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QUALITY OF GROUNDWATER IN LINGALA MANDAL OF YSR KADAPA DISTRICT, ANDHRAPRADESH, INDIA

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Abstract - *In the present study ground water samples of different locations has been carried out in and around Lingala mandal of Kadapa district, Andhra Pradesh. These samples are analysed for their physic-chemical parameters that is, SO4, Iron, Nitrate, fluoride, chloride, PH, TDS, Calcium, Magnesium and Alkalinity. The study area is mainly composed of Gulcheru quartzites, Vempalli dolomites, Pulivendla quartzites, volcanic flows and Tadipatri shales. The results indicate that physic-chemical properties of water in the study area were not found in within desirable limit of drinking water but suitable for irrigation and industrial purpose.*

Keywords: Chemical parameters, TDS, pH, Industrial, Fluoride, Quartzites.

1. INTRODUCTION

Water has always been an important and life sustaining drinking to humans and is essential to the survival of all organisms. The concept of water quality is complex because so many factors influence in it. In particular, this concept is intrinsically tied to the different uses require different criteria. Water quality is one of the most important factor that must be considered when evaluating the sustainable development of a given region (Cordoba et al , 2010).Water quality must be defined based on a set of physical and chemical variables that are closely related to the waters intended use. For each variable, acceptable and un acceptable values must then be defined..Water whose variable meet the pre-established standards for a given use is considered suitable for that use. Water quality is considered the main factor controlling health and the state of disease in both man and animals. The concept of groundwater quality seems to be clear, but the way of how to study and evaluate it still remains tricky. (Chenini and Khemiri 2009, Insaf S.Babiker et al., 2006).The guidelines describe reasonable minimum requirements of safe practice to protect the health of consumes and /or derive numeral guideline values for constituents of water or indicators of water quality. In order to define mandatory limits, it is preferable to consider the guidelines in the context of local or national environmental, social economic and cultural conditions. (WHO, 2011)

Water is essential to sustain life and a satisfactory (adequate, safe and accessible) supply must be available to all improving access to safe drinking water. (WHO, 2011). The contribution from groundwater is vital; because about 2 billion people depend directly upon aquifers for drinking water and 40% of the worlds food is produced by irrigated agriculture that relies largely on groundwater(Morris B.L et al .,2003). Groundwater is the major drinking water source in the villages of Andhra Pradesh state. Currently, nearly 85% of Indians population is dependent on ground water for their domestic demand, particularly as source of drinking in rural areas. Groundwater also plays an important role in agriculture and nearly 140 billion m^3 (BCM) of groundwater is abstracted annually for use in irrigation. Groundwater is a significant water resource in India for domestic, irrigation and industrial needs. More than 85% of rural and 50% of urban domestic water requirements are being met from groundwater resources, while irrigation accounts for around 92% of groundwater extraction(APHA, 2007) Drinking water is an important resource that needs to be protected from pollution and biological contamination. Underground water is clean but it depends upon quality and quantity of materials dispersed and dissolved in it.

Water picks up impurities in during its flow, which are harmful to man and vegetation. The reason for contamination and pollution of water in the natural surroundings and in the storage are pesticides, fertilisers, industrial wastes, inorganic and organic salts from top soil and geological strata (Nanoti, 2004). The domestic water bodies are being used for cattle drinking, human bathing, cloths washing and other domestic purposes. Groundwater is one of the most important natural resources. Due to rapid growth of population and anthropogenic activities the quality of groundwater is deteriorating day by day. The possibility of groundwater contamination is due to the mixing of toxic chemicals, fertilisers and improper disposal o f liquid wastes from the industries. Hence monitoring of groundwater quality has become indispensable. Water quality analysis is one of the most important issues in groundwater studies .Its monitoring assessment is imperative for devising preventive measures against health hazards (Dhiman,2005). Quality of groundwater is equally important to its quantity owing to the suitability of water for various purposes. Variation of groundwater quality in an area is a function of physical and chemical parameters that are generally influenced by geological formations and anthropogenic activities. The hydro chemical study reveals the zones and quality of water that are suitable for drinking, agricultural and industrial purposes. The chemical quality of

groundwater is related to the lithology of the area and residence time of the water in contact with rock material. Weathered mantle, soils and atmosphere are the important factors responsible for contribution of dissolved solid waste.

