ASSESSMENT OF GROUNDWATER QUALITY IN KRISHNAGIRI AND VELLORE DISTRICTS IN SOUTH INDIA

Sridhar.N[1], Chandrasekar.N[2]

Department of Civil Engineering & Applied Geology,

Jayam College of Engineering and Technology South (India)

ABSTRACT

The Present study area is situated in the north and eastern part of Krishnagiri district and south-western part of Vellore district and contiguous with Andhra Pradesh states, India. A total of 31 groundwater samples were collected in the study area. The groundwater quality assessment has been carried out by evaluating the physicochemical parameters such as ***pH, EC, TDS****,* HCO_3^-, Cl^-, SO_4^{2-}, Ca^{2+}, Mg^{2+}, Na^+ *and* K^+*. The dominant cations are in the order of* $Na^+ > K^+ > Ca^{2+} > Mg^{2+}$ *while the dominant anions have the trends of* $Cl^- > HCO_3^- > SO_4^{2-} > CO_3$*. The quality of the water is evaluated using Wilcox diagram and the results reveals that most of the samples are found to be suitable for irrigation Based on these parameters; groundwater has been assessed in favour of its suitability for drinking and irrigation purpose.*

Key Words: Physicochemical Parameters, Ph, EC, TDS.

I. INTRODUCTION

Groundwater resources are dynamic in environment these are affected by factors such as, the expansion of irrigation activities, industrialization and urbanization. So, monitoring and conserving this important resource is vital. The quality of water is defined in terms of it is physiochemical and biological parameters. Ground water is the principal source of drinking water in both rural and urban parts of India. Now a day it is a source used for industrial and agricultural sector.The quality of ground water vary with geology of the particular area, depth of water table, seasonal changes, composition of dissolved salts depending upon sources of salt and surface environment (Ramesh et al., 2012). The urban aquifers are the only natural resource for drinking water supply, they are often perceived as of lesser relevance for the drinking water supply, leading to crisis in terms of drinking water scarcity, becoming increasingly polluted thereby decreasing their potability (Tiwari et al., 2012). The knowledge of hydro- chemistry is important to assess the ground water quality in any area in which the ground water is used for both irrigation and drinking needs (Srinivas et al., 2013). The water quality assessment may give clear information about the subsurface geologic environments in which the water presents (Raju et al., 2011).Most studies on water quality have been carried out by various Researchers in many places in India (Gnanachandrasamy et. al., 2013; Raju et al., 2011; Srinivasamoorthy et al., 2011; Subramanian 2011). Hydrogeochemical investigation of groundwater has been carried out in the coastal aquifers of southern Tamil Nadu, India (N. Chandrasekhar et al., 2014). Ashwani Kumar Tiwari and Abhay Kumar Singh, 2014 have studied groundwater chemistry of Pratapgarh district in Uttar Pradesh. The aim of the study is to assess the quality of ground water and to assess the spatial distribution of various hydrogeochemical parameters for suitability of groundwater resources in the study area.

II. STUDY AREA

The study area is located in the northern part of Tamil Nadu State in India and is situated between north eastern part of Krishnagiri district and south-western part of Vellore district. It is lies between latitudes 12˚ 17’ 40’’ and 12˚ 41’ 53’’ and longitudes 78˚ 14’ 56’’ and 78˚. The study area is drained by Bargur and Mathur rivers. These two rivers merge at the southeast corner, where the Pambar River originates and finally joins the river Ponnaiyar.The study area covers an area of 781 sq. km in the Survey of India Toposheet numbers 57L/6, 57L/7 and 57L/11 on a scale of 1:50,000. Topography of the area is highly and full of massive rock-shoots with fracture zone. A wide array of litho unit ranging from alkali syenites and ultramafics complexes and younger dolerite like intrusive are exposed in the study area. Also, an intrusive igneous complex of Proterozoic age, younger dykes and recent alluvial cover along the Bargur and Mattur river course cover up rest of the geology. The area has a sub-tropical climate without any sharp variations. Temperatures vary from 40˚C in summer to around 20˚C in the winter season. The average rainfall is 857 mm/yr. Public Work Department report (2004).

