A Study on the Chemistry of Ground Water in Rural Areas, of the Village Sawar, Ajmer District, Rajasthan, India

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Abstract

The paper deals with the determination of physio-chemical characteristics and quality of ground waters taken from different areas of village Sawar, Ajmer district, Rajasthan, India. The study of investigation area is made in the pre-monsoon , monsoon and post monsoon seasons of 2014-15. The variations in the values of EC, pH, Total hardness, TDS, chlorine, Na, K, Total Phosphate, Sulphate, DO and COD are not so remarkable in different seasons. It has become clear from the results that there is certain deterioration of water quality in some specific areas of the village Sawar. The hydro-chemical analysis reveal that present status of ground water in Sawar is marginally fit for irrigation and drinking purposes except for a few locations which may further deteriorate in future. However the water of different areas of village may be used safely for drinking and irrigation purposes. But for drinking purpose particularly during the pre-monsoon period sufficient remedial practices should be adopted. The probable reasons for the water quality degradation in some areas of the village Sawar are being investigated.

Keywords: Ground water, pH, Conductivity, Total hardness, Dissolved Oxygen, Chemical Oxygen demand.

Introduction

Ground water quality is important particularly as it accounts for about 90% safe drinking water in rural areas of Rajasthan India, where population is widely dispersed and the infrastructure needed for the treatment and transportation of surface water does not exist.The availability of ground water is neither unlimited nor it is protected from deterioration. For the development and management of ground water , assessment of its quality and quantity is essential pre-requisite (Athawale, R.N 1988). The unscientific and over exploitation of ground water leads to the deterioration of quality of both drinking and irrigation waters. (Hussain et.1991). The underground water is also contaminated by organic and inorganic materials like pesticides and detergents. (Dey, 1999). Levels of daily exposure to ions depend on the geographical area (Shrivastava, 2001). Deformation patterns in the Precambrian basement around Masuda, Central Rajasthan (J.Geol. Soc. India 2001).

In this context, ground water quality evaluation of rural drinking water supply in the village Sawar of Kekri block of Ajmer District, Rajasthan, India was carried. The rate of depletion of water levels and deterioration of ground water quality is of great concern. Water management is therefore a major challenge for planners and decision makers to ascertain the availability of good quality ground water for various users. The state of Rajasthan is one such state where the water level and its quality is fast deteriorating. Most of the blocks in Ajmer districts of Rajasthan have saline water.

The ground water resources in Ajmer district of Rajasthan are continuously under severe pressure due to ever increasing population. The quality of ground water varies from place to place depending upon the seasonal changes and depth to water table. It is primarily governed by the extent and composition of dissolved solids present in it. The kind and concentration of dissolved salts depends on their sources and nature of subsurface environment. For the development and management of ground water, assessment of its quality and quantity is essential pre-requisite. In this context, ground water quality evaluation of rural drinking water supply in village Sawar, Ajmer district Rajasthan, India was carried out. Due to green-revolution in the state there is over exploitation of ground water in many blocks of the districts, also the quality is getting

deteriorated fast due to industrial and agricultural activities and extensive use of pesticides. The top phreatic aquifers are getting degraded due to industrial effluents which are disposed off without treatment (Tiwana and Singh, 1995).

Area and Location

Ajmer District has an area of 8481 Sq. Km, and a population of 25,84, 913 (2011 census). The district is situated in the centre of Rajasthan, and is bounded by Nagaur District to the north, Jaipur and Tonk districts to the east, Bhilwara district to the south, and Pali district to the west. It is divided into eight blocks.

The eastern portion of the district is generally flat, broken only by gentle undulations, but the western parts, from north-west to south-west, are intersected by the great Arawali Range. Many of the valleys in this region are sandy deserts, part of India's Thar Desert, with an occasional oasis of cultivation, but there are also some very fertile tracts, among these is the plain on which lies the town of Ajmer.

Ajmer district is situated between 25o 38' & 26o 58' North latitude and 73o 54' & 75o22' East Longitude covering geographical area of 8,481 sq.km. The investigation area Sawar is located on 25o 58' North & 75o 09' East.

