EFFECT OF GROUND WATER QUALITY ON HUMAN HEALTH IN RURAL AREAS: A CASE STUDY THROUGH CORRELATION STUDIES

C. Narasimha Rao
Department of Zoology, Government College for Men (autonomous), Kadapa-516004, Andhra Pradesh, India

Abstract : Present paper deals with a case study of the effect of ground water quality on the health of human beings residing in industrial area near Tirupati, Andhra Pradesh, India. Water samples were collected from 40 different locations and analyzed for physicochemical parameters such as pH, hard ness, alkalinity, calcium, magnesium, iron, nitrates, chlorides, sulphates, electrical conductivity, total solids (TS), total dissolved solids (TDS), total suspended solids (TSS), dissolved oxygen (DO), chemical oxygen demand (COD) and bio chemical oxygen demand (BOD). The found values were compared with the World Health Organisation water quality standards. Based on the physico chemical analysis and correlation studies, it was found that ground water of some of the areas was polluted and not suitable for drinking purpose. Thus the ground water of these areas needs purification before drinking.

Key words: Ground water, physicochemical parameters, alkalinity, electrical conductivity, dissolved oxygen, bio chemical oxygen demand.

I. INTRODUCTION

Ground water is ultimate and most suitable fresh water resource for human beings. For healthy living of human society, the importance of groundwater cannot be overemphasized[1]. The quality of water may be described according to its physico-chemical and micro-biological characteristics. The particulate problem in case of water quality monitoring is the complexity associated with analysis of the large number of measured variables. To define the resource water quality many researchers treated water quality parameters individually by describing the seasonal variability and their causes. It is a very difficult and laborious task to regularly monitor all the parameters even if adequate manpower and laboratory facilities are available. For this reason, in recent years an easier and simpler approach based on statistical correlation, has been developed using mathematical relationship for comparison of physicochemical parameters. The physico- chemical analysis of water samples was carried by many researchers using by standard methods.

Most of the people in rural areas of Tirupati depend upon ground water for drinking and other domestic needs. Many pharma, plastic, cement, battery, beverage etc., industries were established in this area. In addition, high floating population leads to disposal of much domestic waste which finally contaminates ground water. To understand the contamination and consequent health effects, we undertook a detail survey in this area.

II. EXPERIMENTAL

The ground water samples were collected in clean and dry polythene bottles during summer season because the mineral content in water are likely to reach the maximum. Each sample was filtered using whatmann no.42 filter paper and stored and analyzed for a few important parameters in order to have an idea on the quality of drinking water. Electrical conductivity values were measured using Elico CM 180 Conductivity Bridge. Total alkalinity was evaluated by titration with standard 0.1M HCl using methyl orange and phenolphthalein as indicators. Standard procedures[2] involving spectrophotometry, flame photometry and volumetry were used for the determination of hardness, total dissolved solids (TDS), sulphate, chloride, nitrate, calcium, magnesium and iron. All the chemicals used were of AR grade.

III. RESULTS AND DISCUSSION

The intensity of the acid or alkaline condition of a solution is expressed by pH. Most of the sampling points showed pH values within the limit prescribed by WHO. Abnormal values of pH causes bitter taste to water, affects mucous membrane, causes corrosion and also affects aquatic life. Hardness of water depends upon the amount of calcium and magnesium salts[3]. Exceeding the permissible limit of hardness causes poor lathering with soap, deterioration of the quality of clothes, scale formation and skin irritation. Alkalinity of water indicates its capacity to neutralize a strong acid. It is due to the presence of bicarbonate, carbonate and hydroxide compounds of calcium, sodium and potassium. The major portion of alkalinity in natural water is caused by hydroxide, carbonate and bicarbonate. Water with high amount of alkalinity results in unpleasant taste to water and it turns boiled rice to yellowish color. Excessive chloride concentration increase rates of corrosion of metals in the distribution system. This can lead to increased concentration of metals in the supply. Sulphate occurs naturally in water as a result of leaching from gypsum and other common minerals[4]. Electrical conductivity is a measure of water capacity to convey electric current. It signifies the amount of total dissolved salts. High values of TDS in groundwater are generally not harmful to human beings but high concentration of these may affect persons who are suffering from kidney and heart diseases. The degree of a linear association between any two of the water quality parameters can be measured by correlation coefficient. Correlation coefficient values of various parameters of water samples are presented in table 1. Alkalinity shows significant correlation with calcium indicating that calcium salts are main cause of alkaline nature of the studied ground water. Calcium shows good correlation with chlorides indicating that calcium is associated with chlorides in ground water which confirms the hardness of ground water is permanent in nature[5-7] in the studied area. Conductivity shows significant correlation with calcium, chlorides and DO which reveals that conductance of water samples is mainly due to calcium and chlorides in the ground water of the studied area.