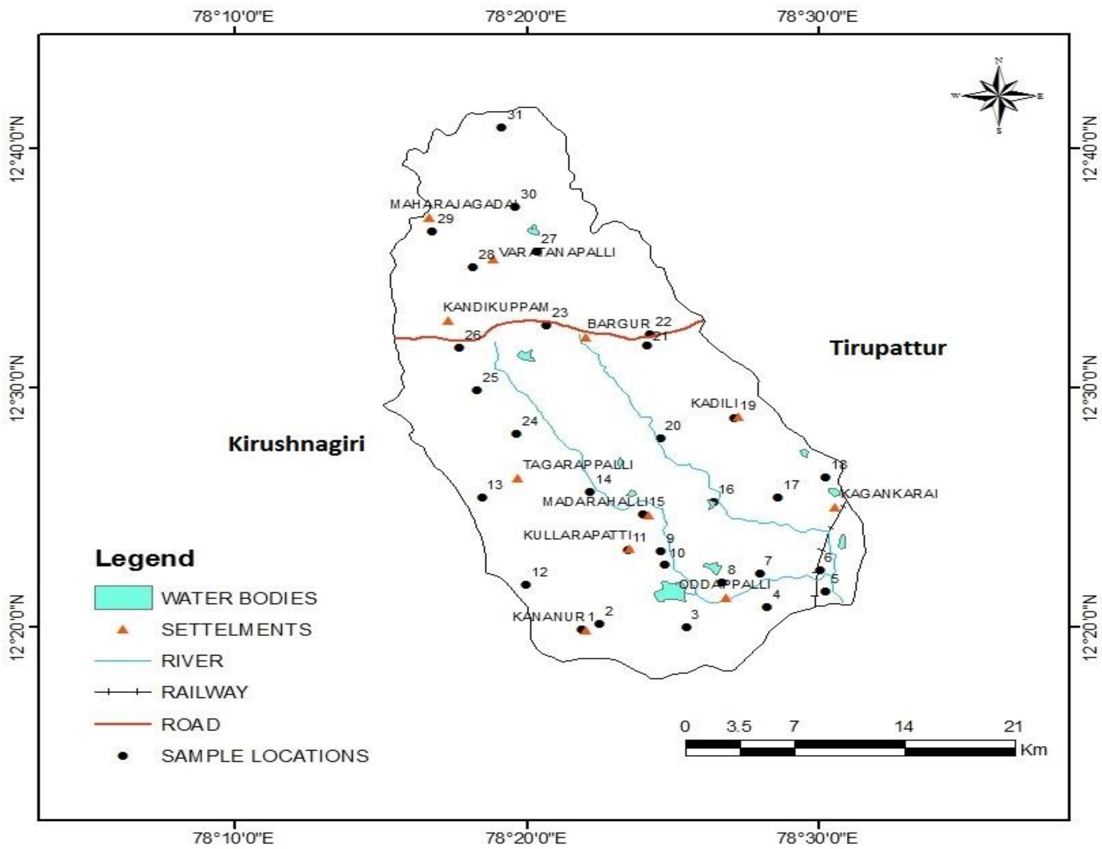

Figure I. Study Area Map

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III. METHODOLOGY

The Groundwater samples have been collected from 31 wells in the study by using Aqua trap sampler. The samples were collected in plastic bottles, which pre-cleaned with 1N Hydrochloric acid and rinsed 3 to 4 times with distilled water. Water analysis was done using Standard methods for the examinations of water and waste water (APHA, 1999). EC and pH were measured in the field using calibrated thermometer with a resolution of 0.1 and Elico portable water quality analyser, respectively. The chemical parameters like Ca, Mg, Cl, HCO_3, and CO_3 were determined by standard titration methods in the laboratory. Sulphate was measured by spectrophotometer whereas Na and K were analysed by flame photometer.

IV. RESULT AND DISCUSSION

The various physic-chemical parameters of Groundwater samples were analyzed and the descriptive statistics of the analyzed parameters are given in Table 1. The ground water quality is the only factor to give information about suitability for drinking purposes and each parameter were papered a spatial distribution maps.

