Study of Various Physico-chemical Parameters of Ground Water and Water Born Diseases Spreading in Jhunjhunu District of Rajasthan

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ABSTRACT

The Jhunjhunu Block has broad spectrum of ground water quality problems. The various water borne diseases spreading in the area are Cholera, Dysentery and Hepatitis, Fluorosis, Blue Baby syndrome etc. Large no. of people are suffering due to prevailing water born diseases. For this purpose, a broad study on estimation of ground water quality was conducted in Jhunjhunu district and various parameters viz. pH, EC, TDS, Alkalinity, Total Hardness, Cl^-, SO_4^{2-} and total coliform bacteria were analysed Analysis shows that many of the parameters are present beyond the prescribed limits of ISI and are causing fatal problems for live hood.

Key words: Ground water, water borne diseases, Toxicity.

INTRODUCTION

Jhunjhunu district has a dry climate with hot summer. In summer, sand storms are a characteristic feature of the district. The cold season starts by the middle of november and continues till the beginning of march. The hot season follows thereafter and extends up to the end of june. The south-west monsoon is from july to mid september. The temperature varies from 1^0c to 48^0c while the mean temperature is 24^0c. The normal rainfall in the district is about 500 mm/year.

There are 8 blocks in the Jhunjhunu district and all the blocks have their unique geological, historical and cultural features. Khetri and Udaipurwati are rocky while Chrawa and Nawalgarh are plain land having great agricultural and irrigational dependence on ground water. Alsisar block is totally desert with saline ground water and no irrigation. Surajgarh and Buhana also depend on ground water but the ground water potential in these blocks is very low. The Jhunjhunu block comprises of the above mentioned features and has broad spectrum of ground water quality problems. The area receives scanty rain fall and has many water quality problems. Some of them are Hepatitis, Dysentry, Chloera, Fluorosis, Blue Baby Syndrome etc. Due to these reasons, the area of Jhunjhunu block was chosen for this research study.

EXPERIMENTAL

In the present study, the Jhunjhunu block of the Jhunjhunu district was selected. From 136 villages (38 Panchayat) of Jhunjhunu block, 269 water samples were collected from different locations/villages. The samples were collected during 2009 (Jan) -2012 (Jan) from tubewells and pumps present in these areas. These samples were collected in wide mouth plastic bottles. before collection bottles were sequentially washed with water, detergent and soaked in 1% nitric acid for 24 hours, then again washed with clean water.[1-6]After collecting, samples were analyzed by the following methods :

1. pH by pH meteric method
2. EC by conductometeric method
3. Alkalinity, hardness and chloride by Titrameteric method.
4. Sulphate by Turbidimetry method
5. Calcium by titrametric method.
6. Bacteriological media method

RESULTS AND DISCUSSION

The values of various parameters of ground water is summarized in the table given below.

MPN- Most Probable Number
pH

The pH range of 6.5 to 8.3 is normally acceptable. All the 269 samples were found in the pH range 7.2 to 8.5. On the basis of pH, it can be said that the ground water under investigated area was found to be potable and within desirable limits.

EC

As significance of conductivity, measurements are essential to indicate concentration of ionizable substances dissolved in water. In the present study, E.C. of the collected water samples was lying in the range 550 to 3400 Microsimens/cm. The permissible limit for EC is 2100 ms/cm. The analysis shows that some of the water samples have EC, greater than permissible limits.

TDS

For drinking water, the desirable concentration of TDS is less than 500ppm and maximum allowable limit is 1500ppm. If the TDS value exceeds 2000ppm, definite laxative effects are observed in those not accustomed to such salinity.

During the study, it was observed that out of 269 water samples collected, 59 water samples have more than 1500 ppm while 10 samples have TDS more than 2000 ppm.

Calcium

In normal potable ground water, calcium should have concentration between 10ppm to 100ppm and within this limit, it has no effect on the health of humans and animals . In the present study, the concentration of calcium hardness (as $CaCO_3$) ranged between 30 ppm to 1200 ppm. As per WHO and ISI standards for drinking water, the desirable calcium (as Ca^{+2}) concentration is 75ppm. High range of calcium is responsible for Heart stroke as well as for the formation of kidney stones.

Magnesium

In the present investigation, the concentration of magnesium hardness (as $CaCO_3$) was found between 50 ppm to 1200 ppm in study areas while maximum relaxable limit of magnesium in drinking water is 100ppm as fixed by ISI and ICMR. Due to large amount of magnesium, chances of heart diseases occurring rises up.

Alkalinity

Bicarbonates, carbonates & hydroxides contribute essentially to the alkalinity or acid neutralizing power of water. Other constituents, namely, borates, phosphates, silicates and anionic matter, contribute alkalinity but these are usually of little significance.
During present investigation, the bicarbonate concentration was found between 100 ppm to 580 ppm.

