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LIMNOCHEMISTRY OF GROUND WATER OF SRI GANGANAGAR DISTRICT (RAJASTHAN) INDIA

Indira Saharan*

Department of Zoology Ch. Ballu Ram Godara Govt. Girls (P.G.) College Sri Ganganagar (Rajasthan).

Corresponding Author: Indira Saharan
Department of Zoology Ch. Ballu Ram Godara Govt. Girls (P.G.) College Sri Ganganagar (Rajasthan).

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ABSTRACT

The drinking water quality directly affects human health. The present investigation is thus a small contribution to understand the quality status of ground water of different villages of Sri Ganganagar district of northern Rajasthan. For sample collection Ganganagar district was divided in six different zones namely zone A, B, C, D, E and F. Total 11 physico-chemical parameters were analyzed. Total 11 physico-chemical parameters such as pH, freeCO_2, dissolved oxygen; chloride, Total hardness, calcium hardness, magnesium hardness, total alkalinity, sulphate, nitrate and total dissolved solids were analyzed. The parameters analyzed in present study show that the ground water is slightly hard water but all the parameters are within the permissible limits for drinking water recommended by WHO, BIS and ICMR.

KEYWORDS: Drinking water, ground water, limnochemistry, physico-chemical.

INTRODUCTION

Water is one of the most abundant substances on the earth. It is essential for survival of any plant and animal, but this valued resource is increasingly being threatened as human populations grow and demand more water of high quality for domestic purposes and economic activities. Water, the precious gift of nature for human beings, is being polluted day-by-day with increasing urbanization. Although three-fourth of the earth is being surrounded by water, a little portion of it can be used for drinking purpose. Water pollution is a phenomenon that is characterized by the deterioration of its quality as a result of various human activities (Akintola and Amadi, 2003). In India, around 62.5 million people are suffering from disorder of teeth or bones through fluorosis, which is due to consumption of Fluoride-rich water (Mayur, *et. al*., 2008). The drinking water quality directly affects human health. According to W.H.O., about 80% of all the diseases in human beings are caused by water. In developing countries like India, most of the diseases such as gastroenteritis, diarrhea, dysentery, cholera, enteric fever etc prevail due to unsafe drinking water. Only 12% of people get good drinking water. The chemistry of natural surface waters is complex, and depends on the equilibrium reached with the normal physical, chemical and biological characteristics of the surrounding environment. Thus, there can never be a normal surface water quality; every natural water will have a different composition (Alabaster and Lloyd, 1980). Ground water is considered as one of the purest forms of water available in nature and meets the overall demand of rural as well as urban population. With the growth of industry the ground water is made susceptible for contamination due to addition of waste materials. Waste materials from the factories percolate with rain water and reach aquifer resulting in erosion of ground water quality. The inherent or borrowed chemical properties of water cause various disorders in the human body. All the above mean that it is necessary to know the quality of water used for drinking and other domestic uses including the use by home animals. Only on knowing to water quality one can plan corrective or remedial measures to make the water potable. Characteristics required for drinking water are specific. It is, therefore, very important to know the quality of drinking water so as to know the possible effects of this water on human beings and animals. The present investigation is thus a small contribution to understand the quality status of drinking water of different villages of Sri Ganganagar district of northern Rajasthan.

MATERIAL AND METHODS

Site description

The area of study Sri Ganganagar district is situated in the north-western part of the state of Rajasthan in the Thar Desert. (Latitude 28.4 to 30.6 and Longitude 72.2 to 75.3) The district Ganganagar has an area of 11,154.66 sq. km., a population of 19,69,168 (2011 census) and a population density of 179 persons/km^2. It is bounded on the north by Punjab state on the east by Hanumangarh

district, on the south by Bikaner district of Rajasthan and on the west by Pakistan. The major work of the district is farming. The river Ghagghar traversing this region is purely seasonal river but gets flash floods during monsoon. The soil of the region is moderate to highly porous and thus non-retentive for water. The climate of this region is semi arid with extreme temperature conditions in summer touching up to 50^0C and in winter up to 0^0C. The site is influenced by the Indian Southern-west or summer monsoon (June-September) and during winter (December-February) by Siberian anti-cyclones. The main rainy season is during July and August when almost 80% of the annual rainfalls. The annual mean rainfall of this region is ranged between 200-250 mm. In the present investigation sampling was done from 100 villages of Sri Ganganagar district and Sri Ganagnagar city. For the sampling point of view the Ganganagar district was divided in six zones namely zone A, B, C, D, E and F.

