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Assessment of Groundwater Quality In K V B Puram Mandal, Chittoor District, Andhra Pradesh, South India.

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Abstract: The aim of present investigation is carried out for knowing quality of the drinking water and irrigation of the study area.24 groundwater samples were collected with a different intervals ,and analyzed the different physico chemical parameters like P^H, EC ,TDS, Ca, Mg, Na, K Hco_3,Co_3 So_4,Cl,Hardness and Alkanity. Subsequently explain the irrigation parameters like sodium absorption ratio, potential salinity, Kelly's ratio, percent sodium etc. The concentration of the majority of chemical constituents exceeds the standards of WHO as a result of various sources of pollution. In the study area water type; $CaMgHCO_3$ water. The chemical elements were derived from the rock -water interaction especially geology like the Hornblende biotite gneiss, granodiorite granitoid gneiss migmatites complex and rock water interaction is shown by the Gibb's plot diagram.

Keywords; Groundwater quality, Drinking purposes, Irrigation, Physico-chemical parameters, piper diagram and K V B Puram Mandal map

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I. INTRODUCTION

Groundwater resources are dynamic in nature and are affected by such factors as the expansion of irrigation Activities, industrialization and urbanization; hence monitoring and conserving this important resource is essential. The quality of water is defined in terms of it ascertaining the quality is crucial before its use of various purposes such as drinking; agricultural, recreational and industrial uses etc [Veeraswamy et al., 2017].water is a essential for the all forms living organism both biotic and a biotic components(Veeraswamy et al., 2017: balaji et al 2018). The water occurring below the earth's surface is divided into two forms (i) Groundwater or subsurface water – occurring in the zone of saturation, where all interconnected voids of the rocks are filled with water and (ii) Vadose water – occurring above the zone of saturation with water filling the voids of capillary dimension, or in the form of vapors occurring in the voids or in the process of filtration from surface. The extent possible pollutants in ground water are unlimited; they may be physico-chemical, biological and radiological. Complex and inter-related series of modifications of ground water quality is created by diverse human activities as well as due to altered rate and type of rock-water interaction (Handa, B.K 1983) .In the present study area, the chemicals were derived from the rock water interaction especially hornblende granitoid complex in archean group of rocks.

II. STUDY AREA

The study area is the one of the important mandal in chittoore district of Andhra Pradesh and K V B Puram is a head quarter of the K V B Puram mandal. It is belongs to Rayalaseema Region. It is located between lat 13°57'67"N and long 79°69'47"E. It is surrounded by Sri Kalasthi and Thottambedu Mandal towards North, Pitchtoor and Nindra Mandals towards South, B.N. Khandriga and Varadhayalapalem Mandal towards East, Narayanavanam and Yerpedu Mandal towards West. It is covers in the Survey of India Toposheet no's 57 O/10, 57 O/11, 57O/14 and 57 O/15 with a scale of 1:50,000.As per 2011 census of India, the mandal had a population of 39,432.the total population constitute,19,897 males, and 19535 females. The geographical extent of an area is 490.87 sq.km(Figure 1.0).

III. MATERIALS AND METHODS

The samples were collected in one liter pre-washed high-density polyethylene bottles and also rinsed with actual water samples at each bore well before collecting. A total of 24 representative groundwater samples were collected during pre-monsoon period (august) with in field measurement of pH and Electrical Conductivity (EC) using portable water analysis kit (P-30 Series Hand-held Water Quality Meters for pH and conductivity-Analytical Instruments Corporation, USA). Then samples were analyzed for cations and anions such as Ca2+, Mg2+, Na+, K+, HCO3-, Cl−, and SO42− , by using the analytical procedures suggested by the Trivedy and Geol 1986; APHA 2005; Mishra et al. 2012; Tripathi et al. 2012). The minimum, maximum and average values of different constituents of water samples are depicted in (Table1).

