Statistical Analysis of Groundwater of Phagi Tehsil, Jaipur (Rajasthan), India

Anurika Mehta[1], Rakesh Duggal[2]
[1]Assistant Professor, Poornima Institute of Engineering & Technology, Jaipur
[2]Director, Poornima Group of Institutions, Jaipur

Abstract: The water quality of Paghi tehsil, Jaipur (Rajasthan) India has been assessed during pre-monsoon and monsoon periods to express the suitability of groundwater for drinking purposes. The values of TDS, EC, nitrate and fluoride exceed the permissible limit prescribed by WHO for drinking purpose. Some sites were also contaminated with high values of chloride. The descriptive statistical analysis was done beside Spearman's correlation. From correlation analysis it was observed that very strong correlations exist between TDS and Cl^- (0.957), SO_4^{2-} and Cl^- (0.726) etc. This study correlates the physico-chemical parameters by using SPSS software. Based on the seasonal variation, the concentrations of most of the parameters considerably decreased during monsoon period and show the dilution effect of rain water in monsoon season.

Keywords: Contaminated, Statistical analysis, Correlation, SPSS, Extraneous sources

I INTRODUCTION

Water being one of the basic necessities of life, is essential but a limited resource, covering about 71.4% of our planet. Groundwater, present beneath earth's surface in pore spaces & fractures of rock formations, is one of the earth's most widely used renewable resources. It is also one of the essential components of the hydrological cycle facilitating unique behavior of water on the continent. [1, 2] Water is a universal solvent and dissolves minerals from the rock with which it comes in contact. This enables water to acquire properties of its surrounding conditions. But matter of concern is the risk of ground water resources getting polluted from point and non-point source pollutants, viz, agricultural and industrial activates, animal waste and household chemicals run-off, failing septic systems, etc. [3, 4, 5, 6] It is a difficult and laborious task to regularly monitor all the parameters. For this particular reason, an easier and simpler approach based on statistical correlation has been developed using mathematical relationship for comparison of physicochemical parameters. [7] A systematic study of correlation of water quality parameters helps to quantify relative concentration of various pollutants in water and provide necessary cue for implementation of rapid water quality management programs. The correlation coefficient is helpful tool for promotion of research in water pollution problems. It helps to analyze quality of groundwater and also to determine its closely interlinked physical and chemical parameters. The present study is an attempt to study interactions between different components of groundwater and their relationship with total dissolved solids, using Spearman's correlation matrix technique.

II MATERIAL AND METHODS

Study area: Phagi tehsil is 51 km far from its district main city Jaipur. It has an average elevation of 383 m (1,257 ft). According to 2011 Census, there are 169 villages with 22,713 households having total population of 161,610 (with 52.12% males and 47.88% females) in Phagi Tehsil.

Water sampling, preservation and data analyses: A total 10 samples were collected from different wells, tube-wells or hand-pumps from 10 villages of Phagi Tehsil during post-monsoon period [From October 05 to 15, 2014]. All samples were labeled properly and according to the prerequisites for the analyses of samples. Temperature, pH, electrical conductivity, total dissolved solids, salinity were measured on site using potable meter (PCS Tester 35 Multi-parameter). All other parameters were analyzed according to the standard methods of APHA [8]. Sampling sites with source type are displayed in by using GIS software as shown in Figure 1 and Table 1.

Table 1: Source & location of samples of different villages of Phagi Tehsil

Sample No.	Sampling Source	Village	Sample No.	Sampling Source	Village
P1	Tube Well	Chittora	P6	Well	Mohanpura
P2	Hand Pump	Choru	P7	Tube Well	Nimeda
P3	Hand Pump	Didwata	P8	Tube Well	Parwan
P4	Tube Well	Ladana	P9	Hand Pump	Phagi
P5	Hand Pump	Lasariya	P10	Hand Pump	Renwal

Special Issue - 2016

International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
NCACE - 2016 Conference Proceedings

Figure 1: Map of Phagi tehsil with sampling sites

III RESULTS AND DISCUSSION

The physico-chemical analysis was carried out using computer software package SPSS (Statistical Package for Social Sciences, later modified to Statistical Product and Service Solutions), version 16.0. It is a very powerful and user friendly program for statistical analysis. SPSS is a comprehensive and flexible statistical analysis and data management solution. Descriptive statistics is been used to summarize and present data in a meaningful manner so that the underlying information can be easily understood. A correlation analysis is a bivariate method that describes the degree of relationship between two variables. A high correlation coefficient means a good relationship between two variables. [9] For this purposes, spearman's correlation coefficient with the help of SPSS, has been calculated. Correlation matrix showed relationships of varied types between different hydrochemical parameters. Calculated correlation matrix of various physico-chemical parameters of pre-monsoon and monsoon periods of groundwater samples are shown in Table 2 and Table 3 respectively.

Table 2: Correlation matrix between pre monsoon data of Phagi Tehsil

Parameter	EC	pH	TDS	HCO_3^-	TA	TH	Ca^{2+}	Mg^{2+}	Cl^-	F^-	SO_4^{2-}	Na^+	K^+
EC	1												
pH	-0.240	1											
TDS	0.423	0.537	1										
HCO_3^-	-0.037	0.043	0.334	1									
TA	-0.015	0.325	0.544	0.949	1								
TH	0.674	-0.055	0.521	-0.248	-0.17	1							
Ca^{2+}	0.678	-0.094	0.151	-0.475	-0.405	0.673	1						
Mg^{2+}	0.498	-0.020	0.585	-0.062	0.0	0.918	0.324	1					
Cl^-	0.533	0.425	0.957	0.184	0.367	0.606	0.202	0.667	1				
F^-	-0.022	0.144	0.135	0.328	0.344	-0.406	-0.331	-0.341	0.081	1			
SO_4^{2-}	0.335	0.345	0.660	-0.283	-0.123	0.631	0.256	0.669	0.726	-0.085	1		
Na^+	-0.201	0.723	0.655	0.526	0.713	-0.270	-0.365	-0.150	0.528	0.437	0.144	1	
K^+	-0.216	0.077	-0.202	-0.069	-0.085	-0.403	-0.041	-0.494	-0.301	0.325	0.134	0.036	1

