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Assessment of Groundwater Quality in Talupula Mandal, Anantapur District, Andhra Pradesh, India

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ABSTRACT

We must guard against pollution and biological contamination of our drinking water. Health, happiness, and the ability to feed one's family are all directly impacted by the availability and quality of clean water. The quality and amount of elements dispersed and dissolved in underground water greatly influences its quality, even when the water itself is free of contaminants. It is therefore a major environmental issue in many nations, particularly in developing countries, where untreated surface water and groundwater sources for home and agricultural use are most vulnerable to the negative effects of low water quality.

Groundwater quality in and around Talupula mandal, Anantapur district, Andhra Pradesh, is the study's primary goal. Survey of India Toposheet no. 57 J/8 covers the subject region under investigation. Thirteen bore wells in Anantapur district's Talupula mandal, Anantapur district, were sampled during the month of January 2018 for drinking water. Grey granite, pink granite, hornblende-biotite gneiss, hornblende-gneiss, biotite gneiss, and migmatite make up the study area's geological makeup. In the last two decades, water quality and management techniques have grown increasingly crucial in developing countries.

Analysis shows that for the fourteen water samples, quality parameters including pH and EC and TDS have been determined as well as total hardness and chloride as well as iron and fluoride as well as sulphate and nitrate concentrations. Fluoride and EC ions concentrations are 57 percent and 78 percent over the WHO and ISI permitted limits, respectively. The remaining water samples are safe to drink and are within the legal limit.

Introduction

More than 95% of the world's fresh water is found in the earth's subsurface. Soil naturally filters groundwater, making it an excellent source of drinking water. Many of Andhra Pradesh's arid and semiarid districts rely on groundwater as their primary source of safe drinking water. Even though groundwater is naturally more protected from contamination than surface water, human activities have a tendency to affect the composition of the groundwater. Although only 0.6 percent of the world's overall water supply comes from groundwater, developing countries like India rely on it for approximately 80 percent of their home water and 50 percent of their urban water needs (Meenakshi and Maheswari. P,2006). To determine the suitability of groundwater for large-scale public water supply, irrigation, industrial use, etc., the quality of groundwater is critical. Overexploitation, contamination, or a combination of both are the most common causes of groundwater quality issues. Individual hydrological, physical, chemical, and biological factors all contribute to the quality of ground water. Toxic materials, living and non-living creatures, and high mineral concentrations should be avoided in drinking water.

Increasing attention is being paid to the importance of water quality in human health. Poor water quality and unsanitary conditions are directly responsible for 80 percent of infections in developing nations like India (Olagire and Imeoktaria, 2001; Prasad, 1984; UNESCO, 2006). Because of their toxicity and accumulative nature, heavy metals and pesticides polluting groundwater have gained significant attention in recent years. Groundwater is essential in dry and semi-arid regions, where surface water is scarce. The formation of a depression cone and the extraction of nonrenewable groundwater are both consequences of groundwater withdrawals exceeding naturally renewable storage. Because it's a dynamic resource, ground water changes in both quantity and quality over time. By interacting with aquifer minerals or combining with other groundwater reservoirs along a flow channel in the subsurface, groundwater undergoes chemical evolution.

Data on the quality of groundwater can reveal a lot about the rocks' geological past, as well as when and how much groundwater is being recharged, discharged, and stored (Walton, 1970). While ground water has long been relied upon by residents of Anantapur's Talupula Mandal, this study will examine its chemical quality. To evaluate the water's quality, major inorganic constituents are identified and quantified. There are many iron ore, mosaic chip stone, barite, etc. in this area.

Objectives

1. To study the Physico - Chemical parameters of groundwater in Talupula mandal, Anantapur district, Andhra Pradesh.

2. To study the sources and distribution of parameters in Talapula Mandal.
3. To assess the Groundwater suitability for drinking, irrigation and industrial purpose.