IV. CONCLUSION

Water is the most vital source and one of the precious natural resources of this planet. Industrialization and urbanization affected the ground water quality due to over exploitation of resources and improper waste disposal practices. According to WHO[8], nearly 80% of all the diseases in human beings are caused by water. Based on the results obtained for physicochemical analysis of ground water samples collected from different locations in the studied area, it can be concluded that in some samples water quality parameters were beyond the permissible limit prescribed by WHO. Hence drinking water pollution should be controlled by the proper environment management plan. Ground water of this area should be pretreated to make suitable for drinking and to maintain proper health conditions of people living in this area. The linear correlation is very useful to get accurate idea of water quality of the ground water by determining only a few parameters experimentally. The diseases monitoring measures are essential for keeping a close watch on water quality and health environment.

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Table 1 Correlation Coefficient values of various physico-chemical parameters of ground water

	pH	TH	TA	Ca^{2+}	Mg^{2+}	Fe^{2+}	NO_3^-	Cl^-	SO_4^{2-}	DO	COD	BOD	Temp	Cond	TS	TDS	TSS
pH	1																
TH	0.71475	1															
TA	0.9663	0.67788	1														
Ca^{2+}	0.91086	0.68084	0.94312	1													
Mg^{2+}	0.64809	0.39211	0.71305	0.68415	1												
Fe^{2+}	0.08168	-0.0363	0.12889	0.18646	0.06415	1											
NO_3^-	-0.0868	-0.2071	-0.0738	-0.0387	0.05185	-0.1277	1										
Cl^-	0.87065	0.59847	0.9245	0.94878	0.72072	0.20413	0.05557	1									
SO_4^{2-}	-0.1037	0.04658	-0.1511	-0.0058	-0.1295	0.15687	0.18111	-0.0346	1								
DO	0.96378	0.6687	0.98601	0.94241	0.72392	0.11654	-0.0437	0.92602	-0.1608	1							
COD	0.66587	0.31434	0.70527	0.7604	0.48339	0.14397	0.07531	0.75371	-0.0255	0.70552	1						
BOD	-0.5896	-0.4045	-0.6754	-0.6399	-0.8561	0.10287	-0.0752	-0.6771	0.14205	-0.6559	-0.553	1					
Temp	-0.0408	0.09319	-0.0821	-0.0699	-0.1549	0.01165	-0.1004	-0.0627	-0.016	-0.052	-0.1722	0.18021	1				
Cond	0.93804	0.66174	0.9376	0.95609	0.69595	0.22104	0.02879	0.94476	-0.0565	0.95106	0.73989	-0.6002	-0.0184	1			
TS	0.4337	0.23675	0.48491	0.48528	0.40555	0.07173	-0.011	0.46536	-0.1679	0.49705	0.35381	-0.2083	-0.0612	0.47201	1		
TDS	0.3918	0.21646	0.44929	0.43877	0.37567	0.01222	-0.0142	0.42533	-0.2065	0.46335	0.30504	-0.214	-0.042	0.41979	0.98243	1	
TSS	0.42232	0.22004	0.4267	0.47104	0.35721	0.28316	0.00679	0.43321	0.05889	0.42592	0.4037	-0.098	-0.1136	0.48653	0.65314	0.50032	-0.1136