Water Samples Collection

Total 170 water samples were collected from different sites of 100 different villages/towns in Ganganagar district and Sri Ganganagar city. For sample collection Ganganagar district was divided in six different zones namely zone A, B, C, D, E and F. For ground water Zone A and zone-E each consists of 16 sampling points, zone B and zone-D each consists of 21 sampling points, while zone-C consists of 23 sample points and zone-F consists of 10 sample points. The selection of sample sites was based on population density, environmental conditions and nearness of domestic pollution. Total 107 samples were collected from ground water (hand pump, tube well). The samples were collected from May, 2015 to December, 2015.

RESULT AND DISCUSSION

The result obtained from physico-chemical analysis of 107 ground water samples of Sri Ganganagar district are given in table 1 to 6. Total eleven physico-chemical parameters such as pH, freeCO_2, dissolved oxygen; chloride, Total hardness, calcium hardness, magnesium hardness, total alkalinity, sulphate, nitrate and total dissolved solids were analyzed. These results were compared with WHO (1963), BIS (1991) and ICMR (1975) drinking water standard.

pH

pH is one of the most important indicator of the quality of water. Though pH has no direct effect on human health, but alters the taste of water. All the biochemical reactions are sensitive to variation in pH. For most of the reactions as well as for human beings, pH seven of drinking water is considered as the best and ideal. In present investigation the groundwater pH was more or less similar in all sample points. The pH for the ground water samples varied between 6.20 (in AS_{15}) to 8.74 (in DS_{19}) with an average value of 7.53. The pH of ground water for all the samples was ranged within permissible limits of WHO & BIS.

Free Carbon dioxide

Carbon dioxide is amongst the common nutrients needed in relatively large quantities by aquatic organisms for their cell development apart from diffusion into water from atmosphere, the CO_2 enter water bodies through precipitation, infiltration and as products of metabolic activity of the organisms in water. The high range of CO_2 is present in polluted water. In present study free carbon dioxide was present in all ground water samples. The value ranged from 1.80 mg/l (in AS_{12}) to 35.2 mg/l. (in AS_{13} & ES_1) with an average value of 9.95 mg/l. The free CO_2 of groundwater were in the permissible limits.

Dissolved oxygen (DO)

The dissolved oxygen (DO) test measures the amount of life sustaining oxygen dissolved in the water. Low level of oxygen in water is a sign of possible contamination. The dissolved oxygen can be expressed either as a concentration (in mg/l or ppm) which is an absolute value, or as percentage saturation, which is an expression of the proportion of dissolved oxygen in the water relative to the maximum concentration of oxygen that water at a particular temperature, pressure, and salinity can dissolve (Department of water Western Australia, 2009). It may be present in water due the direct diffusion from air and photosynthetic activity by autotrophs. The optimum range of dissolved oxygen in natural water is 4 to 6 mg/l. (Gupta and Singh, 2000).

In the present study the dissolved oxygen in groundwater ranged from 1.6 mg/l (in BS_6) to 9.0 mg/l (in BS_{17}) with an average of 4.15 mg/l. In the present study the dissolved oxygen in most of the water samples were reported above the limiting value of 3 mg/l.

Chloride

Chloride is one of the most important parameter in assessing the water quality. It is widely distributed element in all types of rocks in one or other form. Its affinity towards sodium is high. Therefore, its concentration is high in ground water, where the temperature is high and rainfall is less. Soil porosity and permeability also has a key role in building up the chloride concentration (Chanda, 1999). In the present study the chloride concentration of groundwater fluctuated between 3.0 mg/l (in AS_3) to 202.5 mg/l (in BS_{19}) with an average value of 45.57 mg/l. Chloride concentration was generally below the permissible limit (250 mg/l) for groundwater.

