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Ground Water Analysis of Villages of Kishangarh Tehsils, Ajmer District Rajasthan

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Abstract

Water quality of the 36 villages of Kishangarh Tehsil, Ajmer District Rajasthan was analyzed to identify the nature of potability of drinking water. The samples were collected during the month of March-April in clean polyethylene bottles and analyzed for different parameters such as pH, total alkalinity (TA), fluoride (F^-), nitrate, total dissolvedsolids(TDS), chloride(Cl^-), total hardness(TH), electrical conductivity (EC). Ca-H, Mg-H, CO_3^{-2}, HCO_3^-, Na^+ and K^+ using standard techniques.

Keywords: Ground Water, Water Quality, Kishangarh Tehsil, Fluoride Nitrate, Total Dissolved Solids.

Introduction

Water is one of the priceless gift of nature on earth. The development of human civilization and evolution of life on the earth could not have been possible without water. Ground water is a valuable natural resource for various human activities . The safe potable water is absolutely essential for healthy living. Ground water is ultimate and the most suitable fresh water resource for human consumption in both; urban as well as in rural areas. There are several states in India, where more than 90% population is dependent on ground water for drinking, bathing, cooking etc. High concentration of fluoride in ground water is a considerable health problem in several regions of the world considerable part of India has fairly good distribution of fluoride in contaminated ground water . As per report of UNICEF, 20% of total fluoride affected villages in the world are in India and out of these, 10% are in Rajasthan.

Objective of The Study

The present study is to know the hydrobiological characteristics of the underground water of the villages of the Kishangarh Tehsil, District Ajmer. Ground water system in the state of Rajasthan has become extremely vulnerable due to the overuse and water quality degradation. Since the volume of ground water in storage varies both in space and time in accordance with the hydrometeorological and hydrogeological domain conditions together with the external stress loaded on it as per the ground water requirements of various sectors like agriculture, drinking water needs and industrial uses, therefore the net impact imparted on the ground water system need to be studied closely and critically by analysing the behavioural pattern of the different ionic concentrations of the different parameters like pH, F, EC, TDS, Ca , Mg, Cl, TA, Na, K and No_3 of the ground water of study area.

Review of Literature

Ground water is a valuable natural resource for various human activities (Prasad and Narayana, 2008). The safe potable water is absolutely essential for healthy living. Ground water is ultimate and the most suitable fresh water resource for human consumption in both; urban as well as in rural areas. There are several states in India, where more than 90% population is dependent on ground water for drinking, bathing, cooking etc. (C. Ramachandraiah, 2010). High concentration of fluoride in ground water is a considerable health problem in several regions of the world considerable part of India has fairly good distribution of fluoride in contaminated ground water (Sinha, 2012). As per report of UNICEF, 20% of total fluoride affected villages in the world are in India and out of these, 10% are in Rajasthan. (UNICEF, 2012). from deep tube-wells, containing minerals which commonly contain 3 to 5 ppm fluoride in ground water and *The sampling, preservation, digestion and preparations and the analysis of various ions in water samples are made as prescribed by standard*

methods of APHA 1998 using Atomic Absorption Spectrophotometer (Perkin Elmer -403). The water levels reflect the cumulative effect on ground water regime as a consequence of natural recharge - discharge conditions and artificial draft. Where the draft exceeds the recharge, its manifestation is reflected in the decline of water level. (Central Ground water Board year book 2014-15). The world main source of ions in the naturally occurring drinking water derived sometimes natural thermal spring bring it to 10 to 15 ppm fluoride in complex with heavy metals by Madhavan and V. Subramanian (2016). The contamination of underground water depends on the availability and solubility of the parent materials with which these water are in contact (WHO) 2016. The amount infiltrating through the soil mass to contribute to ground water storage is of the order of 5% to 7% in areas underlain by hard rocks and 10% to 15% in alluvial areas, Geological Survey of India (GSI) 2017.

Concepts and Hypothesis

The present research work will be helpful to know the information about the composition of ground water present at the different localities of the rural areas in the present study. The underground water of the study areas have different concentrations, if the concentration of ions is higher and lower then what are its effects on human health. By getting the knowledge of a specific area we can determine what type of hydrological and chemical cycles are found in soil and ground water. It is necessary to carry out detailed investigations of problems in the existing tube-well system and strict vigilance is must for forth coming impacts, comprehensive planning and management of water resource systems are required to increase the levels of quality of life, for years to come.

