

# ASSESSMENT OF WATER QUALITY FOR GROUNDWATER IN THULLUR MANDAL, GUNTUR DISTRICT, A.P, INDIA

<sup>1</sup>P. Akhil Teja, <sup>2</sup>V. Jaya Krishna, <sup>3</sup>CH. Manikanta, <sup>4</sup>M. Musalaiah

<sup>1,2,3</sup> Final B.Tech Students, <sup>4</sup> Assistant Professor,

<sup>1</sup> Department of Civil Engineering,

<sup>1</sup> MVR College of Engineering and Technology, Paritala, Andhra Pradesh, India

**Abstract**— Groundwater is an essential and valuable natural source of water supply all over the world. To meet out the rising demand it is crucial to identify and recognize the fresh water resources and also to find out remedial methods for improvement of water quality. So, assessment of ground water quality has always been paramount in the field of environmental quality management. Physico-chemical parameters of groundwater quality based on physic-chemical parameters plays a prominent role in evaluating its suitability for drinking purpose. The present study deals with the determination of water quality index of Thullur mandal, Guntur district, Andhra Pradesh, in order to ascertain the quality of Groundwater for public consumption, recreation and other purposes. The samples were collected from all 19 villages of Thullur mandal. The samples were analyzed in the laboratory using standard APHA 1985 procedures. From the analyzed data, WQI has been calculated using Weighted Average method. The variations of water quality on different samples were also discussed.

**Index Terms**— Groundwater, Water Quality Parameters, Sampling, Water Quality Standards, Water Quality.

## 1. INTRODUCTION

Water is the most important natural resource, which forms the core of ecological system. Recently there has been overall development in various fields such as agriculture, industry and urbanization in India. This has lead to increase in the demand of water supply which is met mostly from exploitation of groundwater resources.

Ground water quality has become an important water resources issue due to rapid increase of population, rapid industrialization, unplanned urbanization, flow of pollution from upland to lowland, and too much use of fertilizers, pesticides in agriculture. Groundwater quality depends on the quality of recharged water, atmospheric precipitation, inland surface water, and on sub-surface geochemical processes. The drinking water quality depends on many physicochemical parameters and their concentrations, which are derived from laboratory tests on water samples.

Hydro chemical study is a useful tool to identify the suitability of the groundwater. The differences in the water quality can be attributed to the problems associated during the conveyance and distributions. Groundwater quality depends on the type of polluting sources in the surroundings and hence changes from location to location. The physic-chemical parameters of subsequently varies from location to location. Hence, evaluation of groundwater quantity and quality is important for the development of further civilization and to establish database for planning future water resources development strategies. The present study deals with the determination of water quality index of Thullur mandal, Guntur district, Andhra Pradesh.

## 2. STUDY AREA

Thullur mandal is one of the 57 mandals in the Guntur district of the Indian state of Andhra Pradesh. It is under the administration of Guntur Revenue Division and the headquarters located at Thullur. The city is located on the 16.5275°N and 80.4681°E on the bank of Krishna River, bounded by Amaravati, Tadikonda, and Tadepalli and Mangalagiri mandals. This mandal is also a part of the new capital city of Andhra Pradesh to be developed. Majority of the villages of capital city are in this mandal. As per 2011 census, the mandal had a population of 54,081. The total populations constitute 26,791 males and 27,290 females. The average literacy rate stands at 66.93% with 32,578 literates.



Figure 1: Location map of the study area

**3. MATERIALS AND METHODS**

**3.1 Sample collection**

The sample collection was done in the month of January 2017. A field investigation was done to overview the quality of bore well water in various villages of the mandal. Bore wells were pumped for 5min before taking the water samples. Before that, the bottles were rinsed with the corresponding water that is being taken into the container, filled completely and closed well. The capacity of each bottle was 1L. A total of 19 numbers of samples were collected from different villages of the mandal. After the completion of sampling, the containers were stored in a cool and dark place. The Groundwater samples were collected from all 19 villages Thullur mandal. The samples are analyzed using standard procedures in the laboratory (APHA, 1985). The list of samples collected was given in Table 1.