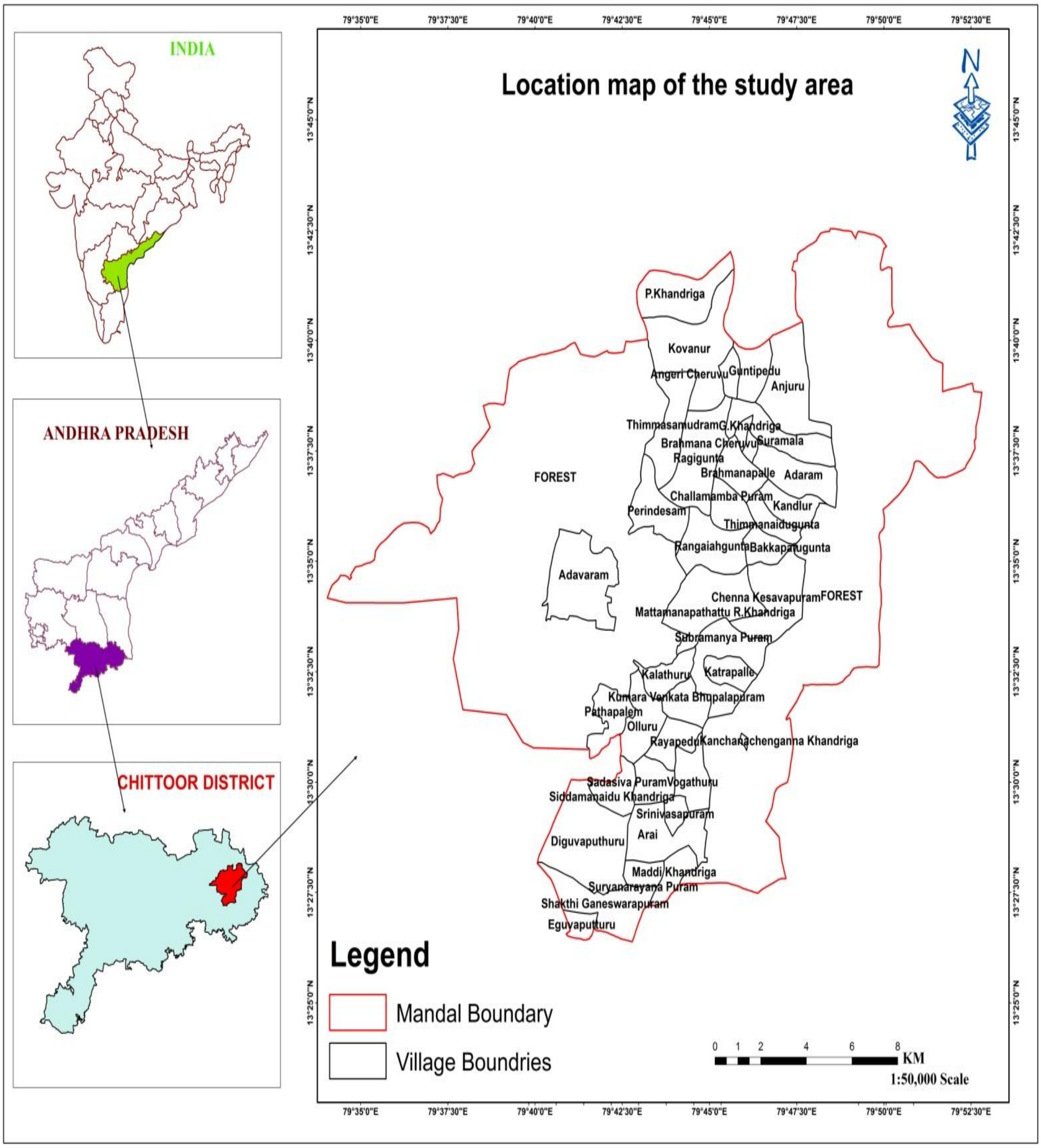

Figure 1.0 Location Map Of The Study Area

IV. RESULT AND DISCUSSION

Evaluation of Drinking Water Quality :

physico chemical parameters of the minimum and maximum and permissible limits are shown in table 1.0. In the present study area, the PH and EC ranges between 7.20 to 8.0 and 520 to 1800, respectively. the concentration of cations like ca^{2+}, Mg^{2+} and Na^{+}, k^{+} are ranges between 102 to 309 mg/l, 100 to 189mg/l and 19 to 64 mg/l, 9 to 22mg/l ,respectively. . The concentration of Cl^{-} and SO_4^{2-} are in the range from 168 to 363mg/l and56 to 99 mg/l and concentration of bi-carbonates and fluorides ranges 491 to 928 ,0.80 to 1.0, respectively. The abundance of the major ions in groundwater is in following order: $Ca^{2+}>Mg^{2+}> Na^{+}>K^{+}$ and $HCO_3^{-}> Cl^{-}>SO_4^{2-}>F^{-}$

