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Original Research Paper

Status of Groundwater Quality in Masuda Tehsil of Ajmer District, Rajasthan During Pre-monsoon Season

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ABSTRACT

In this work an attempt has been made to access the groundwater quality in the Masuda Tehsil situated south-west of Ajmer city covering an area of 87,898 hectare and having the population of 1,87,295 in the year 2001. It consists of 147 villages, nearby all facing an acute shortage of water and, thus, creating a tremendous pressure on the fragile water resources due to high population growth and over consumption, finally leading to deterioration of the quality and quantity of water. The present investigation was carried out by collecting the groundwater samples during the pre-monsoon 2006 from 25 different sites in the Masuda Tehsil. The physicochemical parameters which were analysed are pH, electrical conductivity, TDS, total hardness, calcium hardness, magnesium hardness, total alkalinity, sodium, potassium, fluoride, sulphate and nitrate. The value obtained were compared with standards prescribed by WHO and BIS. The analysis revealed high content of TDS, fluoride, nitrate, bicarbonate, etc. along with high variability, which is a matter of great concern, thus, leading to adverse effects on the people residing in the study area. As it is never late to realize that water is the most critical factor, so we need to take proper remedial measures to maintain its quality and conserve it as we do not have it on any other planet except earth making it the only place where man can survive.

INTRODUCTION

Water acts as a limiting factor for survival of human being. As it is required to meet the increasing demand of power, economic growth and industrialization, many countries throughout the world are suffering from the shortage of water. Supply of potable water has also been affected by contamination of water resources in most developing countries (Ahmed & Begum 2002).

In this country the rainfall distribution is highly uneven and variable in space and time domain, which causes periodical drought in both low and medium rainfall regions constituting 68% of the total land area. It is highly erratic especially in Rajasthan state where water resources are in delicate equilibrium just only 1% of India's water resources (GOI 2004), thus, facing severe drought. In Rajasthan out of 237 blocks only 49 are safe in terms of groundwater while 101 are critical and semi critical and 86 are overexploited. It is a hard reality that dependence on groundwater in Rajasthan is 91% for drinking water. Here, 56% of the water resources are not potable as the villagers suffer from salinity, fluoride and nitrate problems (Khanna et al. 2008). According to the Chaudhary et al. (2002) water must be considered as a national asset and a basic human right to be provided to citizens in proper quantity and safe quality with equity and fairness amongst the users.

Ajmer district, situated in cradle of Aravalli mountain range in centre of Rajasthan, witnesses very scarce rainfall, thus, demarking the Ajmer district a drought-prone area heading towards a fresh-water crisis. Due to the scarcity of surface water groundwater seems to be a very important resources both in rural and urban areas. The anthropogenic exploitation of groundwater has resulted in the limited available potable water resources. In the district, fluoride is present in high level in all the 31 districts and has become a serious health related issue in 23 districts of Rajasthan by Handa (1975) and Patra et al. (2000).

Several parts of the district, especially Masuda Tehsil, is facing an acute shortage of water. The number of hand pumps in the area is low compared to the population but even these are dry as the groundwater level has gone down. As it is a hilly tract, the water here is hard and contain fluoride. The falling water table due to overextraction from ground aquifers and pollution of the water bodies due to agricultural, urban and industrial wastes has posed a never ending threat to groundwater. Thus, measures are needed to be taken to resolve the groundwater problems as depletion of water table and deterioration in groundwater quality are the critical issues (Singh & Singh 2002).

STUDY AREA

In this work an attempt has been made to access the groundwater quality in the Masuda Tehsil situated south-west of Ajmer city covering an area of 87,898 hectare with population of 1,87,295 in the year 2001. It consists of 147 villages, all facing an acute shortage of water and, thus, creating a tremendous pressure on the fragile water resources due to high population growth and overconsumption, finally leading to the deterioration of the quality and quantity of water.

MATERIALS AND METHODS

Groundwater samples were collected during pre-monsoon in the year 2006 from 25 different sites in the Masuda Tehsil. The physicochemical parameters like pH, electrical conductivity, TDS, total hardness, calcium hardness, magnesium hardness, total alkalinity, sodium, potassium, fluoride, sulphate and nitrate were determined by the methods described in APHA (1992) and the values obtained are compared with standards prescribed by WHO and BIS.

