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Pelagia Research Library

Der Chemica Sinica, 2014, 5(6):69-73

Pelagia Research Library
ISSN: 0976-8505
CODEN (USA) CSHIA5

Ground water quality evaluation for drinking purpose in some areas of Unjha Taluka, Mehsana District (North Gujrat), India

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ABSTRACT

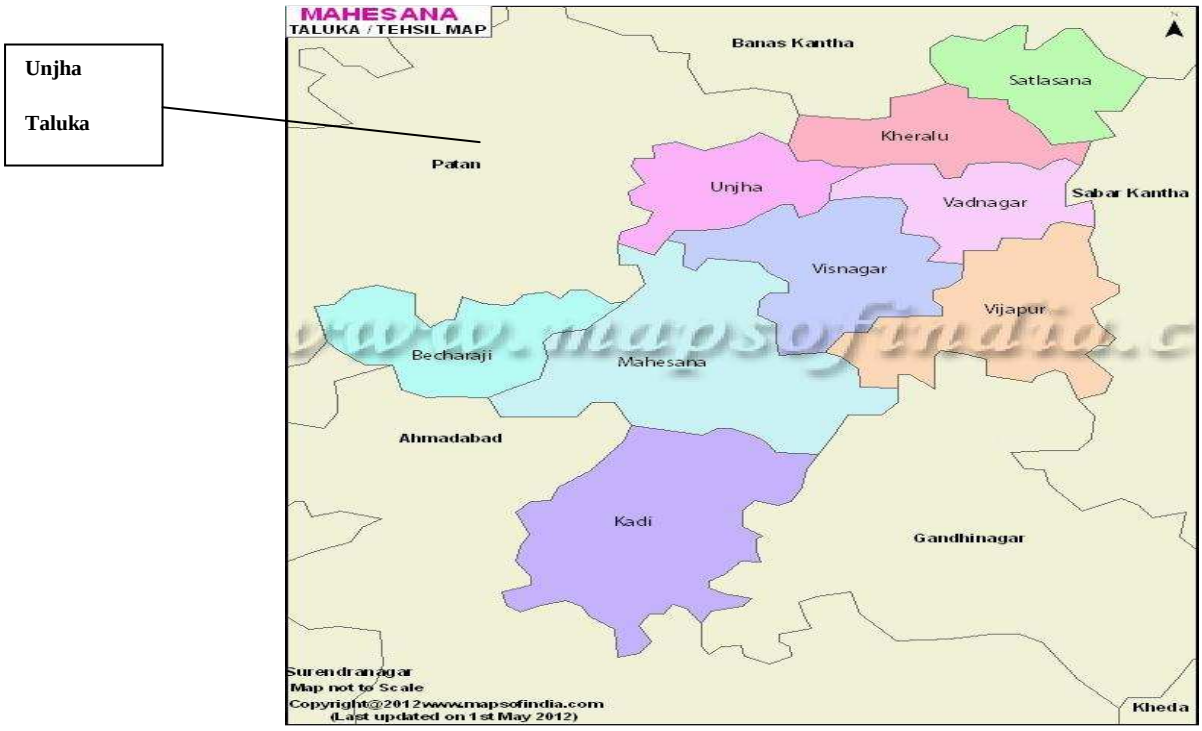
Water plays a vital role in human life. Ground water quality is an essential for healthy population. In the present study of drinking water samples for 20water sources tubewells in the Unjha field has been carried out. The purpose of this study was to ascertain the quality of water from these sources. The physical properties suchas pH and Total dissolved solids (TDS) showed the range of pH (7.24-8.48) and TDS (643.0-1208.6) mg/L which is within the permissible limits of World Health Organization (WHO) except few samples. We have measured of SO_4^{-2},F^-, Cl^- Na^+,K^+,Ca^{+2}*and* Mg^{+2}*also. The analytical data are processed and interpretented as per slandered laboratory method of APHA.*

Key words: Ground water quality, Electric conductivity (EC), Total dissolved Solids(TDS), Sodium adsorption ratio(SAR), American public health association (APHA)

INTRODUCTION

Water is an elixir part of our life .Without water, there is no life on our planet. The safe portable water is absolutely essential for healthy living. Ground water extraction for various purposes has made a major contribution to the improvement of social and economic life of people. However, the development and unsystematic, unplanned and uncontrolled use of water resources resulted into reckless exploitation of resources and have many undesirable and irreversible environmental consequences. Water for different purposes has its own requirements as to composition and purity. Each body of water needs to be analyzed on a regular basis to confirm to suitability. The types of analysis could vary from simple field testing for a single analyze to laboratory based multi-component instrumental analysis. The measurement of water quality is a very rigorous and time consuming process, and a large number of quantitative analytical methods are used for this purpose. Understanding the groundwater quality is important as it is the main factor determining its suitability purposes [1]. In developing countries like India around80% of all diseases are directly related to poor drinking water quality and unhygienic conditions [2].Increasing water pollution causes not only the deterioration of water quality but it also threatens human health and the balance of aquatic ecosystems, economic development and social prosperity.