Table -1.1 Shown Minimum, Maximum and permissible Values Of drinking Water Quality

parameter	Min	Max	Average	MPL
DRINKING WATER QUALITY STATUS				
EC	520	1800	1280.42	NG
pH	7.20	8.0	7.57	6.5-8.5
TDS	338	1170	832.27	500
Ca (mg/l)	132	309	202.25	200
Mg (mg/l)	100	189	139.50	150
Na (mg/l)	19	64	36.29	200
K (mg/l)	9	22	14.71	NG
HCO_3 (mg/l)	491	828	658.21	NG
F (mg/l)	0.80	1.0	1.33	1.5
CO_3 (mg/l)	0.00	0	0.00	NG
Cl (mg/l)	168.00	363	239.63	250
SO_4 (mg/l)	56.00	99	75.04	250
Hardness as CaCO3 (mg/l)	269.00	498	341.46	600
Alkanity as $Caco_3$	136.00	316	185.58	250

Table -1.2 Shown Minimum and Maximum Values of Irrigation Water Quality

parameter	**Minimum**	**Maximum**	**Status**	**Values**
IRRIGATION WATER QUALITY STATUS				
Percent Sodium	4.60	14.36	Excellent Good Permissible Doubtful Unsuitable	0 – 20 20 – 40 40 – 60 60 – 80 > 80
Potential Salinity(Jensen, 1980)	5.33	11.19	Sensitive Moderately Sensitive Moderately Tolerant Tolerant	1.4 3.0 6.0 10
Residual Sodium Carbonate	-18.96	-4.151	Permissible Unsuitable	< 1.25 ≥ 1.25
Gibbs Ratio I	0.27	0.52	-	-
Gibbs Ratio II	0.08	0.32	-	-
Kell's Ratio	0.04	0.14	suitable Unsuitable	<1 ≥1
Mg Ratio	41.05	66.43	Permissible unsuitable	0 –50 >50
Sodium absorption ratio	0.25	0.89	Very low Low Medium High Very high	< 2 2 – 12 12 – 22 22 – 32 > 32
Permeability index	14.89	31.46	Suitable Unsuitable	< 75 ≥ 75

Evaluation of Irrigation Water Quality:
The primary parameters that influence the quality of water for irrigation use are sodium absorption ratio (SAR), percent sodium (%Na), permeability index (PI) and magnesium ratio (MR) and shown in table 1.2.

Sodium absorption ratio:

It Is used to helpful for the determination of the mobility of the sodium ions in the soils .the higher concentration of sodium soils can leads to the diminish the soil porosity and itld to the reduce the yielding capacity of corps. SAR is determined by the following formula

$$SAR = Na+/ (Ca2+ + Mg2+)/2$$

(All ionic concentrations expressed in meq/l)

In the present study area the SAR values ranges 0.25 to 0.89 meq/l. All the samples were fall in the area <10 .it indicates the safe and suitable for the irrigation. The further aspect for the suitability of water for irrigation use can be made by plotting the sodium absorption ratio and electrical conductivity values on the US Salinity Laboratory (USSL) diagram (Figure 1.1). Accordingly, 90% of the samples fall in the category of C3-S1, indicating high salinity and low sodium water type, followed by C2-S1 indicating very medium salinity and low sodium water type, medium salinity and low sodium water type respectively. The groundwater samples which are falling in C3–S1 and C2–S1 are moderate in quality to irrigate semi-tolerant crops.