The parameters include various physical and chemical constituents in each sample were determined. The parameters analyzed in the laboratory according to lab procedures, and those are Electrical Conductivity, Turbidity, pH, Total Dissolved Solids, Total Hardness, Alkalinity, Calcium Hardness, Magnesium, Iron, Fluorides, Chlorides, Nitrites, Nitrates and Sulphates.

**Table 1: List of samples collected**

| S. No | Sample Number | Mandal Name | Name of Village    |
|-------|---------------|-------------|--------------------|
| 1     | Sample No 1   | Thullur     | Uddandarayunipalem |
| 2     | Sample No 2   | Thullur     | Ainavolu           |
| 3     | Sample No 3   | Thullur     | Lingayapalem       |
| 4     | Sample No 4   | Thullur     | Krishnayapalem     |
| 5     | Sample No 5   | Thullur     | Malkapuram         |
| 6     | Sample No 6   | Thullur     | Velagapudi         |
| 7     | Sample No 7   | Thullur     | Venkatapalem       |
| 8     | Sample No 8   | Thullur     | Rayapudi           |
| 9     | Sample No 9   | Thullur     | Thulluru           |
| 10    | Sample No 10  | Thullur     | Borupalem          |
| 11    | Sample No 22  | Thullur     | Dondapadu          |
| 12    | Sample No 12  | Thullur     | Nekkallu           |
| 13    | Sample No 13  | Thullur     | Shakamuru          |
| 14    | Sample No 14  | Thullur     | Anantavaram        |
| 15    | Sample No 15  | Thullur     | Nelapadu           |
| 16    | Sample No 16  | Thullur     | Mandadam           |
| 17    | Sample No 17  | Thullur     | Abbarajupalem      |
| 18    | Sample No 18  | Thullur     | Peddaparimi        |
| 19    | Sample No 19  | Thullur     | Vaddamanu          |

**3.2. Determination Of Water Quality Index**

Water Quality Index (WQI) is a very useful and efficient method for assessing the quality of water. Water Quality Index is very useful tool for communicating the information on overall quality of water. To determine the suitability of the groundwater for drinking purpose, WQI is computed by adopting the following formula. Table 2 provides the information about water quality parameter, their BIS standards and weightages and Table 3 provides the information of water quality index categories .

Water Quality Index (WQI) is given by the formula,

$$WQI = \sum_{i=0}^n Q_i W_i$$

$Q_i$  = water quality rating,  $W_i$  = weight age value of respective parameter

$$Q_i = 100 * \left[ \frac{V_a - V_i}{V_s - V_i} \right]$$

$V_a$  = actual value present in water sample,

$V_s$  = standard value of water

$V_i$  = ideal value (0 for all except pH and DO)

$$W_i = \frac{K}{S_n}$$

$$K = \frac{1}{\left(\frac{1}{V_{EC}}\right) + \left(\frac{1}{V_{Turbidity}}\right) + \left(\frac{1}{V_{pH}}\right) + \dots + \left(\frac{1}{V_{Sulphates}}\right)}$$

$S_n$  (or)  $V_s$  = standard value

**Table 2: Water quality parameter, their BIS standards and Weightages**

| Parameter  | Standard Values ( $V_s$ ) | Weightage ( $W_i$ ) | Parameter | Standard Values ( $V_s$ ) | Weightage ( $W_i$ ) |
|------------|---------------------------|---------------------|-----------|---------------------------|---------------------|
| E C        | 300                       | 0.000130            | Magnesium | 30                        | 0.001304            |
| Turbidity  | 1                         | 0.039124            | Iron      | 0.3                       | 0.130413            |
| pH         | 7.5                       | 0.005217            | Fluorides | 1                         | 0.039124            |
| TDS        | 500                       | 0.000078            | Chlorides | 250                       | 0.000156            |
| TH         | 200                       | 0.000196            | Nitrites  | 0.05                      | 0.782480            |
| Alkalinity | 200                       | 0.000196            | Nitrates  | 45                        | 0.000869            |
| Calcium    | 75                        | 0.000522            | Sulphates | 200                       | 0.000196            |

