Studies on chemistry and Water Quality Index of ground water in Chincholi Taluk, Gulbarga district, Karnataka India

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ABSTRACT

The major water quality parameters exceeding the permissible limits are TH, Ca, Mg, alkalinity and other parameters, the present study is carried out to explore the characteristics of ground water and water quality Index of ground water for Chincholi taluka Gulbarga District. Water samples from tube wells, open wells and hand pumps at various locations were collected using standard procedural methods. Ground water analysis of Chincholi taluka needs some degree of treatment before consumption.

Keywords: Ground water, Water Quality Index, Gulbarga, Chincholi, Chemical characteristics.

1. Introduction

The importance of groundwater for the existence of human society cannot be overemphasized. Groundwater is the major source of drinking water in both urban and rural India. Besides, it is an important source of water for the agricultural and the industrial sector. Water utilization projections for 2000 put the groundwater usage at about 50%. Being an important and integral part of the hydrological cycle, its availability depends on the rainfall and recharge conditions. Till recently it had been considered a dependable source of uncontaminated water. But now the demand for water has increased over the years and this has led to water scarcity in many parts of the world. The situation is aggravated by the problem of water pollution or contamination. The situation is that the world facing the challenges of purification of water and air resources. In spite of many uses the organic compounds are toxic in nature and cause environmental contamination. These toxic chemicals are emerging as a serious global problem. Organic compounds containing industrial effluents from textile, dyeing, chemical and other industries may cause skin cancer due to photo sensitization and photodynamic damage (De Ak 2000 and Patil Nirdosh 2011). Ground water quality has become an important water resource issue due to rapid increase in population, rapid industrial development, increasing mining and petroleum operations and too much use of fertilizers and pesticides in agriculture. Most of the population in India use ground water as its primary source of drinking water (Jain et al 2000).

The present study deals with the ground water quality index of Chincholi taluka of Gulbarga district, Karnataka, India. In this context, to create environmental awareness among the students and public. Study of water quality index of Chincholi taluka has been undertaken.
2. Materials and methodology

Chincholi taluka is located towards north eastern part of Gulbarga district, Karnataka. Major water bearing formation in this area is Deccan Trap Basalt followed by sediments of Bhima formation. The study area falls under one of the hottest regions. The climate is usually warm during most of the year. The maximum temperature in summer is 46°C during March and May and minimum temperature is 10°C during December. Average temperature is 36°C. The winds are generally light and moderate with little intense during the latter part of summer and monsoon. The rainy season occurs between June and October following by winter season between November and January (Ground water information Booklet Karnataka 2008).

![Figure 1: Map showing location of Chincholi taluka](image)

2.1 Experimental studies

Water samples were collected in 11 villages of Chincholi taluka and in each village, at three different points, samples were collected. The samples were collected as per the standard procedural methods (Krishnan Kannan 1991, T. Suresh et al 2009 and Dattatraya Bharati et al 2011) for the chemical analysis of various constituents.

3. Results and discussions

The physico-chemical tests were conducted employing standard scientific methods (P.G.Smith et al 2007 and Kavita.R et al 2010), so as to minimize the determinate errors. Following are the some of the observations revealed from the study of the various water quality parameters (Table 1).
### Table 1: Chemical characteristics of ground water in Chincholi taluka