Total Hardness

The hardness of water reflects the nature of the geological formations with which the water has been in contact. Inland surface water is generally softer than ground water. Hardness is the property of water which prevents the lather formation with soap and increase the boiling point of water (Patil and Patil, 2010). In a semi quantitative scale, water is classified on the basis of the degree of hardness (Abbasi, 1995) as:-

(a) Soft water 75mg.l (as $CaCO_3$) hardness
(b) Moderately hard water 75 to 150mg/l (as $CaCO_3$) hardness
(c) Hard water 150 to 300 mg/l (as $CaCo_3$) hardness
(d) Very hard water 300 mg/l (as $CaCo_3$) hardness

Hardness is important to the pot ability of water, very hard water may cause gastrointestinal discomforts while very soft water, too low in calcium, in known to contribute to heart ailments and calcium deficiency in human (Abbasi,1995). In the present study the hardness of ground water ranged from 18 mg/l (in BS_4) to 570 mg/l (in ES_8) with an average value of 227.4 mg/l. Based on above classifications for hardness the water samples in present study were classified as

Table-5: Classification of water samples on basis of hardness.

S. No.	Ground water Samples	
	Types of Water	Percent of Samples
a.	Soft water	6.54
b.	Moderately hard water	22.42
c.	Hard Water	45.79
d.	Very hard water	25.23

About 71% ground water samples were fall under hard (45.73%) and very hard (25.23%) water and about 29% samples were fall under soft and moderately hard water, Total hardness for ground water fall within the limit of 500mg/l .Only two ground water sampling stations DS_{13}(540 mg/l) and ES_8 (570mg/l) cross the permissible limit.

Table-1: Physico-chemical parameters of Ground Water of Zone – A.

Sr. No.	Sampling Stations	Parameters										
		pH	CO2	DO	Cl	T.H.	CaH	MgH	Total Alkalinity	SO4	NO3	TDS
1	AS1	7.9	8.8	2.6	4.26	84	42.8	10.1	12	10.1	4.8	1110
2	AS2	7.8	4.4	3.6	18.4	204	56.6	35.8	31	8.4	8.9	1040
3	AS3	7.36	12	3.2	3	112	58.7	12.9	30	10.3	13.7	280
4	AS4	7.82	11.8	4.7	8.6	164	74.7	21.6	26	9.6	11.6	748
5	AS5	7.8	8.6	4.4	3.8	86	52.5	8.4	19	8.7	12.1	342
6	AS6	6.94	11.6	3.7	14.6	108	67.6	9.8	27	8.2	7.4	1100
7	AS7	7.18	13.1	4.3	4.8	96	42.5	13	18	9.4	6.1	1070
8	AS8	7.24	7.4	5.1	9.5	116	83.5	7.8	18	7.6	6.4	960
9	AS9	7.7	3.3	4.7	68	406	106	72.9	37	11.3	9.8	1190
10	AS10	7.28	6.4	5.4	61.6	290	62.5	55.2	14	9.6	3.4	780
11	AS11	6.8	4.2	3.6	32.1	330	102	55.4	24	4.8	5.3	260
12	AS12	7.04	1.8	3.8	49.7	370	94.4	66.9	18	6.8	10.1	600
13	AS13	7.34	35.2	4	21.3	104	68.2	8.6	24	3.2	7.3	1500
14	AS14	7.16	4.4	2.4	79.5	300	190.1	9.6	38	8.6	8.3	2270
15	AS15	6.2	7.4	1.8	63.9	350	160	80.9	16	12.4	8.4	1610
16	AS16	7.44	13.2	5.6	46.1	160	16.8	34.7	18	11.7	4.3	1400

Table-2: Physico-chemical parameters of Ground Water of Zone-B.