**Table 3: Water Quality Index Categories**

| Water Quality Index (WQI) | Description        |
|---------------------------|--------------------|
| 0-24                      | EXCELLENT          |
| 25-49                     | GOOD               |
| 50-74                     | POOR               |
| 75-100                    | VERY POOR          |
| >100                      | UNFIT FOR DRINKING |

**4. RESULTS AND DISCUSSIONS**

**4.1. Analysis of Results**

Groundwater samples collected from all the 19 villages of the Thullur mandal. The collected samples were analyzed by the APHA standard procedure the concentration of both physical and chemical parameters in various samples are tested and given in Table.4. In the below table, all the parameters are in mg/lit except Turbidity in N.T.U, Electrical Conductivity in mhos.

**Table 4: List of values of various parameters for all villages**

| Samples | EC    | Turbidity | pH  | TDS   | TH   | Alkalinity | Calcium | Magnesium | Iron | Fluorides | Chlorides | Nitrites | Nitrates | Sulphates |
|---------|-------|-----------|-----|-------|------|------------|---------|-----------|------|-----------|-----------|----------|----------|-----------|
| 1       | 2320  | 3.2       | 7.9 | 1508  | 512  | 336        | 184     | 80        | 0.2  | 0.6       | 352       | Nil      | 8.4      | 104       |
| 2       | 15500 | Nil       | 8.9 | 10075 | 3880 | 880        | 940     | 714       | 0.22 | 0.6       | 3600      | 0.08     | 134      | 620       |
| 3       | 2440  | 12        | 7.9 | 1586  | 536  | 352        | 188     | 85        | 1.2  | 0.6       | 368       | Nil      | 16.8     | 108       |
| 4       | 1980  | 1.2       | 7.7 | 1287  | 440  | 292        | 148     | 71        | 1.1  | 0.6       | 288       | Nil      | 11.4     | 92        |
| 5       | 3320  | 8         | 8.2 | 2158  | 712  | 520        | 224     | 119       | 0.6  | 0.6       | 540       | 0.01     | 24.6     | 126       |
| 6       | 3460  | 12        | 8.1 | 2249  | 732  | 532        | 236     | 121       | 1.2  | 0.6       | 568       | 0.02     | 25.8     | 130       |
| 7       | 2240  | 6         | 7.7 | 1456  | 492  | 324        | 180     | 76        | 0.56 | 0.6       | 336       | Nil      | 10.8     | 102       |
| 8       | 4680  | 12        | 8.4 | 3042  | 880  | 760        | 280     | 146       | 0.28 | 0.6       | 840       | 0.02     | 62       | 204       |
| 9       | 2240  | Nil       | 7.9 | 1456  | 472  | 340        | 176     | 72        | 0.1  | 0.6       | 340       | Nil      | 12.8     | 102       |
| 10      | 11420 | 16        | 8.7 | 7423  | 2520 | 1040       | 740     | 433       | 0.16 | 0.6       | 2320      | 0.05     | 158      | 620       |
| 11      | 2940  | Nil       | 8.1 | 1911  | 648  | 460        | 220     | 104       | 0.1  | 0.6       | 440       | Nil      | 13.7     | 110       |
| 12      | 3840  | 34        | 8.3 | 2496  | 780  | 580        | 260     | 126       | 0.38 | 0.8       | 680       | Nil      | 42       | 142       |
| 13      | 8060  | 14        | 8.6 | 5239  | 1680 | 820        | 560     | 272       | 0.18 | 0.6       | 1620      | 0.04     | 92.6     | 440       |
| 14      | 3580  | Nil       | 8.3 | 2327  | 740  | 540        | 236     | 122       | 0.1  | 0.8       | 640       | 0.01     | 28.5     | 124       |
| 15      | 9380  | Nil       | 8.6 | 6097  | 2020 | 860        | 640     | 335       | 0.1  | 0.8       | 1920      | 0.05     | 112      | 520       |
| 16      | 1774  | 10        | 7.7 | 1153  | 400  | 264        | 140     | 63        | 0.14 | 0.8       | 240       | Nil      | 11.4     | 86        |
| 17      | 6855  | 6.8       | 8.4 | 4456  | 1359 | 739        | 396     | 260       | 0.13 | 0.6       | 1293      | 0.02     | 86       | 364       |
| 18      | 4852  | 10        | 8.2 | 3154  | 954  | 670        | 397     | 175       | 0.24 | 0.8       | 1072      | 0.01     | 62.8     | 285       |
| 19      | 2856  | 2.8       | 8.2 | 1856  | 654  | 482        | 264     | 98        | 0.1  | 0.8       | 528       | Nil      | 24.9     | 138       |