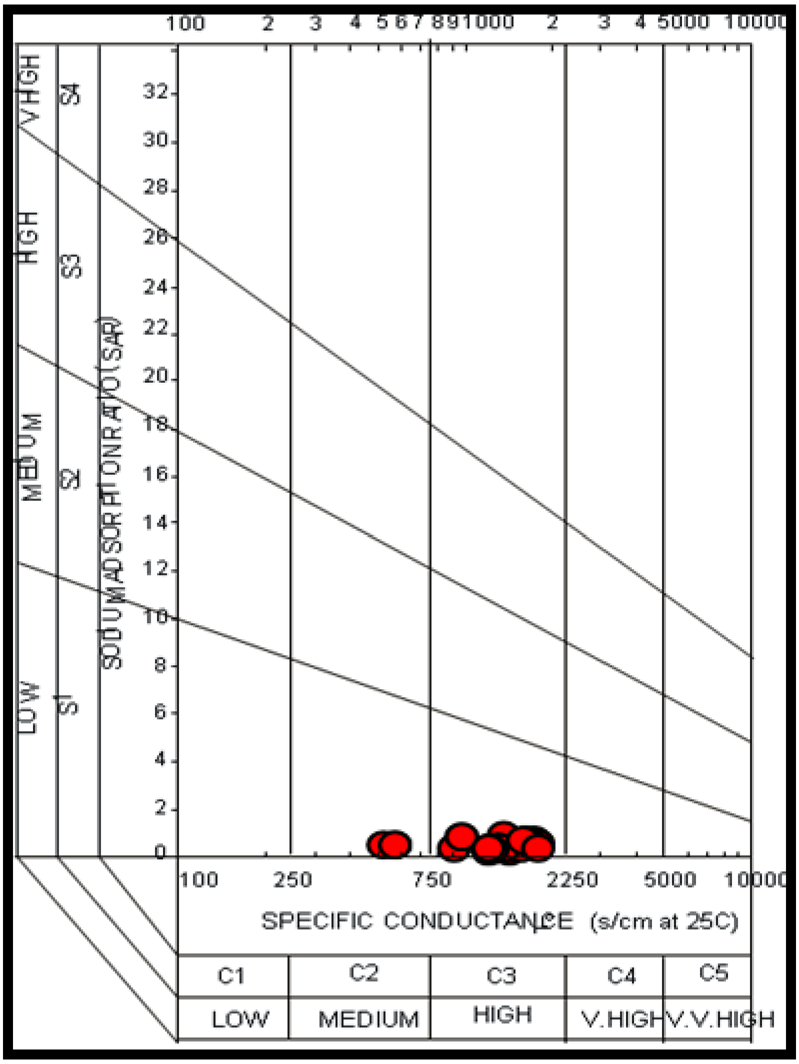

Figure 1.1. The quality of groundwater samples in relation to salinity and sodium hazard

Percent sodium (% Na)

Excess sodium in water reacts with soil, thereby reducing its permeability which shows the importance of Na^+ ion in the classification of irrigation water quality (Purushothman et al. 2012). High percentage sodium ion on water using for irrigation purpose may inhibit the plant growth and reduces soil permeability (Joshi et al. 2009). The sodium percentage was calculated by

$$100\times (Na^+ + K^+)/ (Ca^{2+} + Mg^{2+} + Na^+ + K^+)$$

(All ionic concentrations expressed in meq/l)

In this area, the observed value of SAR ranged from 12.32 to 41.52 meq/l (Table 1). All the samples were within safe limits (<60). Wilcox (1955) has used %Na and EC to assess the quality of water using Wilcox diagram. The analytical data plotted on Wilcox diagram demonstrate that except few samples, most of the groundwater samples fall in good to permissible and permissible to doubtful categories for irrigation use (Figure 5).

