RESEARCH ARTICLE OPEN ACCESS

Seasonal Variation of Groundwater Quality in Parts of Y.S.R and Anantapur Districts, Andhra Pradesh, India

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ABSTRACT
Groundwater is used for domestic, industrial water supply and for irrigation all over the world. The groundwater quality is a function of natural processes as well as anthropogenic activities. The safe potable water is enormously essential for living and groundwater is one of the sources for human consumption in both urban as well as rural areas. The area is located in the survey of India toposheet Number 57 J/3 lying between east $78^0 00' 0''$ to $78^0 15' 0''$ longitudes and $14^0 15' 0''$ to $14^0 30' 0''$ North latitudes covering an area of 720 sq. kms. Geologically, it is underlain mainly by Peninsular gneisses of Archean age followed by Gulcheru and Vemapalli formations comprising quartzites, conglomerates, dolomites and shales. Major geomorphic units are denudational hills, residual hills, pediments, pediplains, structural hills and valleys. The study area experiences a semiarid climate. Physicochemical parameters viz., pH, total hardness, calcium, chloride, total dissolved solids, fluoride were analyzed. Most of parameter show higher value than permissible limit in pre and post monsoon. Further, a moderation in water quality was observed after the monsoon season, which can be attributed to a possible dilution due to groundwater recharge People dependent on this water may prone to health hazard. Therefore some effective measures are urgently required to enhance the quality of water in these areas.
Keywords **–** Seasonal variation, Groundwater quality, Y.S.R, Anantapur Districts

I. INTRODUCTION

Water is indispensable and one the precious natural resource of our planet. Ground water is an important natural source of water supply all over the world. Water is the elixir of life and living organisms can't survive for short duration without water. It is a widespread solvent and as a solvent it provides the ionic balance and nutrients, which maintain all forms of life [1]. Particularly Groundwater plays a pivotal role in human life and development. There are several states in India where more than 90% populations are dependent on groundwater for drinking and other purposes [2, 3]. Groundwater is generally considered to be much cleaner than surface water. Nevertheless, several factors such as discharge of industrial, agricultural and household water, land use practices, geological formation, rainfall patterns, and infiltration rate affect the groundwater quality [4]. Thus groundwater possess little amount of soluble salts. The kind and quality of these salts depend upon the sources for recharge of the groundwater and the strata through which it flows. An excess of soluble salts can be injurious for many crops. Hence, an understanding of the chemistry of groundwater is essential to properly evaluate groundwater quality for drinking and agricultural purposes [5]. Its use in irrigation , industries and domestic usage continues to increase where perennial surface water source are absent [6] The modern civilization, over exploitation, rapid industrialization and increased population have lead to fast degradation of our environment [7]. To meet the rising demand it is imperative to recognize the fresh water resources and also to find out remedial methods for improvement of water quality [8].The quality of water may depend on geology of particular area and 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 soil, subsurface environment. Ground water resources are dynamic in nature and are affected by factors of irrigation activities, industrialization, urbanization and geological processes occurring within them and reactions with aquifer minerals [9,10], rainfall patterns, infiltration rate, leaching of pollutants from the landfill[11].

II. STUDY AREA

The study area lies between Pulivendula and Sanivaripalli situated between parallels of $78^0 00' 0''$ to $78^0 15' 0''$ E longitude and $14^0 15' 0''$ to $14^0 30' 0''$ N latitude with intended boundary falling in Survey of India (SOI) topographic sheet # 57J/03 on 1:50,000 scale covering an area of 720 sq. kms. The

study area includes five revenue mandals namely, Pulivendula, Lingala, Uduma kurti, Krishnam garipalli, and Sanivaripalli and is shown in figure-1. The central and southern part of study area is occupied by high hills, ridges and valleys. The value of contours in the study area ranges from 200-600 m. The slope category is within 1-15 degrees. The Maddaleru is the only seasonal river fed by monsoon which is flowing in the NW direction in the southernal part of the study area. The climate is dry with mean annual rainfall of 100-150 cm and mean annual temperature of 32^0C. The month of May is considered to be the hottest (45^0C) while December is considered to be the coldest (25^0C).

III. METHODOLOGY

In the present study, water samples were collected from twenty tube wells in the study area. The study is carried out with the help of topographic sheets, Garmin e Trex H (GPS) receiver, Arc GIS 9.3 and fieldwork. Toposheets are used to prepare the basemap, drainage map and to understand the general nature of the study area. GPS is used to map the location of each sampling well and finally the results were taken to the GIS for further analysis. The field work included water level measurements, well inventory and collection of water samples from tube wells and the study of geological and geomorphological features of the area in general. The groundwater samples collected during June 2011 were analyzed, as per the procedure of APHA (1995), and suggested precautions were taken to avoid contamination. The various parameters determined were: pH, total hardness (TH), chloride (Cl^-), calcium (Ca^{+2}) and fluoride (F^-). pH was determined by pH meter; TH, Cl^-, Ca^{+2} by titrimetry; F^- was determined by using ion selective electrode (Orion 4 star ion meter, Model: pH/ISE). The location of each wells were taken into the GIS environment and the results of each parameters analysed were added to the concerned wells.

