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GROUNDWATER QUALITY IN AND AROUND OF GUDLAVALLERU TOWN, KIRSHNA DISTRICT, ANDHRA PRADESH

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Abstract:

Water is used for drinking, domestic, agricultural and industrial etc., one of the sources for drinking is groundwater, over usage of groundwater has been contaminated in different region due to dissolved minerals from rocks, industrial effluents and salt water intrusion. The groundwater samples are collected from selected sampling stations in and around of Gudlavalleru town region, Krishna district, and assess the physic-chemical characteristics, and tested the water quality parameters like pH, EC, TDS, TH, SO4, Cl, Mg, K, Na and F. The statistical method involves determination of correlation between the parameters. Finally it was found that there is a high concentration of parameters in ground water during both pre and post monsoon seasons, it indicates a serious health problems will rise in human. Therefore, to protect the public, it is necessary to treat and monitor the water quality before consumption in the study area.

Key words: Groundwater, Drinking, water parameters, Contamination, monitoring.

INTRODUCTION

Water shortages have become a severe issue in the world, particularly in the arid and semi-arid portion of the nations; one by third of the world's population is thought to use groundwater for drinking purposes. The groundwater is believed to be comparatively much clean and free from pollution than surface water. Due to the whims of the monsoon and a lack of surface water, it is a consistent, reliable, and usable water source that may be used for both domestic and industrial applications, the seasonal rainfalls, percolation of water via soil and rock formations replenish the groundwater supply. A diversity of geological formations, especially those with porosity and permeability, serve as groundwater reservoirs and mechanical filters that improve water quality by eliminating suspended particles contamination. (Pophare and Sadawarti 2019), A healthy living absolutely requires access to clean, portable water (Nag and Shreya 2017), Human health may be directly affected by contaminated water, the dissolved particles like fluoride, nitrates, and other harmful substances in high concentrations change the groundwater quality, making it unfit for human consumption (Pophare 2014; Gnana chandraswamy 2015). To find these contaminations in water hydro chemical study is a tool to find the suitability of the groundwater. (Akhil et al., 2017), it needs to check the water quality before consumption and rate of contamination by pollutants in groundwater. The issues with ground water quality are especially severe, in many places groundwater was highly contaminated by industrial effluent, there are about eighty percent of infections in poor countries are directly related to contaminated water and unhygienic settings (UNESCO 2007). Groundwater quality frequently fluctuates periodically due to temporal changes in the recharged water's origin and composition, hydrological factors, and human activities (Aghazadeh & Mogaddam 2010; Milovanovic 2007), India has been facing the problem of deteriorating groundwater quality due to rapid urbanization and its ever increasing population at an exponential rate (Brindha et al., 2011; Ramesh and Elango 2005). Similar studies have done in different area of the globe and focused on domestic and industrial activities and affects of

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groundwater quality by Jalali (2007); Bathrellos et al. (2008); Vasanthavigar et al., 2010; Sudhakar et al., 2018).

METHODOLOGY:

Sample collection and experimental methods

There are fifteen ground water samples are collected from selected sampling stations in and around of Gudlavalleru town study area. Krishna district, Andhra Pradesh. India (Figure 1), the sampling stations such as S1- Chandrala, S2- Chinagonnuru, S3- Mamidikolla, S4- Chitram, S5- Mamidi colla, S6-Kowtaram, S7-Kavataram, S8-Kurada, S9-Singaluru, S10- Vemugunta, S11-ITI College, S12-St Joseph church, S13-Gudlavalleru Busstand, S14-Bharath gas Godown, S15-Hanuman temple, as and analysed in the laboratory to find out the physico chemical parameters and calculated the statistical analysis of water samples. One litre polythene bottles are used for collection water samples, thoroughly cleaned by rinsing with 8M HNO_3 solution before collect the samples, followed by repeated washing with de ionized distilled water and the sample bottles were tightly capped without air gap. Immediately, after collection of the water, the pH, Total Dissolved Solids (TDS) were measured by Water Quality Analyzer. Magnesium (Mg) was determined titrimetrically using standard EDTA. Chloride (Cl-) was determined by standard $AgNO_3$ titration, Sodium (Na+) by flame photometry and fluoride (F-) were analyzed by using ion-sensitive electrode, according to standard water quality procedures WHO, BIS and APHA-1999. All chemical variables (except pH) are expressed in milligrams per litre (mg/L) or parts per million (ppm).

