VOL. 10, NO. 9, MAY 2015 ISSN 1819-6608
ARPN Journal of Engineering and Applied Sciences
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ASSESSMENT OF GROUND WATER QUALITY IN GUNTUR DISTRICT USING DATA PREPROCESSING APPROACH

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ABSTRACT

In this paper we have made an attempt to study water quality analysis in Guntur District in Andrapradesh. In order to assess the detailed analysis of ground water quality has been carried out. Totally 31 water samples have been collected and tested for various physicochemical parameters such as pH, Temperature, Electrical Conductivity, Ammonical Nitrogen, Total Dissolved Solids, Total Hardness, Calcium, Magnesium, Chloride, Sulphate, Total Alkalinity, Fluoride, Sodium, Potassium, Total Phosphorus, Salinity, Total Nitrogen and Dissolved Oxygen. Correlations study was also carried out as it is an excellent tool for the prediction of parameter values within reasonable degree of accuracy. A systematic correlation study showed significant linear relationship among different pairs of water quality parameters. We have applied the Various Data-Mining techniques to analyze the ground water quality by taking a number of samples in various villages and cleanly synthesized the parameters on the water.

Keywords: ground water quality, correlation, physiochemical parameters.

1. INTRODUCTION

Water is required to sustain human life. Rapid growth of population and industrialization has resulted in scaring and pollution. Assessment of water quality is therefore very important for sustainable future. In recent years, it has been recognized that quality of water is also equally important like quantity. The climate of Guntur District is comparatively more pleasant than that of the surrounding districts due to general dryness of atmosphere and appreciable drop in temperature in the monsoon season and in day and night temperature is cover by about 2 to 3ºC. The water quality analysis is done for 20 villages to known concentration of each parameter. It is well known that fluorosis is caused by the consumption of drinking water containing high fluoride and it course dental fluorosis.

Pollution problem is rising day by day and creating contamination of ground water and other resources. Suitability of groundwater for drinking, irrigation and other purposes depends upon its quality. But due to degradation of ground water quality it cannot uses including bathing, recreation and as a source of raw water supply. Contaminated water may have an impact on the health and economic status of the consumers. Contaminants such as bacteria, viruses, heavy metals to inadequate treatment and disposal of waste (human and livestock), industrial discharges, and over-use of limited water resources. The major problem with the ground water is that once contaminated, it is difficult to restore its quality. Hence there is a need and concern for the protection and management of ground water quality [1]. The statistical regression analysis has been found to be a highly useful tool for correlating different parameters. Correlation analysis measures the closeness of the relationship between chosen independent and dependent variables. If the correlation coefficient is nearer to +1 or -1, it shows the probability of linear relationship between the variables x and y. This way analysis attempts to establish the nature of the relationship between the variables and thereby provides to establish the nature of the relationship between the variables and thereby provides a mechanism for prediction or forecasting.

In the present context of study, particular emphasis is placed on the status of water quality in the ground water samples collected from various areas in Guntur District and the correlation analysis of various parameters are presented [5].

2. METHODOLOGY

2.1 Study area

Guntur District lies between 12º 32’ 44” N latitude and 78º13’36”E longitude. The major part of the study area is devoted to water quality analysis for drinking water and agricultural purposes [3].

Location of sampling points: The method of random sampling were adopted to collect water samples at various locations in and around Guntur District and tested for various ground water parameters like, pH, Temperature, Electrical Conductivity, Ammonical Nitrogen, Total Dissolved Solids, Total Hardness, Calcium, Magnesium, Chloride, Sulphate, Total Alkalinity, Fluoride, Sodium, Potassium, Total Phosphorus, Salinity, Total Nitrogen and Dissolved Oxygen. Totally 16 parameters were analysed.

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2.2 Overview of correlation analysis

(i) Mean: The mean is the mathematical average of a set of numbers. The average is calculated by adding up two or more data and dividing the total by the number of values.

(ii) Covariance: The variance of a variable is a measure of the depression of the values taken by the Variable around its mean value.

(iii) Eigen vectors and Eigen values: An Eigen value of a square matrix is a scalar that is usually represents by the Greek letter λ and Eigen vector be a none zero vector.

Eigen values λ = 689883.73 499137.16
Eigen vector λ = 689053.1 498306.56 689.53.13 448306.56

Correlation analysis: Correlation analysis is a preliminary descriptive technique to estimate the degree of association among the variables involved. The purpose of the correlation analysis is to measure the intensity of association observed between two variables. Such association is likely to lead to reasoning about causal relationship between the variables

Correlation matrix between various parameters is shown in Table-1. Most of the parameters were found to bear statistically significant correlation with each other indicating close association of this parameter with each other.

