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Ground Water Quality Assessment : A Case study of Akhori Village, Mirzapur, U.P., India

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ABSTRACT

The physico-chemical quality of ground water of Akodhi village in Mirzapur district was determined during October to December, 2017. Water samples from 11 hand pumps were collected. The parameters measured were pH, turbidity, total dissolved solids, total hardness, calcium hardness, total alkalinity, chloride and sulphate. The value obtained for different parameter was compared with the permissible standard value for drinking water given by BIS. The value of all the parameters except pH and turbidity were beyond the permissible limit for drinking water. The result of correlation analysis found five key parameters i.e. turbidity, total hardness, calcium hardness, total alkalinity and chloride which influenced significantly the other water parameter. The study reveals that combination of statistical tools for water parameter related data analysis can be useful for rapid water quality monitoring and its health hazard assessment.

Keywords: Correlation, Statistical, Hazard, Monitoring. Turbidity

I. INTRODUCTION

The quality of groundwater is very important in evaluating its utility in various fields such as domestic public water supply and agriculture, the assessment of the dissolved constituents thus become very important for safe drinking water. Some ions dissolved in water and present. In appropriate concentration are essential for human beings while higher concentration results in toxicity (Kumari et. al. 2018). In India as high as 72.2 % of the rural population still do not have a access to safe water, nor any methods of water disinfection and 74 % have no sanitary toilets. Studies have shown that a number of socio-cultural particles including open air defection, tethering of animals near human dwelling, proximity of animal fecal matter have found to lead to water contamination resulting in outbreak of Diarrheal disease (Gopal et.al. 2009; Jayanthi and Soundararajan 2018). Water dissolves the minerals present in the soil particles, sediments and rocks and increases the dissolved solid content of ground water. Higher concentration of these dissolved solids in water results objectionable taste and also excessive scaling in water pipes, heaters, boilers, and household appliances. Therefore World Health Organisation (WHO) and Bureau of Indian Standard (BIS) have recommended the standard for drinking water parameter (Ramakrishnaiah et. al. 2009).

This study focuses on the groundwater quality monitoring of Akhori villages of Mirzapur district specially hand pumps. Determination of water quality is necessary to have an understanding about the suitability of water for various purposes. This study can be used for awareness of rural community and policy makers to improve the quality of ground water.

II. MATERIALS AND METHODS

2.1. Study area:

The present study has been carried out in Akhori Village of Mirjapur district in Uttar Pradesh, India. Akhori village is having total population of 5564 (3024 male and 2540 female) with 775 housholds (Agarwal,

et.al. 2012). The major source of drinking water in village is bore well and hand pump. Agriculture is the main profession of this village. Industrial development. education, drinking water, road and electricity are the main concern of this village. The hand pump water samples were collected from eight different locations of the village. The samples have been collected during the period of October to December, 2017.

2.2. Water sampling and Analysis:

Water samples were collected regularly at an interval of one month from selected hand pumps, in 1 litre in pre-cleaned, sterilized polyethylene bottles. The collected samples were analyzed for various physico-chemical parameters such as pH, turbidity, total dissolved solids, total hardness, calcium hardness, total alkalinity, chlorides and sulphate by following the standard procedure (APHA, 2005) (Tripathi and Tripathi, 2016).

2.3. Statistical analysis:

The results obtained were compared to the permissible limit of drinking water quality standard (BIS, IS-10500). Descriptive statistical parameter were analyzed to reduce the range of uncertainty and to select proper treatment to minimize the contaminations of groundwater. The Pearson correlation analysis was performed to determine the significant relationship between different parameters using MS Excel 2010. The result of correlation analysis is presented in the form of correlation matrix table. (Tripathi and Vishwakarma 2015).

III. RESULT AND DISCUSSION

3.1. Physico-chemical characterstics

The result observed in present study shows very high value of Total dissolved solid (TDS), total hardness (TH), calcium hardness (CH), total alkalinity (TA), chloride and sulphate in all eight hand pumps water sample as compared to the permissible limit for drinking water standard (BIS, IS-10500) (Table 1).