Materials and Methods

Water samples from ten hand pumps and tube wells were collected in duplicate from ten selected areas of the village Sawar of Ajmer district, Rajasthan, India in the pre-monsoon (March-May), during monsoon (June-Sept.) and in post monsoon season (Oct.-Feb.) in the year 2014-2015 and were analyzed in the laboratory.The water sampling has been carried out between 7:00 a.m. to 11:00 a.m. from March 2014 to Feb. 2015 from selected investigation areas following the standard procedures. Good quality, air tight plastic bottles with cover lock were used for sample collection and safe transfer to the laboratory for analysis. Water temperature and pH were 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. Bottles are cleaned by rinsing with dilute 1 (N) HNO_3 followed by washing with distilled water several times with adequate precautions (Brown et. Al.1974), pH of the water samples are measured by digital pH meter – Toshniwal make using glass electrodes. Specific conductance is measured by a systronics conductivity meter – 304 with a dip type cell after calibration with KCl solution. Chloride content is determined by titration with $AgNO_3$ solution using Potassium dichromate as indicator. (Jeffery et. al 1978). Total hardness is determined by titration with EDTA (Jeffery et. al 1978). Sodium and Potassium are estimated by Systronics Flame Photometer – 128. Sulphates are estimated by titrating with Barium Chloride. Phosphates are estimated by Spectro-photometer-169 after developing colour with ammonium molybdate and then measuring the absorbance at 460 nm.

The dissolved Oxygen in the water Samples are estimated following Winkler's method (Winkler,1988). Chemical Oxygen Demand of the water samples are estimated by the method developed by Marr (Marr et al 1983).

Table-1

Physicochemical Characteristic of Water Samples of Village Sawar. Parameters Measured in Pre-Monsoon Season (March-May 2014).Each Value is the mean of 8 to 10 Observations.

S.No	Site Name	EC	pH	NO_3	Total Hardness	TDS	Cl	Na	K	PO_4	SO_4	DO	COD
1.	Anjali Milk Dairy, Kekri road, Sawar	690	7.27	1.2	160	296	489	180	68	0.65	200	10.22	55.71
2.	Paras Cement Suppliers	680	7.24	2.8	210	281	580	40	62	1.29	202	10.22	20.22
3.	Sh.Ram Pyre kahar	620	7.67	3.82	220	287	560	98	28	2.15	190	8.23	66.70
4.	Tejaji, Kahar mohalla	1020	7.88	3.2	278	220	580	220	38	0.95	205	3.82	52.12
5.	Bhil Mohalla	530	7.58	2.6	290	136	380	110	41	2.26	202	7.63	44.36
6.	Aushdhalaya	2300	7.01	1.3	200	443	580	178	29	0.23	220	8.25	66.64
7.	Pyau, bus stand	860	6.49	2.8	301	800	280	115	35	1.82	204	9.02	66.42
8.	Regar mohalla	800	7.61	2.6	122	1040	260	118	58	1.28	206	8.21	32.58
9.	Koli Mohalla	300	7.51	1.8	331	94	580	168	42	0.24	201	7.63	20.20
10.	Pyau, Gol Hathai	330	7.58	1.3	580	293	380	176	35	2.05	200	9.02	52.18
	Average												
	Highest	2300	7.88	3.82	580	1040	580	220	68	2.26	220	10.22	66.70
	Lowest	300	6.49	1.2	122	94	260	40	28	0.23	190	3.82	20.20

All the Units Except pH, Specific Conductance (µmhos/cm) are in ppm i.e. Parts Per Million or mg/L.

Table-2
Physicochemical Characteristic of Water Samples of Village Silora. Parameters Measured During Monsoon Season (June-Sept 2014). Each Value is the Mean of 8 to 10 Observations.

S.No	Site Name	EC	pH	NO_3	Total Hardness	TDS	Cl	Na	K	PO_4	SO_4	DO	COD
1.	Anjali Milk Dairy, Kekri road, Sawar	640	7.44	2.1	120	282	460	105	22	1.28	202	7.51	68.12
2.	Paras Cement Suppliers	580	7.61	2.1	200	269	540	114	35	0.22	204	8.91	54.69
3.	Sh.Ram Pyre kahar	610	6.14	1.3	260	74	255	98	25	1.15	200	8.21	22.24
4.	Tejaji, Kahar mohalla	1610	6.91	0.1	540	846	600	190	50	2.23	201	4.411	22.84
5.	Bhil Mohalla	260	7.42	2.73	320	128	560	175	37	0.21	202	7.94	58.19
6.	Aushdhalaya	620	7.16	2.7	220	150	360	190	33	1.22	180	8.16	49.62
7.	Pyau, bus stand	250	7.22	1.8	250	177	480	200	56	2.01	196	7.94	46.32
8.	Regar mohalla	740	7.62	1.3	192	222	520	180	42	1.81	195	8.91	54.57
9.	Koli Mohalla	180	7.21	1.2	172	274	200	24	33	1.68	198	10.20	67.28
10.	Pyau, Gol Hathai	440	6.91	1.9	120	220	560	161	25	0.35	198	5.27	21.20
	Average												
	Highest	1610	7.62	2.73	540	846	600	190	56	2.23	204	10.20	67.28
	Lowest	180	6.14	0.1	120	74	255	24	22	0.21	180	4.41	21.20

All the Units Except pH, Specific Conductance (µmhos/cm) are in ppm i.e. parts Per Million or mg/L.