IV. RESULTS AND DISCUSSION:

The results of chemical and statistical parameters analyzed are given in Table 1 & 2(pre and post monsoon respectively). Understanding the quality of groundwater is as important because it is the main factor determining its suitability for drinking, domestic, agricultural and industrial purposes.

The measurement of pH is one of the most frequently used tests in water chemistry. The groundwater quality in the study area of alkaline type. The pH value is ranges from 6.1 to8.2 in pre monsoon, 6.0 to 8 in post monsoon season. Most of the samples are alkaline in nature except only one station (Ambakpalli) in both pre and post monsoons as acidic in nature. pH values of remaining samples are within the permissible limit

The Electrical Conductivity range in post monsoon, pre monsoon and monsoon is 490 to 720 μS/cm, and 450.0 to 640 μS/cm respectively. There is no prescribed standard suggested by WHO. The EC value is completely depends on the TDS value if TDS is increases the EC value will increase. But the high EC value indicates the more salts in the groundwater.

The total dissolved solids are the sum of total cations and anions. It includes the total ionic species such as sodium, potassium, calcium, magnesium, chloride, bicarbonate, nitrate, sulphate and other trace elements [12]. The TDS range in post monsoon, pre monsoon and monsoon is 314 to 461 mg/L, and 288 to 410 mg/L respectively. Most of the samples are above the permissible limit. It may be due to the agricultural runoff. Water with high dissolved solids generally has inferior palatability and may induce an unfavourable physiological reaction in the person who drinks it. Highly mineralized water is also unsuitable for many industrial applications [13, 14].

Total hardness is caused primarily by the presence of cations such as calcium and magnesium and anions such as carbonates and bicarbonates, chloride and sulphate in water Water hardness has no known adverse effects; however, some evidence indicates its role in heart disease [15]. Total Hardness was varied between 60 to 180 mg/L in pre and 50 to 170 mg/L in post monsoon. Most of the samples are above the permissible limit.

Calcium range in post monsoon, pre monsoon is 8 to 992 mg/L and 8 to 900 mg/L respectively. Few samples are above the permissible limit in two seasons. The high concentration of calcium may be due the dissolution of limestone, dolomite.

The chloride range in post monsoon and pre monsoon is 18 to 167 mg/L, 16 to 160 mg/L respectively. Most of the samples are above the permissible limit in three seasons. The high value is may be due to the discharge of domestic sewage and agricultural waste into ground. And Soil porosity and permeability also has a key role in building up the chloride concentration [18].

The Fluoride range in post monsoon, pre monsoon and monsoon is 0.1 to 6.7 mg/L and 0.1 to 6.6 mg/L respectively. Most of the samples are above the permissible limit in two seasons.

V. CONCLUSION

The water quality parameter like pH, EC, total dissolved solid, total hardness, calcium, chloride and Fluoride are found to be high value in most of the sample at both seasons. The pH value is ranges from 6.1 to 8.2 in pre monsoon, 6.0 to 8 in

post monsoon season. The Electrical Conductivity range in post monsoon, pre monsoon and monsoon is 490 to 720 µS/cm, and 450.0 to 640 µS/cm respectively. The TDS range in pre monsoon and post monsoon is 314 to 461 mg/L, and 288 to 410 mg/L respectively. Total Hardness was varied between 60 to 180 mg/L in pre and 50 to 170 mg/L in post monsoon. Most of the samples are above the permissible limit. Calcium range in post monsoon, pre monsoon and monsoon is 8 to 992 mg/L and 8 to 900 mg/L. The chloride range in post monsoon, pre monsoon and monsoon is 18 to 167 mg/L and 16 to 160 mg/L respectively. The Fluoride range in post monsoon, pre monsoon and monsoon is 0.1 to 6.7 mg/L and 0.1 to 6.6 mg/L. All the water quality parameters analyzed in this study showed a perceptible moderation in the post monsoon observations. This dilution may be attributed to replenishment of the groundwater by rainfall during the monsoon season.

ACKNOWLEDGEMENTS

This research has been financed by Department of Science and Technology (DST-INSPIRE), government of India; INSPIRE fellowship under AORC, sanctioned to second author which is gratefully acknowledged.