RESULTS AND DISCUSSION

The physicochemical parameters of various groundwater samples during the pre-monsoon of 2006 are given in Table 1. The data indicate that most of the water quality parameters of Masuda Tehsil of Ajmer district are within prescribed limit except for some cases.

The pH of the samples varied between 7.1 to 9.0. The lowest value of pH was observed in S1 sampling site, while maximum was observed in S23. The pH values indicate that the water at some places is mildly alkaline whereas at other places it is more alkaline. The electrical conductivity (EC) of the samples ranged between 1.8 mS/cm to 10.50 mS/cm. Minimum value was recorded from S14, and maximum from S10. The total dissolved solids (TDS) ranged from 635 mg/L to 5140 mg/L. All the samples showed higher range of TDS than the highest desirable limits of 500 mg/L (WHO 1971). High concentration of TDS decreases the palatability and reduces the utility of water for drinking, irrigation and industrial purposes.

Hardness in water is caused by metallic ions dissolved in water. Total hardness in the area varied from 50 mg/L to 1435 mg/L. About 80% of the samples in the study area are within the permissible limit of 500mg/L (WHO 1984). Calcium and magnesium is common constituents of natural waters and important contributor to the hardness of water. The calcium concentration in groundwater samples ranged from 12.61 mg/L (S12) to 105.13 mg/L (S8). Maximum and minimum concentrations of magnesium have been observed to be 270.3 mg/L (S14) and 19.4 mg/L (S16) respectively.

Water with high sodium content is not suitable for agricultural use as it tends to deteriorate the soil by contributing to salinity. The sodium concentration ranged from 110.5 mg/L to 809.5 mg/L. Potassium content of the groundwaters of the area ranged between 2.2 mg/L and 10.5 mg/L. Almost all of the samples have potassium lower than the permissible limit of 10 mg/L as prescribed by BIS.

The presence of carbonates in most of the groundwater samples was found to be negligible, though the highest concentration was 20 mg/L. On the other hand bicarbonate concentration is much higher varying from 100.5 mg/L to 925.2 mg/L, thus, making the water hard and unfit for domestic purposes.

A chloride in excess imparts the salty taste to water and people who are not accustomed to high chlorides are subjected to laxative effect (Raviprakash & Krishnarao 1989). The WHO limit for chloride in drinking water is 200-600mg/L. In the present investigation, chloride content varied from 43 mg/L to 1010 mg/L. The data revealed that 44% of the samples have chloride content more than lowest permissible limit of 200 mg/L, whereas 20% of them crossed maximum permissible limit of 600 mg/L. Sulphate values varied from 8 mg/L to 900 mg/L, which indicates that it is a variable parameter, when present in excess amounts causes intestinal disorders.

The nitrate concentration ranged from 43 mg/L to 1010 mg/L, which is high as per standards. Nitrate poisoning is frequent in Rajasthan due to hard and saline water (Kumar et al. 2008). Groundwater gets contaminated by leaching of nitrate generated from fertilisers used in agricultural

Table 1: Physicochemical parameters of groundwater samples of Masuda Thesil in Ajmer district, Rajasthan.

