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Limnochemistry of Surface Water of Different Villages of Sri Ganganagar District (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 surface 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 63 samples were collected from these six zones. The 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 surface water is normal soft water and all the parameters are within the permissible limits for drinking water recommended by WHO, BIS and ICMR.

Keywords - Drinking water, surface water, limnochemistry, physico-chemical.

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INTRODUCTION

Water is basic precondition for life. Quality and quantity of water at a place plays a vital role in Health, Wealth and Prosperity of the region. Water is a critical need for most human activities like household use, agriculture and industrial operations. In developing countries such as India, the bulk of the population lives in rural and remote areas with no access to clean and safe drinking water. The surface water bodies, which are the most important sources of water for human activities are unfortunately under severe environmental stress and are being threatened as a consequence of developmental activities.

Safe drinking water is defined as being free from biological contamination (guinea worm, cholera, typhoid, etc.) and chemical contamination (excess fluorides, brackishness, excess iron, arsenic, nitrates, etc.). Safe drinking water has special importance for keeping good health. For want of safe water people are bound to suffer from various kinds of stomach related diseases. Cholera, diarrhoea, dysentery, typhoid, guinea worms, fluorosis, jaundice are some of the most common forms of health hazards in rural areas because of the dependence of general population on contaminated water. As water is essential for the existence of human beings, some kind of facilities for drinking water, as commonly expected, is available in all inhabited villages. But, the quality of safe drinking water is possible only through tap, tube well or hand pump, which are not sufficiently available in rural areas. It is true that these three sources are also not free from contamination, they are, however, reasonably better than other sources of drinking water, such as well, river, fountain, canal or lake.

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 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. In the present investigation sampling was done from 63

villages/towns 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

The water samples were collected from different sites of 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. The Zone A consists of 11 sample points, zone-C consists of 12 sample points and zone-B, zone-D, zone-E and zone-F each consists of 10 sampling points(Table 3 and 4). The selection of sample sites was based on population density, environmental conditions and nearness of domestic pollution. Total 63 samples were collected from supply water (Surface water). The samples were collected from May, 2015 to December, 2015.

Methodology for Water Quality Analysis

Water samples were collected in one liter polythene sampling bottles from different sites of Sri Ganganagar district and analyzed according to strict sampling protocols described by Gale and Robin (1989). Analysis of pH, CO_2 and dissolved oxygen were conducted on site with portable kit. The samples were transported in ice cooler. Chemical analysis of the water samples were conducted using standard methods recommended by APHA (1998), Trivedi and Goel (1984)

Result and Discussion

The result obtained from physico-chemical analysis of 63 surface 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

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 surface water pH was more or less similar in all sample points. The surface water pH varied between 7.00 (in AS_9) to 8.10 (in DS_5) with an average value of 7.54. The pH for all the samples was ranged within permissible limits of WHO & BIS.

Free Carbon dioxide

The carbon dioxide content of water depends upon the temperature depth, range of respiration, decomposition of organic matter, chemical nature of the bottom and geographical feature of the terrain surround in the water body. The high range of CO_2 is present in polluted water. In present study free carbon dioxide was ranged from 0.0 mg/l. to 13.2 mg/l (in AS_5 & ES_1) with an average 3.19 mg/l. The free CO_2 was absent in about 2/3 surface water sampling stations. The free CO_2 was in the permissible limits.

Dissolved oxygen (DO)

The Oxygen is the one of most important factor in any aquatic ecosystem. The main sources of dissolved oxygen are from the atmosphere and the photosynthesis.

There is no standard for dissolved oxygen for water quality assessment. Low D.O. gives bad odour to water due to anaerobic decomposition of organic wastes.