Table1. Comparison of analytical results with international and national standards

Parameter	Max	Min	Mean	WHO guideline value (2004)	BIS standards (2000)
EC µS/cm	2306.25	471.5	927.0	1,500	-
pH	8.4	7.4	7.9	6.5–8.5	6.5 - 8.5
TDS mg/l	1476	301.8	593.3	1,500	500-2000
Ca mg/l	54	10.0	21.8	200	75-200
Mg mg/l	42	3.6	26.9	150	-
Na mg/l	558	67.0	156.7	200	200-400
K mg/l	103	2.0	20.2	12	-
CO_3 mg/l	15	0.0	2.5	-	-
HCO_3 mg/l	94	30.5	69.3	500	-
Cl mg/l	710	96.0	254.2	600	250
SO_4 mg/l	59	35.3	42.2	250	200-400

The results are compared to the World Health Organisation recommended maximum permissible limits and BIS standards. The electrical conductivity in ground water ranged from 471.5 to 2306 µS/cm and the mean value is 927µS/cm. The higher EC values show at station 7.It is due to geogenic activities in the sounding area. The data in Table 1 showed that that pH of the groundwater ranged from 7.4 to 8.4 and average value is 7.9. The lowest pH (7.4) was found in the Station 25 and the highest pH (8.4) was found in the sample station 6. The permissible range of pH for drinking and agricultural purposes is 6.5–8.5 (IS: 10500-1991). TDS ranged from 301 to 1476 mg/l and mean 593 mg/l. The calcium and magnesium in waters are generally used to classify the suitability of water. Calcium and magnesium are directly related to hardness of the water and these ions are the most abundant elements in the surface and groundwater and exist mainly as bicarbonates and to a lesser degree in the form of sulphate and chloride (Krishna Kumar et. al., 2014). The chloride ion is the most predominant natural form of the element chlorine and is extremely stable in water. The chloride in groundwater may be from diverse sources such as weathering, leaching of rocks and soil, domestic and municipal effluents (Sarthe Prasanth et al. 2012). The order of abundance of cations are $Na^{+} > K^{+} > Ca^{2+} > Mg^{2+}$. The anion chemistry shows that Cl^{-} and HCO_3^{-} are the dominant anions followed by SO_4^{2-}, and CO_3^{-} (Table 1). The spatial distribution of all the anions and cations shows in the **Figure II to XI.**

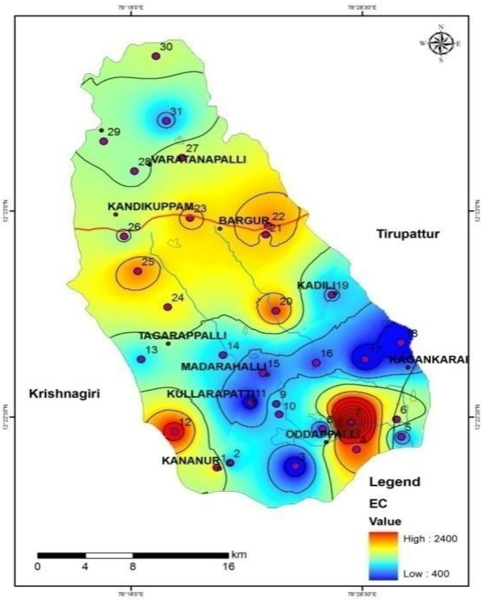


Fig. 1: Spatial variation of distribution of EC in study area

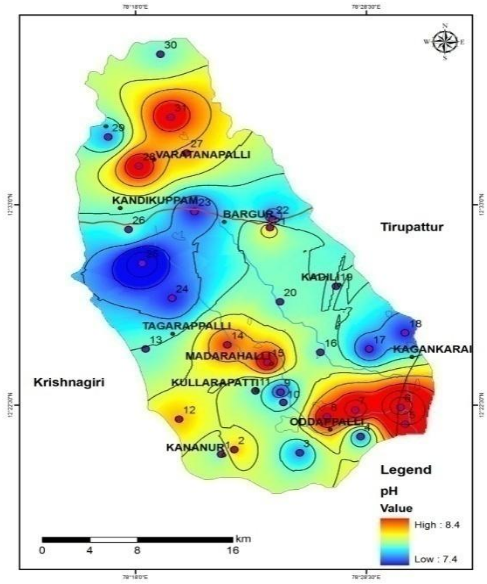
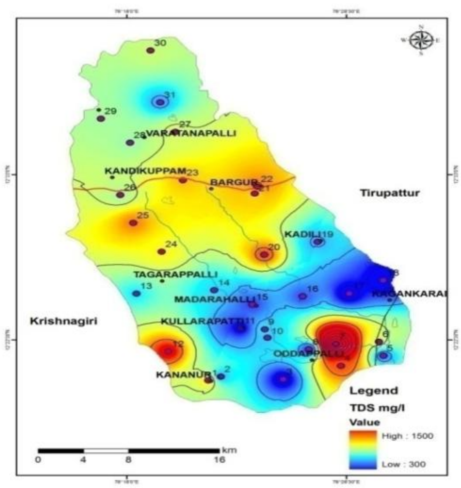