Sr. No.	Sampling Stations	Parameters										
		pH	CO2	DO	Cl	T.H.	CaH	MgH	Total Alkalinity	SO4	NO3	TDS
1	BS1	6.7	12.6	2.4	163	28	13.3	3.5	26	8.4	5.6	202
2	BS2	7.24	11.4	3.6	154	70	28.2	41.8	38	6.8	7.3	210
3	BS3	6.92	8.4	4.7	167	64	29.3	8.4	42	2.8	8.4	240
4	BS4	6.8	11.2	3.8	158	18	7.8	2.4	32	7.8	6.1	196
5	BS5	7.8	9.8	4.2	62	210	81.5	31.2	36	8.4	8.3	198
6	BS6	8.02	7.6	1.6	29.8	300	92.5	50.4	40	7.6	4.7	570
7	BS7	7.83	11.4	3.8	36.4	270	84.5	45	23	7.3	7.2	496
8	BS8	7.32	9.7	5.3	14.6	64	29.6	8.3	24	6.8	7.6	208
9	BS9	7.53	8.8	5.2	4.2	50	21	7	14	8.8	2.8	200
10	BS10	6.96	6.4	5.6	66.7	180	75.6	25.3	18	14.1	7.8	310

11	BS11	6.8	9.6	2.4	41.8	130	54.6	18.3	28	7.4	7.3	237
12	BS12	7.06	8.8	2.6	11.3	92	38.6	12.9	20	6.8	3.3	211
13	BS13	7.02	7.6	2.4	15.6	220	92.5	30.9	14	6.6	1.8	312
14	BS14	7.5	8.2	4.1	19.8	202	88	27.7	36	8.04	7.8	220
15	BS15	6.94	10.2	5.1	16.3	170	82	21.3	28	8.8	6.8	320
16	BS16	6.76	7.6	3.6	3.1	120	75.6	10.7	34	6	2.3	240
17	BS17	7.09	9.6	9	31.9	200	84.1	28.1	20	12.8	4.8	340
18	BS18	7.14	11.4	4.3	61.4	174	66.4	26.1	27	7.4	5.2	460
19	BS19	7.52	7.2	4.8	202.5	190	79.8	26.7	16	11.8	4.1	280
20	BS20	7.73	13.2	7.2	60.3	82	67.2	3.5	20	11.6	4.1	120
21	BS21	7.4	2.4	2.8	5.68	70	46.2	10	18	11.4	5.4	160

Table-3: Physico-chemical parameters of Ground Water of Zone-C.

Sr. No.	Sampling Stations	Parameters										
		pH	CO2	DO	Cl	T.H.	CaH	MgH	Total Alkalinity	SO4	NO3	TDS
1	CS1	7.4	4.4	3.8	35.3	110	68.9	9.9	16	8.3	1.4	400
2	CS2	7.28	6.2	4.1	64.6	190	80.1	26.7	22	6.4	4.3	800
3	CS3	7.62	2.4	5.3	31.3	210	69.4	34.1	26	8.1	2.7	1130
4	CS4	7.8	10.1	4.7	19.8	164	47.6	28.2	18	6.2	4.5	1060
5	CS5	7.42	9.6	3.6	21.3	76	26.7	11.9	20	7.6	9.7	576
6	CS6	7.35	2.2	3	68.1	110	11.7	23.8	14	5.4	8.1	802
7	CS7	7.96	8.8	3.1	170	320	92.5	55.2	14	10.2	8.4	800
8	CS8	7.8	22	3.6	10.6	200	32.1	40.7	16	12.1	5.3	630
9	CS9	7.3	12.2	4.8	17.1	280	142.7	33.3	14	7.5	4.8	780
10	CS10	7.84	9	4.2	80.2	320	56.8	63.9	31	8.1	6.1	600
11	CS11	7.88	3.6	4.4	52.4	308	86.3	53.8	13	2.4	3.1	300
12	CS12	8.01	5.4	5.6	36.5	212	67.7	35	29	6.8	4.8	980
13	CS13	7.92	11.2	3.9	39.1	241	88.1	37.1	17	6.4	7.2	630
14	CS14	7.42	7.2	4.3	18.6	182	28.4	37.3	23	4.9	12.1	810
15	CS15	7.18	8.4	4.7	33.2	190	24.5	40.2	11	7.5	6.4	430
16	CS16	7.56	5.1	3.9	68.6	218	46.3	41.7	19	13.6	7.4	780
17	CS17	7.42	7.2	3.7	69.2	262	63.6	48.2	20	9.6	6.3	318
18	CS18	7.76	7.8	6.2	32.1	197	24.8	41.8	22	9.1	3.3	260
19	CS19	7.96	7.2	7	42.1	108	18.7	21.6	18	10.1	2.9	1010
20	CS20	7.88	12.2	3.7	12.7	110	77.3	7.9	22	8.1	8.1	710
21	CS21	7.92	11.6	3.9	39	274	78.4	47.5	24	12.8	4.2	880
22	CS22	7.84	12	3.7	37.3	226	83.3	34.6	21	13.8	3.8	490
23	CS23	7.67	4.2	4.4	44.6	176	58.4	28.5	18	6.6	2.2	680