3. IMPLEMENTATION

The study involves correlation analysis of the ground water quality data of various locations of Guntur. pH levels vary from 7.37 to 7.70. The temperature ranges from 31oC to 31.5oC. EC levels vary from 394 to 933 Kmho cm-1. Total dissolved solids were recorded from 276 to 780 mg.L^{-1}. Values of ammonical nitrogen were found ranging from 0.01 to 0.04 mg.L^{-1}. Chloride ranges from 64 to 110 mg.L^{-1}. The amount of sulphate ion is estimated to vary from 2-68 mg.L^{-1}. The hardness values were recorded between 320 and 520 mg.L^{-1} [5].

Alkalinity ranges between 110 and 210 mg.L^{-1}. Nitrate was found ranges between 1.73 and 11.64 mg.L^{-1}. Fluorides were found within the desirable limits sets (0.01 to 0.05 mg.L^{-1}). Sodium and potassium were recorded 10.5 to 33.80 mg.L^{-1} and 1.1 to 9.30 mg.L^{-1}. The values of calcium and magnesium ranged from 52.1 to 93.79 mg.L-1 and 46.17 to 93.31 mg.L^{-1}. Total Nitrogen varies between 0.4 to 2.24 mg.L^{-1}. Total phosphorus varies between .06 to 0.16 mg.L^{-1}. DO recorded ranges from 2.6 to 3.5 mg.L^{-1}[6].

Correlation is the mutual relationship between two variables. Direct correlation exists when increase or decrease in the value of one parameter is associated with a corresponding increase or decrease in the value of other parameter. When r is 0.0, there is no relationship. When r is positive, there is a trend that one variable goes up as the other one goes up. When r is negative, there is a trend that one variable goes up as the other one goes down.

The correlation matrix for different ground water quality variables for Guntur district is depicted in Table-1.

Very high positive correlation coefficient is observed between TDS and EC (0.942), TDS and Sulphates (0.962), TDS and SAR (0.966), TDS and TH (0.985), TDS and Mg++ Hardness (0.936), EC and sulphates (0.987), EC and SAR (0.997), Chlorides and Ca++. Hardness (0.95), Sulphates and SAR (0.993), Sulphates and TDS (0.970), SAR and TH (0.987),Total alkalinity and Total phosphorus (0.907), Nitrate and Total phosphorus (0.999), Sodium and Potassium (0.934), Potassium and Magnesium (0.976), Calcium and Salinity (0.947), pH and Total alkalinity (0.959), pH and total phosphorus (0.936), TDS and sodium (0.973), TDS and Potassium (0.99), TDS and Magnesium (0.937), EC and Sodium (0.994), Chlorides and calcium (0.95), Sulphates and total alkalinity (0.918), Sulphates and Sodium (0.995), Sulphates and Potassium (0.928), SAR and Sodium (0.9995), SAR and Potassium (0.923), Total hardness and Sodium (0.988), Total hardness and Potassium (0.951), Calcium hardness and (Salinity (0.947),Magnesium hardness and Potassium (0.976).High positive correlation is observed between EC and Ammonical Nitrogen (0.817), Ammonical Nitrogen and Chlorides (0.811), Sulphates and Mg++ Hardness (0.827), SAR and Mg++ Hardness (0.817), TH and Mg++ Hardness (0.866), Total alkalinity and Sodium (0.875),Total alkalinity and Potassium (0.818), Fluoride and Magnesium (0.873), Sodium and Magnesium (0.833), TDS and Total alkalinity (0.83), EC and Total alkalinity (0.857), EC and Potassium (0.889), Ammonical nitrogen and Salinity (0.812), Sulphates and Magnesium (0.827), SAR and Total alkalinity (0.867), SAR and Magnesium (0.817), Total hardness and alkalinity (0.801), Total hardness and Magnesium (0.866), Magnesium hardness and Fluoride (0.873), Magnesium hardness and Sodium (0.833), pH and Ammonical Nitrogen (0.735), EC and Chlorides (0.704), EC and Mg++ Hardness (0.767), Ammonical Nitrogen and Sulphates (0.783), Ammonical Nitrogen and SAR (0.778), Ammonical Nitrogen and Ca++ Hardness (0.789), Total alkalinity and Magnesium (0.731), Fluoride and Potassium (0.759), Sodium and Total phosphorus (0.733), pH and Sodium (0.707), EC and Magnesium (0.767), EC and Salinity (0.71), Ammonical nitrogen and Total alkalinity (0.768), Ammonical nitrogen and Sodium (0.764), Ammonical nitrogen and Calcium (0.789), Magnesium hardness and Total alkalinity (0.731). While highly negative correlation coefficient is seen among Nitrate and Fluoride (-0.035), Ca++ Hardness and Mg++ Hardness (-0.147), Fluoride and Salinity (-0.160), Fluoride and Total Phosphorus (-0.06), Calcium and Magnesium (-0.147), Ammonical nitrogen and Fluoride (-0.185), Ammonical nitrogen and DO (-0.12), Chlorides and Fluoride (-0.168), Calcium hadness and Magnesium (-0.147), Magnesium hardness and Calcium (-0.147) [4].