**4.2. Water Quality Index**

The Water Quality Index (WQI) for each collected sample was calculated by using the above explained procedure. The calculated values of WQI for each village are tabulated in the Table 5.

**Table 5: Determined values of WQI for all villages**

| Samples | EC   | Turbidity | pH   | TDS  | TH   | Alkalinity | Calcium | Magnesium | Iron | Fluorides | Chlorides | Nitrites | Nitrates | Sulphates | Total WQI |
|---------|------|-----------|------|------|------|------------|---------|-----------|------|-----------|-----------|----------|----------|-----------|-----------|
| 1       | 0.1  | 12.5      | 0.94 | 0.02 | 0.05 | 0.03       | 0.13    | 0.35      | 8.69 | 2.35      | 0.02      | 0        | 0.02     | 0.01      | 25        |
| 2       | 0.67 | 0         | 1.98 | 0.16 | 0.38 | 0.09       | 0.65    | 3.1       | 9.56 | 2.35      | 0.23      | 125      | 0.26     | 0.06      | 143       |
| 3       | 0.11 | 46.9      | 0.94 | 0.03 | 0.05 | 0.04       | 0.75    | 0.37      | 52.2 | 2.35      | 0.02      | 0        | 0.03     | 0.01      | 105       |
| 4       | 0.09 | 4.7       | 0.73 | 0.02 | 0.04 | 0.03       | 0.1     | 0.31      | 47.8 | 2.35      | 0.02      | 0        | 0.02     | 0.01      | 56        |
| 5       | 0.14 | 31.3      | 1.23 | 0.03 | 0.07 | 0.05       | 0.16    | 0.51      | 26.1 | 2.35      | 0.03      | 15.6     | 0.05     | 0.01      | 78        |
| 6       | 0.15 | 46.9      | 1.13 | 0.04 | 0.07 | 0.05       | 0.16    | 0.53      | 52.2 | 2.35      | 0.04      | 31.3     | 0.05     | 0.01      | 135       |
| 7       | 0.1  | 23.5      | 0.73 | 0.02 | 0.05 | 0.03       | 0.13    | 0.33      | 24.3 | 2.35      | 0.02      | 0        | 0.02     | 0.01      | 52        |