Table-4: Physico-chemical parameters of Ground Water of Zone-D.

Sr. No.	Sampling Stations	Parameters										
		pH	CO2	DO	Cl	T.H.	CaH	MgH	Total Alkalinity	SO4	NO3	TDS
1	DS 1	7.8	8.8	4.6	85.2	110	92.6	4.2	14	6.5	9.2	400
2	DS 2	7.78	8.4	3.6	10.6	80	83.4	0.8	28	10.2	6.4	380
3	DS 3	7.26	7.8	4.2	18.6	118	88.4	7.1	32	11.4	4.4	710
4	DS 4	7.74	17.6	3.8	7.1	276	37.8	57.9	28	4.8	2.2	838
5	DS 5	7.8	22.8	3.2	120	340	50.4	70.3	24	12.8	7.6	1300
6	DS 6	7.67	12.4	4.6	132	410	90.4	77.6	32	11.8	9.2	800
7	DS 7	7.6	22	3.4	29.8	90	78	2.9	40	10.8	7.2	250
8	DS 8	8.1	14	4.1	22.6	280	94	45.1	23	6.4	6.1	740
9	DS 9	7.74	9.8	5	27.2	313	109	49.5	29	3.2	6.8	980
10	DS 10	7.84	16.4	3.8	8.5	300	37.8	63.7	18	8.8	7.8	954
11	DS 11	8.23	19.3	4.5	23	500	108.5	95.1	41	11.3	8.3	1610
12	DS 12	7.8	10.2	3.9	22	349	97.3	61.1	34	3.4	8.3	770
13	DS 13	8.26	13.2	4.4	11.3	540	54.6	117.9	18	11.8	9.6	1300
14	DS 14	7.2	30	3.6	24.8	294	79.8	52	10	12.7	4.9	1200
15	DS 15	6.82	18.4	4.5	34	249	60.5	45.8	23	11.6	7.1	1280

16	DS 16	7.62	7.8	4.1	18.4	310	90.2	29.1	21	8.9	4.2	1568
17	DS 17	7.6	11.3	5.2	25.6	190	45.7	33.7	18	11.5	10.1	680
18	DS 18	8.7	2.8	4.4	7.1	100	15.1	20.6	10	8.3	1.1	306
19	DS 19	8.74	6.3	5.1	13.4	134	26	26.4	18	10.6	7.3	376
20	DS 20	8.44	17.6	4	49.7	462	46.2	101	16	7.2	8.2	402
21	DS 21	7.84	8.2	4.3	38.6	210	81.3	31.2	18	8.3	4.6	690

Table-5: Physico-chemical parameters of Ground Water of Zone-E.

