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Groundwater contamination and vulnerability assessment using gis technique

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***Abstract*—-As most of the Earth's liquid freshwater is found not in lakes and rivers, but is stored underground in aquifers. In India, Groundwater is playing the pivotal role in fulfilling the demands of domestic,indusrial and agricultural sectors. The suitability irrigation water remain in the soil as water evaporates or used by the crop. Therefore, it is to investigate and to create groundwater status capsule by means of groundwater quality mapping using the state of art GIS technique.**

INTRODUCTION

Water is essential for sustaining all forms of life, food production, economic development and for general well being. Groundwater is a prime resource which is extensively used for domestic, irrigation and industrial purpose. In India, groundwater is playing the pivotal role in fulfilling the demands of domestic, industrial and agricultural sectors. It is to investigate the present status of groundwater quality in the study area in terms of physico-chemical characteristics.

The Noyyal river basin located between north latitude 10°56´ and 11° 19´, east longitude 76° 41´ and 77° 56´.River Noyyal originates at the Velliangiri hills in Western Ghats and passes through the Coimbatore district (Coimbatore south, Palladam and Tiruppurtaluks), Erode district (Perundurai, Kangeyam and Erode taluks) and Karur district (Aravakurichitaluk) in Tamil Nadu state and joins Cauvery at Kodumudy. The total area of the river basin is 3510 sq.km. The flow in the river is seasonal and is contributed by the North East and South West monsoons.

The study area taken in this project is located between latitude 11.2993 and 10.5773, longitude 77.0481 and 76.9352. 12 water samples are collected.

SAMPLE	LOCATION	LATITUDE	LONGITUDE
S1	SULUR	11.0227	77.1257
S2	PEELAMEDU	11.0303	77.0417
S3	GANAPATHY	11.0393	76.9787

TEST REPORTS:

The tests were made to find the quality of water samples collected and the results are obtained.

WATER QUALITY:

The chemical, physical and biological characteristics of groundwater determine its usefulness for various purposes. Chemical analysis of groundwater includes the determination of the concentrations of inorganic constituent. The analysis also includes measurement of pH and specific electrical conductance. Temperature, colour, turbidity, odour and taste are evaluated in a physical analysis. Biological analysis generally consists of tests to detect the presence of coli form organisms. Lloyd and Helmer (1991) observed that the water quality problem may be associated with and traceable to, any or all of the following:

Poor quality source of water,
Poor site selection or protection such as apron,
Construction difficulties.

PHYSICO-CHEMICAL QUALITY

The term physico-chemical quality is used in reference to the characteristics of water which may affect its acceptability due to aesthetic considerations such as colour and taste; produce toxicity reactions, unexpected physiological responses of laxative effect, and objectionable effects during normal use such as curdy precipitates (WHO, 1995).

TASTE AND ODOUR

Taste and odour problems account for the largest single class of consumer complaints in drinking water supplies, due to the water source, the treatment method, distribution system or a combination of all three (WHO,1984). Taste in drinking water is measured by taste tests such as the threshold test or taste rating tests.

TEMPERATURE

The growth rate of microorganisms, some of which produce bad tasting metabolites is positively associated with temperature. The odour of substance is also temperature influenced because of relationship between odour and vapour pressure, therefore odour measurement usually specifies temperature.

pH

pH influences the taste and odour of a substance significantly, especially when it controls the equilibrium concentration of the neutral and ionized forms of a substance in solution. The

average threshold increases from 0.075 to 0.450 mg/l as the pH increases from 5.0 to 9.0 (WHO, 1984).

TURBIDITY

Turbidity is an expression of certain light scattering and light absorbing properties of the water sample caused by the presence of clay, silt, suspended matter, colloidal particles, plankton and other microorganisms (WHO, 1984). Turbidity can be measured by turbidity and nephelometry. Turbidity of water affects other water quality parameters such as colour, when it is imparted by colloidal particles. It also promotes the microbial proliferation, thus affecting negatively the microbiological quality of water.