Table 1. Physico-chemical characteristics of hand pump water samples

Sr. No.	pH	Turbidity	TDS	Total Hardness	Calcium Hardness	Total Alkalinity	Chloride	Sulphate
1	9.0	25	3200	520	380	156	732.72	57.61
2	7.0	CLEAR	2000	132	105	778	147.93	67.07
3	7.0	CLEAR	4000	150	140	637	110.65	74.45
4	7.5	CLEAR	2000	275	225	892	113.31	76.55
5	8.0	CLEAR	2000	150	145	686	153.25	8.78
6	7.5	CLEAR	3000	270	220	882	123.96	10.63
7	8.5	CLEAR	2000	305	230	834	174.55	78.50
8	8.0	CLEAR	1000	290	220	156	157.33	12.19
9	9.0	CLEAR	2400	1000	830	150	283.29	81.15
10	9.0	25	4199	550	370	565	698.94	106.99
11	9.0	CLEAR	1000	300	220	150	160.71	111.68
BIS Std	**6.5-8.5**	**5**	**500**	**300**	**200**	**300**	**250**	**100**

The mean pH value of four sites i.e. 1,9,10 and11 was observed higher (9) than the BIS permissible limit (6.5-8.5). This indicates slightly alkaline nature of hand pump water. Turbidity is a measure of degree of opaqueness of water and interference presented by suspended matter to the passage of light. Turbidity is caused by wide variety of materials like clay, silt, finely divided organic matter and inorganic matter and microscopic organisms. Turbidity of water samples collected from site-1 and site-10 were exceeded (25 NTU) the permissible limits of 5 NTU (BIS). The higher value of turbidity might be due to wide variety of suspended particles in water (Tripathi and Tripathi, 2016; Sharma, 2018).

The average TDS values were ranging from 1000 to 4199 mg/l and all sites were above the permissible limit for drinking water (500 mg/l) (BIS). The household waste discharged into the drain, pits and ponds percolate down to the water table and increase the TDS value (Meena et. al., 2010). Hardness of water is caused by carbonates, bi-carbonates, sulfates, chlorides and nitrates of calcium and magnesium (Manahan, 2017). The mean value of total hardness at site 1, 9 and 11 was observed higher (520 to 1000 mg/l) than the permissible limit for drinking water (BIS, IS-10500). This may be due to the natural accumulation of calcium and magnesium salts through contact with soil and geological formations (Patil and Patil, 2010; Sharma et al., 2013). Similarly the mean value of calcium hardness was also observed higher at site 1,9 and 10 (370 to 830 mg/l) against the permissible limit of BIS (200 mg/l). This might be due to the leaching of rain water through deposits of limestone, dolomite and gypsum (Singh et al., 2010).

The alkalinity of water is its capacity to neutralize acids. The alkalinity of natural waters is due to the salts of carbonates, bi carbonates, borates, silicates, and phosphates along with the hydroxide ions. However the major portion of alkalinity in natural waters is caused by hydroxide, carbonate and bicarbonates which may be ranked in order of their association with high pH values (Manahan, 2017). Mean total alkalinity of all the hand pump water samples collected except from sites 1, 8, 9 and 11 were observed higher (565 to 892 mg/l) than the permissible limit (300 mg per liter) for drinking water (BIS). High value of alkalinity gives undesirable taste to water (Sharma, 2004; Hui and Wescoat 2018).

Chloride content in drinking water normally increases as the mineral content increases. Upland and mountain supplies usually quite low chlorides in ground water whereas in the coastal areas the ground water usually have a considerable amount of chlorides. In present study the mean value of chloride in all hand pump water was found below the permissible limit (250 mg/l) of BIS except site 1 and 10 (698.94, 732.72). The higher concentration of chloride in drinking water imparts salts taste to water and causes laxative effects (Akoto et. al. 2017; Sharma et. al. 2017). Sulphate value of all the hand pump water was observed within the permissible (100 mg/l) limit for drinking water (BIS) except site 10 and 11 (106.99, 111.68). The higher concentration of sulphate in drinking water imparts offensive odor, objectionable taste and laxative effects (Carpenter et. al. 2018; Dubey et. al. 2018).