RESULTS AND DISCUSSION

The hydrogen ions concentration indicates that the acid or alkalinity of water (Mondal et al., 2002; Pophare and Sadawarti 2019), pH is measured as an ecological factor and an important portion in order to many types of geochemical equilibriums (Shyamala et al., 2008). The pH levels varies from 7.21 (Gudlavalleru busstand) to 9.52 (ITI College) in pre monsoon and 7.62 (Chandrala) to 9.41 (ITI College) in post monsoon, the mean and standard levels of pH 8.30 ± 0.68 in pre monsoon and 8.34 ± 0.54 in post monsoon (table 1, 2 & fig 1) as per the standard level the maximum levels indicated alkalinity of water due to infiltration of the leachate percolation in groundwater might be in methanogenic phase that is contributing to neutral to alkaline pH in the ground water at the stations (Gautam et al., (2011). The similar study results have been observed by Sebiawu et al. (2014). The Electrical conductivity levels varies from 1648 µs/cm (Chitram) to 2863 µs/cm (Mamidi colla) in Pre monsoon, 1928 µs/cm (Chitram) to 2547 µs/cm (Mamidi colla) in post Monsoon and the mean and standard levels are 2139.06 ± 310.75 pre monsoons, 2161.6 ± 206.16 in post monsoon (Table 1,2 & fig 2 &3). The Total dissolved solids values are varies from 648 ppm (Chinagonnuru) to 2140 ppm (kavataram) and the mean & standard deviation levels are 1195.46 ± 417.97in pre Monsoon. 752 ppm (Chitram) to 2148 ppm (kavataram) and the mean & standard deviation levels are 1214.73 ± 368.7 in post monsoon (table 1,2 & fig 3 & 4), all the sampling stations have high concentration of TDS and exceeded the as per the permissible limit of the WHO in both seasons (Kataria et al., 2011). Agricultural and developmental activities has resulted more usage of water from groundwater leads to contaminated and polluted (Krishan et al., 2013, Singh et al., 2015).

The total alkalinity values are varies from 247 ppm (kavataram) to 546 ppm (St joseph church) and mean and standard deviation levels are 372.86 ± 95.48 in pre monsoon, 214 ppm (Kavataram) to 653 ppm (ITI College) and the mean and standard deviation were calculated as 363.6 ± 120.98 in post monsoon in the study area (Table 1,2 and figure 5), the higher alkalinity levels were found in sampling stations ITI College > St joseph church > Hanuman temple >