The D.O. level in natural waters depends upon physical, chemical and biological activities prevailing in the water bodies. The amount of D.O. also varies with water temperature and altitude. Depletion of D.O. is enhanced by high concentration of organic matter of the water bodies (Rana and Palharia 1988).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. 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 surface water varied from 2.4 mg/l (in AS_{10}) to 8 mg/l (in ES_3) with an average value of 4.27 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. High chloride content can cause high blood pressure in people. Chloride in excess (<250 mg/l) imparts a salty taste to water and

people who are not accustomed to high chloride may be subjected to laxative effect. High Chloride concentration is also an indicator of large amount of organic matter (Yadav2002) 14. In the present study the chloride concentration of surface water varied between 2.8 mg/l (in AS_1& AS_2) to 27.6 mg/l (in CS_{11}) with an average 10.39 mg/l. Chloride concentration was generally below the permissible limit (250 mg/l) for all samples.

Total Hardness

Hardness is a measure of the ability of water to cause precipitation of insoluble calcium and magnesium salts of higher fatty acids from soap solutions. The principal hardness causing cations are calcium, magnesium bicarbonate, carbonate, chloride and sulphates. Hardness below 300 mg/l is considered potable but beyond this limits cause gastro-intestinal irritation (ICMR 1975). Normal water hardness does not pose any direct health problems. Jain et.al 1998 reported that high concentration of hardness (150 to 300 mg/l and above) May cause kidney problems 16.

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, 2008) 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

In the present study the hardness was varied from 28 mg/l (in BS_4) to 162 mg/l. (in DS_5) with an average value 82.76 mg/l. On the basis of above classification about 46.04% water samples fall under soft water and rest (53.96%) under moderately hard water. Total hardness fall within the limit of 500mg/l.

Calcium

The observed value of calcium for surface water was ranged from 2.5 mg/l (in ES_3) to 61.4 mg/l (in AS_{10}) with an average value of 26.21 mg/l. The observed value of calcium was within the permissible limits. A small concentration of calcium is reducing corrosion in water pipes.

Magnesium

The observed magnesium value was ranged from 2.4 mg/l (in BS_4) to 36.3 mg/l (in DS_5) with an average value of 13.6 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).

Total Alkalinity

Alkalinity in itself is not harmful to human being; still the water samples with less than 100 mg/l are desirable for domestic use (Loganayagi et al 2008)9. The high alkalinity imparts an unpleasant taste. In the present investigations the 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 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 ion does not affect the taste of water if present in low concentration. In present investigation the sulphate ion concentration 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 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. Generally water bodies polluted by organic matter exhibit higher values of nitrate. In the present study nitrate values 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 showed low concentration of nitrate well below permissible levels of WHO (45 mg/l). Moreover, the increased nitrate level in drinking water may adversely affect the central nervous system (Chern et al, 2005).

Total dissolved solids (TDS)

The most important aspect to drinking water quality is its effect on taste (Bruvold et al, 1966) 10. The drinking water containing more than 5000 mg/l of TDS is not considered desirable11 and it can also

cause excessive scaling in water pipes, water heaters, boilers and household appliances (Tihansky,1974)12.

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. In the present investigation the value of TDS 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 was within the maximum permissible limit 2000 mg/l of BIS.

CONCLUSIONS

The present study was undertaken with an aim to analyze certain physico-chemical parameters of surface water samples in different villages of Sri Ganganagar district. All the parameters were within WHO and BIS limits, therefore water is safe for drinking purpose.

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Table-1 : Physico-chemical parameters of surface water of Zone-A