2. STUDY AREA.

The study area is located on 77^0 55'30" to 78^0 13' 30" E longitude and 14^0 22' 30" to 14^0 36' 00" N latitude with an areal extent of 313 sq km[Fig.1 and 2].. The study area is mainly composed of Gulcheru quartzites, Vempalli dolomites, Pulivendla quartzites, volcanic flows and Tadipatri shales.

Figure.1. Location map of the Study area.

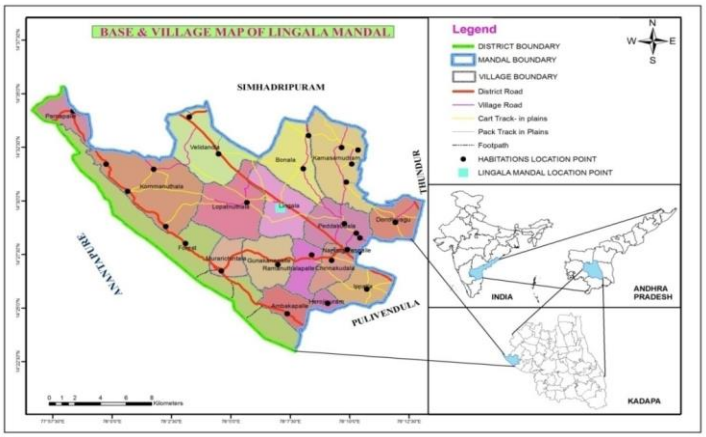
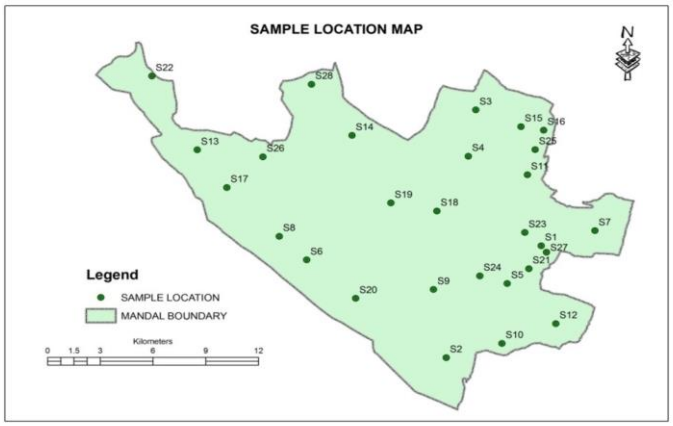


Fig.2 Sample location map of Study area.



3. METHODOLOGY

Sampling was carried out in the month of July during the year 2014. A total of fifty samples were collected from selected bore wells located throughout the study area. Samples were collected in sterilized bottles using the standard procedure in accordance with standard methods of APHA (1998).Collected samples were analyzed for various water quality parameters, such as sulphate, hardness, iron, nitrate, fluoride, chloride, pH, Total dissolve solids, and alkalinity by adopting standard methods (APHA1998).Table.1.; All the parameters were compared with guidelines suggested by Bureau of Indian Standards (BIS, 2003).The analysed parameters, analytical met6hods and the desirable and permissible limits of BIS for the water sample analysis are presented in Table.3

4. RESULTS AND DISCUSSION

The results obtained after analysing the fluoride content of water samples collected from the various locations of the study area have been tabulated in Table.1

4.1. p^H

In the study area p^H ranges from7.0 to 8.1 with a mean of 7.8 and standard deviation is 0.3. The low p^H values may cause corrosion and high values may produce sediment deposition (Kumaraswamy, 1991). According to BIS Standards the permissible limit of p^H is 6.5 to 8.5 and all the water samples of the study area are acceptable as per the standards.