COLOUR

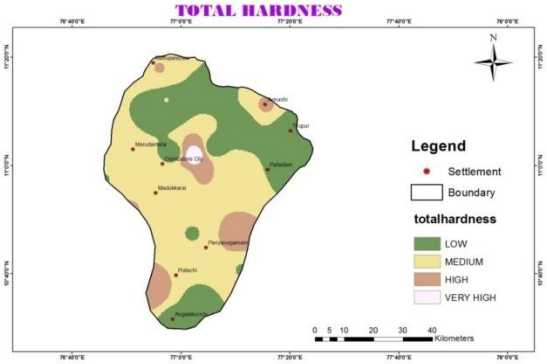
Colour in drinking water is caused by the presences of coloured organic substances, usually humic, which originate from the decay of vegetation in surface water. Iron and manganese also give water a red and blue colour respectively by the action of bacteria, which oxidize them to their ferric and manganese oxides respectively.

TABLE 2.2 TDS LEVEL OF DRINKING WATER

➢ *Rating(mg/l)*	➢ *TDS levels*
Excellent	<300
Good	300-600
Poor	600-900
Unacceptable	>1700

TOTAL HARDNESS

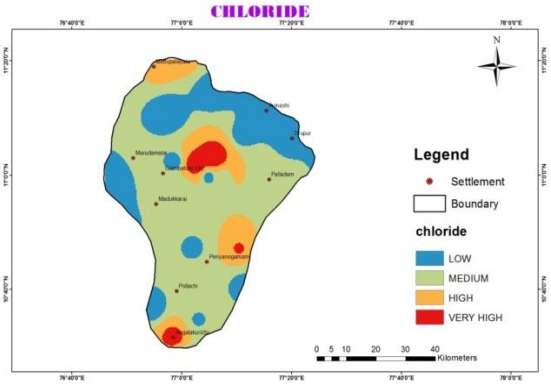
The TH values of groundwater samples collected from various places were tested and TH values were characterized within the desirable limit, permissible limits and above the permissible limits are shown in the figure 4.1 . The desirable value of total hardness is 200mg/l &maximum value is 600mg/l.



Spatial distribution of TH:

Out of 12 samples, 2 samples contain TH above permissible value and 8 samples contain TH within permissible value. None of the water samples collected in the study area is classified as soft water or moderately hard.2 samples are classified as non potable as per IS: 10500 standards due to TH values exceeding the permissible limit of 600 mg/L. The maximum value of hardness is 1500 mg/L in the sample S10. The TH values of the groundwater samples S3and S10 exceed the permissible.

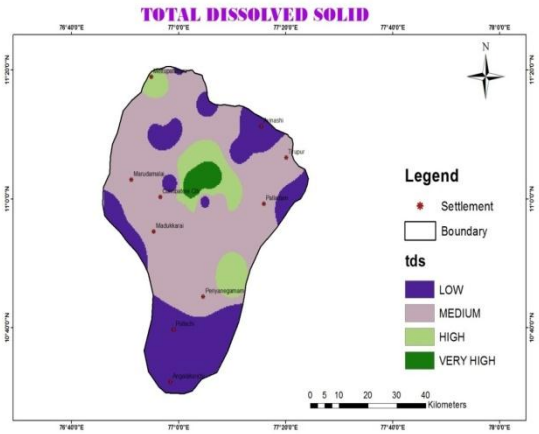
Spatial distribution of Cl



The desirable value of chlorine is 200mg/l whereas maximum value 1000mg/l. From 12 samples taken 5 samples are less than permissible limits.1 sample is greater than permissible limit and 6 samples are within permissible limits. Sample S4 has minimum value of 4mg/l & sample S1 has maximum chloride content of 1100 mg/l. samples S3,S5,S7,S8,S10,S12 has chloride content lies within the permissible limits.

Spatial distribution of TDS

The desirable value of TDS is 500mg/l whereas maximum value 2000mg/l. From 12 samples taken 2 samples are less than permissible limits. The TDS value of 3 samples are greater than permissible limit and 7 samples are within permissible limits. Sample S4 has the minimum value of 85mg/l & sample S10 has maximum TDS content of 3994 mg/l. samples S2,S5,S6,S7,S8,S9,S12 has TDS value lies within the permissible limits. From the map, it can be understood that the TDS content are widely varying across the study area.



Spatial distribution of Ca

Water samples from 4 locations of the study area (S2,S4,S6,S8) contain calcium within desirable limit. Samples from 4 locations(S5,S9,S10,S12) contain calcium within the permissible limit. 4 water samples(S1,S3,S7,S11) contain calcium above permissible limit. The maximum calcium content of 280 mg/L is present in the sample S10.The minimum calcium content of 12 mg/L is present in the sample S4. The Ca values of the groundwater samples S1, S3&S10 exceed the permissible limit.