Sr. No.	Sampling Stations	Parameters										
		pH	CO2	DO	Cl	T.H.	CaH	MgH	Total Alkalinity	SO4	NO3	TDS
1	ES1	7.13	35.2	4.2	106.5	280	127.7	37	18	7.2	4.3	1200
2	ES2	7.40	5.2	3.2	74.5	260	81.8	43.3	18	9.7	3.1	800
3	ES3	7.38	6.8	4.4	62.1	230	76.1	37.3	16	8.8	3.8	900
4	ES4	7.64	6.3	4.7	51.4	212	58.6	37.2	22	7.9	4.6	860
5	ES5	7.35	6.4	2.4	127.8	200	74.5	30.4	30	11.3	6.7	710
6	ES6	7.86	6.4	3.9	74.2	190	42.8	35.7	28	6.4	1.8	680
7	ES7	7.76	8.2	4.7	76.2	272	90.2	44.1	19	9.1	3.6	644
8	ES8	7.56	4.4	4.4	28.4	570	131.6	106.5	14	8.3	3.4	1400
9	ES9	7.50	17.6	3.2	19.1	120	36.4	20.3	38	11.6	6.3	490
10	ES10	7.28	17.6	3.2	62.4	440	51	94.5	48	12.5	4.6	692
11	ES11	7.36	3.8	5.2	34.6	340	62.1	67.5	34	6.9	4.12	880
12	ES12	7.38	16.1	3.9	66.4	308	84.3	54.3	18	7.6	7.8	658
13	ES13	7.30	4.4	4.8	28.4	256	159.7	23.4	28	10.3	5.2	800
14	ES14	7.32	8.8	3.6	63.9	440	217	29.8	36	7.2	4.5	960
15	ES15	7.33	6.6	4.8	63.1	460	146.6	76.1	36	7.1	8.3	1300
16	ES16	7.62	5.6	4.6	37.2	360	72.2	69.9	24	3.4	2.7	1080

Table-6: Physico-chemical parameters of Ground Water of Zone-F.

Sr. No.	Sampling Stations	Parameters										
		pH	CO2	DO	Cl	T.H.	CaH	MgH	Total Alkalinity	SO4	NO3	TDS
1	FS1	7.72	6.4	4.2	66.4	310	56.1	61.6	16	6.2	6.4	712
2	FS2	7.1	11.2	2.8	34	264	72.7	46.4	42	2.4	3.4	336
3	FS3	7.18	10.5	5.1	18.6	301	91	51	30	8.1	1.3	860
4	FS4	7.9	5.8	4.3	12.8	286	70.4	52.3	24	10.6	4.1	722
5	FS5	8.06	8.8	3.8	8.5	180	54.6	30.4	20	9.1	6.2	410
6	FS6	8.16	13.2	4.2	35.5	360	168.2	46.6	30	8.2	3.8	980
7	FS7	7.94	13.1	4.3	24.3	396	101	71.6	42	8.6	7.4	1604
8	FS8	7.98	3.2	3.9	56.4	354	68.4	69.4	27	7.8	5.6	1120
9	FS9	7.46	2.8	2.8	19.8	281	67.3	51.9	33	9.3	3.7	460
10	FS10	7.38	9.6	5.4	36	144	46.5	23.6	18	6.7	3.6	1010

Calcium and magnesium

The observed value of calcium for ground water was ranged from 7.8mg/l (in BS_4) to 217 mg/l (in ES_{14}) with an average value 71.65 mg/l. The observed values of calcium for ground water were within the permissible limits. A small concentration of calcium is reducing corrosion in water pipes.

The observed magnesium value for ground water was varied from 0.8 mg/l (in DS_2) to 117.9 mg/l (in DS_{13}) with an average value of 37.86 mg/l. Observed value of magnesium in present study was within the permissible limit. Magnesium hardness particularly associated with sulphate ion has laxative effect on person unaccustomed to it (Khursid, 1988). The magnesium and calcium quantities in ground water depend upon the type of rocks. (Akoteyon et al., 2011).

Total Alkalinity

The alkalinity of water is its capacity to neutralize a strong acid and is characterized by the presence of all hydroxyl ions capable of combining with hydrogen ion. In the present investigations the alkalinity of ground water was ranged from 10mh/l (in DS_{14} and DS_{18}) to 48mg/l (in ES_{10}) with an average value of 24.07 mg/l. In surface water alkalinity was varied from 4 mg/l (in AS_9) to 30mg/l (in AS_2) with an average value of 15.93 mg/l. The observed values of alkalinity for both ground water and surface water were within the permissible range of WHO. Moyel (1946) proposed that alkalinity of 40ppm could be considered a dividing line between hard and

soft water. Based on this water samples investigated were fall under soft water.