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Chinagonnuru > Mamidi colla > Chandrala > Kowtaram > Singaluru > Mamidikolla > Vemugunta in the study area. The total hardness values are varies from 214 ppm to 1045 ppm, and mean and standard deviation levels 602.53 ± 277.15 in pre monsoon and 218 ppm to 1135 ppm the mean and standard deviation levels are 676.86 ± 306.02 in post monsoon (table 1,2 & figure 5). The calcium and magnesium salts were contributed the hardness of water (Kataria et al., 2011), The sample have high Total hardness in ITI College > kavataram > Kurada > Vemugunta > Singaluru > Chandrala > Kowtaram > Bharath gas Godown > Mamidi colla > Hanuman temple > Gudlavalleru busstand > Mamidikolla > Chinagonnuru (table 1,2 & figure 5). The high concentration leads to heart diseases in human. And the materials like pipes and distribution system it might be affected by scaling problems (Heydari et al., 2013). The Chlorides concentrations were varies from 109 ppm (Chitram) to 641 ppm (Chandrala) and the mean & standard deviation levels are 357.8 ± 178.74 in pre monsoon, 118 ppm (Chitram) to 742 ppm (Chandrala) and the mean & standard deviation levels are 340.93 ± 160.59 in post monsoon (table 1,2 & figure 5). the samples like Mamidikolla, Chitram, Singaluru, Bharath gas Godown are below the permissible limit of chloride remaining all exceeded the permissible limit as per WHO. High concentrations of chloride are added from domestic wastes and disposals by human activities in groundwater (Jha and Verma 2000). The sulphates levels are varies from 109 ppm (Mamidikolla) to 324 ppm (Singaluru) and the mean and standard deviation levels are 206.2 ± 80.91 in pre monsoon, 104 ppm (Hanuman temple) to 418 ppm (Mamidi colla) and mean and standard deviation levels are 270.8 ± 91.56 in post monsoon, The sample in Mamidi colla > Kurada > Chandrala > kavataram >Kowtaram > Vemugunta > Gudlavalleru busstand > Singaluru > ITI College have higher levels of sulphates and exceeded the standard limit (200 ppm) of the sulphates as per the WHO standards (table 1 ,2 & figure 6). The major sources of magnesium in the underground water sampled may be attributed to geological sources such as dolomite, biotite and pyroxenes (Fetter 2000) are abundant in the basement rocks of the sampled area (Key 1992). The Mg^{2+} concentrations observed here are in agreement with previous reports by Cobbina et al. (2012), Sebiawu et al. (2014) and Salifu et al. (2015).

The calcium levels are varies from 68 ppm (Gudlavalleru busstand) to 261 ppm (Chinagonnuru), and the mean and standard deviation levels are 153.13 ± 69.65 in pre monsoon, 86 ppm (Bharath gas Godown) to 1042 ppm (Chandrala) and the mean and standard deviation levels are 248.53 ± 247.64 in post monsoon (table 1,2 & figure 5). The Mg minimum, maximum, mean and standard deviation levels are found in Bharath gas Godown (58), kavataram (104) and 80.66 ± 13.40 in pre monsoon, the sampling stations Mamidi colla (64), kavataram (112) and 86.73 ± 12.90 in post monsoon (Table 1,2 & Figure 6). The K values were varies from 108 ppm (Mamidi colla) to 324 ppm (ITI College) mean and standard deviation levels are 214.06 ± 63.33 in pre monsoon and 54 ppm (Chinagonnuru) to 468 ppm (Vemugunta), mean and standard deviation levels are 271.53 ± 100.06 in post monsoon (table 1,2 & figure 6), All the sampling stations have high Calcium, magnesium and potassium levels in both seasons, this may be infiltration of $CaCO_3$ and Ca Mg $(CO_3)_2$, through precipitation (Lakshmanan et al. 2003; Sudhakar et al., 2014). The sodium levels are varies from 106 ppm (Chitram) to 342 ppm (ITI College), the mean and standard deviation levels are 259.26 ± 63.15 in pre monsoon and 106 ppm (Gudlavalleru bus stand) to 342 ppm (Hanuman temple) and the mean & standard deviation levels are 288.13 ± 93.94 in post monsoon (table 1, 2 & figure 6), The high sodium levels were found in Chandrala > Singaluru > Hanuman temple > Kowtaram > kavataram > ITI College > Chinagonnuru > Vemugunta > Bharath gas Godown etc. The heart problems might be caused by high concentration of sodium ion in drinking water and also cause the salinity problems due to high sodium concentration in irrigation water (Chadrik & Arabinda, 2011). The F concentration varies from 0.01 ppm to 1.54 ppm, the mean and standard deviation levels are 0.8 ± 0.56 in pre monsoon and 0.1 ppm to 2.74 ppm, the mean and standard deviation levels are 340.93 ± 160.59 in post monsoon, the fluoride level are slightly exceeded the permissible limit in Mamidi colla > kavataram > ITI College > Kurada remaing all the sampling stations are below the standard limit. The high concentration of fluoride in the

