



Study on Groundwater Quality in Prakasam District and Its Suitability for Drinking

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ABSTRACT

Groundwater samples were collected from different places in Prakasam District for their physico-chemical studies. Laboratory tests were performed for analysis of samples for pH, chlorides, hardness, total dissolved solids and nitrates. Besides models, several water quality indices have been developed and used time to time. Water quality Indices are generally used as a tool to convert a large data set into a much reduced and informative form. Water Quality Index (WQI) by weighted arithmetic Index method is used in the present study to assess the suitability for drinking. It was found that most of the stations have WQI value in the range of 25-49 and concluded as good for drinking. But three stations namely Ongole, Kandukur and Kanigiri have WQI values more than maximum value of hundred and not fit for even domestic use. The higher value of these parameters may have health implications and therefore need attention.

INTRODUCTION

With rapidly growing population and improved living standards the pressure on water resources is increasing. To meet the rising demand it is imperative to recognize the freshwater resources and also to find out remedial methods for improvement of water quality. Water is a universal solvent and it dissolves the minerals from the rocks in which it is stored and thus chemical and physical attributes of groundwater depend on geology of a particular area. The quality of groundwater may also vary with depth of water table and seasonal changes, and is governed by the extent and composition of the dissolved salts depending upon source of the salt and subsurface environment. The quality of groundwater is the resultant of all the processes and reactions that act on the water from the moment it condenses in the atmosphere to the time it is discharged by a well.

The socioeconomic growth of a region is severely constrained by nonavailability of safe drinking water. Groundwater meets domestic needs of more than 80% rural and 50% urban population, besides fulfilling irrigation needs of around 50% irrigated agriculture. Around two-fifth of India's agriculture output is contributed from areas irrigated by groundwater. Assessment of groundwater quality and its suitability for drinking is the objective of the present study. On comparing the results against drinking water quality standards laid by Indian Council of Medical Research (I.C.M.R), the suitability of groundwater for domestic use has been based on WQI, which was derived by weighted arithmetic index method.

MATERIALS AND METHODS

Samples were collected in polythene bottles from various wells covering the study area. Utmost care was taken during sampling to avoid any kind of contamination. pH was measured at the time of sampling itself. Physical attributes like TDS and EC were evaluated by microprocessor. Nitrates were done spectrophotometrically. Hardness and chlorides were analysed using the standard titrimetric methods. WQI was obtained by Weighted Arithmetic Index method as given below.

$$\text{Water Quality Index (WQI)} = \sum q_i w_i$$

Where, q_i is water quality rating

$$q_i = 100 * (V_a - V_i) / (V_s - V_i)$$

V_a = actual value of the parameter present in water sample

V_i = ideal value

$w_i = k / S_n$, where, w_i = unit weight

$$k \text{ (constant)} = 1 / (1/V_{s1}) + (1/V_{s2}) + (1/V_{s3}) + \dots + (1/V_{sn})$$

S_n = standard value

RESULTS AND CONCLUSION

The standards for drinking water are given in Table 1, the results of the water analysis in Table 3, and the water quality indices in Table 2. The lower pH may cause tuberculation and corrosion while the higher values may produce incrustation, sediment deposit and difficulties in chlorination for disinfection of water. In the present studies, pH values in all the samples ranged from 7.9-9.1. The highest pH value more than the highest desirable level 7-8.5 set by ICMR was present at the two stations namely Markapuram and Addanki.

Table 1: Standards for drinking water (the values in mg/L except pH).

Parameter	WHO	ISI	ICMR
pH	6.5-8.5	6.5-8.5	7-8.5
Total Dissolved Solids	500	-	500
Chlorides	250	250-1000	250-1000
Nitrates	45	45	45
Total Hardness	500	300	300

Table 2: Water quality scale with reference to WQI.

WQI	Quality of water
0-24	Excellent
25-49	Good
50-74	Poor
75-100	Very Poor
>100	Unfit for drinking

Table 3: Physico-chemical characteristics of groundwater collected from different locations in Prakasam district.

Location of Sampling Station	pH	Hardness	Chlorides	Nitrates	TDS	WQI
1. Ongole	8.18	102	120	25	1464	143
2. Kandukuru	8.47	259	140	13	998	138
3. Kanigiri	8.28	702	680	98	2147	142
4. Marturu	8.78	200	60	31	596	32
5. Markapuram	9.10	199	230	4	1034	26
6. Addanki	9.02	138	50	10	599	28
7. Cumbum	8.38	340	310	25	922	40
8. Vetapalem	8.24	158	30	4	237	42
9. Giddalur	8.63	521	330	31	1089	40
10. Podili	8.41	340	160	31	586	40
11. Darsi	8.40	179	40	2	358	40
12. Chinaganjam	8.23	141	40	4	210	43
13. Jarugumalli	8.50	402	380	88	1843	38
14. Gudluru	8.30	402	160	3	638	41
15. Rallapadu	8.74	139	30	1	427	33
16. Pamuru	8.82	282	180	3	1480	32
17. C.S.palem	8.83	319	200	4	690	32
18. P.C.palli	8.57	221	30	10	564	37
19. Tripurankam	8.51	159	100	3	470	38
20. Kuruchidu	8.30	499	530	81	2033	42
21. Ballikurava	8.85	118	60	51	1133	31
22. Korisapadu	8.90	119	150	47	966	30
23. Naguluppapadu	7.90	41	60	3	610	49
24. Ballipalli	8.54	221	40	8	406	37
25. Kakaria	8.71	242	130	5	656	34
26. Talluru	8.63	542	150	23	804	35
27. Ulichu	8.62	540	890	72	3026	37
Average	8.55	278.70	195.56	25.19	962.44	48.15
Max.value	9.10	702	890	98	3026	143
Min.value	7.90	41	30	1	210	26

Note: All the characteristics are expressed in mg/L except pH and WQI.

Chloride concentration in all the samples ranged from 30-890 mg/L. Chloride concentration in some of the samples was found to be higher than the highest desirable level i.e., 200 ppm as stipulated by ICMR, yet these values are well below the maximum permissible limits of 1000 ppm. High chloride concentration indicated organic pollution.

Total hardness varied from 41-702 mg/L. Hardness is an important factor for domestic as well as industrial purposes. I.C.M.R. has set highest desirable level for total hardness as 300 ppm. In general, hardness has got no adverse effect on human health. Water with hardness above 200 mg/L may cause scale deposition in the water distribution system and

more soap consumption. Higher hardness values were recorded for some of the stations namely Kanigiri, Cumbum, Giddalur, Podili, Jarugumalli, Gudluru, C.S. Palem, Kuruchedu, Talluru and Uluchi. For the stations Marturu, Addanki, Vetapalem, Darsi and Chinnaganjam, hardness values were less than 50 mg/L and these can be considered as very soft waters.

TDS concentration in all the sample ranged from 210-3026 mg/L. The highest TDS values of more than highest desirable level 500 mg/L set by ICMR were present at many stations, while Rallapadu and Ballipalli station samples were within the permissible value.

Nitrate concentration in all the samples ranged from 1-98 mg/L. Most of the stations were well within the desirable limit of 45 mg/L. Nitrates at higher concentration than 45 mg/L cause a disease called blue baby disease or methaemoglobinaemia in infants.

When WQI is greater than 100, it implies that the pollutants are above the standard limits. Similarly, $0 < \text{WQI} < 100$ reflects its unsuitability for human use. The three stations namely Ongole, Kandukuru and Kanigiri have WQI greater than 100 and unfit for drinking and domestic use.

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