Computational Assessment Of Ion Distribution On Applying Multivariate Analysis Using Geographic Information Systems

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Abstract

Study on geochemical aspects of ground water carried out by collecting samples from the existing bore well and open wells apart from surface water bodies i.e., lakes and tanks in Miryalaguda area. Electrical conductivity, pH, TDS and concentration of di and momo-valent elements controlling the parameters of drinking water carried out. The area is composite of crystalline granites of Precambrian age. The groundwater is hard water that varies from acidic to alkaline. Dissolution of fluorine into groundwater mainly by weathering of rocks is primarily involved with water pollution and water borne ailments.

Introduction

Major ion geochemical study of groundwater in study area carried out to asses groundwater quality apart from fluoride concentration used as major resource for drinking in the region. Under natural conditions, it has the self-purification process, play a large role in controlling the concentrations to a certain extent. The tremendous increase in population urbanization, industrialization, agriculture, etc is the major cause of pollution [1].

Fluoride has more impact on teeth and bones rather than other elements.Flourine content lower than 0.6 mg/lit lead to cavitation in teeth and > than 1.2 mg/lit causes fluorosis [2, 3]. Increase of concentration in drinking water is the problem across the globe. India is also facing flourosis in 17 states including Telangana effecty 62 million people in the form of dental sketal and/or non skeletal fluorosis [4]. Studies carried out now and earlier indicate concentration of fluoride is due to granitic gneiss rocks [5, 6]. The present work is to demarcate the area of the region in to safe zone and unsafe zones by analyze groundwater with refer to concentration of fluoride. It is done by adopting simulation methods to reduce the usage of natural instead of chemical fertilizers to reduce groundwater contamination levels and to bring the quality of water for drinking [7]. The integrated groundwater prospects maps are preferred by using different geochemical studies [8].

The area of study is between latitude from $17^05'$ to $17^055'$ and East longitude $79^030'$ to $79^040'$ form part in the survey of India toposheet No. 56 P/9 (Fig.1).Grey and pink granites are formed by magmatic origin, are subjected to high degree of weathering. This can be inferred by the field studies and presence of boulders in plain terrain. Tropical climate in led to variation in temperature, ranging from [42ºC to 47ºC] very hot in summer with low humidity. The origin of these rocks is due to the "parental" magma [9].

Materials and Methods

Groundwater analysis carried out by collecting underground source and surface water bodies (Fig.2). For using standard methods major ion concentration carried out [10]. Hydrogen ion concentration and Electrical conductivity are measured. Total Dissolved Solids (TDS) are computed by multiplying the electrical conductivity by a factor (0.55 – 0.75) depending on the relative concentration of ions. Fluoride was analyzed standard method. Total alkalinity as $CaCO_3$, Carbonate (Co_3^{-2}) and bicarbonate (HCO_3^-) were estimated. Total hardness as $CaCO_3$ and Calcium (Ca^{+2}) were analyzed. Magnesium concentration analyzed by taking the difference between TH and Ca^{+2} values where as Sodium and Potassium content analyzed by Flame Photometer. Chloride ion was estimated by standard $AgNO_3$ titration and the values are mentioned in (Fig 2).

Results & Discussion

Analysis of groundwater tabulated in (Table1). Groundwater pH varies from 7.2 to 8.5 indicate it is acidic to alkaline nature. TDS varies from 236 to 1322 mg/l hardness ranges from 125 to 1690 mg/l .Hardness of these samples were correlated with standard values [11]. Indicate 75.86% water is hard water. Carbonate and bicarbonate ions in groundwater vary from 0 to 45 mg/l. and 27.1 to 225.7 mg/l respectively (Table-2). Bicarbonate content is within the limits. Sodium varies from 21.9 to 151.8 mg/lit and it is within limit of 200 mg/lit drinking water, Potassium ranges from 0.6 to mg/lit to 53.6 mg/lit indicate suitability for drinking. Calcium ranges from 20 mg/lit to 514 mg/lit with refer to prescribed limit of calcium 75 mg/lit [12].Indicate 79.37% of groundwater samples a fall under drinking water category.