Sr. No.	Sampling Stations	Parameters										
		pH	CO2	DO	Cl	T.H.	Ca	Mg	Total Alkalinity	SO4	NO3	TDS
1	AS1	7.55	Ab	2.8	2.8	36	7.8	6.8	6	2.3	1.4	160
2	AS2	7.3	12	3.2	2.8	112	58.7	12.9	30	0.3	0.7	180
3	AS3	7.44	1.5	4.4	6.2	62	28.4	8.1	18	3.3	1.7	880
4	AS4	7.95	4.4	4.9	17	40	8.9	7.5	10	1.5	0.8	110
5	AS5	7.95	13.2	2.8	16.3	110	27	20.1	24	4.4	1.6	240
6	AS6	7.42	1.4	4.6	8.3	74	28.4	11	20	3.5	1.5	770
7	AS7	7.5	8.8	3.8	9.9	160	54.6	25.6	14	1.4	1.2	810
8	AS8	8.05	8.8	3.8	22	100	54.6	11	12	2.7	2.3	1300
9	AS9	7	4.4	4.6	17.7	60	23	8.9	4	2.6	1.8	1240
10	AS10	8.05	3.2	2.4	9.3	80	61.4	4.5	16	3.1	1.1	240
11	AS11	7.05	8.8	2.7	26.9	60	23.8	8.7	14	0.7	0.8	390

Table-2 : Physico-chemical parameters of surface water of Zone-B

Sr. No.	Sampling Stations	Parameters										
		pH	CO2	DO	Cl	T.H.	Ca	Mg	Total Alkalinity	SO4	NO3	TDS
1	BS1	7.38	Ab	4.7	8.6	74	21.6	12.7	15	3.2	0.4	460
2	BS2	7.69	Ab	5.2	16.3	70	29.4	9.8	12	4.1	3.2	380
3	BS3	7.74	2.2	3.6	7.1	34	9.4	5.9	20	7.4	3.8	140
4	BS4	7.73	13.2	4.8	4.2	28	17.8	2.4	14	3.8	1.7	120
5	BS5	7.78	8.8	4.4	3.5	120	33.6	20.9	10	2.2	1.6	100
6	BS6	7.12	3.6	3.2	6.3	82	20.4	14.9	18	3.3	1	186
7	BS7	7.23	3.8	4.1	3.7	74	31.6	10.3	13	1.8	2.7	270
8	BS8	7.88	8.8	2.5	9.9	40	27.6	3.7	6	1.6	2.4	240
9	BS9	7.04	6.6	2.5	8.4	84	34.1	12.1	14	2.5	0.8	1200
10	BS10	7.93	Ab	4.6	14.2	50	26.0	5.8	12	3.1	2.8	1610

Table-3 : Physico-chemical parameters of surface water of Zone-C

Sr. No.	Sampling Stations	Parameters										
		pH	CO2	DO	Cl	T.H.	Ca	Mg	Total Alkalinity	SO4	NO3	TDS
1	CS1	7.46	1.6	4.5	6.3	116	26.4	21.7	14	3.2	2.6	660
2	CS2	7.22	3.4	4.8	8.3	108	32.2	18.4	12	3.1	2.4	884
3	CS3	7.06	Ab	3.6	9.2	128	30.4	23.7	16	4.2	1.8	1680
4	CS4	7.64	3.2	4.4	12.8	98	24.6	17.8	10	4.6	2.0	1884
5	CS5	7.08	2.8	4.8	5.6	140	15.1	30.3	10	2.8	1.6	1164
6	CS6	7.6	1.3	5.2	8.2	92	22.6	16.8	14	3.2	0.8	1536
7	CS7	7.18	1.2	4.6	12.4	88	18.4	16.9	12	0.1	1.6	960
8	CS8	7.26	Ab	4.6	3.5	106	12.6	22.6	12	3.4	4.6	1086
9	CS9	7.24	0.8	3.8	8.4	118	36.2	19.8	12	2.4	2.2	1160
10	CS10	7.40	2.4	4.2	12.8	96	24	17.4	18	4.1	1.8	1030
11	CS11	7.72	Ab	3.8	27.6	140	28.5	27	16	0.04	2.3	1588
12	CS12	7.46	1.8	4.8	18.4	102	30.6	17.3	14	3.8	1.2	1208