Study area

Talapula mandal is located in the Andhra Pradesh state of India's Anantapur district. It is part of the Rayalaseema region and is located 101 kilometres east of Anantapur, the district capital. Kadiri, Gandlapenta, Vemula, and Vempalli are the four Mandals that surround it, with Vempalli in the East... To the west of this location, the districts of Anantapur and YSR Kadapa meet. In terms of elevation, it stands at 382 feet above sea level. It is located in the Anantapur district, between Latitudes 14° 2' 30" - 14° 24' 30" N and Longitudes 78° 8'00" - 78° 24' 30" E. Aquifers are the primary source of water for drinking and agriculture in this semi-arid region, hence the high amount of fluoride exposure there is a big concern. There is no primary porosity in these rocks, hence the groundwater in these formations is found in the worn and fractured zones. Secondary porosity has evolved as a result of fracture and weathering. In this dry terrain, the most common methods of obtaining water for home and agricultural use are open wells and bore wells. Granitic rocks rich in fluorine and soils made from these rocks are the primary sources of fluoride in groundwater. This area receives an average of 54 cm of rain each year (Nagaraju et al. 2011). Groundwater with high fluoride concentrations is used to irrigate crops in communities due to low rainfall volumes. The average daily high temperature is between 29 and 42 degrees Fahrenheit. The coldest months of the year are November, December, and January, with lows of 17.2 degrees Celsius. Groundwater with high fluoride concentrations is used to irrigate crops in communities due to low rainfall volumes. The region receives an average of 572 mm of rain each year. For the South West monsoon period, the normal rainfall is 338 mm, which accounts for around 61.2 percent of the year's total rainfall. When it comes to rain, the North East monsoon period is responsible for 28.3 percent of the total amount (October to December). It is warm and dry throughout the rest of the year in March, April, and May.

