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SPATIAL ANALYSIS OF GROUNDWATER QUALITY FOR CHINNAR RIVER SUB BASIN, TAMILNADU,INDIA USING GIS

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ABSTRACT

Groundwater is one of the most important natural resources. Groundwater has become a vital resource over the past decades due to the increase in its usage for drinking, water supply, irrigation and industrial uses etc. Groundwater resources are now facing threats due to anthropogenic activities. Mapping of spatial variability of groundwater quality is of vital importance and it is particularly significant where groundwater is the primary source of potable water. The present study has been undertaken to analyse the spatial variability of groundwater quality for Chinnar river sub basin of Perambalur and Ariyalur Districts, Tamilnadu,India. The groundwater samples are collected from 65 locations and analyzed for pH, EC, TDS, cations and anions. Geographic Information System (GIS) is used for spatial and temporal mapping of water quality in the study area.

Keywords: GIS, Groundwater, Chinnar river sub basin,Tamilnadu

1.INTRODUCTION

Water is a prime natural resource, a basic human need and is a precious national asset and one of the most stable compounds as well as universal solvent. Besides drinking purpose, it is required for other human activities like cooking, bathing, washing, agriculture, industry, recreation, navigation, fisheries etc. Rapid growth of population, expansion of irrigation and increasing trend of industrialization have contributed towards rising demand for groundwater in many areas (Bhattacharya et.al.,,2005). Geochemical processes in groundwater involve the interaction of rocks with water, leading to higher concentration of chemical elements in water (Tiwari,1985). The principles governing the chemical characteristic of groundwater were well documented in many parts of the world. The area chosen for study is Chinnar river sub basin which is located in Perambalur and Ariyalur districts.The area is bound between latitudes 11° 9' to 11 19' N and longitude 78° 39' to 79° 10' E(fig.1). The area chiefly composed of Archaean group rccks in the western part and eastern part composed of clay, sandstone and limestone of Cretaceous of age.The Cretaceous formation are underlain by hard igneous rock in some places. Upper Gondwana rest on Archaean gneisses and are overlain by the Cretaceous formation and alluvium.The main objective of this study is to evaluate the spatial variability of chemical parameters that control the ground water quality of the study area.

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2.METHODOLOGY

The groundwater samples were collected during post monsoon (2014) season. Totally sixty five water samples were collected in order to cover different litho units of the study area. The samples collected were analysed for major cations like Ca,Mg by Titrimetry,Na and K by Flame photometer; anions, Cl and HCO_3 by Titrimetry, SO_4,PO_4 and H_4SiO_4 by spectrophotometer. EC and pH were determined in the field using electrode. The analyses were done by adopting standard procedures (APHA,1998 & 2005). The base map of the Perambalur and Ariyalur districts are derived from the thematic map collected from Survey of India toposheets on 1:50,000 scale. The base map was Geo referenced; digitized and spatial analysis by using Arc Gis9.3. Spatial interpolation technique through Inverse Distance Weighted (IDW) approach has been used in the present study to delineate the distribution of water chemistry.

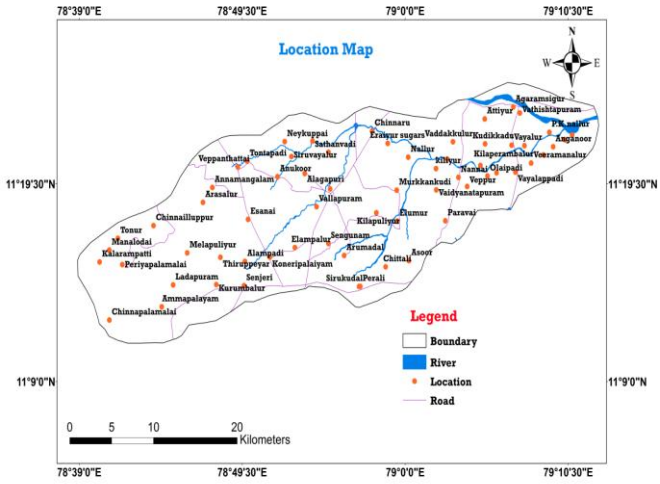

Fig. 1.Sample location Map

3.RESULTS AND DISCUSSIONS

The maximum, minimum and average value for groundwater are represented in table- 1. With the chemical parameters viz., pH, EC, TDS, cations and anions and their various thematic maps have been prepared using ArcGIS 9.3.

pH

pH is one of the important parameters of water and determines the acidic and alkaline nature of water. The pH value of water ranged between 6.7 to 8. The pH of the samples are within the prescribed standards for drinking water (WHO,1993). The spatial variation map for pH was prepared and presented in Fig 2.