In pre-monsoon period pH shows negative correlation with most of the variables indicating that pH of the samples is not dependent on any variable. [10] The value of TDS & EC indicates highly positive correlation with most of the variables such as Cl^-, TH, Mg^{2+}, Na^+ and SO_4^{2-}. The good positive correlation was observed between Ca^{2+} and TH, TH & Cl^-, TA & Na^+, TH & Mg^{2+}, TA & HCO_3^-, and HCO_3^- & Na^+ (Table 2). In monsoon period pH shows negative correlation with only K^+ ion. EC and TDS show highly positive correlations with mostly all parameters as same in pre-monsoon period (Table3).

Special Issue - 2016

International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
NCACE - 2016 Conference Proceedings

Table 3: Correlation matrix between during monsoon data of Phagi Tehsil

Parameter	EC	pH	TDS	HCO_3^-	TA	TH	Ca^{2+}	Mg^{2+}	Cl^-	F^-	SO_4^{2-}	Na^+	K^+
EC	1												
pH	0.047	1											
TDS	0.462	0.677	1										
HCO_3^-	-0.106	0.394	0.267	1									
TA	-0.045	0.557	0.439	0.962	1								
TH	0.723	0.039	0.588	-0.233	-0.17	1							
Ca^{2+}	0.970	0.021	0.467	-0.095	-0.029	0.799	1						
Mg^{2+}	0.502	0.042	0.563	-0.268	-0.215	0.957	0.590	1					
Cl^-	0.577	0.560	0.961	0.142	0.284	0.702	0.560	0.672	1				
F^-	0.035	0.043	0.184	0.323	0.334	-0.267	-0.096	-0.312	0.109	1			
SO_4^{2-}	0.330	0.420	0.654	-0.467	-0.301	0.625	0.349	0.671	0.664	-0.074	1		
Na^+	-0.063	0.790	0.722	0.589	0.716	-0.122	-0.128	-0.103	0.594	0.454	0.229	1	
K^+	0.180	-0.017	0.028	0.205	0.283	-0.266	0.175	-0.442	-0.057	0.409	-0.237	0.187	1

IV CONCLUSION

The study revealed that most of samples in the Phagi tehsil are slightly alkaline and brackish salty. The percent sodium level of samples indicated that 35% samples are doubtful while 20% samples are in good category of the sodium hazards for irrigation purposes indicating a mixed pattern of suitability of groundwater for drinking and irrigation in study area. It is observed by statistical representation of studied parameters and special management for salinity control appears to be the requirement for continuous monitoring in areas with disturbed value indicators. This reveals deterioration of groundwater quality and immediate remedial action in Phagi tehsil.

REFERENCES

[1]   D. K. Todd and L. W. Mays, "Groundwater Hydrology", 3rd edn. Wiley, Hoboken, N.J., 656, 2005.

[2]   R. Mathur, A. K. Suthar, A. Sharma and S. Sharma, "Assessment of Groundwater Quality of Rajasthan with Special Reference to Jodhpur and Barmer region", Int. Jour. Chem. Sci., Vol. 8 (3), pp. 1992-1998, 2010.

[3]   C. Aelion and B. Conte, "Susceptibility of Residential Wells to VOC and Nitrate Contamination", Environ. Sci. Technol., Vol. 38, pp. 1648- 1653, 2004.

[4]   B. K. Mitra, C. Sasaki, K. Enari, N. Matsuyama and M. Fujita, "Suitability Assessment of Shallow Groundwater for Agriculture in Sand Dune Area of Northwest Honshu Island", Appl. Ecol. Environ. Res., Vol. 5 (1), pp. 177-188, 2007.

[5]   S. Venkateswaran, M. Vijay Prabhu, M. Mohammed Rafi and L. K. Vallel, "Assessment of Groundwater Quality for Irrigational use in Cumbum Valley, Madurai District, Tamil Nadu, India", Nat. Environ. Pollut. Tech., Vol. 10, pp. 207-212, 2011.

[6]   Z. Sharifi and A. A. Safari Sinegani, "Arsenic and Other Irrigation Water Quality Indicators of Groundwater in an Agricultural Area of Qorveh Plain, Kurdistan, Iran", American-Eurasian Jour. Agric. and Environ. Sci., Vol. 12 (4), pp. 548-555, 2012.

[7]   Iyer, C. S. Padmanabha, M. Sindhu, S. Kulkarni, S. Tambe and D. Kulkarni, Journal of Environmental Monitoring, 5, pp 324-327, 2003.

[8]   APHA methods 3111: Standard methods for the examination of water and waste water, American Public Health Association, Washington, DC, 2005.

[9]   S. K. Srivastava and A. L. Ramanathan, "Geochemical Assessment of Groundwater Quality in Vicinity of Bhalswa Landfill, Delhi, India, using Graphical and Multivariate Statistical Methods", Environ Geology, Vol. 53, pp 1509-1528, 2008.

[10] A. Mehta, N. Jain and R. Duggal "Statistical Representation of Groundwater Analysis for Irrigation Purposes of Sanganer Tehsil, Jaipur, Rajasthan", International Journal of Innovative Research in Science, Engineering and Technology, Vol. 4 (10), 2015.