| Village     | Sample point | pH  | TH  | Ca  | Mg  | Cl  | TDS | Fe   | F    | NO₃ | SO₄ |
|-------------|--------------|-----|-----|-----|-----|-----|-----|------|------|-----|-----|
| Ainaapur    | 1            | 6.5 | 320 | 299 | 21.0| 182 | 922 | 0.32 | 3.00 | 53.0 | 22.6|
|             | 2            | 7.0 | 380 | 322 | 58.0| 210 | 1020| 0.28 | 3.20 | 56.0 | 24.2|
|             | 3            | 7.2 | 399 | 350 | 49.0| 244 | 1122| 0.30 | 3.40 | 58.0 | 26.2|
| Chimman chod| 1            | 7.5 | 256 | 201 | 55.0| 168 | 892 | 0.26 | 3.8  | 46.0 | 18.2|
|             | 2            | 7.6 | 292 | 212 | 80.0| 172 | 926 | 0.28 | 3.9  | 47.0 | 16.8|
|             | 3            | 7.8 | 286 | 226 | 60.0| 169 | 912 | 0.32 | 3.7  | 49.0 | 15.9|
| Kerolli     | 1            | 8.0 | 480 | 322 | 158 | 212 | 1200| 0.28 | 2.00 | 32.0 | 19.2|
|             | 2            | 8.2 | 492 | 312 | 180 | 220 | 1182| 0.22 | 2.10 | 38.0 | 18.6|
|             | 3            | 7.9 | 472 | 326 | 146 | 246 | 1222| 0.24 | 2.20 | 34.0 | 18.9|
| Kodli       | 1            | 6.8 | 296 | 194 | 102 | 165 | 892 | 0.18 | 4.00 | 28.0 | 18.9|
|             | 2            | 6.5 | 302 | 214 | 88  | 186 | 862 | 0.16 | 4.2  | 26.0 | 20.6|
|             | 3            | 6.3 | 298 | 193 | 105 | 164 | 914 | 0.20 | 3.9  | 29.0 | 22.2|
| Nidgunda    | 1            | 8.0 | 328 | 196 | 132 | 156 | 816 | 0.19 | 3.5  | 119.5| 28.2|
|             | 2            | 7.9 | 342 | 212 | 130 | 162 | 822 | 0.20 | 3.42 | 112.2| 29.10|
|             | 3            | 8.2 | 392 | 199 | 193 | 174 | 912 | 0.18 | 3.8  | 114.2| 26.20|
| Narmal      | 1            | 6.00| 382 | 198 | 184 | 288 | 1012| 0.18 | 3.00 | 27.30| 26.4 |
|             | 2            | 6.20| 399 | 202 | 197 | 302 | 1092| 0.16 | 3.2  | 29.32| 28.2 |
|             | 3            | 6.5 | 392 | 220 | 172 | 312 | 1112| 0.19 | 3.22 | 29.60| 27.9 |
| Chengta     | 1            | 8.00| 622 | 512 | 110 | 312 | 1284| 0.19 | 2.00 | 26.2 | 32.2 |
|             | 2            | 7.8 | 612 | 519 | 93  | 298 | 1299| 0.22 | 2.20 | 28.4 | 33.2 |
|             | 3            | 7.9 | 618 | 522 | 96  | 304 | 1322| 0.20 | 2.28 | 26.9 | 35.2 |
| Kupnoor     | 1            | 8.00| 428 | 323 | 105 | 262 | 919 | 0.28 | 3.50 | 119  | 29.2 |
|             | 2            | 8.1 | 426 | 319 | 107 | 272 | 929 | 0.24 | 3.80 | 122  | 27.4 |
|             | 3            | 8.3 | 424 | 328 | 96  | 269 | 982 | 0.26 | 3.69 | 113  | 28.9 |
| Venkatapur  | 1            | 8.00| 432 | 319 | 113 | 202 | 1194| 0.19 | 3.62 | 68.8 | 19.2 |
|             | 2            | 7.9 | 442 | 328 | 114 | 198 | 1092| 0.20 | 3.64 | 72.26| 22.6 |
|             | 3            | 7.62| 434 | 323 | 111 | 208 | 1019| 0.22 | 3.5  | 71.28| 24.8 |
| Marpalli    | 1            | 7.6 | 512 | 384 | 128 | 282 | 1182| 0.29 | 4.5  | 69.2 | 29.6 |
|             | 2            | 7.8 | 514 | 392 | 122 | 296 | 1192| 0.22 | 4.28 | 72.4 | 28.9 |
|             | 3            | 7.7 | 519 | 394 | 125 | 288 | 1189| 0.26 | 4.42 | 74.6 | 28.2 |
| Soma lingadalli | 1        | 7.2 | 612 | 491 | 121 | 319 | 1499| 0.19 | 2.00 | 82   | 32.0 |
|             | 2            | 7.4 | 618 | 489 | 129 | 322 | 1423| 0.22 | 2.10 | 86   | 34.0 |
|             | 3            | 7.5 | 623 | 496 | 127 | 329 | 1412| 0.24 | 2.28 | 92   | 35.2 |
4. Water quality index

For computing water quality index three steps are followed. In the first step, each of the 10 parameters has been assigned a weight (wi) according to its relative importance in the overall quality of water for drinking purposes (table-3). The maximum weight of 5 has been assigned to the parameter nitrate due to its major importance in water quality assessment. Weight of 4 has been given to fluoride.

Second step, relative weight (Wi) is computed from the following equation:

\[ Wi = \frac{wi}{\sum_{i=1}^{n} wi} \]

where (Wi) is the relative weight, (wi) is the weight of each parameter and ‘n’ is the number of parameters calculated relative weight (wi) values of each parameter are also given in table-3. In the third step, a quality rating scale (qi) for each parameter is assigned by dividing its connections in each water sample by its respective standard according to the guidelines laid down in the BIS and the results is multiplied by 100:

\[ qi = \frac{Ci}{Si} \times 100 \]

where (qi) is the quality rating, (Ci) is the concentration of each parameter in each water sample in mg/l, except pH, and (Si) is the BIS (Bureau of Indian standards) water standard for each chemical parameter in mg/l according to the guidelines of the BIS-10500-1991. For computing the WQI, the SI is first determined for each chemical parameter, which is then used to determine the WQI as per the following equation:

\[ SI_i = Wi \times qi \]

\[ WQI = \sum SI_i \]

SIi is the sub index of the Ith parameter, qi is the rating based on concentration of ith parameter and n is the number of parameter. The computed WQI values are classified into five types “excellent water”, “good water”, “poor water”, “very poor water”, “water unsuitable for drinking”. As shown in table 5.3.
4.1 WQI steps

Step-1

Wi= according to relative importance overall quality of water for drinking purpose.