Electrical Conductivity (EC)

The Electrical Conductivity (EC) ranges from 284.8mhos/cm to 5150 mhos/cm. The spatial variation map for Electrical Conductivity (EC) was prepared and presented in Fig 3. From the map it has been observed that very small portion of the study area, the EC value is within 2250 mhos/cm, and the remaining area falls under the poor range (>3000 mhos/cm) and constitutes a small part of the study area.

Total Dissolved Solids (TDS)

The TDS varies between 137 mg/l to 2980 mg/l with an average of 969.57 mg/l in Post monsoon. The spatial variation map for TDS was prepared based on these ranges and presented in Fig 4. From the spatial variation map it was observed that part of the study area, the TDS value is in the poor range (>1000 mg/l). In the study area, the TDS value is in the medium range (500-1000 mg/l) and the smaller portion of the study area has TDS under the good range (0-500 mg/l). Water contains less than 500 mg/l of dissolved solids, it is generally satisfactory for domestic use and for many industrial purposes. If the water with more than 1000mg/l of dissolved solids usually gives a disagreeable taste or makes the water unsuitable.

Sulphates

Sulphates occur in natural waters at concentration upto 50 mg/l and concentration of 1000 mg/l can find in the water having contact with certain geological formations such as pyrite, lignite and coal(Sinha, 1994). Sulphate varies between 0.4 to 5.4 mg/l, based on these ranges the spatial variation map for Sulphates has been obtained and presented in Fig 5. From the spatial variation map, it was observed that part of the study area, the sulphate value is in the good range.

Table-1 Hydrogeochemical data of the study area(post monsoon)

S.No	Min	Max	Average
pH	6.7	8	7.38
TDS	137	2980	969.57
EC	284.8	5150	1810.47
Ca	20	216	103.51
Mg	4.8	192	43.68
Na	72	687	224.68
K	11	162	38.28
NO_3	0.004	0.25	0.08
Cl	70.9	1116.7	338.69
F	0	2.7	0.68
SO4	0.4	5.4	2.00
PO4	0.005	0.175	0.05
HCO_3	256.2	1330	786.44
H_2SiO4	4	20	11.95

Calcium

Calcium occurs in the water mainly due to the presence of limestone, gypsum and dolomite minerals(Kudesia,1996). Calcium values varies between 20 to216 mg/l and based on these ranges the spatial variation map for calcium has been obtained and presented in Fig 6. From the figure it is evident that major part of the study area has a moderate range (75-200 mg/l) of calcium.

Chloride

Cl is higher indicating the impact of saline water and Base exchange reactions (Allen freeze and Cherry,1979) Concentrations greatly in excess of 100mg/l may cause physiological damage. Groundwater with Chloride value below 600mg/l is portable(WHO,1993).In the study area, Chloride value varies between 70.9 to 1116.7 mg/l, based on these ranges the spatial variation map for Chloride has been obtained and presented in Fig 7.

Potassium

Potassium values in groundwater ranged from 11 to 162 mg/l. The concentration of K levels in many areas exceeded the desirable limit and based on these ranges the spatial variation map for potassiumhas been obtained and presented in Fig 8.