Sulphate

Sulphate is found in small quantities in ground water. Sulphate may come into ground water by dissolving of minerals like gypsum and anhydrite or by industrial or anthropogenic additions in the form of sulphate fertilizers. Sulphate ion does not affect the taste of water if present in low concentration. In present investigation the sulphate ion concentration for ground water was ranged from 2.4 mg/l (in CS_{11}& FS_2) to 14.1 mg/l (in BS_{10}) with an average value of 8.54 mg/l. The sulphate ion value for surface water was ranged from 0.04 mg/l (in CS_{11}) to 7.4 mg/l (in BS_3) with an average value of 3.15 mg/l. The observed value of sulphate for both the, ground water and surface water in present study was found within the permissible limits of WHO (1993) (250 mg/l). Bouwer (1978) report that sulphate concentrations in drinking water should not exceed 250 mg/l because the water will have a bitter taste and can produce laxative effects at higher levels.

Nitrate

Nitrate is an important parameter in water quality assessment. It may be found naturally in groundwater or due to human activities such as leaching of animal manure or chemical fertilizer (www. Env.gov.bc.ca). Generally water bodies polluted by organic matter exhibit higher values of nitrate. In the present study nitrate values in ground water ranged from 1.3 mg/l (in FS_3) to 13.7 mg/l (in AS_3)with in average of 5.93 mg/l. Whereas, nitrate values observed in surface water was ranged from 0.4 mg/l (in BS_1) to 4.6 mg/l (in CS_8) with an average value of 1.87 mg/l.

In the present study water samples of both ground water and surface water showed low concentration of nitrate well below permissible levels of WHO (45 mg/l).The ground water contamination is due to the leaching of nitrate present on the surface with percolating water. Nitrate in high concentration has been observed in ground water of Churu of Rajasthan (Kugali et al, 2013). Moreover, the increased nitrate level in drinking water may adversely affect the central nervous system (Chern et al, 2005).

Total dissolved solids (TDS)

TDS is important parameter in drinking water. This includes various kinds of minerals present in the water. Organic substance present in the polluted water may also contribute to the TDS. However, dissolved solids do not conation any gas and colloids. In natural waters, TDS are composed of mainly of carbonates, bicarbonates, chlorides, sulphates, phosphates and nitrate of calcium, magnesium, sodium, potassium and manganese (Mahandnda, 2010). Dissolved solids give a particular taste to the water at high concentration and also reduce its palatability. High concentration of dissolved solids above 3000 mg/l may also produce distress in cattle and live stock. In industries, the use of water with high amount of dissolved solids may lead to the sealing in boilers, corrosion and degraded quantity of the product. In the present investigation the value of TDS for groundwater varied from 120 mg/l (BS_{20}) to 2270 mg/l in (AS_{14}) with an average value of 726.2 mg/l. whereas, the TDS value for surface water was observed between 100 mg/l (in BS_5) to 1884 mg/l (in CS_4) with an average value of 748 mg/l. The TDS value for both ground water and surface water was within the maximum permissible limit 2000 mg/l of BIS. Only one ground water sample point (AS_{14}) had 2270 mg/l TDS which was probably due to high waste disposal around the sample point. Similar view have expressed by Dasgupta and Purohit (2000).

CONCLUSIONS

The present study was undertaken with an aim to analyze certain physico-chemical parameters in the ground water and surface water samples in different villages of Sri Ganganagar district.

1. The parameters analyzed in present study show that the ground water is slightly hard water but all the parameters are within the permissible limits for drinking water recommended by WHO, BIS and ICMR.
2. This study would help the water quality monitoring and regulation in order to improve the quality of drinking water with better sustainable management.
3. The outcome can be taken into consideration by the authorities concerned to take the needed measures to safeguard the quality of the respective water resources.
4. The finding of this study are expected to convey essential information on the safe use of the waters from tube well, hand pumps and tanks.

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