Study of Ground Water Quality at Selected Locations in Anantapur Town, Andhra Pradesh

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ABSTRACT

Ground water is a part of the hydrologic cycle that lies beneath the surface, but is tied to surface supplies. Ground water is the largest potential source of supply of fresh water in the hydrologic cycle larger than all surface lakes and streams combined.

The present study aims at determining the suitability of ground water quality for drinking purpose at selected locations in Anantapur town. Various water samples were taken at fourdifferent locations. The samples are analysed for physico-chemical parameters. The results were compared with Drinking water standards of Bureau of Indian Standards (IS: 10500) and World Health Organisation Standards (WHO 2011) standards. Further the correlation studies among the different parameters of water were estimated.

Key words: Ground water, Anantapur town, Physico-Chemical parameters, Correlation, Hydrologic cycle.

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1. INTRODUCTION

Ground water is the major resource of drinking water. The ground water is clean and free from pollution when compared to surface water. The ground water is polluted due excessive use of fertilizers and pesticides, increased human activities and rapid growth of industries. Since Ground water contains high amount of various Ions, salts etc its quality has to be tested before using it as portable water for domestic purposes. Other wise it may lead to water borne diseases. Hence it is very essential to maintain the quality of ground water for human consumption. Present study was under taken to investigate the impact of the ground water quality of Bore wells water samples in Anantapur at various locations. Thus in this work the physico-chemical parameters of ground water like pH, Temperature, EC, TDS, DO, Alkalinity, Hardness, Calcium , Magnesium, chlorides and Sulphateswere determined.

Continuous discharge of industrial waste, domestic sewage and solid waste cause the ground water to be polluted [1].Since the ground water is continuously polluted it is necessary to protect and manage the ground water quality[2]. Physico-chemical status of ground water for different samples was assessed in Akot City which is situated in Akola district, Maharastra[3]. During last decades it is observed that the ground water get polluted drastically because of increased human activities[4].Physico- chemical analysis of ground water for drinking from selected sample points around the Banmeru Science College, Lonar Buldana district of Maharashtra indicated that there is a safe level of pollutant in water and can be consumed with little treatment[5]. The results of water parameters were compared with the Bureau of Indian Standards[6] (IS: 10500) and World Health Organisation standards[7] WHO (1993).

2. MATERIALS AND METHODS

2.1. Sample collection

Water samples were collected from bore wells at four different localities in Anantapur town, Andhra Pradesh based on the area importance. The samples were collected in 5.0 litre water cans. Drinking water sampling locations in the Anantapur town shown in Fig. 1

2.2. Physico-Chemical Analysis

Water quality parameters were analysed using standard methods[8-10]. During the sample collection temperature was noted using Thermometer and details of different methods relevant to parameters are shown in the Table.1.

3.RESULTS AND DISCUSSION

The results of physico-chemical parameters of drinking water in selected locations of Anantapur town were estimated and it are shown in Table.3.

Temperature

Temperature is an important biologically significant factor, which plays an important role in the metabolic activities of the organism. The temperature was ranging from 23°C at S1 to 26°C at S4 in the study areas. There is no difference in change of temperature between the locations found.

pH and Electrical Conductivity (EC)

Intensity of acidity or alkalinity conditions of a solution can be measured by the scale pH. Most of the water samples are slightly alkaline due to presence of carbonates and bicarbonates [11]. The pH values of water samples varied between 7.17 at S1 location to 7.71 at S2 location and were found within the limit (6.5 - 8.5) prescribed by BIS. EC is the most important parameter to define salinity hazard and suitability of water for irrigation purpose. EC values were found in the range of 1.46 to 5.73 mS/cm at S3 and S1 locations respectively. The high conductivity in S1 and S2 sites is likely due to continued and concentrated domestic house hold activities and geological conditions obtaining high concentrations of the dissolved minerals[12] .

Total Dissolved Solids (TDS)

Groundwater behaviour of salinity can be indicating by Total Dissolved Solids (TDS). Water containing more than 500 mg/L of TDS is not considered desirable for drinking water supplies[13]. In the present study TDS values varied from 710 mg/l (S3) to 2820 mg/l (S1). The sampling points S1, S2, S3 and S4 showed higher TDS values than the prescribed limits.

Dissolved Oxygen (DO)

Dissolved oxygen is important parameter in water quality assessment and reflects the biological processes predominant in the water. The DO values are indicates the degree of pollution in water bodies. In the Ground water locations DO values found in low levels and varied from 0.8 (S1) to 2.6 mg/l (S4).