4.2. Total Dissolve Solids

In the study area TDS ranges from 521.3 to1296.8 mg/l. According to BIS standards the desirable limit of TDS is 500mg/land2000mg/l permissible, when no alternate source is available (BIS, 2003). Beyond this permissible limit water will get peculiar taste and reduce its portability. In the study area almost all samples are within the permissible limit.

4.3. Total Alkalinity

The alkalinity of ground water is mainly due to carbonates and bicarbonates. The desirable limit of alkalinity is 200 mg/l and 600mg/l is the permissible limit. The alkalinity ranges from 136 to 728 mg/l in the study area. Only one sample is within the desirable limit and 24 samples are within permissible limit and remaining samples are above the permissible limits.

4.4. Chloride

Chloride occurs in all natural waters with varying concentrations. The excessive chloride in potable water is not particularly harmful and the criteria set for this ion is based primarily on the palatability and its potentially high corrosiveness(Bujangaiah and Vasudeva Nayak, 2005).In the present study, chloride concentration ranges from 96 to696 mg/l with mean of 401 mg/l and with standard deviation of 143.5mg/l. In the study area one sample is within the desirable limit and remaining samples are showing below the permissible limits.

4.5. Nitrate

Nitrate can reach both surface water and groundwater as a consequence of agricultural activity including excess

application of inorganic nitrogenous fertilizers and manures from waste water treatment and from oxidation of nitrogenous waste products in human and animal excreta, including septic tanks (WHO, 2011).Higher nitrate levels in water can cause blue baby syndrome. In the study area nitrate concentration ranges from 3.5 to 45 mg/l almost all samples in the study area below desirable limit.

4.6. Fluoride

Fluoride is essential for human beings as a trace element and higher concentration of this element causes toxic effects. Due to higher concentration of fluoride in groundwater may develop molting of teeth, skeletal fluorosis, deformation of in knee joints, etc. The desirable limit of fluoride in drinking water is 1mg/l and the maximum permissible limit is1.5mg/l. The concentration of fluoride in water samples analysed varied from 0.43 to 2.26 mg/l in the study area. In the study area eleven samples are within the desirable limit six samples are within the permissible limit and remaining samples above the permissible limit.

4.7. Sulphate

Sulphur in groundwater is normally present in sulphate form. Sulphate may enter into groundwater through weathering of sulphide bearing deposits (Chadetrik Rout, Arabinda Sharma, 2011). Sulphate concentration above the permissible limit can cause gastrointestinal disorders and diarrhea in human beings. In the present investigation sulphate values are found in the range of 1 to 100 mg/l. Almost all samples in the study area are below the desirable limit.

4.8. Iron

Iron is essential as micronutrients for life processes in animals and plants. The values of iron were in the range of 0.01 to 0.96 mg/l with mean of0.416 mg/l and standard deviation of 0.2941. In the study area 15 samples are within the desirable limit remaining samples are within the permissible limit.

4.9. Calcium and Magnesium

In the study area Calcium and Magnesium were found in the range of 85 to 209 mg/l and120 to 600 mg/l, respectively which was analogous to their respective hardness values. Concentration of calcium and magnesium was more than its permissible limit. The high values of magnesium at all stations and a few values of calcium may be due to the over deposit of limestone, dolomite and gypsiferous shell, magnesium rock in the surrounding area. High concentration of calcium and magnesium in the groundwater may cause kidney stone formation problem in the regular users of the area.