Drinking water prescribed limit is 30 mg/lit as against the sample show magnesium from 1.2 mg/lit to 147.1 mg/for lit. Indicate 56.89% of the samples are as per specification. Content of Fluoride with refer to standard 1.5 mg/lit] [13] and Optimum various from 0.8 to 1.2 mg/lit. 89% of samples it is less than 0.8 mg/lit lower indicate water is suitable for drinking [14]Concentration of fluoride correlated of certain dissolved other constituent concentration. The weathering caused by alternative wet and dry conditions of semi arid climate is responsible for the leaching of fluoride from minerals in the soils and rocks [5, 15, 6, and 16]. In the contour map Fig. 3. Distribution fluoride concentration mentioned.

Acidic climatic conditions are primary factor for fluoride concentration in groundwater. Dissolution of fluoride fro minerals, ion exchange [17, 18, 19, 20], evaporative concentration, led to higher concentration of which is mainly influenced by local, regional geology and hydrological conditions. The chief source of fluoride is from minerals (Fluoride, Fluorapative, Cryolite and Pophylite) as well as fluoride replacing OH ion ferromagnesium silicates (amphiboles and micas) and soils consisting of clay minerals [21, 22, 23, 24]. The degrees for weathering and leachable fluoride in terrain is more important indicate fluoride content in water rather than more presence from the rocks [23, 25].
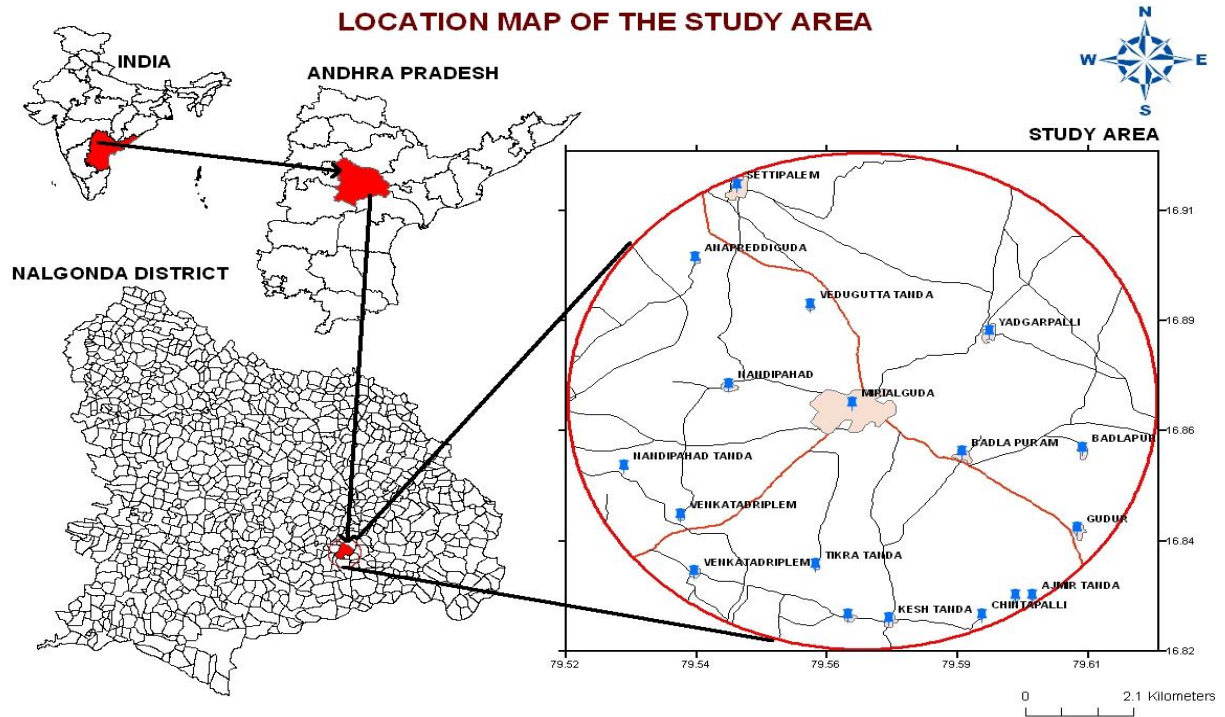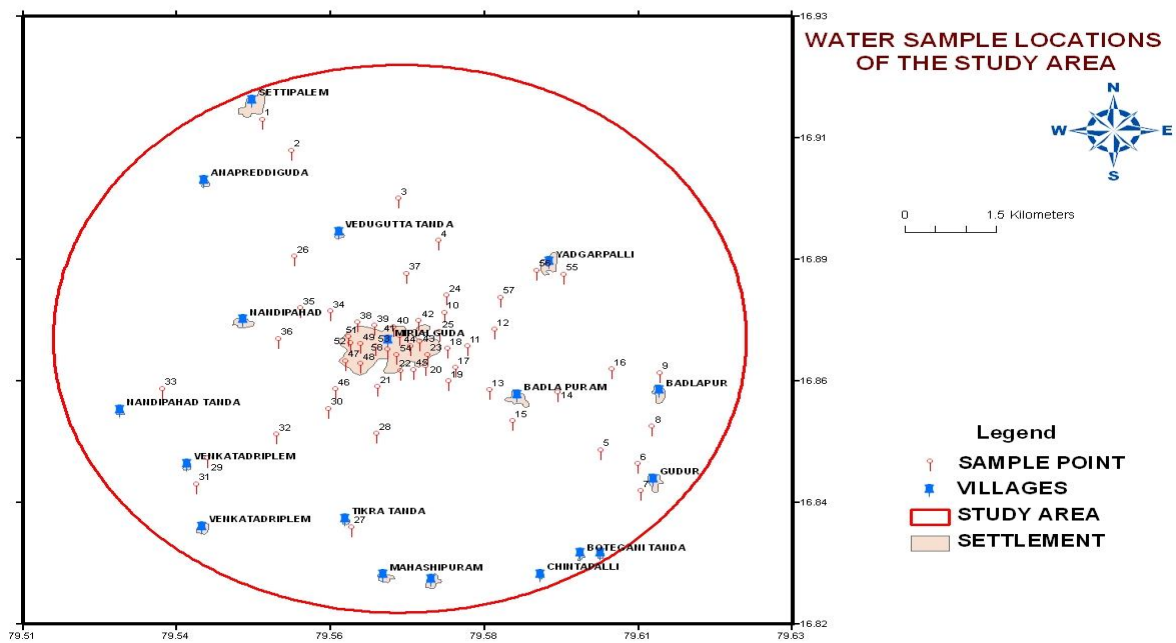
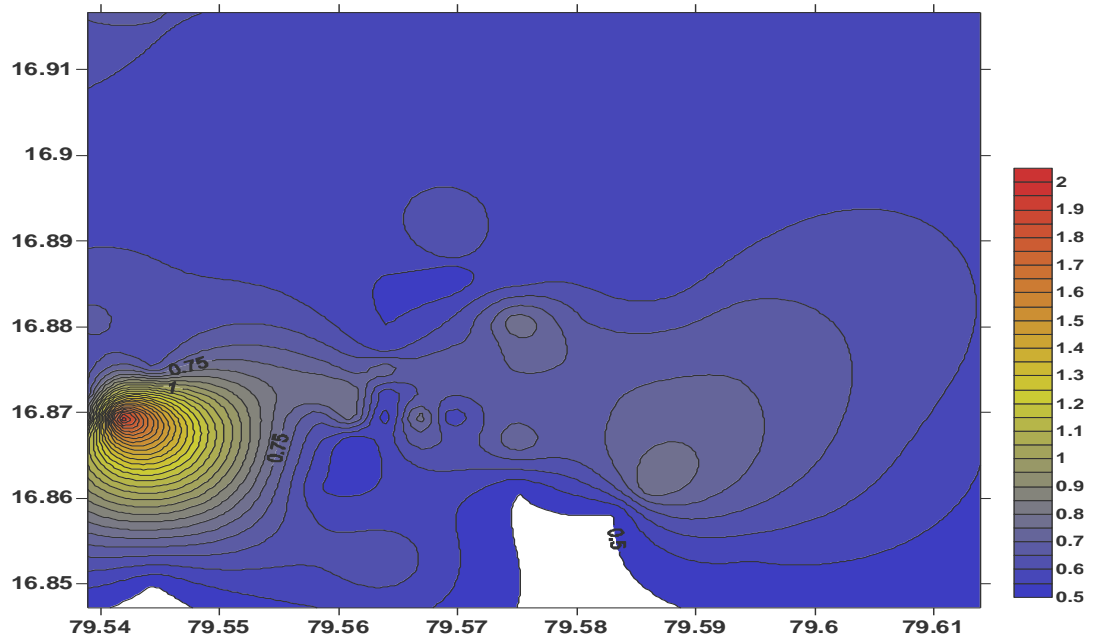**Fig 1: Location map of the study area**