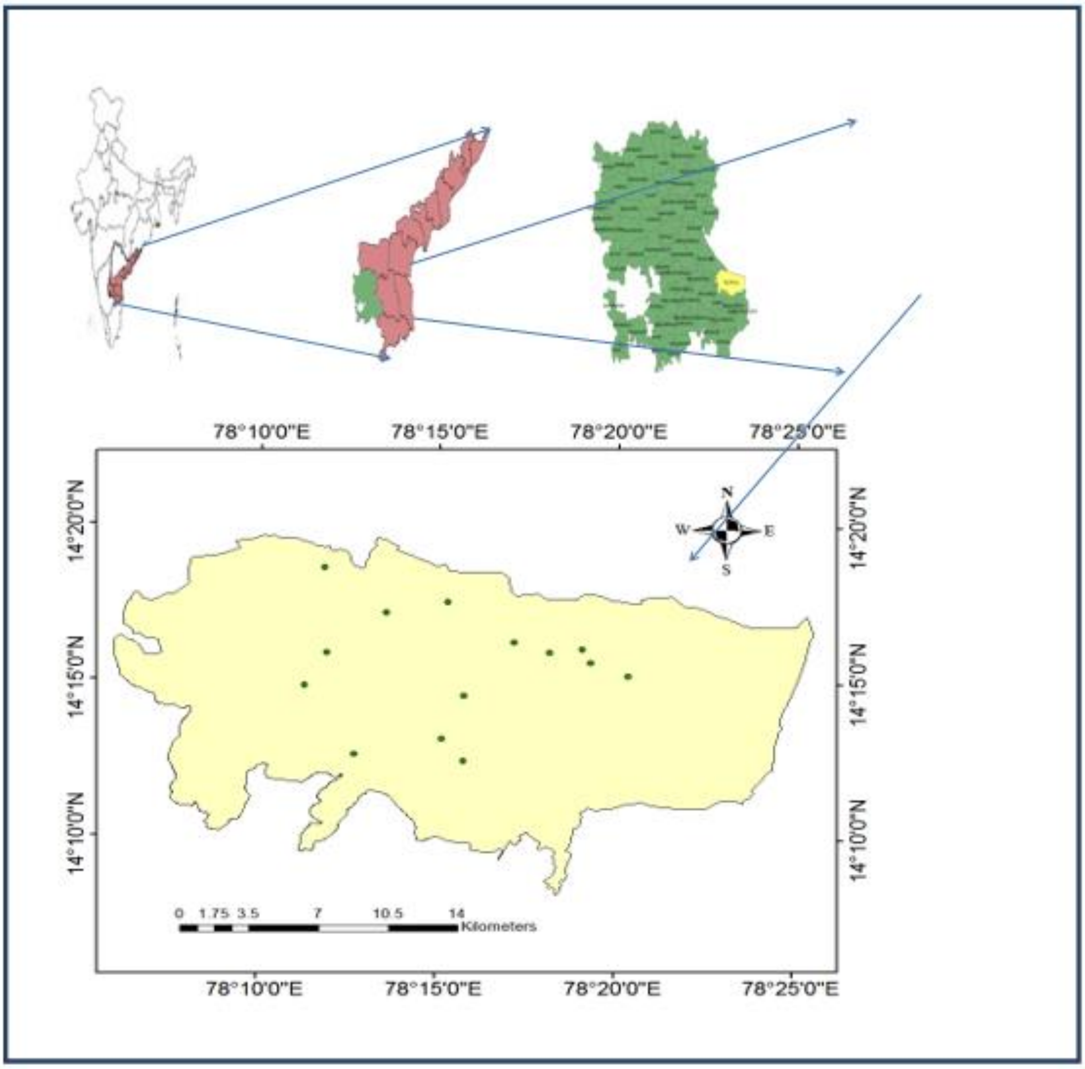

Fig 1: Location Map

Geology

Geological formations ranging in age from the Archean to the Recent are found in the area. Almost all of the area is covered by the Dharwar supergroup's granites, gneisses, and metadecite, as well as rhyolite, quartz, quartz porphyry, and quartzo-felspathic gneiss. Granite in various shades of grey and pink, as well as closepet granite, can be found. The Archaen rocks that make up the rest of the district include Schists, Gneisses, Migmatites, and newer Granites, Pegmatites, Quartz veins, and basic dykes. The Archean rocks have been metamorphosed and recrystallized as a result of extensive tectonic disturbances. Quartzites, limestones, and shales from the Cuddapah and Kurnool group of rocks are found in the northeastern section of the district.