Table-3
Physicochemical Characteristic of Water Samples of Village Sawar. Parameters Measured During Post Monsoon Season (Oct.2014-Feb. 2015). Each Value is the Mean of 8 to 10 Observations.

S.No.	Site Name	EC	pH	NO_3	Total Hardness	TDS	Cl	Na	K	PO_4	SO_4	DO	COD
1.	Anjali Milk Dairy, Kekri road,Sawar	840	6.92	1.3	340	371	240	115	28	0.82	202	11.82	71.01
2.	Paras Cement Suppliers	940	7.51	1.29	290	82	410	140	36	0.79	198	10.26	52.96
3.	Sh.Ram Pyre kahar	1940	7.22	2.8	286	930	570	102	25	2.21	191	9.27	58.29
4.	Tejaji, Kahar mohalla	1790	7.61	2.2	520	622	510	180	43	1.44	198	4.62	72.40
5.	Bhil Mohalla	800	7.49	1.6	180	560	420	99	27	1.62	199	8.42	26.96
6.	Aushdhalaya	820	6.69	2.2	280	282	390	88	36	0.39	197	8.22	60.42
7.	Pyau, bus stand	726	6.20	1.9	330	242	360	120	32	0.20	189	7.22	65.56
8.	Regar mohalla	820	7.02	1.2	320	390	502	26	28	1.92	182	10.11	62.81
9.	Koli Mohalla	180	7.37	2.9	100	618	280	167	20	0.82	190	10.02	52.23
10.	Pyau, Gol Hathai	912	7.29	3.12	318	265	270	168	22	1.12	188	10.55	25.21
	Average												
	Highest	1940	7.61	3.12	520	930	570	180	43	2.21	202	11.82	72.40
	Lowest	180	6.20	1.29	100	82	240	26	20	0.20	182	4.62	25.21

All the Units Except pH, Specific Conductance (µmhos/cm) are in ppm i.e. parts Per Million or mg/L.

Results and Discussions

Electrical Conductivity (EC) and Total Dissolved Substances (TDS)

The values of Electrical Conductivity of ground water (tube well) ranged from 2300 to 300 µmhos/cm in the pre-monsoon ; it ranged 1610 to 180 µmhos/cm in the monsoon and 1940 to 180 µmhos/cm in the post monsoon seasons respectively. The conductivity values are lowering in the rainy season due to the dilution of soluble salts by rains. Rain water penetrates in the soil and raises the water level, thus dilution occurs. Similarly observation is made by Yaduvanshi (1995). EC is maximum in the premonsoon season, because of the lowering of ground water level which arise mainly due to excess of ground water lifting for agriculture, irrigation and cultivation. In a similar way the maximum TDS is observed in the pre-monsoon season 1040 to 94 mg/L. The values of dissolved particles ranged from 930 to 82 mg/L in the post monsoon and 846 to 74 mg/L in monsoon period. Electrical conductivity is related to TDS. As like electrical conductivity, the higher TDS value in the pre-monsoon season is also high due to lifting of excess water in most of the villages of the study area. Similar observations are also reported by Paka and Rao (1997).

pH

pH is a important parameter which guides not only the status of acid-alkali balance of the water but also serves as an important index for the degree of pollution. The factors like respiratory activity, exposure to air, temperature and disposal of sewage etc. bring about the changes in pH (Saxena 1987).The recorded values of pH in of the village Sawar, Kekeri district Ajmer, there are no significant changes in pH values(Table 1,2,3,) are not observed in pre-monsoon, monsoon and post monsoon seasons. Lowering of pH values from pre-monsoon season to post monsoon season may probably be due to dilution effect by rains. The values vary from 7.88 to 6.49 ppm in the pre-monsoon and 7.62 to 6.14 ppm during monsoon and 7.61 to 6.20 ppm in the post monsoon. In all the three seasons pH values are within the permitted limits. For domestic purposes the recommended limits by ICMR (1975) are 6.80 to 8.50 ppm.