Fig 2: Sample location map

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Fig 3: Fluoride Distribution map of the study area

Table 1: Correlation matrix of the study area

	pH	Ec	TH	TDS	Mg	Na	K	Cl	Ca	CO3	HCO3	NO3	SO4	F
pH	1.000													
Ec	-0.273	1.000												
TH	-0.135	*0.479*	1.000											
TDS	-0.265	*0.999*	*0.471*	1.000										
Mg	-0.127	0.323	*0.833*	0.317	1.000									
Na	-0.042	-0.003	0.064	-0.003	0.107	1.000								
K	0.127	0.299	0.051	0.321	-0.054	-0.017	1.000							
Cl	-0.151	*0.456*	0.162	*0.460*	0.081	0.015	0.050	1.000						
Ca	-0.066	0.447	*0.848*	0.439	*0.453*	0.005	0.116	0.167	1.000					
CO3	*0.523*	-0.171	-0.019	-0.168	0.072	-0.030	0.050	-0.230	-0.089	1.000				
HCO3	*-0.477*	*0.654*	0.141	*0.647*	0.062	-0.012	0.251	0.310	0.124	-0.306	1.000			
NO3	-0.103	0.038	0.253	0.036	0.249	0.008	0.003	0.056	0.188	-0.051	-0.042	1.000		
SO4	0.076	0.258	-0.055	0.257	-0.055	-0.004	0.023	0.023	-0.055	-0.034	0.389	-0.024	1.000	
F	-0.140	0.206	-0.001	0.202	0.019	0.000	0.134	-0.076	-0.022	0.028	0.133	-0.047	-0.094	1.000

Table 2: Statistical parameters of ground water samples

	pH	Ec	TH	TDS	Mg	Na	K	Cl	Ca	CO₃	HCO₃	NO₃	SO₄	F
Mean	7.9	1165	559	749	54	70	3.6	144	137	14.1	113	27	14	0.7
Median	7.9	1102	460	706	35	78	1.9	126	128	15.0	107	17	12	0.7
Mode	8.2	1888	685	1208	35	86	0.9	121	52	15.0	159	33	12	0.6
Standard Deviation	0.3	469	326	305	42	35	7.2	96	81	9.8	47	79	14	0.2
Skewness	-0.1	0.1	1	0.2	0.9	0.4	6.1	2.7	1.9	0.5	0.2	7.3	7	5.1
Range	1.3	1602	1565	1085	146	130	53.0	579	494	45.0	199	606	108	1.5
Minimum	7.2	370	125	236	1.2	22	0.6	36	20	0.0	27	2	5	0.5
Maximum	8.5	1972	1690	1322	147	152	53.6	614	514	45.0	226	608	113	2.0

Conclusion

The study reveals that the groundwater of the regions is acidic to alkaline in nature. the climatic condition of the region lead to high rate A high rate of evapotranspiration and prolonged contact with weathered zone and stagnation in the led to increase in   fluoride content beyond the limit of the region.

Acknowledgements

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