Research Design / Materials and Methods

All the analysis methods followed standard procedures mentioned in "Standard Methods for Examination of water and waste water" 20^{th} edition published by APHA, and " Chemical and Biological Methods for water pollution studies" by Trivedi and Goel(1986). The water samples of selected hand pumps, tube wells and open wells of Kishangarh Tehsil, Ajmer District Rajasthan were collected and analyzed as prescribed by standard methods of water and waste water examination. Good quality, air tight plastic bottles with cover lock were used for sample collection and were safely transferred to the laboratory for analysisi. The water pH was determined in field because of their unstable nature. While the rest of the parameters were analyzed in the laboratory using standard APHA 2000, Trivedy and Goel, 1986. *The 36 water samples are selected from identified tube wells in the study areas and samples were collected in pre cleaned black coloured car buoys of 2litres capacity with necessary precautions. The sampling, preservation, digestion and preparations and the analysis of the different parameters in water samples are made as prescribed by standard methods of APHA using Atomic Absorption Spectrophotometer (Perkin Elmer -403)*

RESULTS AND DISCUSSION: The following data present the ground water quality status of the villages of Kishangarh Tehsil, Ajmer district, Rajasthan.

Potentia Hydrogenii: pH

The pH value ranges between 6.2-8.3 the lowest value was observed in Goondli and the highest in Chak Beer village (Table 1). pH is expressed as a number ranging from 0-14. The number is an expression of the concentration of H^+ ion in the solution. 98% water samples were found to be within limit (Table 2). According to WHO, the permissible limit for pH is 6.9 to 9.2.

Fluoride (F^-)

Fluoride content of ground water samples of the study area ranges from 0.26 ppm to 8.10 ppm. Minimum (0.26 ppm) and maximum (8.10 ppm) concentration of F^- was observed from Deenwara and Balapura villages, respectively (Table 1). Permissible limit for F- concentration is 1-1.5 ppm according to WHO (2008). The data revealed that 69.16% villages of Kishangarh tehsils are affected with high concentration of F^-, whereas 9.16% villages have lower F^- content. Whereas, 21.6% villages contained optimum limit of F^- concentration (Table 2). Low concentration of F^- below 0.5 ppm causes dental caries and higher concentration beyond 1.5 ppm causes dental and skeletal fluorosis. The maximum permissible limit of fluoride in water is 1.5 mg/l by WHO & ICMR. The fluoride in drinking water has been studied. In Rajasthan out of 27 district, 16 districts have been confirmed fluoride affected areas and have more concentration of fluoride than permissible limit.

Table 1 : Values of various Parameters in ground water of the villages of Kishangarh Tehsils District Ajmer