Chloride

In the present research investigation, the chloride concentration was observed in between 30 ppm to 580 ppm. As per ISI standards, the highest desirable limit of chloride for drinking water is kept at 250ppm and maximum permissible limit is 1000ppm.

Table 1: Physico Chemical Analysis of Ground Water

S. No.	Source	Gram Panchayat	Total No. of Samples	pH	E.C.	T.D.S	Alkali-nity	T.H.	Ca-H	Mg-H	Cl⁻	SO₄⁻²
1	O.W.	Bishanapura	8	7.7–8.5	1200–1600	840–1110	100-580	70-130	30-50	50-80	95-160	10-35
2	OW HP	Siriyasar Kalan	8	7.3–8.3	2200-2700	1540-1890	260-450	170-350	60-140	110-230	270-450	45-90
3	OW HP	Abusar	9	7.3–8.3	2200-2228	1540-1890	260-450	170-350	60-140	110-230	270-450	45-90
4	OW HP	Denwala	11	7.2–8.3	1371-2314	960-1620	250-440	210-330	50-120	70-180	220-390	25-70
5	OW HP	Hanumanpura	7	7.9–8.5	1300–3000	910–2100	260-560	120-1800	80-1000	130-800	260-545	20-95
6	OW HP	Kuhadu	5	7.9–8.5	2286-3314	1600-2520	310-580	770-2000	90-800	120-1200	300-580	50-95
7	OW HP	Wahidpura	6	7.9–8.3	2000-2400	1400-1680	320-400	190-230	70-120	120-160	295-320	40-60
8	OW HP	Meharadasi	7	7.7-8.4	1500-2985	1050-2590	290-540	240-1870	90-1200	170-770	310-520	40-85
9	OW HP	Bheemsar	6	7.7-8.1	1700- 3400	1260-2580	300-510	180-2100	70-1200	110-900	235-580	45-95
10	OW HP	Nua	7	7.8-8.2	1500–1828	1050-1280	270-340	190-230	60-90	130-160	240-285	20-40
11	OW HP	Bahadurwas	8	7.3–8.4	1300-2514	990-1820	250-460	200-230	70-80	130-180	260-375	35-68
12	OW HP	Chatarpura	9	7.7-8.4	1500-2000	1120-1400	290-400	220-280	60-100	150-190	230-340	35-45
13	OW HP	Bakra	8	7.5–8.1	1357-1600	950-1120	210-300	80-200	30-60	50-100	140-190	25-40
14	OW HP	Budana	10	7.9–8.5	1328-2400	990-1680	290-470	160-290	50-90	100-215	220-450	35-65
15	OW HP	Ajari Kalan	5	7.6-8.0	900-1200	630-840	160-260	150-200	60-70	90-130	95-145	15-28

No.	Type	Name										
16	OW	Beebasar	8	7.4-8.1	1285-1885	960-1120	220-310	190-210	60-100	120-140	160-260	20-30
	HP											
17	OW	Bas Nanag	6	7.4-8.1	1028-1642	720-1550	150-260	120-230	40-80	70-150	135-245	23-44
	HP											
18	OW	Sigra	6	7.8-8.3	1800-2000	1260-1400	330-370	250-300	40-120	150-210	290-375	60-70
	HP											
19	OW	Bharunda Khurd	10	7.7-8.3	657-1600	460-1120	150-240	150-210	40-90	110-150	90-235	20-62
	HP											
20	OW	Indali	5	7.7-7.9	1200-2000	840-1400	180-220	100-280	70-90	50-210	155-290	25-55
	HP											
21	OW	Kulod Kalan	14	7.4-8.3	1200-2285	770-1400	180-330	110-300	50-110	70-250	160-410	22-70
	HP											
22	OW	Patusari	8	7.6-8.2	1500-2200	1050-1540	160-290	100-230	40-90	50-160	200-405	28-48
	HP											
23	OW	Purohito Ki Dhani	7	7.7-8.3	1585-2900	1120-2030	280-460	150-480	60-180	90-300	200-520	55-75
	HP											
24	OW	Islampur	5	8.0-8.3	657-814	460-570	180-270	160-200	50-70	100-130	60-75	10-15
	HP											
25	OW	Makhar	6	7.7-8.3	550-1628	385-1140	120-290	60-230	30-90	50-140	60-190	10-35
	HP											
26	OW	Jai Pahari	4	7.4-7.7	1457-2000	1020-1400	160-330	150-240	30-60	90-190	260-300	54-75
	HP											
27	OW	Bhojasar	4	7.7-7.9	1000-1400	700-980	150-220	140-190	40-80	110-120	165-210	20-35
	HP											
28	OW	Shekhsar	7	7.7-8.2	1700-2500	1190-1750	310-370	230-270	80-100	150-180	225-400	40-90
	HP											
29	OW	Bharu	7	7.6-8.0	1300-1700	910-1190	120-250	140-210	50-60	90-130	165-275	20-40
	HP											
30	OW	Nayasar	5	7.6-7.7	1500-2400	1050-1680	230-350	170-350	70-120	100-230	265-365	40-90
	HP											
31	OW	Partappura	11	7.6-8.4	1300-1585	980-1120	220-300	140-180	50-80	80-110	210-235	20-35
	HP											