3.2. Correlation Analysis

Correlation analysis is a very useful data analysis tool to measure the degree of relationship between two or more water quality parameters. The correlation coefficient (r) among various water quality parameters of all hand pump water samples has been calculated and the numerical values of correlation coefficient are presented in the form of tabulated correlation matrix in table No. 2.

Among the various physiochemical parameters of ground water, only few parameters exhibited significant correlations. pH value was found to have a significant positive correlation with total hardness (r =

0.6998), calcium hardness (r = 0.6304) and chloride (r = 0.6418), whereas negative correlation with total alkalinity (r= -0.6469). This shows that the value of total hardness, calcium hardness, chloride, and total alkalinity in the study area has greatly influenced the pH value. Similar type of significant correlation of pH with other ground water parameter is observed by Salehi et. al. 2018. The value of turbidity shown highly significant positive correlation with chloride (r =0.9790). This shows the concentration of chloride in ground water has greatly influenced the turbidity value. The value of total hardness and calcium hardness shown significant positive correlation (r = 0.9896). Rest other parameters have not shown significant correlation with other water parameters.

Table 2. Correlation matrix of ground water parameter

	pH	Turbidity	TDS	Total Hardness	Calcium Hardness	Total Alkalinity	Chloride	Sulphate
pH	1							
Turbidity	0.5278	1						
TDS	-0.0412	0.5864	1					
Total Hardness	0.6998*	0.3457	0.1835	1				
Calcium Hardness	0.6304	0.2322	0.1472	0.9896*	1			
Total Alkalinity	-0.6469	-0.2711	0.2275	-0.5447	-0.5205	1		
Chloride	0.6418	0.9790*	0.5342	0.5083	0.4035	-0.3838	1	
Sulphate	0.3973	0.2688	0.1877	0.3286	0.2726	-0.1525	0.2954	1

*Significant correlation

IV. CONCLUSION

The present study was aimed to assess the physico-chemical characteristics of hand pump water used by the villagers in Akhori village of Mirzapur district, Uttar Pradesh. The other objective of the study was identification of key water parameters, which influence the other parameters. Pearson correlation analysis was performed to measure the degree of relationship between all the eight water parameters. The average concentration of all the water parameters was observed high at site 9, 10 and 11 in relation to the other sites. Values of all the parameters observed were above the permissible limit of BIS for drinking water except pH and turbidity. The result of Pearson correlation analysis identified five key water parameters i.e. turbidity, total hardness, calcium hardness, total alkalinity and chloride, which has significantly influenced the other water parameters. Thus, the combination of correlation analysis with descriptive statistical analysis i.e. mean, standard deviation, variance for ground water data analysis can serve as an excellent tool in interpretation of water quality and in understanding the degree of relationship between various water parameters.

V. REFERENCES

[1]. Agarwal, R., Agarwal, E., Garg, R. D., & Garg, P. K. (2012). A GIS Based Study Of Water Pollutants, Characteristics And Their Affects In Hilauli Block, India. i-Manager's Journal on Civil Engineering, 2(2), 11.

[2]. Akoto, O., Gyamfi, O., Darko, G., & Barnes, V. R. (2017). Changes in water quality in the Owabi water treatment plant in Ghana. Applied Water Science, 7(1), 175-186.

[3]. Carpenter, S., Bhawsar, A., & Bhat, M. A. (2018). Comparative study of physicochemical

characteristics of ground water and surface water in Bhopal city, India. International Journal of Current Research in Life Sciences, 7(02), 923-926.