4.10. Fluoride sources and Geological Influence

Fluoride incidence in groundwater is mainly a natural phenomenon, influenced basically by the local regional geological settings and granite gneiss commonly contains fluorine bearing minerals. The important fluorine bearing minerals are fluorite, apatite, certain amphiboles and micas. The solubility constant of barium fluoride BaF_2 is $1.84x10^{-7}$.The solubility constant of fluorite in pure water at 25^0c is $3.45x10^{-11}$.Magnesium fluoride solubility constant value $5.16x10^{-11}$ is more soluble than calcium fluoride; sodium fluoride is very soluble (Karanth, 1995).In the study area the concentration of fluoride in the groundwater vary from0.04 to 2.2.26 mg/l. In the study area high weathering rates and enhanced circulation of water in the weathered rocks due to intensive and long time irrigation are responsible for the leaching of fluoride from their parent minerals present in soils and rocks. Further concentration has been brought about due to the arid climate of the region and residence time of groundwater in the aquifer. Under the conditions of the arid climate, the action of evaporation and concentration is strengthened, thus mutual action and exchange absorption action among ions are also strengthened. In the conditions of the semi arid climate movement of groundwater is slow and distribution areas of weathering crust of granite and alkaline magmatic rock and area of soda Stalinized soil are advantageous to the concentration of fluoride ion groundwater.

4.11. Correlation between different parameter

In the present study the correlation coefficient (r) between every parameter pairs is computed by taking the average values as shown in table.4.Correlation coefficient(r)between any two parameter, x and y is calculated for parameters such as p^H, TDS, Ca, Mg, iron, Chloride, Sulphate, Nitrate, Alkalinity and Fluoride of Lingala Mandal, Kadapa district. The degree of line association between any two of the water quality parameters as measured by the simple correlation coefficient(r) is presented in the Table.2 as 9x9 correlation matrix. p^H has been found to show (+) correlation with TDS, Ca ,Chloride , Sulphate and Nitrate, while (-) correlation with Magnesium, Iron, Alkalinity and Fluoride. TDS has been found to show (+) correlation with Calcium, Magnesium, Chloride, Sulphate and Nitrate, while (-) correlation with Iron, Alkalinity and Fluoride. Calcium has been found to show (+) correlation with Magnesium, Iron, Chloride, sulphate, and Alkalinity, while (-) correlation with nitrate and fluoride. Magnesium has been found to show (+) correlation with Chloride, Sulphate, while (-) correlation with Iron, Nitrate, Alkalinity and Fluoride. Iron has been found to show (+) correlation with Chloride, Sulphate, Nitrate, Alkalinity and Fluoride. Chloride has been found to show (+) correlation with Sulphate, Nitrate, Alkalinity and Fluoride. Sulphate has been found to show (+) correlation with Fluoride while (-) correlation with Nitrate and Alkalinity. Nitrate has been found to show (+) correlation

with Alkalinity and Fluoride and Alkalinity has been found to show (+) correlation with fluoride.

5. CONCLUSION

The study area reveals that p^H, TDS, Calcium, Magnesium, Iron, Chloride, Sulphate, Chloride, Nitrate, Sulphate, Alkalinity and Fluoride are within permissible limits as prescribed the BIS guidelines. Out of 28 samples 11 samples are within the desirable limit and 6 samples are within the permissible limit remaining samples above the permissible limit. The study is reveals that almost all waters are suitable for irrigation and industrial purposes.

Table .1 Chemical quality analysis of groundwater's in the Study area.