Table-4 : Physico-chemical parameters of surface water of Zone-D

Sr. No.	Sampling Stations	Parameters										
		pH	CO2	DO	Cl	T.H.	Ca	Mg	Total Alkalinity	SO4	NO3	TDS
1	DS1	7.64	1.2	4.2	12.1	74	24.0	12.1	18	3.2	1.8	680
2	DS2	8.00	Ab	3.6	14.2	50	36.5	3.2	24	1.6	1.2	140
3	DS3	7.2	3.2	3.0	7.1	60	23.4	8.8	20	3.4	1.8	120
4	DS4	7.8	2.4	4.6	16.4	68	18.6	12	18	3.8	0.8	940
5	DS5	8.10	Ab	2.5	7.8	162	12.6	36.3	18	2.8	1.6	1400
6	DS6	7.80	1.4	4.8	8.8	82	24.5	13.9	20	4.2	2.4	880
7	DS7	7.26	Ab	5.2	7.1	120	29.4	22	10	3.2	2.1	740
8	DS8	7.82	Ab	6.8	5.6	80	13.3	16.2	20	2.6	2.4	340
9	DS9	8.00	Ab	3.6	8.3	128	23.5	25.3	10	6.2	3.1	820
10	DS10	7.66	Ab	6.0	6.4	96	29.4	16.1	24	5.4	2.6	1400

Table-5 : Physico-chemical parameters of surface water of Zone-E

Sr. No.	Sampling Stations	Parameters										
		pH	CO2	DO	Cl	T.H.	Ca	Mg	Total Alkalinity	SO4	NO3	TDS
1	ES1	7.24	3.6	4.8	9.5	66	22.8	10.4	20	3.3	1.8	620
2	ES2	7.40	2.7	5.2	12.1	68	18.6	12	22	4.1	2.6	840
3	ES3	7.74	Ab	8.0	14.2	46	2.5	10.5	18	4.1	2.4	220
4	ES4	7.80	2.8	3.8	14.2	60	24.5	8.6	26	1.6	1.4	140
5	ES5	7.12	7.6	4.6	17.7	40	17.8	5.3	12	4.3	0.6	110
6	ES6	7.26	Ab	4.7	10.4	56	18.3	9.1	18	3.4	0.8	340
7	ES7	7.48	0.6	4.5	11.3	62	21.4	9.8	13	1.5	2.0	670
8	ES8	7.62	1.8	5.3	12.4	76	20.8	13.4	20	5.1	1.8	490
9	ES9	7.42	4.3	5.4	11.4	74	26.3	11.5	21	3.5	2.4	990
10	ES10	7.85	3.2	3.4	12.2	80	31.5	11.7	22	2.0	1.7	1120

Table-6 : Physico-chemical parameters of surface water of Zone-F

Sr. No.	Sampling Stations	Parameters										
		pH	CO2	DO	Cl	T.H.	Ca	Mg	Total Alkalinity	SO4	NO3	TDS
1	FS1	7.60	8.8	2.8	4.2	80	47.2	7.9	14	4.2	1.8	280
2	FS2	7.42	4.2	4.4	6.4	86	26.4	14.4	16	4.4	3.1	780
3	FS3	7.7	2.6	5.3	9.5	72	18.0	13.1	18	4.1	1.8	990
4	FS4	7.55	3.6	3.8	11.3	60	20.4	9.6	12	2.8	2.8	1096
5	FS5	7.80	2.4	4.8	4.5	86	18.0	16.5	20	4.5	1.2	1400
6	FS6	7.20	Ab	4.7	9.6	64	22.2	10.1	18	4.1	0.8	836
7	FS7	7.33	4.4	4.6	7.1	100	54.6	11	16	3.4	2.2	1700
8	FS8	7.90	6.4	2.5	10.6	76	39.7	8.8	20	3.8	2.8	1200
9	FS9	8.02	Ab	5.1	12.2	92	14.6	18.8	20	2.3	3.1	550
10	FS10	7.60	1.8	4.4	5.7	68	24.1	10.6	14	2.3	1.8	430

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