[4]. Dubey, S., Agarwal, M., & Gupta, A. B. (2018). Recent Developments in Defluoridation of Drinking Water in India. In Environmental Pollution (pp. 345-356). Springer, Singapore.

[5]. Gopal, S., Sarkar, R., Banda, K., Govindarajan, J., Harijan, B. B., Jeyakumar, M. B., ... & Thomas, V. A. (2009). Study of water supply & sanitation practices in India using geographic information systems: Some design & other considerations in a village setting.

[6]. Hui, R., & Wescoat Jr, J. L. (2018). Visualizing peri-urban and rurban water conditions in Pune district, Maharashtra, India. Geoforum.

[7]. Jayanthi, M. S., & Soundararajan, P. (2018). A SPATIO-TEMPORAL ANALYSIS OF SUSTAINABLE RURAL DEVELOPMENT PROGRAMMES AND REDUCTION OF POVERTY IN INDIA. INDIAN JOURNAL OF APPLIED RESEARCH, 8(2).

[8]. Kumari, R., Datta, P. S., Rao, M. S., Mukherjee, S., & Azad, C. (2018). Anthropogenic perturbations induced groundwater vulnerability to pollution in the industrial Faridabad District, Haryana, India. Environmental Earth Sciences, 77(5), 187.

[9]. Meena MK, Dutta S, Pradhan R (2010). Environmental impacts of wastewater irrigation on groundwater quality-a case study of Ajmer city, Rajasthan (INDIA). Elect J Environ Agric Food Chem, 9: 760-766.

[10]. Manahan, S. (2017). Environmental chemistry. CRC press.

[11]. Patil VT, Patil PR (2010). Physico-chemical analysis of selected groundwater samples of Amalner town in Jalgaon District, Maharashtra, India. Journal of Chemistry, 7(1): 111-116.

[12]. Ramakrishnaiah, C. R., Sadashivaiah, C., & Ranganna, G. (2009). Assessment of water quality index for the groundwater in Tumkur Taluk, Karnataka State, India. Journal of Chemistry, 6(2), 523-530.

[13]. Sharma MR (2004). Assessment of ground water quality of Hamirpur area in Himachal Pradesh. Pollution Research, 23: 131-134.

[14]. Singh P, Saharan JP, Sharma K, Saharan S (2010). Physico-chemical & EDXRF analysis of groundwater of Ambala, Haryana, India. Nature and Science, 2(1): 68-75.

[15]. Sharma J, Sharma M, Sharma K, Beena (2013). Comparative statistical analysis of surface and underground water of Rajgarh, Alwar, Rajasthan. International Journal of Scientific Research and Reviews, 2(1): Suppl., 78- 88

[16]. Tripathi, S. K., & Vishwakarma, S. K. (2015). Physico-chemical and statistical evaluation of bore well water in two villages of Varanasi (Up), India. Int J Sci Res Environ Sci, 3(9), 314-321.

[17]. Tripathi, R. & Tripathi S. (2016). Impact of anthropogenic activities on water quality of prominent water bodies of Varanasi, UP, India. ESSENCE - International Journal for Environmental Rehabilitation and Conservation, 7(2), 53-60.

[18]. Sharma, D. A., Rishi, M. S., & Keesari, T. (2017). Evaluation of groundwater quality and suitability for irrigation and drinking purposes in southwest Punjab, India using hydrochemical approach. Applied Water Science, 7(6), 3137-3150.

[19]. Salehi, M., Abouali, M., Wang, M., Zhou, Z., Nejadhashemi, A. P., Mitchell, J., ... & Whelton, A. J. (2018). Case study: Fixture water use and drinking water quality in a new residential green building. Chemosphere, 195, 80-89.

[20]. Sharma, H. S. (2018). A SUCCESS STORY OF 24 X 7 WATER SUPPLY FACILITY OF HARAOROU VILLAGE, IMPHAL EAST, MANIPUR. Journal of Rural Development, 37(1).