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groundwater is due to the use of fertilizer to kill insects in agricultural activities. Skeletal fluorosis is an important disease caused by high fluoride content in groundwater (Mangale et al., 2012). The correlation was calculated based on the water parameters concentration the positive correlation has been observed TDS and EC, TH, Ca, Cl, SO4, Mg, Na, K and F. The SO_4 has positive relation with EC, TDS, Cl, Ca,TH and TA. The K has positive correlation with TH, TA, Cl, SO_4 and Mg. Mg has positive correlation with Ca, TH, Cl, SO_4, TDS. The Fluoride has positive correlation with SO_4, EC, TA, TDS, Cl, Ca, Mg, K (Table 3).

CONCLUSION:

It is essential to ensure that the groundwater quality for drinking, as the groundwater in the Gudlavalleru Mandal region has been affected by various pollutants. Our study has shown that the Electrical conductivity, Total Dissolved Solids, Total Hardness, Alkalinity, Calcium, Magnesium, potassium, Chlorides, and Sulphates concentrations are high in Groundwater the sampling stations like ITI college, Kavataram, Bharath gas Godown, Chandrala, Gudlavalleru bus stand sampling stations showed high concentrations, the results indicates a serious problems due to increase the levels of contaminants. In order to protect the public, it is necessary to treat the water before consumption in the study area.

Table:1. min & max values of groundwater parameters

	Pre monsoon		Post Monsoon	
parameters	Min	Max	Min	Max
pH	7.21	9.52	7.62	9.41
EC	1648	2863	1928	2547
TDS	648	2140	752	2148
TA	247	546	214	653
TH	214	1045	218	1135
Ca	68	261	86	1042
Cl	109	641	118	742
SO_4	109	324	104	418
Mg	58	104	64	112
K	108	324	54	468
Na	106	342	99	418
F	0.01	1.54	0.1	2.74

Table:2. Mean and Standard deviation of groundwater

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parameters	Pre -Mean and SD	Post-Mean and SD
pH	8.30 ± 0.68	8.34 ± 0.54
EC	2139.06 ± 310.75	2161.6 ± 206.16
TDS	1195.46 ± 417.97	1214.73 ± 368.7
TA	372.86 ± 95.48	363.6 ± 120.98
TH	602.53 ± 277.15	676.86 ± 306.02
Ca	153.13 ± 69.65	248.53 ± 247.64
Cl	357.8 ± 178.74	340.93 ± 160.59
SO_4	206.2 ± 80.91	270.8 ± 91.56
Mg	80.66 ± 13.40	86.73 ± 12.90
K	214.06 ± 63.33	271.53 ± 100.06
Na	259.26 ± 63.15	288.13 ± 93.94
F	0.8 ± 0.56	1.55± 0.79

Table:3. Correlation matrix in groundwater parameters

	pH	EC	TDS	TA	TH	Ca	Cl	SO_4	Mg	K	Na	F
pH	1											
EC	0.018	1										
TDS	-0.29	0.30	1									
TA	0.441	0.08	-0.30	1								
TH	0.482	0.13	0.184	0.173	1							
Ca	-0.28	0.26	0.070	0.032	0.047	1						
Cl	-0.35	0.64	0.313	0.134	0.303	0.55	1					
SO_4	-0.04	0.75	0.457	0.102	0.28	0.23	0.58	1				
Mg	-0.23	-0.21	0.248	0.02	0.33	0.447	0.21	0.116	1			
K	0.383	0.021	0.180	0.39	0.555	0.092	0.31	0.26	0.15	1		
Na	0.467	0.27	0.054	0.149	0.592	0.42	0.28	0.02	0.28	0.30	1	
F	0.085	0.32	0.220	0.315	0.172	0.141	0.26	0.403	0.13	0.16	0.016	1