S. No.	Name of Village	Source	pH	F (ppm)	EC □ mhos/cm	TDS mg/l	$Ca^{-}H$ (mg/l)	$Mg^{-}H$ (mg/l)	TH (mg/l)	Cl^{-} (mg/l)	TA (mg/l)	Na^{+} (mg/l)	K^{+} (mg/l)	NO_3^{-} (mg/l)
1	Aau	HP	7.4	3.80	1254	878	255	98	352	284	306	63	0.87	219
2	Balapura	HP	7.7	8.10	2384	1669	270	120	390	650	310	192	0.67	106
3	Beeti	HP	7.9	0.89	303	212	120	30	180	84	120	45	1.07	24
4	Chak Beer	HP	8.3	2.55	3802	2663	150	80	227	260	370	50	0.10	390
5	Chosla	HP	7.1	1.20	691	484	120	60	180	180	180	120	0.30	390
6	Dang	HP	8.0	2.30	5565	3897	190	110	300	210	530	192	0.48	40
7	Deendwara	HP	7.3	0.26	1320	930	150	80	230	220	510	70	1.98	20
8	Dholpuriya	HP	7.8	4.01	1330	690	320	200	520	180	400	80	1.80	40
9	Goondli	HP	6.2	2.60	1287	900	310	320	670	110	420	85	1.40	30
10	Harmara	HP	7.8	0.90	1430	1000	210	180	390	110	400	80	1.50	5
11	Jajota	HP	6.6	1.20	1215	850	110	250	360	150	380	15	1.30	10
12	Arain	HP	7.1	1.60	886	620	140	110	250	110	400	20	1.40	20
13	Bandar Seendri	HP	7.8	0.70	1272	890	410	130	540	200	520	70	1.35	32
14	Barna	HP	7.1	1.60	772	540	120	90	210	260	390	85	1.80	72
15	Brijpura	HP	7.5	1.20	1072	750	160	110	270	110	310	30	1.30	120
16	Chak Motpura	HP	7.2	3.00	1130	790	180	110	290	180	760	50	0.30	5
17	Cheeta Khera	HP	7.5	1.40	1170	820	180	160	340	260	910	50	0.18	46
18	Dangra	HP	7.2	3.40	1230	860	70	60	120	140	310	10	0.10	125
19	Deopuri	HP	7.4	2.50	1300	910	120	40	160	100	480	80	0.80	20
20	Dothli	HP	7.8	1.80	1000	700	100	80	180	180	560	40	0.30	28
21	Ganeshpura	HP	7.0	1.06	1330	930	50	70	180	65	230	50	0.30	17
22	Gopal pura	HP	7.0	1.80	1030	720	110	100	210	90	290	20	0.25	5
23	Harpura	HP	7.4	2.00	1170	820	110	60	170	130	320	60	0.40	80
24	Jakholai	HP	7.1	4.80	1316	920	210	130	340	240	420	5	1.20	28
25	Amarpura	HP	7.4	4.10	1716	1200	140	100	240	70	280	70	1.30	50
26	Bansra	HP	7.0	4.30	1273	890	120	80	200	160	230	20	0.30	10
27	Bhairwai	HP	7.9	3.60	1716	1200	150	60	210	360	450	40	0.90	40
28	Bhawsa	HP	7.4	7.00	2259	1580	200	110	310	320	270	45	0.29	5
29	Bhejiyawas	HP	7.0	2.60	1458	1020	70	50	120	190	120	80	0.89	26
30	Bulraro	HP	7.9	3.01	1400	980	470	90	560	120	190	60	0.82	12
31	Choondari	HP	7.3	5.20	1008	710	150	60	210	360	200	44	0.46	70
32	Dadiya	HP	7.4	3.10	1740	1220	110	60	170	80	230	5	0.70	60
33	Gagoonda	HP	7.5	6.80	1130	790	210	130	340	520	280	70	1.30	80
34	Goojarwara	HP	7.8	6.01	1272	890	140	80	220	140	220	25	0.85	40
35	Indoli	HP	7.2	1.02	1773	1240	120	40	160	125	480	80	0.82	105
36	Jhadol	HP	7.0	1.01	924	650	70	50	90	140	320	5	1.80	45

Electrical Conductivity (EC)

Electrical conductivity is a useful tool to evaluate the purity of water. USPH and WHO recommended permissible limit for EC is 300 □ mhos/cm. The values of EC ranged from 303-5565 □ mhos/cm. Minimum and maximum EC was reported from Beeti and Dang villages, respectively (Table 1). EC of all water samples was found higher than permissible limit (Table 2). EC signifies the amount of TDS in water.

Total Dissolved Solid (TDS)

Total dissolved solid indicates the salinity of ground water. TDS ranged from 212 to 3897 mg/l. Minimum and maximum TDS was reported from Beeti and Dang village (Table 1). According to WHO (2008). TDS should be between 500-1500 mg/l. TDS was found to be within the limit in 70.84% villages, lower in 11.66% villages whereas 17.5% villages showed TDS higher than the limit.

Calcium Hardness (Ca-H)

Calcium hardness ranged from 50 to 470 mg/l minimum Ca-H was observed from Ganeshpura village whereas maximum Ca-H was recorded from Bulraro village (Table 1). Ca-H was found to be within the limit in 65% villages, lower in 5.83% villages whereas 29.16% villages are towards higher side.

Magnisium Hardness (Mg-H)

(Mg-H) Magnesium Hardness is assessed from 30 mg/l to 250 mg/l. Minimum magnesium hardness, was traced from Beeti village whereas, maximum Mg-H was reported from Jajota village. Mg-H was within permissible limit in 87.5% villages while the remaining 12.5% villages contained Mg-H higher than the optimum limit. (Table 2).

Total Hardness (TH)

It is the property of water, which prevents the lather formation with soap and increases the boiling point of water Mg-H and Ca-H combine to form total hardness. TH varied from 90 to 670 mg/l. Minimum TH was traced from Village Jhadol and Maximum TH was reported from the Village Goondli. WHO (2008) recommended 100-500 mg/l as safe permissible limit. In ground water, hardness is mainly due to carbonates, bicarbonates, sulphates and chlorides of Ca and Mg. Total hardness was higher in 4.16% villages where as 95.83% samples contained TH within optimum limit. (Table 2).