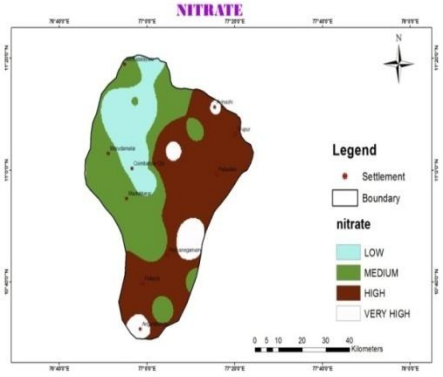
Spatial distribution of SO4

The desirable value of SO4 is 200mg/l whereas maximum value 400mg/l. From 12 samples taken 9 samples are less than permissible limits,1 sample is greater than permissible limit and 2 samples are within permissible limits. Sample S4 has minimum value of 4mg/l & sample S1 has maximum chloride content of 454mg/l. samples S3&S10 has sulphate values lies within the permissible limits. From the map, it can be

understood that the sulphate content are widely varying across the study area.

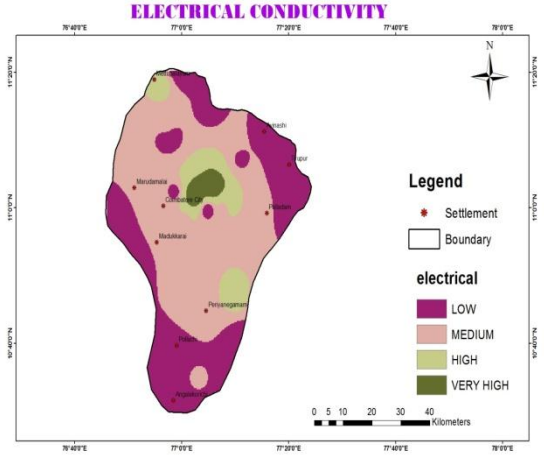
Spatial distribution of NO3:

The nitrate values of all the samples of the study area contain nitrate within desirable limit. No samples contain nitrate within the permissible limit. The maximum value of the nitrate content of the study area is 88 mg/L and it is present at the sample S3. The minimum value of the nitrate content of the study area is 2 mg/L and it is at the sample.



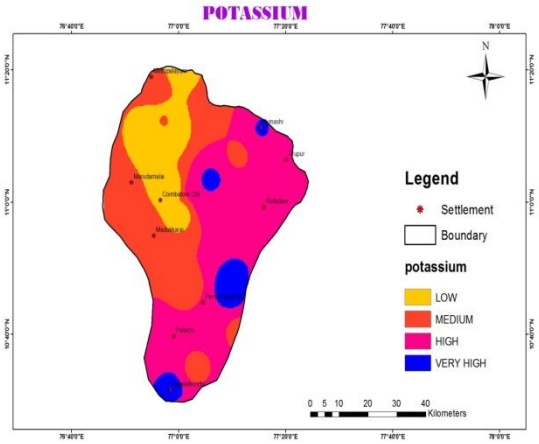
Spatial distribution of EC

EC greatly affects the taste since it is the measure of salinity. Thus EC has a significant impact on determining the portability of water. The EC of water at 25°C is due to the presence of various dissolved salts. The EC varies with water sample and ranges between 469.2µS/cm and 1173µS/cm.



Spatial distribution of Potassium

The permissible value of potassium is 300mg/l. All the samples have Potassium contents less than the permissible limit. The Potassium content of the study area varies from 8 mg/L to 150 mg/L. The water sample S4 has a minimum Potassium content of 1mg/L and the sample S1 has maximum Potassium content of 150mg/L during pre monsoon.



REGRESSION ANALYSIS

Linear regression analysis will help to understand the linear relation between the parameters taken for the analysis. TDS is considered as the index of general groundwater quality. TDS depends on all the chemical parameters present in water.

The relationship between the influencing chemical parameters and TDS is developed using regression analysis. The linear regression equations between TDS and major chemical parameters have also been developed. The software SPSS 17.0 is used to conduct regression analysis. TDS is taken as the dependent variable and other water parameters were taken as independent variables.

The linear regression analysis is computed and the chart is developed for pre monsoon samples of different places of study area

CONCLUSION

The major conclusions are derived from the hydro-chemical studies, water quality and vulnerability assessment using GIS mapping. The discussion on results of various studies to evaluate the quality of groundwater for drinking and irrigation purposes had been done.

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