The consequence of urbanization and industrialization leads to spoil the quality of water. For agricultural purposes, ground water is explored in rural areas especially in those areas, where other sources of water like dam, river or a canal is not available. During last decade, it has been observed that the groundwater gets polluted significantly because of increased human activities [3, 4]. Consequently, number of cases of water borne diseases has been seen causing health hazards [5, 8] .So basic monitoring of water quality has become necessary to observe the demand and pollution level of ground water8. A good number of water analysis experiments are regularly conducted by different groups of chemists and biologists all across the country [9, 12].



MATERIALS AND METHODS

Unja is a Talukain Mehsana district of Gujarat State, India. Unjha city lies on the geographical coordinates of 23° 48' 0" N, 72° 24' 0" E. Total population of 174303 ,The 53876 persons lives in town and 120427 lives in rural areas. It is located 116 meters above Sea level and it is too hot in summer. Unjha summer highest day temperature is in between 35^0C to 43^0 C. The area of Unjhataluka is lack of rainfall.

The natural water analysis for physical and chemical properties including trace element contents is very important for public health. 20 water samples were collected from various locations covering the entire study area (**Fig. 1**). Pre washed one and 500 litter polyethylene bottles were used for sample collection and preservation. Before using the samples bottles carefully cleaned with concentrated HCl then rinsed with tap water finally with distilled water. The samples were kept in a refrigerator and till analyzed. PH, Temperature, diameter, depth, static water level of the tube wells are measured on the sites during.

Physico-Chemical Analysis

The people of North Gujarat region have been facing potable water crisis due to inadequate rains. In Gujarat, ground water is considered as the first water source for drinking, irrigation and other uses. The climate of the Unjha plain can be described as being hot, windy and arid with humidity; air temperature is over 43°C in the period from May to September. The major source of drinking water in unjha area is only ground water, the aim of this study was to investigate the quality of the ground water. Samples were collected from the Unjhatube wells. Chemical and physical characteristics were analyzed.

In all, about 20 samples of water were examined for electrical conductivity, pH and the proportion of various cations and anions. The chemical analysis was carriedout following standard procedures. Chemical analysis data of the water samples are given in Table 1. It presents different ratios to judge the quality of these water samples from drinking viewpoints.

The ground water samples were collected from 20tube wells in selected stations of Unjha Talukas region. The samples were collected as per the standard methods recommended by APHA. Before water sampling, all the double-stopper polythene containers were cleaned and rinsed thoroughly with water samples to be analyzed. In the laboratory, the water samples were analyzed for the major anions i.e. bicarbonate, chloride, sulphate etc. and cations i.e. calcium, magnesium, sodium, potassium etc. The various instruments and methods were used in the laboratory for the chemical analysis of water samples. Sodium and potassium were analyzed by flame emission spectrophotometer, calcium hardness (Volumetric methods,) total hardness by standard EDTA method. Chloride, carbonate, and Bicarbonate were measured by standard volumetric methods given by APHA 1995.

RESULTS AND DISCUSSION

The physical and chemical parameters exhibited significant variations from sample to sample. All the measurements were carried out in the vicinity of temperature 30^0C.

The observations are summarized in the Table 1.

Table 1 (a): Physico-chemical characteristics of ground water in UNJHA taluka (N. Gujarat)