S. No.	Sampling sites	pH	EC	TDS	TH	Ca^{+2}	Mg^{+2}	Na^{+}	K^{+}	CO_3^{-2}	HCO_3^{-}	Cl^{-}	SO_4^{-2}	NO_3^{-}	F^{-}
1	S1	7.1	4.1	3003	230	84.1	48.60	150.7	5.25	Nil	431.2	120.7	330	300	0.7
2	S2	7.4	4.1	2690	140	50.46	134	225.5	9.85	Nil	451.1	71	360	250	0.66
3	S3	7.2	4.5	2770	190	71.48	27.9	124.14	5.75	14	100.5	113.6	8	200	0.53
4	S4	7.4	4.3	2450	210	79.89	25.5	142.53	3.45	18	122.6	127.8	10	150	0.51
5	S5	8.1	6.5	4380	310	42.05	49.83	423.01	5.25	20	880.8	653.2	140	60	0.88
6	S6	7.8	4	2940	130	46.25	135.02	308.06	2.15	12	925.2	369.2	160	25	6.11
7	S7	8.1	4.2	3260	140	50.46	34	809.5	2.2	42	490.8	106.5	275	30	0.74
8	S8	7.7	3.6	2800	350	105.1	21.27	326.45	7.2	Nil	550.2	397.6	120	30	3.61
9	S9	8	5	3440	875	29.43	44.72	375.5	9.3	Nil	175.6	99.4	130	60	2.36
10	S10	7.5	10.5	4580	210	37.84	28.07	188.51	6.5	8	371.5	958.5	118	30	5.42
11	S1 1	8.6	4.6	3180	90	29.43	24.01	386.23	9.2	10	825.2	350	108	30	2.93
12	S12	7.8	4.1	2850	1315	12.61	332	234.49	3.8	Nil	498.2	171	295	25	5.4
13	S13	8.9	3.1	2130	1435	16.82	252.2	202.31	10.5	Nil	580	749	850	25	2.6
14	S14	8.6	1.8	5140	1400	15.75	270.3	331.05	2.45	Nil	726	1010	900	30	2.5
15	S15	7.5	3.8	2360	140	50.46	34	110.5	8	Nil	285.4	100	63	25	1.4
16	S16	7.2	5.2	3840	50	16.82	19.4	142.53	2.55	10	240.2	57	16	25	0.8
17	S17	7.7	3.8	2820	260	96.72	44.9	151.73	2.75	16	240.2	43	120	30	0.3
18	S18	8	4.2	2700	220	84.1	24.3	142.53	3.25	18	285.4	78	180	25	0.64
19	S19	8	4.4	3180	180	67.28	29.1	220.7	3.9	18	600.5	100	65	20	1.1
20	S20	7.9	4.4	3350	190	71.48	27.9	165.52	5.5	12	315	71	52	20	0.72
21	S21	8	4.6	4590	120	42.05	36.4	160.93	3.5	Nil	550.2	252	115	25	0.8
22	S22	8.2	4.7	4220	190	71.48	27.9	514.97	9.8	Nil	575.3	241	125	25	0.72
23	S23	9	2.6	1970	160	67.28	57.1	155.6	8	Nil	580	114	50	20	0.14
24	S24	7.5	3.2	635	230	82.1	97.2	216.1	7.2	Nil	330.8	730	13	2	1.1
25	S25	7.6	2.8	3710	625	96.1	88.1	331.05	5.86	10	435.8	299	490	500	1.16

All the values are in mg/L except pH and conductivity (mS/cm).

lands and waste dumps in rural and urban areas (Majumdar 2003). The greatest risk of nitrate poisoning (methaemoglobinaemia) occurs in infants fed with well water containing nitrates.

The fluoride content of groundwater ranged between 0.3 mg/L and 6.11 mg/L, which is a matter of great concern as the permissible limit for fluoride is 1.5 mg/L. About 36% of the samples showed higher concentration of fluoride than the maximum permissible limit. In Ajmer district, the widespread fluoride-rich water and the prevalence of fluorosis in certain areas are also indicative of features of regional and local geological significance (Bhargava et al. 1978). Higher fluoride concentration exerts a negative effect on the course of metabolic processes and an individual suffer from skeletal fluorosis, dental fluorosis, nonskeletal manifestations or a combination of the all.

Thus, an overall picture that arise from the present study reveals that most of the physicochemical parameters have high variation between lowest and highest values, thus, indicating that water is palatable at some places whereas at others it is totally unfit for consumption.

CONCLUSION

It is clear that there is an acute shortage of water, thus, creating a tremendous pressure on the fragile water resources due to high population growth and overconsumption, finally leading to the deterioration of quality and quantity of water. Some samples showed high content of TDS, fluoride, nitrate, bicarbonate, etc. along with high variability, which is a matter of great concern. As water resources are limited and the demand continues to rise steeply, it calls for an urgent need of an efficient planning and implementation of programmes of water resources appraisal, development, conservation and management in the study area.

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