Total NO_3

Apart from the geological sources, nitrate is generally contributed to ground water by industries, sewage,animal wastes and agricultural activities.Amount of total Nitrate values ranging from 3.82 to 1.2 ppm in the pre-monsoon season, 2.8 to 0.20 in monsoon and 3.12 to 2.29 ppm in post monsoon season. The nitrate values in the ground water of Sawar varies between 0.20 to 3.12 ppm .

The higher values of Nitrogen salts may be due to unscientific use of chemical fertilizers containing ammonia and ammoniun salts which penetrate into soil during Rabi and Kharib cultivation. The constant use of chemical fertilizers can raise the amount of Nitrates.The average mean value of nitrate is within the BIS (Bureau of Indian Standards) limit. Hence the perusal of the data shows that nitrate concentration in ground waters of all the areas in the village Silora is within the desirable limit.

Total Hardness ($CaCO_3$)

The total hardness during the study period in the investigation area of village Sawar varies from 580 to 122 ppm in the pre-monsoon season, 540 to 120 ppm in monsoon and 520 to 100 ppm in post monsoon season. The maximum hardness is observed in the pre-monsoon season in the investigation areas of the village Sawar which is followed by lowering of the value in the monsoon and post monsoon seasons. This may be due to lowering of water level in the pre-monsoon season. Similar results are also recorded by Pujari and Sinha (1999).

Sodium and Potassium (Na and K)

The different values of sodium and potassium content, Na: ranging from 220 to 40 ppm in the pre-monsoon season, 190 to 24 ppm in monsoon and 180 to 26 ppm in post monsoon season: K : ranging from 68 to 28 ppm in the pre-monsoon season, 56 to 22 ppm in the monsoon and 43 to 20 ppm in post monsoon season of the study area, are higher than the normal values (Heath, 2000) which may be due to infiltration of saline water of Gondolav lake (Kishangarh town). The values become lower during the monsoon and post monsoon seasons due to rain.

Phosphate (PO_4)

Presence of phosphate in the study area is high ranging from 2.26 to 0.23 ppm in the pre-monsoon season, 2.23 to 0.21 ppm in monsoon and 2.21 to 0.20 ppm in post monsoon season. This may be due to the application of the chemical fertilizers used during the Agricultural practices. Although these values are not harmful for the agricultural lands and also for human beings but it is an alarm to the environmentalists.

Sulphate (SO_4)

The sulphate values varies from 220 to 190 mg/L in the pre-monsoon season, 200 to 184 mg/L in monsoon and 202 to 182 mg/L in post monsoon season. The values are within the safe limit for house hold and agricultural uses. The values are decreasing from pre-monsoon to post monsoon period.

Dissolved Oxygen (DO)

The maximum value recorded is 11.82 to 4.62 mg/L in the village Sawar in the post monsoon period with the maximum 10.22 to 3.82 mg/L during the pre-monsoon period and 10.20 to 4.41 mg/L during the monsoon period. Although the high values do not totally correspond the ICMR (1975) values, But the values (Table 1,2 and 3) in all the seasons support Masood and Krishnamurty (1990). The oxygen resources of the test waters do not seem to be stressed to any significant extent. The water quality in general, is not deleterious.

Chemical Oxygen Demand (COD)

It is a measure for ascertainment of the extent of oxidisable matters like organic compounds and others present in water which in turn indicates the quality of water by aesthetic view (Rudd, 1979) and the amount of pollutant present in the water. The COD values of the present study thus recorded 66.70 to 20.20 ppm in the pre-monsoon season, 67.28 to 21.20 ppm in monsoon and 72.40 to 25.21 ppm in post monsoon season. The increasing values from the pre-monsoon to post monsoon period may be due to increased in infiltration of bio-mass and organic matters during rains in the rural area.

Conclusion

The hydro-chemical analysis in most of the areas of the village Sawar and in some sites of the rural areas of investigation, there are variations in the physico-chemical parameters in underground water of village Sawar, Kishangarh District Ajmer, Rajasthan

studied in the year 2011-2012 shows higher values in the pre-monsoon season and lower values in post monsoon season. This is mainly due to overlifting of underground water for Agriculture, irrigation, cultivation, Industrial activities and construction of buildings during the last four decades. This should be stopped immediately and other fruitful measures must be taken to ensure pure and good quality drinking water supply. Increase of COD values in the village tube well waters indicate want of proper sanitation in this area. The physico-chemical parameters such as pH, EC, Total NO3,Total hardness, TDS, Chlorine, Sodium, Potassium, Phosphate, Sulphate, Dissolved oxygen and chemical oxygen demand, do not exceed to much from the safe limit for drinking and agricultural purposes.

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