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Positive correlation is obtained between 191 unions (i.e. 75.49% of the total number) and rest of the unions (62 unions i.e. 24.51% of total number) demonstrates negative correlations.

4. RESULTS

Table-1. Correlation coefficients among different water quality parameters.

	PH	Temp	TDS	EC	Amm.N	Cl	SO4	SAR
PH	1							
Temp	-0.873	1						
TDS	0.638	-0.931	1					
EC	0.694	-0.936	0.942	1				
Amm. N	0.735	-0.753	0.594	0.821	1			
Cl	0.223	-0.445	0.469	0.704	0.811	1		
SO4	0.773	-0.979	0.962	0.987	0.783	0.586	1	
SAR	0.699	-0.95	0.966	0.997	0 .778	0.649	0.993	1

Cont. Table 1

	TH	Ca++	Mg++	TA	NO3	F	Na	K
TH	1							
Ca++ Hard	0.367	1						
Mg++ Hard	0.866	-0.147	1					
TA	0.8	0.224	0.731	1				
NO3	-0.259	0.165	-0.364	-0.778	1			
F	0.584	-0.468	0.873	0.316	-0.035	1		
Na	0.988	0.405	0.833	0.875	-0.379	0.493	1	
K	0.951	0.066	0.976	0.818	-0.384	0.759	0.934	1

Cont. Table 1

	Ca	Mg	Salinity	Total-N	Total Phos	DO
Ca	1					
Mg	-0.147	1				
Salinity	0.947	0.151	1			
Total N	0.179	-0.335	0.199	1		
TotalPhos.	0.502	0.39	0.519	-0.735	1	
DO	-0.705	0.608	-0.582	-0.745	0.244	1

5. DISCUSSIONS

Water temperature shows a negative correlation with most of the parameters i.e. TDS, EC, Ammonical nitrogen, Chlorides, Sulphates, SAR, Total hardness, Ca++ hardness, Mg++hardness. Temperature was negatively correlated with pH it indicates that if temperature will increase than pH will decrease. In pure water, the hydrogen ion concentration is the result of the dissociation equilibrium:

H2O H+ + OH-, pKw (25°C) = 14.0 [8]

The negative logarithm of Kw decreases with increasing temperature, and hence the pH will decrease (pH in pure water = pKw/2). At 0°C, the pH of pure water is 7.49, compared with a value of 7.0 at 25°C (the hydrogen ion concentration at 0°C is only 32% of the value at 25°C). There is a negative correlation between temperature and calcium. This might be due to the decrease in the solubility of CaCO3 as the temperature increases. Electrical conductivity was positively correlated with chlorides, sulphates, sodium, potassium, calcium, magnesium etc. which constitutes major anions and cat ions present in ground water [9].

The correlation between EC and TDS were found very high (i.e. >0.9), which indicates that EC is a measure of dissolved solids in ground water. TDS maintained positive relationship with chloride, sulphate, calcium, magnesium, fluoride, sodium, potassium etc. The major exchangeable ions Na-Ca correlate positively (0.405) and strong correlation between sodium and magnesium shows that cat ion exchange dependency is evident. Positive correlation between sodium and potassium indicates that the ground water of our study area is suitable for irrigation. Chloride show positive correlation with most anions and cat ions [10]. Occurrence of good correlation between calcium and chlorides indicates about the total hardness of water. Dissolved oxygen shows negative correlation with temperature, nitrate, ammonical nitrogen, chlorides, calcium hardness, total nitrogen, salinity while positive correlation with pH, sulphates, etc.

6. CONCLUSIONS

From the above study, it is concluded that the correlation studies of the water quality parameters have a great significance on the study of water resources. In current study, it is evident that distribution of electrical conductivity, sulphates, SAR, total hardness, Mg++ hardness ,sodium, potassium, magnesium were significantly correlated (R>0.9) with total dissolved solids, the distribution of sulphates, sodium and SAR were significantly correlated (R>0.9) with electrical conductivity and distribution of SAR, total dissolved solids, total alkalinity, sodium, potassium were significantly correlated (R>0.9) with sulphates, and the distribution of sodium and potassium were significantly correlated (R>0.9) with SAR and total hardness.

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