Fig. 2: Spatial variation of distribution of pH in study area



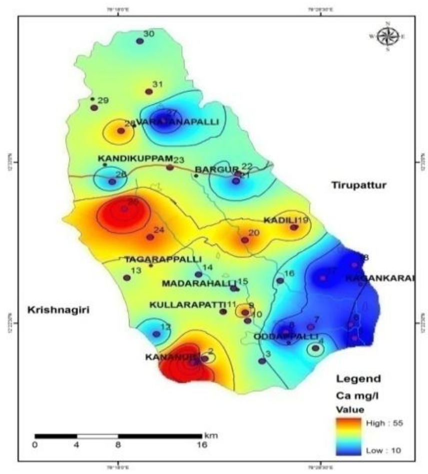


Fig. 3: Spatial variation of distribution of TDS in the study area

Fig4: Spatial variation of distribution of TDS in the study area

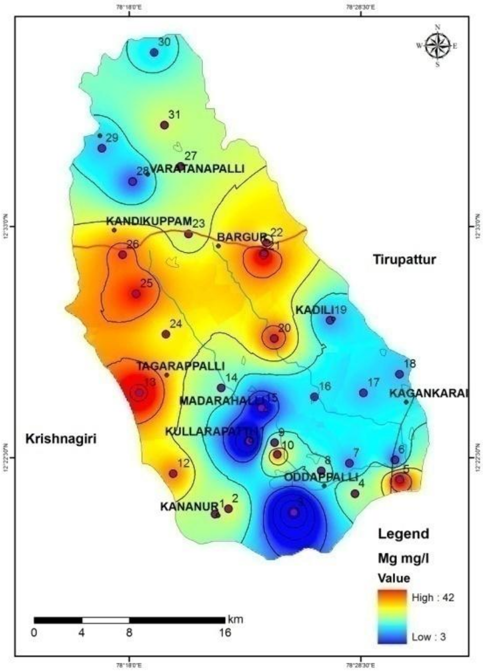


Fig. 5: Spatial variation of distribution of Mg in the study area

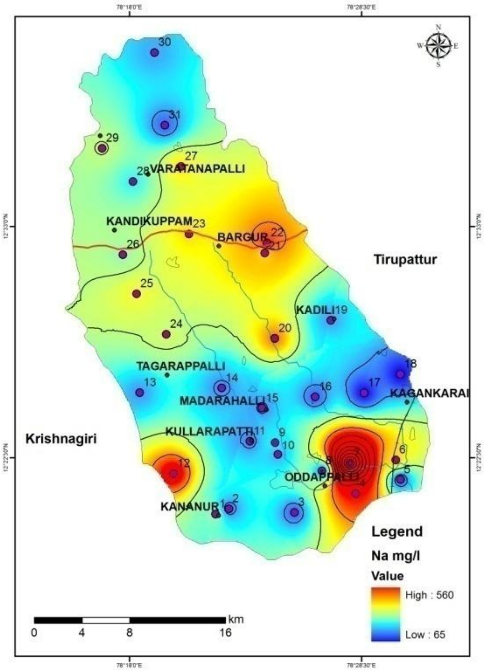


Fig. 6: Spatial variation of distribution of Na in the study area

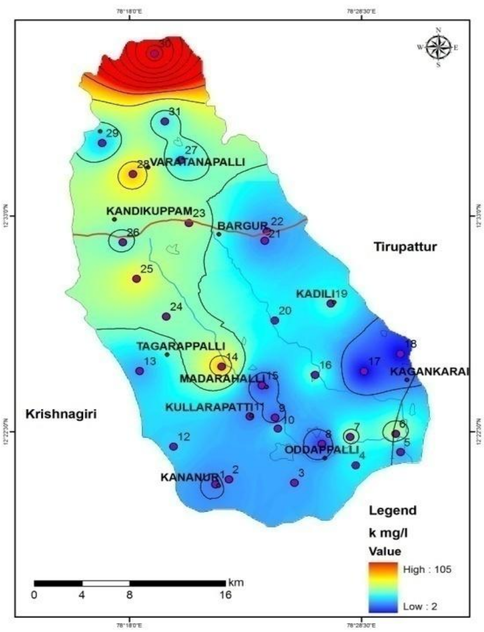


Fig 7: Spatial variation of distribution of K in the study area

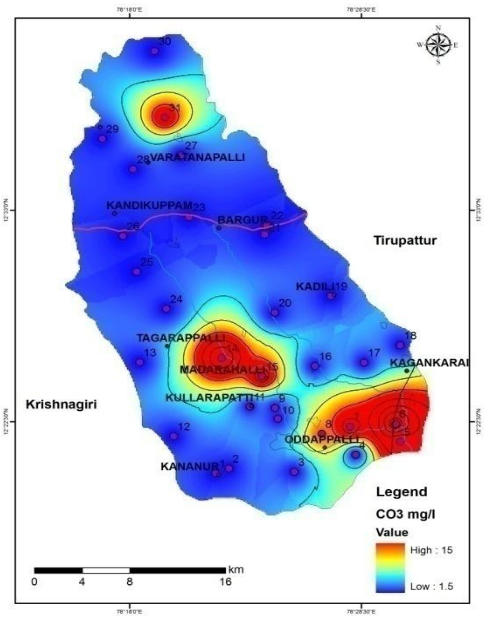


Fig. 8: Spatial variation of distribution of CO_3 in the study area

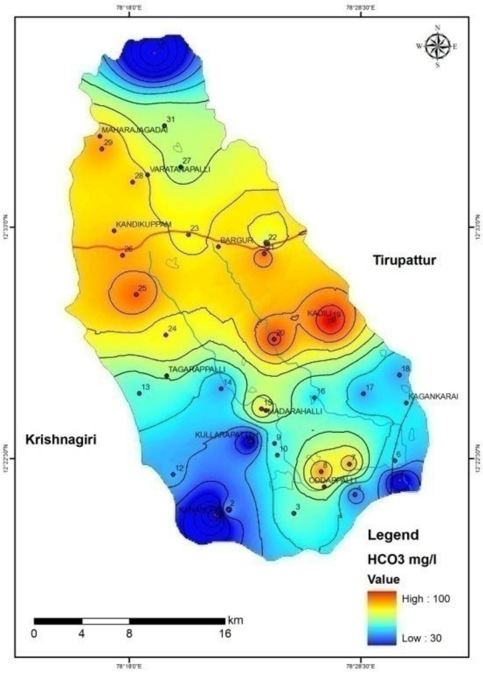


Fig. 9: Spatial variation of distribution of HCO_3 in the study area

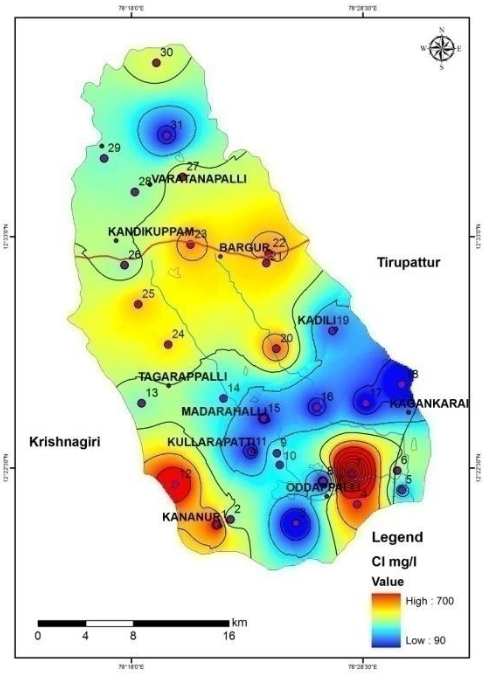


Fig. 10: Spatial variation of distribution of Cl in the study area

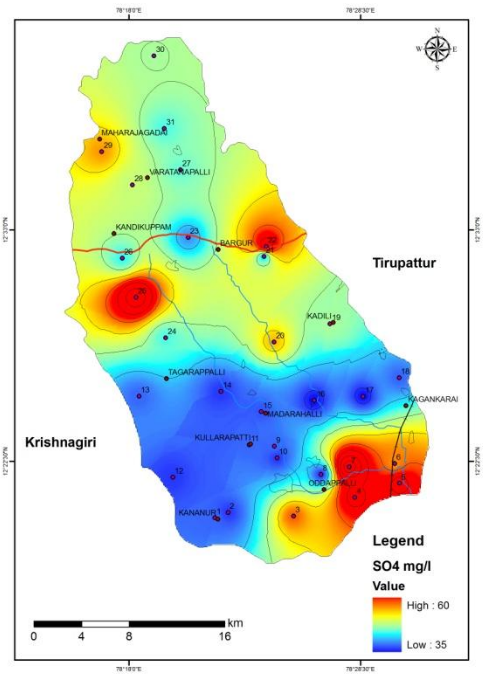