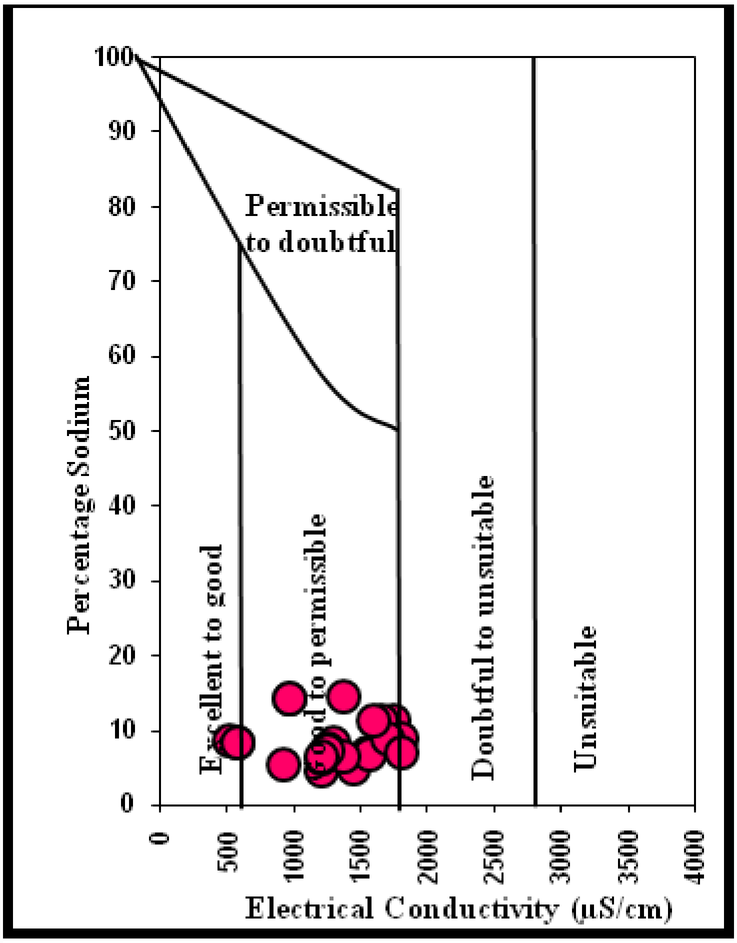

Figure 1.2 The quality of groundwater in relation to electrical conductivity and percent sodium

Permeability index (PI)

The permeability of the soil is affected by the long-term use of water for irrigation as it is influenced by sodium, calcium, magnesium and bicarbonate content of the soil. Doneen (1964) has proposed a criterion for assessing the groundwater suitability for irrigation use based on the PI as shown in the given formula

$$PI= (Na^{+}+\sqrt{HCO_3^{-}}\times 100/ (Ca^{2+}+Mg^{2+}+Na^{+})$$

(All ionic concentrations expressed in meq/l)

In this area, the observed value of PI ranged from 14.89 to 31.46 meq/l (Table 1) indicated that the water can be suitable for irrigation use.

Kelly's ratio (KR)

Kelly (1951) has discussed the hazardous effect of sodium on water quality for irrigation usage. Water beyond 1.0 Kelley's ratio indicates an excess level of sodium and is not suitable for irrigation and water with Kelly's ratio below 1.0 is suitable for irrigation. The Kelly's ratio can be calculated with the following formula as given below

$$\text{Kelly's ratio} = Na^{+}/ (Ca^{2+} + Mg^{2+})$$

(All ionic concentrations expressed in meq/l)

In the study area, Kelly's ratio value varied between 0.04and 0.14 meq/l (Table 1). It was observed that all the groundwater samples were within permissible limits.

Magnesium ratio (MR)
Generally, Ca^{2+} and Mg^{2+} keep equilibrium in most waters (Hem, 1985). In equilibrium magnesium in waters will adversely affect crop yield (Nagaraju et al. 2006). The magnesium ratio can be calculated as

$$MR = 100^* (Mg^{2+}/ (Ca^{2+}+Mg^{2+}))$$

(All ionic concentrations expressed in meq/l)

Magnesium ratio above 50 percent is considered unsafe and unsuitable for irrigation purposes. The MR values of waters in the study are varying from 41.05 to 66.43meq/l (Table 1). From this, it is clear that all the samples were within the acceptable limit of 50%.

Mechanisms controlling groundwater chemistry
Gibbs diagram and water-rock interaction
Gibb's (1970) suggested two plots such as (i) TDS vs Cl^-/ $(Cl^-+HCO_3^-)$ and (ii) TDS vs (Na^++K^+)/ $(Na^++K^++Ca^{2+})$. In the present study, it is found that most samples are falling into the rock dominance region which revealed that the rock-water interaction (Figure 6). The silicate weathering prevails if HCO_3^- and SO_4^{2-} dominate Ca^{2+} and Mg^{2+}, resulting in increasing the concentration of HCO_3^- in groundwater (Elango and Kannan 2003 indicating the primary process concerned in the evolution of groundwater was silicate weathering.

