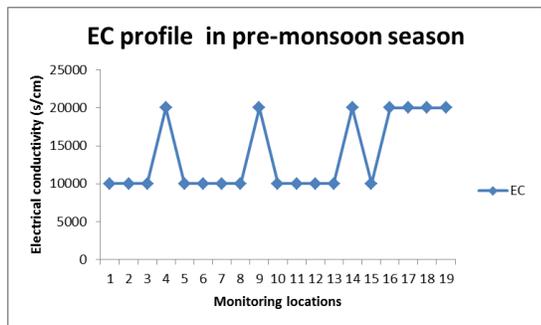


Fig.7. Electrical conductivity profile

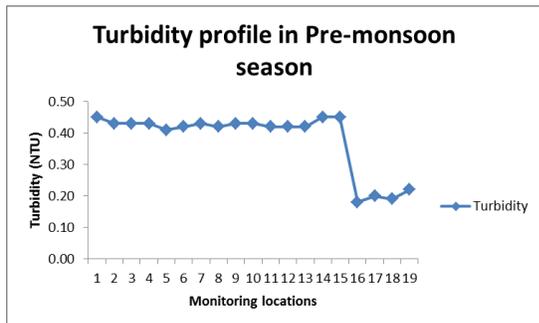


Fig.8.Turbidity profile

TABLE IV. water quality parameters at different stations

Sample ID	pH	Chlorides (mg/l)	Acidity (mg/l)	Alkalinity (mg/l)	DS(mg/l)	EC(s/cm)	Turbidity(N TU)
S1	6.98	152.00	910.00	920.00	340.45	10000.00	0.45
S2	7.00	153.00	902.00	915.00	442.35	10000.00	0.43
S3	7.00	153.00	902.00	914.00	180.37	10000.00	0.43
S4	7.00	155.00	900.00	914.00	410.32	20000.00	0.43
S5	7.00	154.00	901.00	910.00	380.53	10000.00	0.41
S6	7.00	153.00	901.00	911.00	280.15	10000.00	0.42
S7	7.00	153.00	901.00	912.00	630.32	10000.00	0.43
S8	7.00	155.00	903.00	913.00	190.73	10000.00	0.42
S9	7.00	153.00	902.00	912.00	640.73	20000.00	0.43
S10	7.00	154.00	902.00	911.00	140.32	10000.00	0.43
S11	7.00	154.00	902.00	911.00	240.35	10000.00	0.42
S12	7.00	155.00	900.00	913.00	310.63	10000.00	0.42
S13	7.00	154.00	901.00	912.00	290.35	10000.00	0.42
S14	7.00	152.00	910.00	920.00	440.56	20000.00	0.45
S15	6.98	153.00	900.00	912.00	418.32	10000.00	0.45
S16	7.83	162.00	915.00	927.00	520.35	20000.00	0.18
S17	7.73	161.00	913.00	925.00	380.43	20000.00	0.20
S18	7.71	161.00	913.00	922.00	340.89	20000.00	0.19
S19	7.00	160.00	910.00	923.00	700.76	20000.00	0.22
Min.	6.98	152.00	900.00	910.00	140.32	10000.00	0.18
Max.	7.83	162.00	915.00	927.00	700.76	20000.00	0.45
Average	7.12	155.11	904.63	915.63	383.10	13684.21	0.38

VI. CONCLUSION

The quality of groundwater taken from the study area was studied by analysing the Physico-chemical characteristics. The main idea of this study was to create a digital database, and to map and determine the groundwater quality in study area. From the study, the inference that can be made is that the pH in most of the wells in the region is acidic and alkaline in nature. The WQI<50 for all ground water samples. Water is excellent for drinking purpose.

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