- The maximum weight = 5 has been assigned to the parameter nitrate and fluoride
- The minimum weight= 2 has been assigned to the parameter alkalinity and acidity

Step-2

Relative weight (wi)

\[ W_I = \frac{w_i}{\sum_{i=1}^{n} w_i} \]

\[ S_I = w_i \times Q_i \]

where

- Qi= quality rating
- Ci= concentration of each chemical parameter in each water sample in mg/l
- Si= Indian drinking water standard for each chemical parameter in mg/l according to (BIS 10500:1991)

### Table 2: Water quality classification based on WQI value

| WQI Value | Water quality          |
|-----------|------------------------|
| <50       | Excellent              |
| 50-100    | Good water             |
| 100-200   | Poor water             |
| 200-300   | Very poor water        |
| >300      | Water unsuitable for drinking |

Note: Qi = ci/si * 100, where Qi= quality rating

### Table-3: Water Quality Index for Chincholi Taluka

| Sl No | Chemical parameters | Indian Standards | Weightage (wi) | Relative weight (Wi) | Quality rating (Qi) | Sub index (SI) |
|-------|---------------------|------------------|----------------|----------------------|---------------------|---------------|
| 1     | pH                  | 6.5-8.5          | 4              | 0.114                | 88                  | 10.03         |
| 2     | Total hardness (TH) | 300-600          | 3              | 0.086                | 72.44               | 6.22          |
| 3     | Ca                  | 75-200           | 2              | 0.057                | 159.65              | 9.10          |
| 4     | Mg                  | 30-100           | 2              | 0.057                | 115.36              | 6.57          |
| 5     | Chloride            | 250-1000         | 3              | 0.0896               | 23.90               | 2.14          |
| 6     | Total dissolved solids (T.D.S) | 500-2000 | 4      | 0.114                | 54.19               | 6.17          |
| 7     | Fluoride            | 1-1.5            | 4              | 0.114                | 22.00               | 2.50          |
| 8     | Nitrate             | 45-100           | 5              | 0.143                | 216.66              | 24.69         |
| 9     | Iron                | 0.3-1.0          | 4              | 0.114                | 62.19               | 8.89          |
5. Conclusions

After the careful study of analysis interpretation and discussions of the numerical data following are the conclusions have been drawn for the Chincholi Taluka.

1. The ground water is crystal clear, odorless, and palatable. And at few sample points are of salty taste.
2. Few of the bore wells yield saline water with high mineral or dissolved salts.
3. Water is moderately hard in almost all the sampling points.
4. At few places there is considerable increase in chloride. This shows that there is a possibility of contamination of groundwater due to percolation of polluted surface water.
5. The concentration of fluoride in the few villages is beyond the permissible limits. Hence treating the water becomes mandatory.
6. The concentration of nitrate was also high in few villages which may be due to percolation of polluted surface water.
7. Higher values of iron, nitrate, TDS, hardness, fluorides and chloride in the ground water, were observed at few sampling points. The reason may be due to contamination by sewage and drainage water.
8. The analysis reveals that the groundwater of the area needs certain degree of treatment before consumption, and it also needs to be protected from the perils of contamination.
9. From water quality index the water of Chincholi taluka is considered as GOOD WATER.

6. References

1. De.A.K. (2000), Environmental chemistry 4th edition, New Age International Publishers (p) Ltd, New Delhi.
2. Patil Nirdosh et al., (2011), Study on the physico-chemical characteristics of ground water of Gulbarga city Karnataka, International Journal of Applied Biology and Pharmaceutical Technology, 1(2), pp 518-523.
3. Jain. C.K. et al, (2000), Ground water quality in Sagar district, Madhya Pradesh; Indian Journal of Environmental Health, 42(4), pp 151-158.
4. Ground water Information Booklet Gulbarga district Karnataka, Ministry of Water Resource, South western Region Bangalore, 2008, second edition, pp 12.
5. Krishnan Kannan. Fundamentals of Environmental Pollution; S. Chand and Co. Ltd New Delhi, Fifth edition, 1991.
6. T.Suresh. et al., (2009), Assessment of Groundwater quality of Hospet taluka. Rasayan. J.Chem. 2(1), pp 221-233.

7. Dattatraya Bharati et al, (2011), Physicochemical Characteristics of borewell water quality in Nagpur region (South Zone). Journal of Chemical and Pharmaceutical Research, 3(2), pp 922-927.

8. P.G.Smitha et al (2007), Physico-chemical Characteristics of water samples of Bantwal taluka Southwestern Karnataka. Journal of Environmental Biology 5(3), pp 51-595.

9. Kavita. R. et al (2010), Groundwater Quality Characteristics at Erode District, Tamilnadu. International Journal of Environmental Sciences. 1(2) pp 145-150.

10. Veeresh. B. et al (2011), Evaluation of Physico-Chemical Parameters of Underground water of Hungund taluk of Bagalkot District. Asian Journal of biochemical and Pharmaceutical Research, 3(1), pp 362-370.

11. Y. Shastri. Et al (2001). Physico-chemical Characteristics of Percolation tank of Dimalgaon. Journal of Environmental Health. 43(1), pp 174-175.