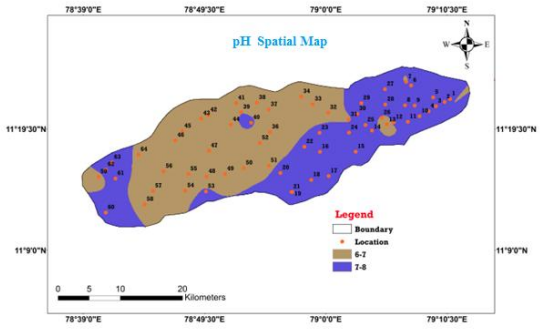

Fig.2 pH Variation map in the study area

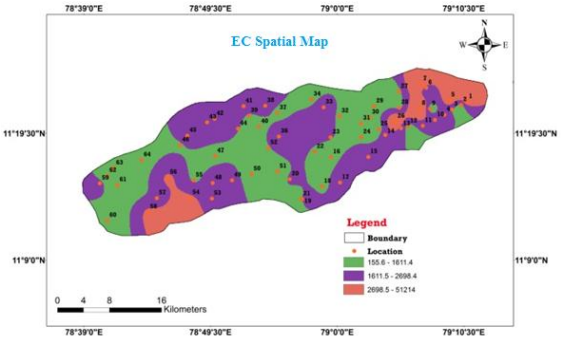

Fig.3 EC Variation map in the study area

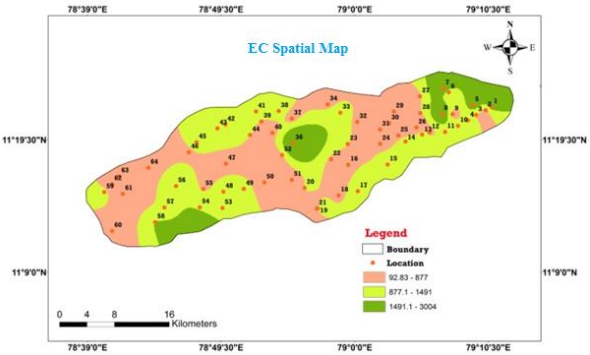

Fig.4 TDS Variation map in the study area

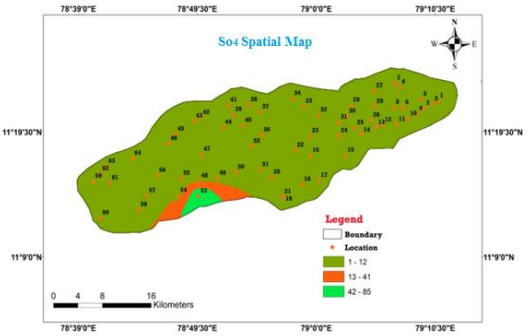

Fig.5 SO_4 Variation map in the study area

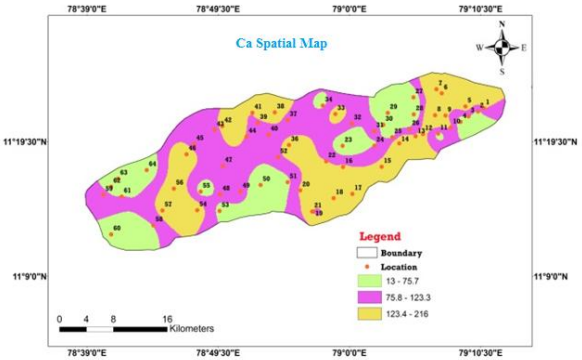

Fig.6 Ca Variation map in the study area

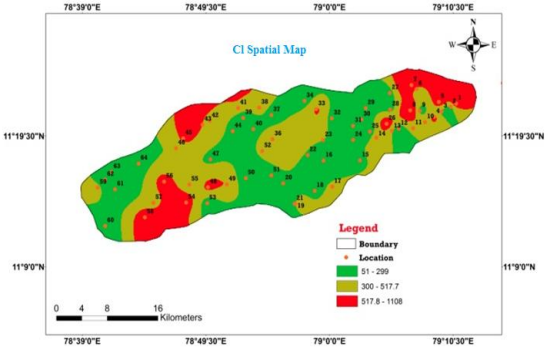

Fig.7 Cl Variation map in the study area

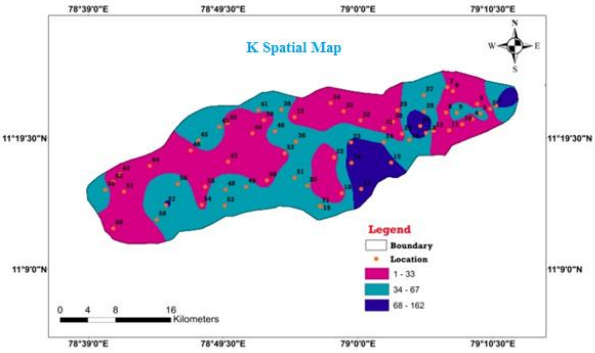

Fig.8 K Variation map in the study area

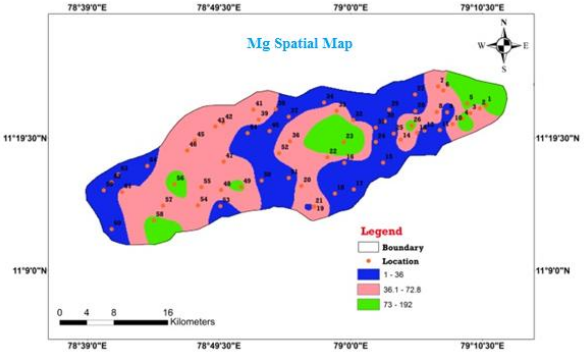

Fig.9 Mg Variation map in the study area

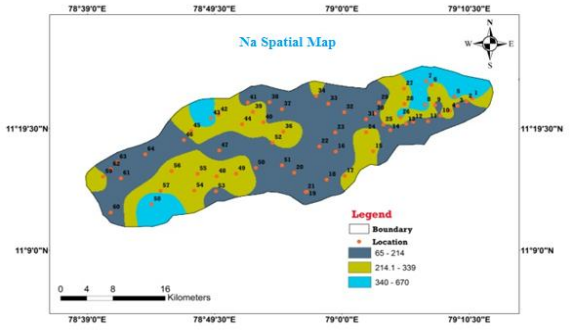

Fig.10 Na Variation map in the study area

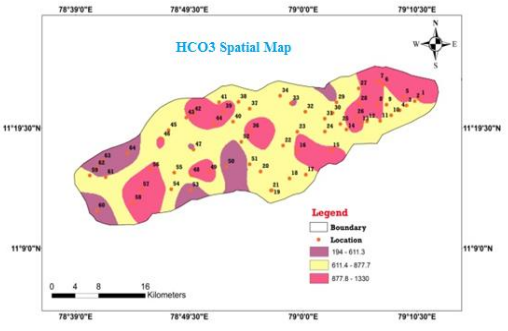

Fig.11 HCo_3 Variation map in the study area

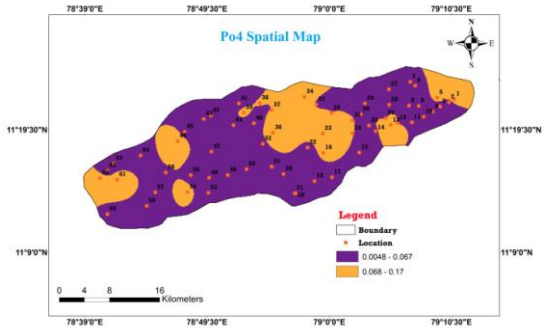

Fig.12 Po_4 Variation map in the study area

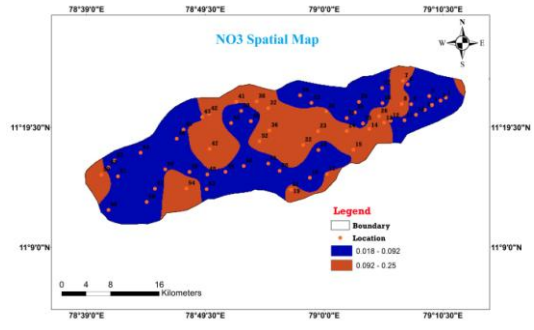

Fig.13 No_3 Variation map in the study area

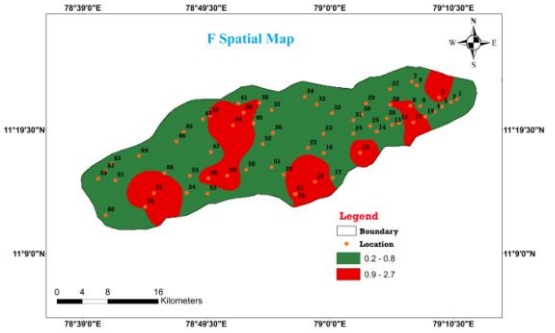

Fig.14 F Variation map in the study area

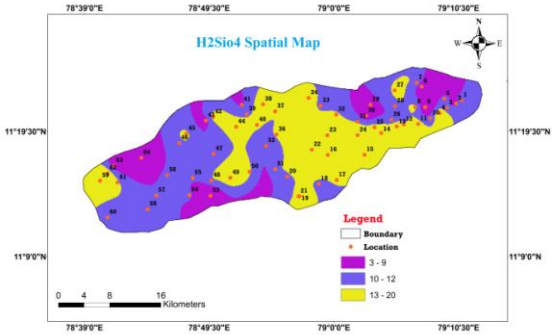

Fig.15 H_2Sio_4 Variation map in the study area

Magnesium

Magnesium values in groundwater ranged from 4.8 to 192 mg/l and based on these ranges the spatial variation map for magnesium has been obtained and presented in Fig 9.

Sodium

Sodium is the important and most abundant alkali metal which is highly mobile and soluble in groundwater. Groundwater with sodium value below175mg/l is portable (WHO,1993).In the study area, sodium values ranged from 72 to 687 mg/l. The spatial distribution of sodium in the study area is shown in fig.10.The figure shows that most of samples fall within the allowable limit.

Bicarbonates

Bicarbonate represents the major sum of alkalinity. Alkalinity in water is a measure of its capacity of neutralization. It is formed mainly due to the action of atmospheric CO_2 and CO_2 released from organic decomposition. In the study area, bicarbonate values ranged from 146 to 1085 mg/l. The spatial distribution of bicarbonates in the study area is shown in figure 11.

4.CONCLUSIONS

The resultant water quality is obtained by overlaying the following parameters viz., pH, EC, TDS, cations and anions. The output of GIS analysis has been classified as good and poor water quality regions. From the GIS analysis ,it is inferred that the quality of groundwater is predominantly of good category ,while poor category of water is found in many locations.

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