Table 2
Permissible limit and percentage in the villages of Kishangarh Tehsils of Ajmer district

Parameters	Permissible Limit	Villages %		
		Below	Optimum	Higher
pH	6.9-9.2	2.50%	97.50%	-
F^-	1-1.5-ppm	9.16%	21.60%	69.16%
EC	300 μmhos /cm	-	-	100%
TDS	500-1500 mg/l	11.66%	70.84%	17.50%
Ca-H	75-200 mg/l	5.83%	65.00%	29.16%
Mg-H	30-150 mg/l	-	87.50%	12.50%
TH	100-500 mg/l	-	95.83%	4.16%
Cl^-	200-600 mg/l	65%	30.83%	4.17%
Alkalinity	200 mg/l	15%	4.16%	80.84%
Na^+	50-60 mg/l	45.83%	5.00%	49.16%
K^+	20 mg/l	100%	-	-
NO_3^-	40-50 mg/l	50.83%	6.67%	42.5

Chloride (Cl^-)

Chloride concentration varied from 65 to 650 mg/l. WHO (2008) recommended (200-600 mg/l.) as safe permissible limit for chloride. Minimum and maximum chloride was reported from Ganeshpura and Balapura villages (Table 1). It was observed that 65% of the samples have chlorides below the permissible limit, 4.17% samples are in higher limit and 30.83% samples have chloride within optimum limit. High content of chloride gives salty taste in water.

Total Alkalinity (TA)

Bicarbonate ions (HCO_3^-) and carbonate (CO_3^{-2}) ions together make total alkalinity (TA) of water. TA ranged 120-910 mg/l. Minimum was reported from Beeti village and maximum was observed at Cheeta Khera village (Table 1). 80% of the samples have TA higher than permissible limit.

Highest concentration (910 mg/l) of alkalinity was found in Cheeta Khera village and lowest (120 mg/l) in Beeti village. It is recorded that 15% samples are below the permissible limit and 80.84% samples are in higher limit. The optimum value is 4.16% of the samples. According to WHO (2008). TA should be between 200 mg/l. The higher values of alkalinity gives an undesirable taste to water.

Sodium (Na^+)

Sodium Na^+ concentrations were recorded between 5 mg/l to 192 mg/l. The permissible limit for sodium (Na^+) 50-60 mg/l according to WHO (2008). The minimum values of sodium are recorded in Dadiya, Jhadol and Jakholai villages whereas maximum sodium was recorded from Balapura and Dang villages. Sodium was found to be within limit in 5% villages, lower or below in 45.83% villages and higher in 49.16% villages. Table 2.

Potassium (K^+)

Potassium(K^+) content of water samples varied from 0.10 to 1.98 mg/l. It is reported that the minimum potassium content was observed from Chak Beer and Dangra villages and maximum from Deendwara village. Table 1. According to WHO (2008) the permissible limit of K^+ is 20 mg/l. All the water samples (100%) contained K^+ content lower than permissible limit (20 mg/l). Table 2.

Nitrate (NO_3^-)

In the present study the nitrate concentration ranged between 5 mg/l to 390 mg/l. Highest concentration (390 mg/l) of nitrate was observed in Chak Beer village and lowest concentration of nitrate (5 mg/l) was recorded from Harmara, Chak Motpura, Gopalpura and Bhawsa villages. (Table1). The NO_3^- content was below permissible limit (40-50 mg/l) in 50.83% villages, 6.67% were within the limit whereas 42.50% villages had NO_3^- concentration higher than the permissible limit. (Table 2). Nitrate concentration if present more than 45 mg/l is harmful for newly born kids.

Findings and Conclusion

The observed data indicate that the ground water of the villages of Kishangarh tehsil is deteriorated as it is polluted with high amount of fluoride, alkalinity and electrical conductivity. Most of the parameters were either more than permissible limit or just below limit. Therefore, drinking water of most of the villages of the Kishangarh tehsil is not potable. Therefore proper treatment of ground water is suggested prior to its use for drinking purpose.

Suggestion

Firstly Regular physico-chemical analysis of water at source must be carried out to determine or check quality of drinking water source. Hence a good knowledge of the chemical qualities of raw water is necessary so as to guide its suitability for use. Secondly there is a need for an appropriate water policy and institutional arrangements for coordination in the management of water resources. Water quality monitoring and surveillance should be given top priority, low awareness regarding the importance of water quality at all levels is a mojor constraint. Rural people specially the lactating mothers should be motivated to use fluoride free and safe water. Domestic Roof Top Rain Water Harvesting System (RRHS) provides a viable solution to bridge the gap between demand and supply of water in such areas, especially during periods of water scarcity, RRHS is applicable.

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