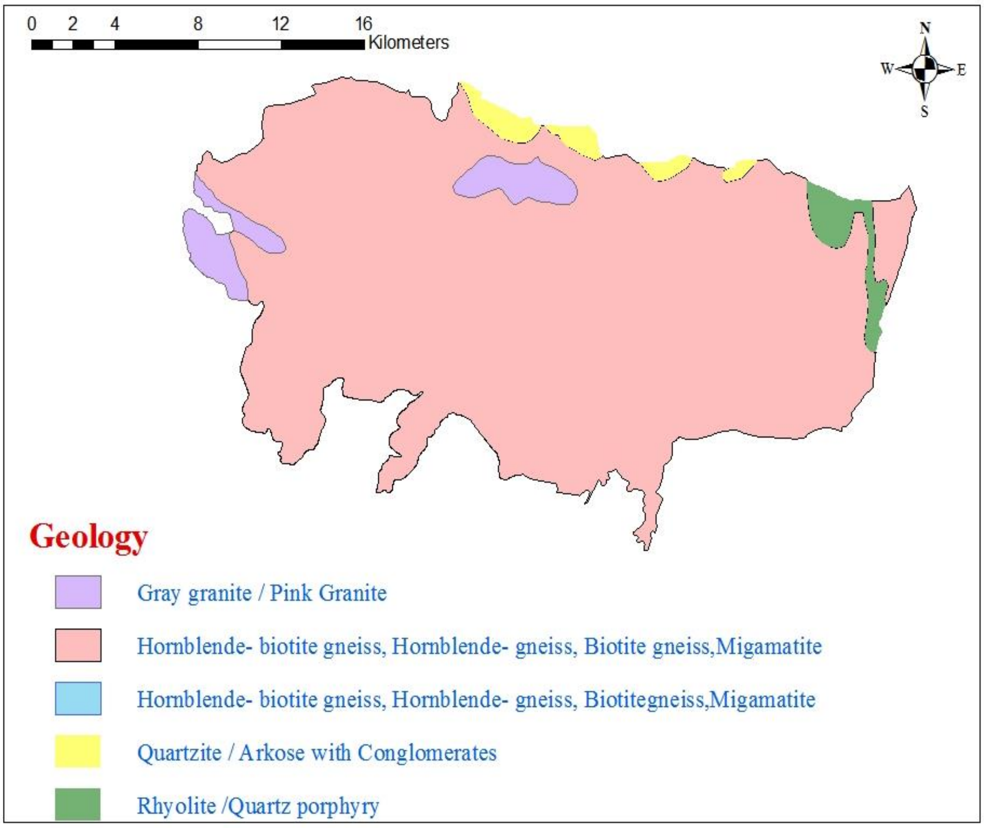

Fig 2: Geological Map

Results and Discussion

Sample	pH	EC µS/cm	TDS mg/l	Alkalinity mg/l	Hardness mg/l	Cl mg/l	F mg/l	NO_3 mg/l	SO_4 mg/l	Fe mg/l
1	7.63	1460	949	323	416	217	1.25	6.2	26	0.16
2	7.14	1893	1230	348	483	208	1.90	16.9	30	0.05
3	7.90	1976	1284	260	316	281	0.74	58.0	12	0.03
4	7.46	2015	1309	413	502	196	1.83	13.9	19	0.12
5	7.13	1476	959	289	372	216	1.92	7.3	46	0.02
6	7.46	1878	1220	485	316	280	0.52	0.0	73	0.16
7	7.60	2013	1308	430	507	216	2.06	34.2	45	0.09
8	7.19	2136	1388	513	360	286	0.83	0.0	80	0.10
9	7.86	1576	1024	279	416	273	1.20	5.5	80	0.23
10	7.97	1987	1291	259	316	196	0.56	11.2	46	0.12
11	7.12	1342	872	317	411	260	1.66	20.6	21	0.19
12	7.28	1760	1144	325	302	225	2.24	9.7	53	0.08
13	7.49	2279	1442	293	418	308	1.57	28.3	19	0.25
14	7.10	1978	1285	413	376	216	2.10	19.5	80	0.17

Table 2: Results of the chemical analyses of groundwater samples in the study area(mg/l).

pH

When it comes to solubility calculations, water's pH is a critical indicator of its quality and serves as a useful guideline (Hem, 1985). The pH ranges from 7.10 to 7.97 in the research area's groundwater. 6.5 to 8.5 is the range of pH values that can be used for drinking water (ISI, 1983). One hundred percent of the groundwater is found to be within the allowable limits.

Electrical conductivity

It is a measure of the water's ability to carry electricity. The EC concentrations examined varied from 1460 to 2279

/cm. Ionic concentrations can be determined by measuring conductivity. Temperature, ion concentration, and kind of ions all play a role (Hem, 1985). In terms of EC drinking water, the maximum permitted concentration is 1500 s/cm3 (WHO, 1996). Sample 13 has the highest EC value of 2279 s/cm, and sample 1 has the lowest EC value of 1460 s/cm, according to the data. 78 percent of the groundwater is found to be in violation of the allowed limits.

Total Dissolved Solids

Between 949mg/l and 1442mg/l of total dissolved solids are found in groundwater. TDS levels in drinking water should not exceed 500 mg/l. It may produce gastrointestinal irrigation if concentrations above this level of palatability (ISI,1983). The desired limit is not exceeded in any of the samples taken from the area.

Total Hardness

Talupula mandal has a total hardness content of 302 mg/l to 507 mg/l. 360 milligrammes per litre is the maximum permissible level of total hardness in potable water (ISI, 1983). No sample of groundwater in the research region has been found to be above or below the acceptable levels. The presence of alkaline earths such as calcium and magnesium causes water to be hard.