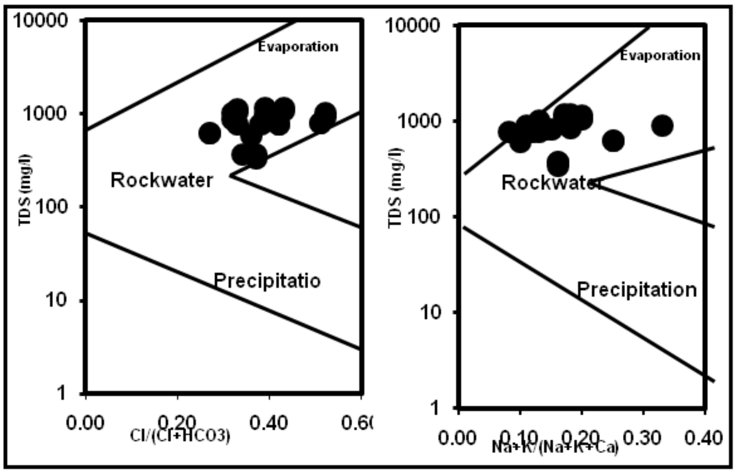

Figure 1.3 Shows The Gibb's Diagram

Classification of the groundwater facies
The classification of ground water facies represented by the piper diagram. This diagramme contains diamonds field(piper 1944). The plot shows that 100% of the groundwater samples arefalling in the field of $CaMgHco_3$ water.

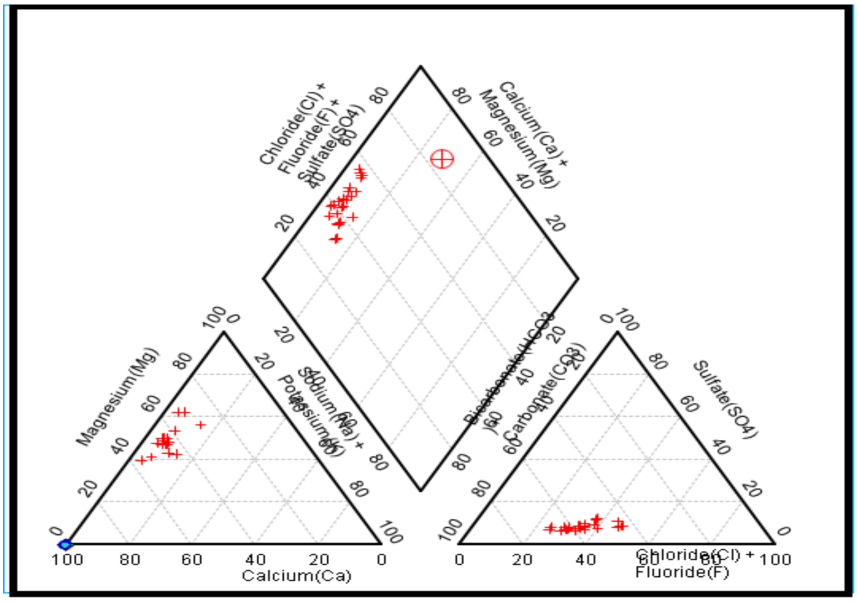

Figure 1.4. Trilinear diagram for representing the analyses of groundwater quality (Piper diagram)

V.CONCLUSION

The present study reveals that the groundwater in KVB Puram region. The order of the abundance of the major ions in groundwater's of the study area is as follows Ca^{2+}>Mg^{2+}> Na^{+}>K^{+} and HCO_3^{-}> Cl^{-}>SO_4^{2-}>F^{-} .The piper trilinear diagram shows that the dominant groundwater type was Ca-mg-HCO_3^{-} the Gibbs diagram indicates interaction of rocks like the Hornblende biotite gneiss granodiorite granitoid gneiss migmatites complex were responsible for the generate of the chemical components in water, moreover extensive usage of fertilizers and pesticides and some anthropogenic activities like mining activity. In overall, the study area, fairly suitable for the drinking and irrigation.

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