Fig. 11: Spatial variation of distribution of SO_4 in the study area

V. HYDRO-CHEMICAL FACIES

The conventional techniques such as trilinear plots, statistical techniques are widely accepted methods to determine the quality of water. The problems of ground water quality are more acute in areas that are coastal, densely populated and thickly industrialized and have shallow groundwater tube wells.(Krishna kumar et al. 2011; Padmalal et al. 2012; Bagyaraj et al. 2013; Sel- vam et al. 2013). The chemical processes and the evolution of the groundwater in the aquifers due to the residence and the flow may be evaluated using the hydrochemical facies. This can be well interpreted by drawing the Hill Piper plot (Piper 1953).The elevation of hydrochemical parameters of ground water can be understood by plotting the concentration of major cations and anions in the piper diagram (fig.12).the plots shows that most of the water fall in the field of NaCl with one stations showing mixed CaMgCl. From the plot, it is observed that alkalis (Na and K) exceed the alkaline earth (Ca and Mg) and Cl exceed other anions.

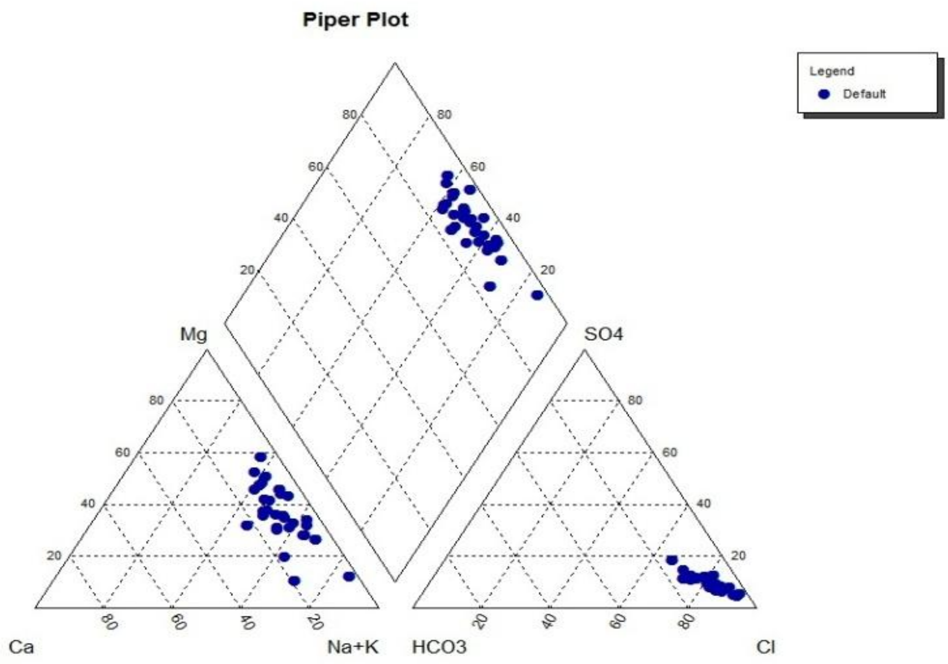


Fig.12 Piper Diagram

5.1 Wilcox diagram

The concentrations are in meq/l. According to the sodium % and specific conductance in evaluating the suitability of the water samples are varying from excellent to doubtful classes for irrigation. The results shows that (fig.14) about 52% of the samples fall in the very good to good region; 6 % samples are in the good to permissible region indicating that these waters are very much suitable for irrigation. 32% of the samples fall in the permissible to doubtful region and only one sample (station 7) fall in the doubtful to unsuitable region this is mainly due to the rock water interaction among the location. This station demonstrates high TDS value with higher concentration of Na. since excess sodium affects the plants, hence station 7 is not suitable for irrigation.