Figure:1. pH levels in groundwater samples

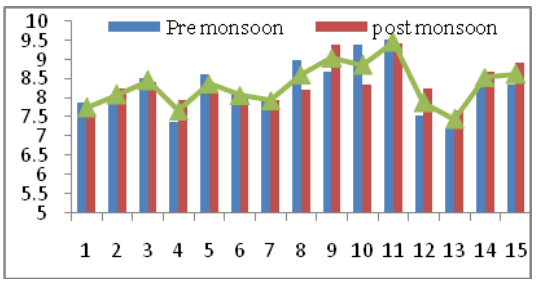

Figure:2. EC levels in groundwater

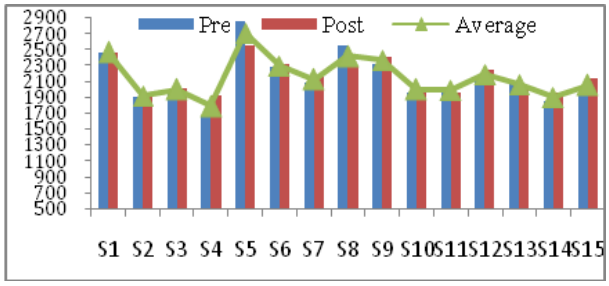

Fig:3. TDS levels in Groundwater

Fig:4. Average values of EC and TDS

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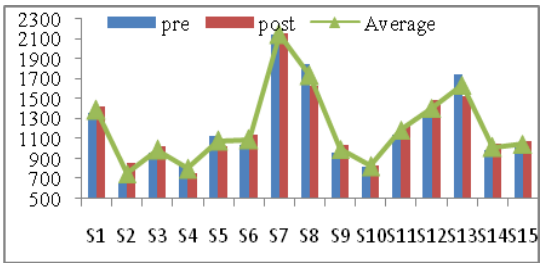


Fig:5. Average values of TA, TH, Ca, Cl

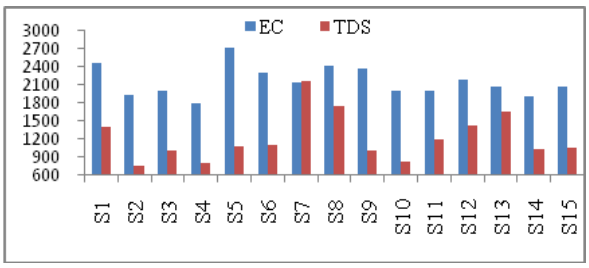
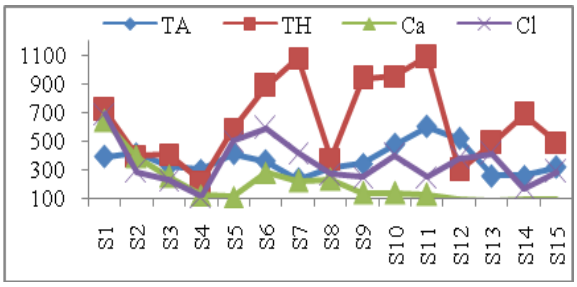
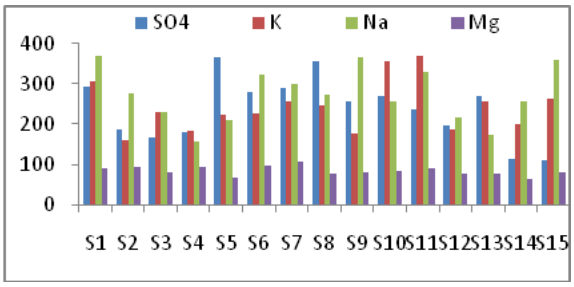


Fig:6. Average values of SO_4, K, Na and Mg





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Competing interests

The authors declare that they have no competing interests.

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