|    |      |      |      |      |      |      |      |      |      |      |      |      |      |      |     |
|----|------|------|------|------|------|------|------|------|------|------|------|------|------|------|-----|
| 8  | 0.2  | 46.9 | 1.46 | 0.05 | 0.09 | 0.08 | 0.2  | 0.64 | 12.2 | 2.35 | 0.05 | 31.3 | 0.12 | 0.02 | 96  |
| 9  | 0.1  | 0    | 0.94 | 0.02 | 0.05 | 0.03 | 0.12 | 0.31 | 4.35 | 2.35 | 0.02 | 0    | 0.02 | 0.01 | 8   |
| 10 | 0.5  | 62.6 | 1.77 | 0.12 | 0.17 | 0.1  | 0.52 | 1.88 | 6.96 | 2.35 | 0.14 | 78.2 | 0.31 | 0.06 | 156 |
| 11 | 0.13 | 0    | 1.15 | 0.03 | 0.06 | 0.05 | 0.15 | 0.45 | 4.35 | 2.35 | 0.03 | 0    | 0.07 | 0.01 | 9   |
| 12 | 0.17 | 133  | 0.45 | 0.04 | 0.08 | 0.06 | 0.18 | 0.55 | 16.5 | 3.13 | 0.04 | 0    | 0.08 | 0.01 | 154 |
| 13 | 0.35 | 54.8 | 0.6  | 0.08 | 0.17 | 0.08 | 0.39 | 1.18 | 7.83 | 2.35 | 0.1  | 62.6 | 0.18 | 0.04 | 131 |
| 14 | 0.16 | 0    | 1.36 | 0.04 | 0.07 | 0.05 | 0.16 | 0.53 | 4.35 | 3.13 | 0.04 | 15.6 | 0.06 | 0.01 | 26  |
| 15 | 0.41 | 0    | 0.6  | 0.1  | 0.2  | 0.08 | 0.45 | 1.46 | 4.35 | 3.13 | 0.12 | 78.2 | 0.22 | 0.05 | 89  |
| 16 | 0.08 | 39.1 | 0.73 | 0.02 | 0.04 | 0.03 | 0.1  | 0.27 | 6.09 | 3.13 | 0.02 | 0    | 0.02 | 0.01 | 50  |
| 17 | 0.3  | 26.6 | 1.46 | 0.07 | 0.13 | 0.07 | 0.28 | 1.13 | 5.65 | 2.35 | 0.08 | 31.3 | 0.17 | 0.04 | 69  |
| 18 | 0.21 | 39.1 | 1.25 | 0.05 | 0.09 | 0.07 | 0.27 | 0.76 | 10.4 | 3.13 | 0.07 | 15.6 | 0.12 | 0.03 | 71  |
| 19 | 0.12 | 10.9 | 1.25 | 0.09 | 0.06 | 0.05 | 0.18 | 0.43 | 4.35 | 3.13 | 0.03 | 0    | 0.05 | 0.01 | 21  |

The average WQI of the entire THULLUR mandal is 77.6 and the range of WQI is POOR.

The water quality index was found to be excellent in the villages Thullur, Dondapadu, Vaddamanu whereas the WQI was found to be good in the villages Uddandarayunipalem, Anantavaram. WQI was poor in the villages Venkatapalem, Krishnayapalem, Mandadam. Villages with Very Poor range are Malkapuram, Rayapudi, Nelapadu, Peddaparimi, Abbarajupalem. Villages where WQI is very poor are Inavolu, Velagapudi, Lingayapalem, Borupalem, Nekkallu, Sakhamuru are the villages where water is unfit for drinking. The data obtained above is classified based on the standards of WQI given in Table 5 and tabulated in Table 6.

Table 6: Overview

| EXCELLENT                         | GOOD                              | POOR   | VERY POOR                          | Unfit for Drinking  |
|-----------------------------------|-----------------------------------|--|------------------------------------|---|
| Dondapadu<br>Thullur<br>Vaddamanu | Anantavaram<br>Uddandarayunipalem | Abbarajupalem<br>Krishnayapalem<br>Mandadam<br>Peddaparimi<br>Venkatapalem | Malkapuram<br>Nelapadu<br>Rayapudi | Borupalem<br>Inavolu<br>Lingayapalem<br>Nekkallu<br>Shakamuru<br>Velagapudi |

The obtained values of WQI of all the villages are plotted in the below graph.



Graph.1. Comparisons of WQI results with standard WQI values

5. CONCLUSIONS

It is necessary that drinking water should be pure. However the absolute pure water is not found in nature. Even the rain water which absolutely pure at the instant it is formed becomes impure because as it passes through atmosphere it dissolves certain gases, traces of minerals, dust, and other miscellaneous substances. It is essential to assess the quality of water available from various sources whether the water is potable or not. To reveal this aspect we require various physic-chemical parameters like Electrical Conductivity, Turbidity, pH, Total Dissolved Solids, Total Hardness, Alkalinity, Calcium Hardness, Magnesium, Iron, Fluorides, Chlorides, Nitrites, Nitrates and Sulphates.