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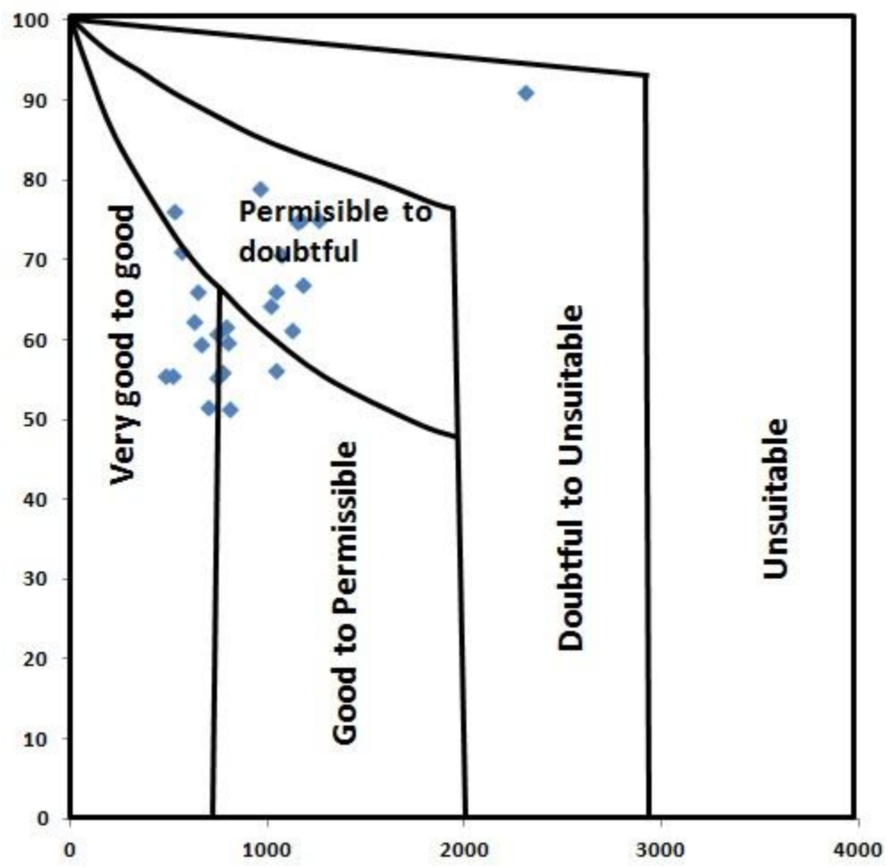

Fig.13 Wilcox Diagram

5.2 Statistical analysis

The correlation coefficient is commonly used to measure the relationship between two variables. It is a measure to exhibit how well one variable (Table.1) predicts the behaviour of the other (Lee et al., 2003). The results show that the Na has highly significant correlation with Cl and SO_4. Similarly Mg and K have positive correlation with Cl. The hydrochemical character of alkalies explains the correlation of sodium with chlorine ion. CO_3 has highly significant correlation with pH indicating that changes in the hydrogen ion concentration will directly correlation of carbonate in the water. The Ca/Na ratio is estimated to be 0.14 which is slightly below the value deduced by Galy and France Lanord (1999). Among the cations, no significant correlation is observed highly competitive relationship but in the case of anions Cl has significant correlation with SO_4, HCO_3 and CO_3 have low positive correlation with SO_4, low correlation exists between K and Cl ; Na and CO_3.