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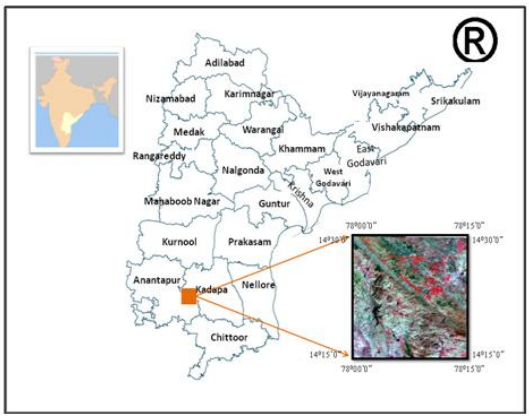

Figure 1: Study area location map

S. No	Village Name	pH	EC	TDS	TH mg/L	Ca^{+2} mg/L	Cl^- mg/L	F^- mg/L
1	Kottala	7.9	680	435	100	104	32	0.2
2	Gajjalapalli - 1	7.8	590	378	140	88	128	1.5
3	Gajjalapalli - 2	7.4	580	371	160	16	110	6.7
4	Gajjalapalli - 3	7.6	490	314	100	8	92	4
5	Malakavemula	8.2	620	397	80	32	57	1.9
6	Sanevaripalli	8	630	403	140	48	131	1.7
7	Kotareddypalli	7.9	520	333	100	16	67	3.8
8	Vaddekindi tanda	8.2	630	403	100	240	64	2.7
9	Mallepalli	7.1	640	409	180	64	121	2.9
10	Yogi Vemana Reservoir	8	540	346	120	992	74	2.4
11	Dorigallu	7.2	580	371	100	32	88	2.1
12	Eguvapalli	6.9	530	339	140	256	43	0.1
13	Diguvapalli	7.2	610	390	60	32	18	0.4
14	Ambakapalli	6.1	720	461	120	64	28	0.6
15	Nalagondavaripalli- 1	7.9	600	384	80	104	64	0.7
16	Nalagondavaripalli- 2	7.8	580	371	120	88	78	0.2
17	Mallikarjunapuram	8	590	378	100	80	28	0.7
18	Ippatla	7.8	650	416	180	32	160	0.5
19	Chinnakuddala	7.6	670	429	180	40	167	0.5
20	Lingala	8	530	339	180	56	100	0.3
	MAX	8.2	720	461	180	992	167	6.7
	MIN	6.1	490	314	60	8	18	0.1
	MEAN	7.63	599	383	124	119.6	82.5	1.695
	STDEV	0.51717	58.6604	37.542	37.0490	215.765	43.5968	1.69627

Table 1: Result of chemical analysis and statistical parameters of groundwater samples collected from the study area during pre monsoon season.

S. No	Village Name	pH	EC	TDS	TH mg/L	Ca^{+2} mg/L	Cl^- mg/L	F^- mg/L
1	Kottala	7.6	600	384	80	100	30	0.2
2	Gajjalapalli - 1	7.4	550	352	120	80	120	1.3
3	Gajjalapalli - 2	7.2	500	320	140	16	100	6.6
4	Gajjalapalli - 3	7.2	450	288	80	8	90	3.8
5	Malakavemula	8	560	358	70	30	50	1.6
6	Sanevaripalli	7.8	580	371	130	46	130	1.5
7	Kotareddypalli	7.7	480	307	80	14	60	3.6
8	Vaddekindi tanda	8	560	358	90	220	60	2.5
9	Mallepalli	7	570	365	170	60	120	2.7
10	Yogi Vemana Reservoir	7.8	460	294	100	900	70	2.2
11	Dorigallu	7	500	320	80	30	80	2
12	Eguvapalli	6.6	460	294	130	250	40	0.1
13	Diguvapalli	7	520	333	50	30	16	0.2
14	Ambakapalli	6	640	410	100	60	26	0.3
15	Nalagondavaripalli- 1	7.7	530	339	70	100	60	0.5
16	Nalagondavaripalli- 2	7.4	520	333	100	80	70	0.2
17	Mallikarjunapuram	7.8	460	294	80	70	26	0.5
18	Ippatla	7.6	580	371	160	30	158	0.3
19	Chinnakuddala	7.4	600	384	170	40	160	0.3
20	Lingala	7.8	470	300	160	50	98	0.2
	MAX	8	640	410	170	900	160	6.6
	MIN	6	450	288	50	8	16	0.1
	MEAN	7.4	529.5	338.88	108	110.7	78.2	1.53
	STDV	0.50	56.14	35.93	36.93	196.15	43.08	1.68

Table 2: Result of chemical analysis and statistical parameters of groundwater samples collected from the study area during post monsoon season.

S.No	Parameters	ISI 1983	Mean value of parameters under analysis	
			Pre monsoon	Post Monsoon
1	PH	6.5-8.5	7.63	7.4
2	EC	-	599	529.5
3	TDS	500	383.36	338.88
4	TH	300	124	108
5	Ca^{+2}	75	119.6	110.7
6	Cl^-	250	82.5	78.2
7	F^-	1.5	1.695	1.53

Table 3: Indian Standards (ISI 1983) for drinking and public health purposes.