No.	Type	Location		pH									
32	OW / HP	Kasimpura	7	7.8-8.3	1800-2400	1260-1680	110-430	200-310	90-140	110-190	265-360	40-60
33	OW / HP	Lalpur	7	7.9-8.3	2200-2500	1540-1750	320-420	290-340	100-120	190-220	365-460	40-60
34	OW / HP	Khajpur naya	6	7.8-8.2	1500-2100	1050-1470	200-320	140-180	40-70	90-140	220-320	40-55
35	OW / HP	Udawas	10	7.4-8.4	1943-2600	1360-1820	330-460	190-340	90-170	130-220	105-430	45-60
36	OW / HP	Bagar	3	7.4-8.3	1300-1600	910-1120	180-190	120-230	30-50	70-200	150-300	52-60
37	OW / HP	Kishorepura	5	7.7-8.0	1000-1300	700-910	160-240	230-360	40-80	170-250	105-230	35-37
38	OW / HP	Solana	4	7.6-7.9	700-1200	440-490	200-200	210-350	40-80	140-290	50-165	25-39

1.O.W. – Open Well   2. H.P.- Hand Pump   TDS, Ca^{+2}, Mg^{+2}, Alkalinity, Hardness, Cl-, SO$_4^{-2}$ is in ppm   EC is in ms/cm

Sulphate

During the study, sulphate concentration varied from 10 ppm to 95 ppm. Indian council of Medical Research has fixed the maximum permissible limit for drinking water which should not be more than 400ppm. Therefore, on the basis of these limits, it can be said that the sulphate concentration in ground water was found within the desirable limit of drinking water standards.

Hardness

As per ICMR and WHO standards, water for domestic use should not contain more than 80ppm hardness. During research investigation, it was noted that in 36.30% of total water samples, hardness was found more than 150ppm and in 12.73% samples, it was reported more than 500ppm.

Total Coliform Bacteria

Coliform bacteria are commonly found in soil, on vegetation, and in surface water.

They also live in the intestines of warm-blooded animals and humans. Some coliform bacteria strains can survive in soil and water for long periods of time. Coliform bacteria will not likely cause illness. However, because coliform bacteria are most commonly associated with sewage or surface waters, the presence of coliform bacteria in drinking water indicates that other disease-causing organisms (pathogens) are also present in the water system. There are three different groups of coliform bacteria; each has a different level of risk.

Total coliform, fecal coliform, and *E. coli.* Total coliform bacteria are commonly found in the environment (e.g. soil or vegetation) and are generally harmless

Fecal coliform bacteria are a sub-group of the total coliform group. They appear in great quantities in the intestines and feces of people and animals.

E. coli is a subgroup of the fecal coliform group. Most E. coli are harmless and are found in great quantities in the intestines of people and warm-blooded animals. Some strains, however, may cause illness. The presence of *E. coli* in a