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	EC	pH	TDS	Ca	Mg	Na	K	CO_3	HCO_3	Cl	SO_4
EC	1.00										
pH	0.16	1.00									
TDS	1.00	0.16	1.00								
Ca	0.11	-0.38	0.11	1.00							
Mg	0.24	-0.07	0.24	0.07	1.00						
Na	0.97	0.20	0.97	-0.05	0.09	1.00					
K	0.18	0.04	0.18	0.08	-0.01	0.04	1.00				
CO_3	0.12	0.75	0.12	-0.31	-0.12	0.17	0.03	1.00			
HCO_3	0.22	0.00	0.22	-0.08	0.16	0.26	-0.24	-0.04	1.00		
Cl	0.98	0.12	0.98	0.16	0.28	0.93	0.17	0.06	0.10	1.00	
SO_4	0.59	0.01	0.59	0.05	0.02	0.60	0.14	0.18	0.21	0.51	1.00

Table 1: correlation coefficient of water parameters

VI. CONCLUSION

In this study, different water quality parameters of the groundwater of the north-eastern part of Krishnagiri district and south-western part of Vellore district were evaluated. The TDS values of almost the entire study area have values not exceeding 1000 mg/l except at one station indicating the suitability of these water for drinking and irrigation according to WHO limit. The cation chemistry of the ground water shows excessive presence of Na except in few locations.

The order of abundance is $Na^+ > Mg^{2+} > Ca^{2+} > K^+$. The anion chemistry of the ground water shows excessive presence of chloride except in few samples. The order of abundance is $Cl^- > HCO_3^- > SO_4^{2-} > CO_3^{2-}$. The result of hydrochemical facies reveals the type of water as NaCl with mixed CaMgCl. The quality of the water is evaluated using Wilcox diagram and the results shows that about 60% of the groundwater samples are found to be good for irrigation. The remaining sample falls in the region of permissible to doubtful. A correlation study shows highly significant correlation with respect to Na and Cl in hydro chemical character of the alkali ions.

REFERENCE

[1] N. Chandrasekar , S. Selvakumar , Y. Srinivas, J. S. John Wilson, T. Simon Peter and N. S. Magesh 2014 Hydrogeochemical assessment of groundwater quality along the coastal aquifers of southern Tamil Nadu, India. Environ Earth Sci (2014) 71:4739–4750.

[2] APHA (1999). Standard methods for the examination of water and wastewater, 20th edn. American Public Health Association,Washington DC.

[3] Ashwani Kumar Tiwari and Abhay Kumar Singh (2014). Hydrogeochemical investigation and groundwater quality assessment of Pratapgarh District, Uttar Pradesh Journal Geological society of India. Vol.83, March 2014, pp.329-343.

[4] Bagyaraj M, Ramkumar T, Venkatramanan S, Gurugnanam B (2013) Application of remote sensing and GIS analysis for identifying groundwater potential zone in parts of Kodaikanal Taluk, South India. Front Earth Sci 7(1):65–75.

[5] BIS (2000) Drinking water specification. Bureau of Indian Standards,New Delhi IS 10500.

[6] G. Gnanachandrasamy , T. Ramkumar, S. Venkatramanan , S. Vasudevan , S. Y. Chung, M. Bagyaraj (2013). Accessing groundwater quality in lower part of Nagapattinam district, Southern India: using hydrogeochemistry and GIS interpolation techniques, Appl Water Sci , DOI 10.1007/s13201-014-0172-z.

[7] Galy, A., France-Lanord, C., 1999. Weathering process in the Ganges–Brahmaputra

[8] basin and the riverine alkalinity budget. Chem. Geol. 159, 31–60.

[9] Krishna Kumar S, Chandrasekar N, Seralathan P, Godson PS, Magesh NS (2011) Hydrogeochemical study of shallow carbonate aquifers, Rameswaram Island, India. Environ Monit Assess 184(7):4127–4139.

[10] Lee SM, Min KD, Woo NC, Kim YJ and Ahn CH (2003) Statistical models for the assessment of nitrate contamination in urban groundwater using GIS. Environmental Geology. 44: 210–221.

[11] Padmalal D, Maya K, Narendra Babu K, Baiju RS, Babura B (2012) Hydro chemical characterization and water quality assessment of the coastal springs of southern Kerala, India. J Appl Geochem 14(4):466–481.

[12] Pang Z, Yuan L, Huang T, Kong Y, Liu J and Li Y (2013). Impacts of human activities on the occurrence of groundwater nitrate in an alluvial plain: a multiple isotopic tracers approach. J EarthSci 24 (1):111–124

[13] Piper AM (1944) A graphical interpretation of water analysis. Trans Am Geophys Union 25:914–928.