Alkalinity

Both CO_3^- and HCO_3^- contribute to the alkalinity of the water and are associated with the hardness of water which gives an unpleasant taste to water. The primary source of CO_3^- and HCO_3^- ions in groundwater is the dissolved CO_2 in rainwater that on entering in the soil dissolves more CO_2. Normally in natural water as the pH value ranges from 7.0-8.0 would contain much more bicarbonates than carbonates .

Total Hardness

For Domestic and Industrial purpose, Total hardness is an important parameter of water for its use. Salts of Calcium and magnesium are important sources for total hardness in groundwater. In this study the TH value of groundwater estimated and found that the high value of 590 mg/l found at S1 location and it is deviated from the permissible level of 500 mg/l. Excess hardness is undesirable mostly for economic reasons. TH of remaining water sampling locations (S2, S3 and S4) is within permissible limit.

Calcium (Ca^{2+}) and Magnesium (Mg^{2+})

Calcium and Magnesium content is very common in groundwater, because they are available in most of the rocks, abundantly and directly related to hardness. The obtained Calcium concentration exceed the permissible limit (<75mg/l) in all the locations and varies between 190 (S2) to 500 (S1) mg/l. Magnesium (Mg2+) usually occurs in lesser concentration than Calcium due to the fact that the dissolution of Magnesium rich minerals is slow process. Magnesium concentration varies between 30 (S4) to 90 (S1) mg/l which were found S1, S2 and S3 samples exceed the prescribed limit (<30 mg/l). If the concentration of Calcium and Magnesium in drinking water is more than the permissible limit, it causes unpleasant taste to the water.

Chloride (Cl^-) and Sulphate (SO_4^{2-})

Chloride is essential element for normal cell functions in plant and animal life in required concentration level. The estimated levels of Chloride concentration varies between 150 to 650 mg/l and the S1 location (650 mg/l) exceed the prescribed limit (<250 mg/l) as per BIS. Sulphate is an essential nutrient for plants or animals at lower concentration, but at higher concentrations, may cause adverse effects. Sulphate occurs naturally in water due to leaching from gypsum, other common minerals and discharge of domestic sewage and

industrial effluents tends to increase its concentration. Sulphate concentration of water samples varied between 60 to 210 mg/l and S1 location found above the desired limit (<150 mg/l) as per BIS.

Correlation Studies

The correlation matrix was also calculated for different parameters of drinking water (Table 4). Correlation coefficient is the commonly used measure to establish the relationship between two variables. Data were analyzed by using the computer software Statistical Package for Social Sciences (SPSS) version 11.5 for Windows. Here in discussion consider the significant correlation between the parameters of $r^2>0.5$. Temperature was significantly positively correlated with pH and D.O. pH was positively and significantly correlated with D.O. and Alkalinity. Similarly, EC and TDS showed significant related with TH, Ca^{2+}, Mg^{2+}, Cl^- and SO_4^{2-}. TH content showed significant and positive relation with Ca^{2+}, Mg^{2+}, Cl^- and SO_4^{2-}. Ca^{2+} content, while significant and negative correlation with Mg^{2+}, Cl^- and SO_4^{2-}. Finally, Mg^{2+} and Cl^- positively correlated with SO_4^{2-}.

CONCLUSION

The present study concluded that the ground water samples of selected locations in Anantapur Town have deviations from standard permissible limits. The water samples from site S1 showed poor water quality as compared to other water samples. The water samples from sites S1 is polluted and unfit for drinking purpose. The sampling point S1 showed high EC, TDS, TH, Calcium and Magnesium content indicating the need of some treatment for minimization of these parameters. The sampling sites S2, S3 and S4 showed maximum physicochemical parameters within the water quality standards and the quality of water is good and it is fit for drinking purpose.

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Table1: Different water quality parameters and estimated standard methods.