Table 2: Bacteriological Estimation of Ground water

S. No	Village	Samples			MPN/
		10 ml	1 ml	0.1 ml	100 ml
1.	Bishanapura	2	0	0	9
2.	Doradas	1	0	2	11
3.	Misharpura	0	1	3	12
4.	Binjusar	1	1	3	19
5.	Siriyasar Kalan	2	0	1	14
6.	Chanrapura	0	2	3	16
7.	Durana	3	0	2	64
8.	Durana ka bas	2	0	1	14
9.	Abusar	1	0	3	15
10.	Seetsar	2	2	3	42
11.	Angasar	0	2	3	16
12.	Durjanpura	2	0	1	14
13.	Derwala	2	2	1	28
14.	Hanumanpura	2	3	3	53
15.	Khidarsar	2	3	3	53
16.	Warispura	0	1	1	6
17.	Jeetash	0	1	1	6
18.	Tetra	2	1	3	34
19.	Kisari	3	3	3	95
20.	Mojas	3	1	2	120
21.	Godu ka bas	2	3	0	29
22.	Wahidpura	2	0	2	64
23.	Shyopura	3	0	2	64
24.	Dhani josiyo ki	2	2	3	42
25.	Mehradasi	3	1	2	120
26.	Mukhwas	3	1	2	34
27.	Todarwas	3	0	3	64
28.	Bheemsar	3	0	3	95
29.	Rasoda	3	0	2	64
30.	Nua	3	1	0	43
31.	Hameerwas	2	1	2	27
32.	Phooshkani	3	1	2	120
33.	Seshwas	3	0	2	64
34.	churichatrpura	3	0	3	95
35.	Ajeetgargh	0	0	3	9
36.	Deenwa	3	1	0	43
37.	Bakra	3	0	2	64
38.	Utrasar	3	0	0	43
39.	Devipura	0	3	3	19
40.	Jeeva ki dhani	1	1	2	15
41.	Pakori ki dhani	3	0	2	64
42.	Budana ka bas	2	3	2	44
43.	Ajari kala	2	3	0	29
44.	Beebasar	2	3	2	44
45.	Fatesara	3	0	2	64
46.	Bas Nanag	2	2	3	42
47.	Togra khurd	0	3	0	9
48.	Bhompura	0	1	1	6
49.	Sigri	3	2	0	93
50.	Bharunda Khurd	3	0	1	39
51.	Chichroli	2	2	3	42
52.	Marot	2	2	3	42
53.	Indali	0	3	3	19
54.	Kulod Kalan	2	1	3	34
55.	Ajari khurd	3	0	2	64
56.	Dorasar	3	0	1	39
57.	Narsinghpura	1	1	1	11
58.	Khatehpura	0	3	3	19
59.	Malsar	1	0	0	4
60.	charanwas	1	0	1	7
61.	Meelo Ki Dhani	2	2	0	21
62.	Islampur	3	0	2	64
63.	Makhar	2	2	3	42
64.	Ratan Shahar	2	3	2	44
65.	Jai pahari	2	3	0	29
66.	Bhojasar	2	1	3	34
67.	Kumas	1	3	2	24
68.	Motisar	0	3	2	16
69.	Hetamsar	1	3	2	24
70.	Nayasar	2	1	2	27
71.	Samspur	1	0	2	11
72.	Sultanpura	1	3	2	24
73.	Kasimpura	3	0	2	64
74.	Hamirwas lamba	2	3	3	53
75.	Lalpur	2	2	3	42
76.	Kaleri ki dhani	2	1	1	20
77.	Khajpur purana	1	2	3	24
78.	Udawas	2	3	2	44
79.	Badalwas	2	1	2	27
80.	Badalwas	0	3	3	19
81.	Bagar	3	0	2	64
82.	Bagar	3	1	1	75
83.	Kayamsar	0	3	3	19

drinking water sample almost always indicates recent fecal contamination meaning that there is a greater risk that pathogens are present[9].

As per ISI standard, maximum permissible limit for drinking water should not be more than 10 coliform/100 ml. During Analysis, MPN (Most Probable Number) was found to be in the range 4 to 120/100 ml. The value of MPN is very high. The presence of coliform bacteria in drinking water indicates that other disease causing pathogens are also present in the water system.

Due to toxicity range of various parameters, water born diseases are spreading in area. Water borne diseases are infectious which spread primarily through contaminated water. Though these diseases are spread either directly or through flies or filth, water is the chief medium for the spreading of these diseases and hence they are termed as water borne diseases. These diseases are more prevalent in areas with poor sanitary conditions.

A survey was conducted in 269 villages during 2009 (Jan) to 2012 (Jan). The information was collected from 50 Govt. hospitals running in these areas. Cholera, Dysentery, Hepatitis, were commonly found in the study area.

Cholera

Spread by the bacterium vibrio cholerae. When drinking water gets contaminated with bacterium, it causes cholera. In severe forms, it is known to be one of the most rapidly fatal illnesses.

The symptoms include very watery diarrhea, nausea, cramps, nosebleed, rapid pulse, vomiting and hyporolemic shock[8]. In severe cases, death can occur in 12-18 hours. It was found that 1270 patients were affected by the cholera.

Dysentery

Caused by a number of species in the genera shigella and salmonella, with the most common being shigella dysenteriae. When water gets contaminated with bacterium it causes dysentery. Frequent passage of faeces with blood and /or mucus and in some cases, vomiting of blood are the symptoms of this disease[11]. It was found that 1548 patients were affected by the Dysentery.

Hepatitis

A group of viruses known as the hepatitis viruses, cause most cases of hepatitis but it can also be due to toxins (alcohol, certain medications some industrial organic solvents and plants), other infections and autoimmune disease. Initial features may include malaise, muscle and joint aches, fever, nausea or vomiting, diarrhea and headache. In acute hepatitis, symptoms include loss of appetite, dark urine, yellowing of the eyes and skin and abdominal discom fort[12]. It was found that 350 patients were effected by the Hepatitis.

From the above study it is concluded that water of this area is not potable for drinking purpose, therefore, it should be used after proper treatment which includes Reverse osmosis, water softening, Ion exchange resin devices & Defluoridation of water.

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