Sample no.	Location/ village	P^H	TDS Mg/L	EC Mmhos/cm.	$Ca^{+2}{}_{+Mg}{}^{+2}$ Meq/L	Na^+ Meq/L	K^+ Meq/L	CO_3^{-2} Meq/L
S_1	Aithor	7.71	710	1.956	5.8	5.81	0.02	0.2
S_2	Amuth	7.89	643	1.625	12.5	7.62	0.01	0.1
S_3	Bhakhar	8.10	695	1.519	7.7	4.33	0.03	0.1
S_4	Bhunav	7.91	597	1.245	7.4	4.65	0.06	0.1
S_5	Brahmanwada	8.21	879	1.871	10.1	8.96	0.05	0.2
S_6	Dabhi	7.87	789	1.765	8.8	6.18	0.02	0.4
S_7	Hagipur	8.01	645	1.588	6.7	6.77	0.03	0.6
S_8	Jagnnathpura	7.24	656	1.487	9.6	9.39	0.04	0.1
S_9	kamli	7.89	564	1.411	11.9	11.64	0.02	0.2
S_{10}	kantharavi	8.13	889	1.712	13.3	10.02	0.02	0.1
S_{11}	Karali	8.19	632	0.687	9.7	9.02	0.01	0.5
S_{12}	Maherwada	7.75	669	0.703	6.4	4.34	0.01	0.6
S_{13}	Maktupur	7.64	900	1.847	9.7	7.56	0.01	0.4
S_{14}	Pali	7.76	968	1.977	11.0	12.30	0.03	0.1
S_{15}	Ranchhodpura	8.17	872	1.654	8.5	9.10	0.04	0.1
S_{16}	Shihi	7.93	692	1.612	11.5	7.34	0.03	0.1
S_{17}	Tundav	7.65	1208	1.793	12.6	6.63	0.01	0.2
S_{18}	Unava	7.80	566	1.588	9.2	4.56	0.02	0.2
S_{19}	Upera	8.36	645	1.677	9.9	6.34	0.02	0.6
S_{20}	Vanagala	8.48	843	1.865	11.0	7.39	0.01	1.4

Table 1 (b): Physico-chemical characteristics of ground water in UNJHA Taluka (N. Gujarat)

Sample no.	Location/village	HCO_3^- Meq/L	RSC Meq/L	SAR Meq/L	SSP %	Cl^- Meq/L	F^- Mg/L	SO_4^{-2} Mg/L
S_1	Aithor	6.7	1.1	3.417	50.12	3.2	1.11	132.2
S_2	Amuth	7.2	-5.2	3.048	37.92	4.0	1.13	109.5
S_3	Bhakhar	3.4	-4.2	2.209	36.15	4.0	0.78	74.5
S_4	Bhunav	7.6	0.3	2.409	38.89	4.6	0.80	155.3
S_5	Brahmanwada	3.2	-4.0	4.000	47.14	2.9	1.80	55.8
S_6	Dabhi	11.8	3.4	2.956	41.33	8.1	0.98	149.8
S_7	Hagipur	10.0	3.9	3.699	50.37	6.7	1.66	109.1
S_8	Jagnnathpura	5.2	-4.3	4.287	49.55	4.3	0.87	127.4
S_9	kamli	5.5	-4.0	4.777	49.49	11.0	1.36	95.6
S_{10}	kantharavi	3.1	-8.6	4.056	43.01	3.5	1.45	45.4
S_{11}	Karali	4.1	-9.1	4.465	48.21	2.6	0.73	32.5
S_{12}	Maherwada	5.5	-3.7	2.438	40.46	4.3	1.36	143.0
S_{13}	Maktupur	7.6	-1.7	3.436	43.83	4.5	2.12	177.7
S_{14}	Pali	12.8	1.9	5.256	52.85	8.5	0.87	100.0
S_{15}	Ranchhodpura	4.0	-7.4	4.417	51.81	3.1	1.48	103.0
S_{16}	Shihi	7.93	-3.16	3.017	39.01	4.3	2.00	156.01
S_{17}	Tundav	7.63	-4.95	2.652	34.51	4.6	1.96	134.5
S_{18}	Unava	6.1	-2.9	2.130	33.23	4.5	1.68	162.0
S_{19}	Upera	5.5	-3.8	2.855	39.11	6.3	0.91	124.5
S_{20}	Vanagala	11.4	1.8	3.158	40.21	8.0	1.08	126.3

Table 2: Rating of different parameters in water

parameter	Acidic	Normal Moderately safe	Saline Moderately unsafe	Alkaline unsafe
pH	<7.00 Good	7.00to7.50 safe	7.50to8.50 marginal	>8.50 unfit
E.C. (mmhos/cm)	<0.250 Low	0.250 to 0.750 medium	0.750 to 2.250 high	>2.250 very high
SAR	<10.0 Safe	10.0 to 18.0 Marginal	18.0 to 26.0 doubtful	>26.0 doubtful
RSC (meqL-1)	<1.25 Safe	1.25 to 2.50 Marginal	>2.50 Doubtful	

Table 3: Standards of Physical and Chemical Water Quality

Prescribed by the Bureau of Indian Standard(IS:10500:1991)Prescribed by ICMR(1975)						
Sr. No.	parameters	Requirement desirable limit	Permissible limit in the absence of alternate source	Highest desirable level	Maximum Permissible level	USPH standard
1	TDS mg/L	500	2000	500	1500	500
2	P^H value	6.5-8.5	6.5-8.5	7.0-8.5	6.5 - 9.2	6.0-8.5
3	Ca^{+2}mg/L	75	200	75	200	100
4	Mg^{+2}mg/L	30	100	-	-	30
5	Cl^{-1}mg/L	250	1000	200	1000	250
6	$S0_4^{-2}$mg/L	200	400	200	400	250
7	F^-mg/L	1	1.5	1	1.5	1.5
8	Conductivity Mmhos/cm	3.00	-	-	-	-

Based on these tabulated values and the figures, the following observations are made. It is observed that the pH of the water was slightly alkaline (7.24 to 8.48) and only minor fluctuation in pH was recorded. The pH levels were within the limits set for domestic use as prescribed by APHA.