S.No	Parameters	Test Methods
1	Temperature	Thermometer
2	pH	pH Meter
4	EC	Digital Conductivity Meter
5	TDS	Digital Meter
6	D.O.	Winkler's method
7	Alkalinity	Acid titration
8	Hardness	EDTA titration
9	Calcium	EDTA titration
10	Magnesium	EDTA titration
11	Chlorides	Argentometric titration
12	Sulphates	Turbidity Spectrophotometric

Table 2: Water sampling locations in Anantapur Town

S.No	Sample Location	Source	Sample Number
1	Chinnmaya Nagar	Bore well	S1
2	Venugopal Nagar	Bore well	S2
3	KouvurNagar	Bore well	S3
4	Railway Station	Bore well	S4

Table 3: Results of Physiochemical parameters of water at different locations in Anantapur

Parameter	Units	S1	S2	S3	S4	BIS (IS 10500)	WHO (2011)
Temperature	^{0}C	23	25	24	26	-	-
pH	-	7.17	7.71	7.56	7.47	6.5-8.5	7.5-8.5
EC	mS/cm	5.73	2.22	1.46	1.87	-	-
TDS	mg/l	2820	1080	710	920	500	500
D.O.	mg/l	0.8	2.0	2.4	2.6	>6	>6
Alkalinity	mg/l	15	38	22	20	-	-
Hardness	mg/l	590	250	320	190	500	500
Calcium	mg/l	500	190	280	160	75	75
Magnesium	mg/l	90	60	40	30	30	30
Chlorides	mg/l	650	250	150	280	250	200
Sulphates	mg/l	210	80	120	60	150	200

Table 4: Pearson correlation among the estimated water quality parameters

	Temp	**pH**	**EC**	**TDS**	**D.O.**	**Alkalinity**	**TH**	**Ca^{2+}**	**Mg^{2+}**	**Cl^-**	**SO_4^{2-}**
Temp	1.00										
pH	**0.60**	1.00									
EC	-0.71	-0.85	1.00								
TDS	-0.71	-0.85	**1.00**	1.00							
D.O.	**0.80**	**0.72**	-0.97	-0.97	1.00						
Alkalinity	0.40	**0.87**	-0.48	-0.48	0.31	1.00					
TH	-0.93	-0.82	**0.91**	**0.91**	-0.93	-0.55	1.00				
Ca^{2+}	-0.93	-0.84	**0.89**	**0.89**	-0.90	-0.60	**1.00**	1.00			
Mg^{2+}	-0.78	-0.59	**0.92**	**0.91**	-0.98	-0.15	**0.88**	**0.84**	1.00		
Cl^-	-0.60	-0.88	**0.99**	**0.99**	-0.92	-0.53	**0.85**	**0.83**	**0.85**	1.00	
SO_4^{2-}	-0.95	-0.80	**0.87**	**0.87**	-0.90	-0.57	**1.00**	**1.00**	**0.84**	**0.80**	1.00

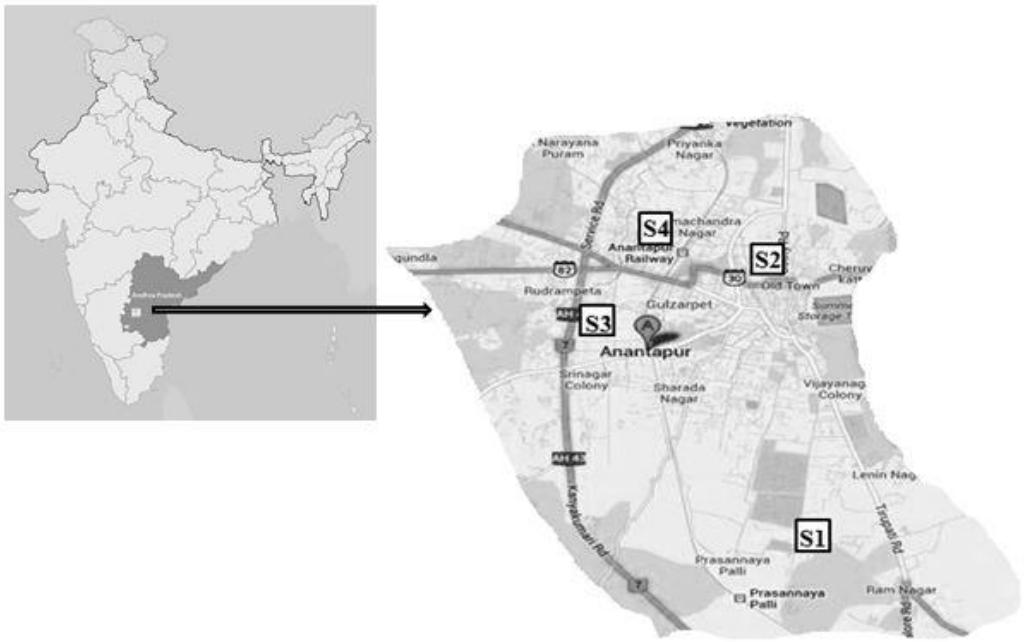

Fig.1: Water sampling location in Anantapur town, Andhra Pradesh