Out of 19 villages of Thullur mandal only three villages situated in 'Excellent' category, two villages in 'Good' category, five villages in 'Poor' category and rest of them in Very poor and unfit for drinking. Hence in all sampling stations water required some degree of treatment before consumption and it also need protection against contamination.

6. ACKNOWLEDGMENT

The authors are very grateful to the Professors and students, Department of Civil Engineering, of the college for their immense support throughout the research work. Gratitude goes specially Swamy and Kiran, Rural Water Supply and Sanitation for their support, guidance and supervising the work.



## REFERENCES

- [1] BIS 10500-2012- Bureau of Indian standards for drinking water.
- [2] APHA, (1985), Standard methods for the examination of water and wastewater, American Public Health Association, New York, U.S.A.
- [3] World Health Organization 2011 Guidelines for Drinking-water Quality - 4<sup>th</sup> edition 2011.
- [4] G. Arun Kumar, P. Sankara Pitchaiah, G. Sudhakar, G. Swarnalatha, Physico-Chemical Analysis of Selected Groundwater Samples of Inkollu Mandal, Prakasam District, Andhra Pradesh, India, International Journal of Engineering Research and Applications, ISSN : 2248-9622, Vol. 5, Issue 4, ( Part -4) April 2015, pp.65-70
- [5] S. Packialakshmi, Meheli Deb & Hrituparna Chakraborty, Assessment of Groundwater Quality Index in and Around Sholinganallur Area, Tamil Nadu, Indian Journal of Science and Technology, ISSN 0974-5645 December 2015 Vol 8(36).
- [6] Sudhakar Gummada, Swarnalatha G, P.Brahmaji Rao, V. Venkataratnamma, Water Quality Analysis in Acharya Nagarjuna University Region, Guntur, Andhra Pradesh, India, IOSR Journal of Environmental Science, Toxicology and Food Technology, ISSN: 2319-2402,p- ISSN: 2319-2399.Volume 8, Issue 9 Ver. II (Sep. 2014), PP 37-40.
- [7] Gopal Krishan, Surjeet Singh, CP Kumar, Suman Gurjar And NC Ghosh, Assessment of Water Quality Index (WQI) of Groundwater in Rajkot District, Gujarat, India, Journal of Earth Science & Climatic Change, ISSN:2157-7617 Volume 7 • Issue 3 • 1000341
- [8] Ch. Maruthi Devi, Kiran Yarrkula, Usha Madhuri T, Assessment and mapping of water quality index in Prakasam district A.P, using geographical information systems, International Journal on Geomatics and Geosciences, Volume 3, No 3, 2013 ISSN 0976 – 4380
- [9] K. Sundara Kumar, Ch. Satish Kumar, K. Hari Prasad, B. Rajesh, R. Sivaram Prasad, T. Venkatesh, Assessment Of Ground Water Quality Using Water Quality Index, International Journal of Innovative Research in Advanced Engineering, ISSN: 2349-2163, Issue 3, Volume 2 (March 2015)
- [10] M. Sujatha, A. Gopalakrishnayya, And Dr.T. Satyanarayana, Assessment Of Groundwater Quality In Rural Areas Of Vijayawada, A.P, International Journal of Engineering Research and Applications, ISSN: 2248-9622, Vol. 2, Issue 4, June-July 2012, pp.645-648
- [11] Syam Kumar Bariki, Byragi Reddy T. And Geetha Saramanda, Assessment of Physico- Chemical Quality of Drinking Water in Araku Valley Mandal of Visakhapatnam District, Andhra Pradesh, India, The International Journal Of Science & Technology, Vol 3 Issue 3 March, 2015
- [12] C. R. Ramakrishnaiah, C. Sadashivaiah And G. Ranganna , Assessment of Water Quality Index for Groundwater in Tumkur Taluk, Karnataka State, India, E-Journal of Chemistry, ISSN: 0973-4945 2009, 6(2), 523-530.