The WHO has suggested a limiting value of 500 mg/L of TDS for potable water. In the present investigation, this limit is crossed i.e. 564-1208 mg/L of the samples. However, in the sample No.S_{17}(Tundav), The TDS value is about to reach the maximum permissible limit (1208 mg/L). The water of the remaining some samples have reasonable values of TDS (564–879 mg/L). These values are acceptable for domestic use and agricultural purposes. It is a useless for drinking purpose.

Electrical conductivity is a useful tool to evaluate the purity of water. Maximum EC at 1.977 mmhos/cm (S_{14}-Pali) and minimum at 0.687 mmhos/cm(S_{11}-Karali) the result indicates that all most all the water samples are within the permissible limits of 2.250 mmhos/cm

The summation of calcium hardness and magnesium hardness is regarded as the total hardness of water. In the present investigation, it has been observed that the calcium and magnesium concentration of the samples has registered a high value of calcium magnesium hardness (5.8-13.3meq/L) (Tables 1). The hardness scale has shown value more (13.3meq/L) for sample S_{10}. So water is very hard. These minerals in water can cause some day-to-day problems, as they react with soap and produced a deposit called “soap curd”.

A significant presence of anions like chloride and sulphate was also observed in the water samples under investigation. It has been reported that greater amount of sulphate in drinking water causes diarrhea. The chloride and sulphate amounts in the samples ranged from2.6-11.0 meq/L and 32.5-177.7mg/L, respectively. Here, it was observed that the sulphate concentration in the samples fall well within the prescribed limit, but the chloride content is much higher than the permitted values of WHO19 and ISI. High chloride content in ground water attributed to lack of under-ground drainage system and bad maintenance of environment around the sources.

The sodium and potassium ions were investigated in drinking water samples. Their concentrations were in the range of (4.33-12.30meq/L) and (0.01-0.06meq/L) respectively. These results were within the permissible limits by WHO. The values of HCO_3^- in the water samples varied from 3.2 to 11.8meq/L. The lowest value of 3.2meq/L was observed in the water sample obtained from Brahmamwada, whereas the highest value of 11.8meq/L was observed in Dabhi Village. All the samples were far below the permissible limit of 120 meq/L.

Fluoride content of ground water samples of the study areas ranged from 0.87 to2.12 mg/L. Maximum allowable limit is 1.5 ppm (WHO, 1999). It is under permissible limit. Small concentration of fluoride in drinking water has some beneficial effect also on human body. Low concentration of fluoride below 0.5 ppm causes dental caries and higher concentration beyond 1.5 ppm causes dental and skeletal fluorosis. The result indicates that 65% water sample have higher values of fluoride content. Due to this more people facing fluorosis disease in this taluka today.
The suitability of the tube well water samples was judged by determining the SAR value and these were categorized under different irrigation classes on the basis of salinity and alkalinity hazards. Sodium adsorption ratio (SAR) was computed by using values of water soluble cation (Table 1). The SAR values varied from 2.209 to5.256meq/L. The data revealed that all of the water samples of the taluka under study have low values (< 10.0) and safe.

Residual sodium carbonates (RSC) were computed by using values of anions of sodium $CO_3^{-2}$and HCO_3^{-1}) and cations (Ca^{+2}+ Mg^{+2}), where the ionic concentration is in meq/L. The RSC values varied from –9.1 to 3.9. The soluble sodium percentage (SSP) values of the water samples of unjhataluka ranged from 33.23 to 52.85 percent. The lowest value of 33.23 per cent was observed in Unava Village whereas the highest values of 52.85 percent were

recorded in a water sample from Pali Village. Further, the data revealed that about all of the water samples have low values (< 60) of SSP.

CONCLUSION

The results obtained from the analysis of the samples revealed that the quality of ground water in Unjhataluka been assessed by comparing each concentration with the standard desirable limit of that parameter in drinking water as prescribed by WHO. The analytical data of TDS, chloride ion and sodium ion concentrations were in the permissible limit. The concentration of sulphate ion was lower than the permissible limit and the concentration of fluoride ion was higher than the permissible limit given by WHO.

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