Chloride

The chloride concentration of the groundwater is 196mg/1 to 308mg/1. The maximum amount of chloride allowed in drinking water is 250mg/1 litre (ISI,1983). 100 percent of the groundwater sample does not exceed the allowed limit. The source of chloride in the groundwater is due to the weathering of phosphate minerals and residential sewage (karanth, 1987).

Total Alkalinity

Between 260mg/1 and 513mg/l of HCO3- are found in the groundwater in the research region. Normal carbonate water and sub carbonate water samples are found in the research location. As a result, "normal carbonate water" can be used to describe the groundwater in the research region.

Nitrates

Between 9.3 mg/l and 31.2 mg/l of NO_3^{2-} is found in the groundwater of the research area. 45 mg/l is the maximum nitrate concentration allowed in major drinking water sources. In addition to human and animal waste that is improperly disposed of, unlined drainage and sewage systems may also contribute to the groundwater's nitrate contamination (Jack and Sharma, 1993). The permitted limit is met in all of the study's groundwater samples.

Fluoride

Fluoride concentrations up to 1.5mg/l are considered safe. Fluoride concentrations in the study area's groundwater range from 1.02 mg/l to 2.05 mg/l. Fluoride is one of the most common trace elements found in groundwater, and it is usually present in abundance. Fluoride is found in high concentrations in groundwater because of the presence of fluoride minerals in bedrock. Fluoride ions in natural water are influenced by the availability of these minerals to the flowing water. One-fifth of the groundwater samples tested in the research region were found to be toxic.

Sulphate

A naturally occurring ion, sulphate can be found in virtually any body of water. But above 200mg/L, it is not acceptable for any home purposes. In the research area, sulphate concentrations in groundwater range from 23 mg/l to 80 mg/l. Sulphate may be generated by the dissolving of minerals on the surface of limestone. Groundwater samples taken throughout the research region were all within acceptable levels.

Iron

There is a 1.0mg/l limit for iron in drinking water. The iron concentration in the groundwater varies from 0.05 mg/l to 0.19 mg/l in the studied area. Natural deposits, industrial waste, the refinement of iron ores, and the corrosion of iron-containing metals can all release iron into the water. Shallow wells and surface water often include iron in combination with naturally occurring organic substances. Yellow or brown in appearance, this water can also be clear. Permissible limits have been established for groundwater samples in the study area.

Drinking water quality standard

When it comes to public health and drinking water, the Talupula mandal in Andhra Pradesh, India, is compared to the WHO's recommended requirements for groundwater quality (W.H.O.,2004).

S.No	Parameters	WHO standards		Study Area values	
		Minimum	Maximum	Minimum	Maximum
1	pH	6.5	8.5	7.10	7.97
2	EC	500	1500	1460	2279
3	TDS	500	2000	949	1442
4	Alkalinity	200	600	260	513
5	Hardness	300	600	302	507
6	Chloride	200	600	196	308
7	Fluoride	1.0	1.5	0.56	2.24
8	Nitrate	45	58.0	9.3	31.2
9	Sulphate	200	400	12	80
10	Iron	0.3	1.0	0.02	0.25

Table 4: Comparison Table of Talupula area results with WHO standards.

Conclusion

Water is one of the most valuable natural resources, which is facing depletion due to increase in consumption by increasing population and industrial activities. This calls for active need for water management which requires water quality analysis as the initial stage. The present investigation focuses on the characteristic phenomenon of the quality of water sample from Talupula mandal area by measuring their physical and chemical properties. The results of pH, TDS, hardness, alkalinity, chloride, nitrates, sulphate and iron concentrations in all the groundwater samples of the study area are within the permissible limits. Electrical conductivity with 78% concentration of groundwater samples above the permissible limits. 57% of Fluoride concentration of the groundwater samples is above the permissible limits. The results obtained from the analysis of the samples revealed that the quality of the groundwater in study area has been assessed by comparing each concentration with standard desirable limit of the parameter in drinking water as prescribed in WHO and ISI standards. Fluoride and Electrical conductivity of the samples are above permissible limits hence the ground water with a little bit of treatment are potable and useful for irrigation and other industrial activities.

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