Habitation Name	Longitude	Latitude	pH	TDS	Ca	Mg	Fe	cl	SO4	NO3	Alkalinity	F
AKKULAGARI PALLE	78.171	14.475	7.42	897.51	152	448	0.84	288	15	18.56	464	1.79
AMBAKAPALLE	78.123	14.412	8.03	1224.29	200	544	0.42	448	90	23.81	408	1.05
ANKEVARI PALLE	78.138	14.551	8.17	1191.95	184	344	0.35	552	68	25.19	344	1.77
BONALA	78.134	14.525	8.12	1216.59	200	464	0.72	696	82	45	472	1.35
CHINNAKUDALA	78.154	14.454	8.09	906.5	160	200	0.16	424	23	41.89	432	1.01
DIGUVAPALLE	78.052	14.467	8.06	1056.09	184	440	0.88	504	72	45	456	0.84
DONDLAVAGU	78.199	14.483	7.76	717.11	168	208	0.3	416	31	26.9	672	2.1
EGUVAPALLI	78.038	14.480	8	1242.27	112	312	0.85	464	100	40.57	472	2
GUNAKANEPALLE	78.116	14.451	7.98	1240.98	120	280	0.3	616	50	40.57	376	1.4
HEROJIPURAM	78.151	14.420	7.7	1161.37	88	144	0.01	120	5	3.53	136	0.43
INTIOBAYA PALLE	78.164	14.515	7.76	1290.42	200	600	0.45	504	80	22.05	408	1.05
IPPATLA	78.179	14.431	7.93	1296.84	144	488	0.45	440	94	22.05	568	1.35
K.CHERLO PALLI	77.996	14.529	7.26	715.83	80	120	0.68	480	33	45	728	1.73
K.PAPAYAPALLI	78.075	14.537	7.54	759.48	96	120	0.24	528	32	40.57	656	2
KAMASAMUDRAM	78.161	14.542	7.52	521.3	176	216	0.96	232	50	14.99	672	2.26
KAMMAVARI PALLE	78.173	14.540	8.12	920.62	176	224	0.68	392	51	45	488	1
KOMMANUTHALA	78.011	14.508	8.12	706.2	88	120	0.08	312	33	24.69	344	1.47
LINGALA	78.118	14.494	7.77	1296.84	168	584	0.08	336	90	18.08	392	0.88
LOPATNUTHALA	78.095	14.499	7.46	1050.31	192	504	0.64	408	65	29.1	512	0.93
MURARICHINTALA	78.077	14.446	7.83	772.32	104	328	0.21	96	1	6.18	272	0.68
NARASINGARAO PALLE	78.165	14.462	7.76	1290.42	200	600	0.45	504	80	22.05	408	1.05
PARNAPALLI	77.973	14.570	7.09	758.84	128	520	0.18	200	94	7.49	312	0.73
PEDDAKUDALA	78.163	14.482	8.15	813.41	152	464	0.32	320	88	16.79	344	1.82
RAMANUTHALAPALLE	78.140	14.458	8.16	1045.17	112	352	0.1	448	10	40.13	464	0.93
RAMAPURAM	78.16817	14.529	7.79	897.57	168	280	0.86	496	78	45	576	1.32
TATHIREDDI PALLE	78.02918	14.525	7.79	876.97	184	480	0.04	296	84	10.58	360	0.84
THERNAMPALLE	78.17396	14.471	7.7	1007.94	192	400	0.3	496	88	18.35	336	1.77
VELIDANDLA	78.05408	14.565	7.32	933.46	152	600	0.11	216	88	8.88	264	1.14

Table .2 Correlation matrix of dissolved ions within the study area.

Parameter	pH	TDS	Ca	Mg	Fe	cl	SO4	NO3	Alkalinity	F
pH	1									
TDS	0.369	1								
Ca	0.1656	0.3274	1							
Mg	0.1018	0.5195	0.6112	1						
Fe	-0.0395	-0.0231	0.2997	-0.0251	1					

Cl	0.3892	0.4532	0.3339	0.0258	0.3375	1				
SO4	0.0073	0.4144	0.5456	0.664	0.1755	0.2912	1			
NO3	0.3798	0.1086	-0.0015	-0.3555	0.4688	0.7637	-0.055	1		
Alkalinity	-0.1479	-0.3115	0.0345	-0.3245	0.5704	0.4153	-0.0637	0.5775	1	
F	-0.034	-0.3344	-0.0448	-0.3481	0.394	0.3054	0.0365	0.2268	0.5856	1

Table.3. Water quality parameter, method and standard value of BIS for physic-chemical analysis in mg/l.

Parameter	Analytical method	Standard value of BIS	
		Desirable	Permissible
pH	pH meter	6.5 to 8.5	No relaxation
TDS	0.64Xec(rAaghunath,2 0030	500	2000
Alkalinity	Titrimetry	200	600
Total	EDTA-Titrimetry	200	600
Calcium	EDTA-Titrimetry	75	200
Chloride	Mohrs-Titrimetry	250	1000
Nitrate	Colorimetry	45	No relaxation
Fluoride	Selective ion meter	1	1.5
Sulphate	Spectrophotometry	200	400

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