



# **GROUND WATER QUALITY SPECTRUM OF COLORFUL SHEKAVATI : A STUDY OF DRINKING WATER QUALITY OF DESERT AFFECTED AREA OF JHUNJHUNU DISTRICT IN RAJASTHAN**

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## **ABSTRACT**

Detailed studies have been made for testing the drinking water quality of the Jhunjhunu area in Rajasthan. In these studies, twenty five spots were selected and samples of water were collected from open wells, public wells and tube wells in the area. The various parameters such as pH, total dissolved solids, total hardness, Mg hardness, Ca hardness, alkalinity, Cl<sup>-</sup>, fluorides, nitrates, sulphates, carbonates, bicarbonates, DO etc. were monitored and compared with different standard parameters. The analysis revealed that the water is not suitable for domestic and drinking purpose. Water of almost all the sampling areas was highly contaminated with total dissolved solids (TDS) and nitrate. TDS may cause gastrointestinal irritation and high concentration of nitrate in drinking water give an immediate health concern for infants and pregnant women because nitrate in drinking water has been linked to 'Methamoglobinemia' or blue baby syndrome, in which the oxygen carrying capacity of an infant's blood is greatly reduced, sometimes leading to death. The findings have been discussed in details.

**Key words:** Jhunjhunu, Public wells, Tube well, Nitrate, Fluoride, Water quality.

## **INTRODUCTION**

Ground water comes into contact with various minerals, which are soluble in water to varying degrees. The dissolved solutes determine the usefulness of water for various purposes. Ground and surface water attain their chemical characteristics by chemical reactions with solids. i.e. soil sediments and sedimentary rocks.<sup>1</sup> The ground water contains higher degree of minerals, which varies according to the quality of soil and rocks. Sharma and Hussain et al<sup>2-4</sup> noticed certain variations in ground water quality due to ecological factors and industrialization. Water being a very good solvent dissolves all kind of

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impurities (solid, liquid and gases). Suspended or colloidal organic impurities are obtained from decomposition of plants and animals, particles suspended in water such as clay, silt, sand and other solid particles that absorb or reflect light turbidity<sup>5</sup>. Excess of these impurities causes pollution of water and make it unsafe for drinking purpose including heavy metals like Fe, Mn, as well as fluoride, nitrates and chloride. Their excess in water causes many diseases in plants and animals. The present study has been carried out to find out the water pollutants and to test the suitability of water for drinking and irrigation purpose of the Jhunjhunu and surrounding areas in Rajasthan.

## EXPERIMENTAL

### Materials and methods

Water samples were collected in polythene bottles as per standard procedure from 25 sources situated in different villages and close to the Malsisar marked for the study of ground water suitability for drinking and other domestic purposes. Sample bottles were well washed with distilled water, dried and were stored in refrigeration at 4<sup>0</sup>C till the analysis were completed. The physicochemical parameters like pH, dissolved oxygen, total dissolved solids and alkalinity were analyzed by using potable kit at the sampling sites and rest of the parameters were determined by following the standard methods APHA (1995)<sup>5-7</sup>. Distilled water and AR grade chemicals were used, whenever required. Parameters and methods employed in the test samples are detailed in Table 1.

**Table 1: Parameters, methods and standard values selected in the physico-chemical examination of samples**

Parameters	Method	Standard values as guided by Bureau of Indian Standards	Unit
Colour	By sight	-	-
Odour	Smelling	-	-
Temperature	Thermometric	-	<sup>0</sup> C
pH	pH meter	6.5-8.5	-
Nitrate	Ion meter	100	mg/L

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<b>Parameters</b>	<b>Method</b>	<b>Standard values as guided by Bureau of Indian standards</b>	<b>Unit</b>
Fluoride	Iron selective electrode	1.5	mg/L
Total alkalinity	Titrimetric	600	mg/L
DO	Azide modification	7.0 to 9.0 mg/L at 20 <sup>0</sup> C -30 <sup>0</sup> C	mg/L
Total hardness	Titrimetric	600	mg/L
Carbonate hardness	Titrimetric	600	mg/L
Non-carbonate hardness	Titrimetric	600	mg/L
Calcium hardness	Titrimetric	200	mg/L
Magnesium hardness	Titrimetric	100	mg/L
Calcium	Titrimetric	-	mg/L
Magnesium	Titrimetric	-	mg/L
Total dissolved solids (TDS)	Conductivity bridge	2000	mg/L
Chloride	Argentometric	1000	mg/L
Sulphate	Gravimetric	400	mg/L

## RESULTS AND DISCUSSION

The results of physico-chemical characteristics are depicted in Table 2. All the samples were colorless and odourless. The decrease and increase in the temperature of the samples analyzed might be due to the low water level, low velocity, and atmospheric conditions etc. The pH value of the sample analyzed were recorded in the range from 7.2-7.8, which shows that the samples are alkaline in nature. The dissolved oxygen concentration of the samples varied from 5.3 to 6.5 mg/L. The value of alkalinity in water samples varied from a minimum of 160 mg/L to maximum of 1110 mg/L. Calcium concentration in the samples ranged from 20 mg/L to 340 mg/L and magnesium concentration from 36 mg/L to 468 mg/L.

**Table 2: The physico-chemical characteristics of the various sample stations**

Parameters	Site-1	Site-2	Site-3	Site-4	Site-5	Site-6	Site-7
Colour	Colourless	Colourless	Colourless	Colourless	Colourless	Colourless	Colourless
Odour	Odourless	Odourless	Odourless	Odourless	Odourless	Odourless	Odourless
Temperature	30.2	30.4	30.4	30.2	30.4	30.3	30.3
PH	8.7	8.3	8.0	7.3	7.2	8.2	8.5
DO	5.7	5.4	5.8	6	5.3	5.4	5.4
Total dissolved solids (TDS)	4620	5880	5340	7300	7500	4800	4880
Total hardness (TH)	750	2110	1820	1030	1000	720	520
Ca hardness as CaCO <sub>3</sub>	190	850	330	230	160	150	240
Mg hardness as MgCO <sub>3</sub>	560	1260	1690	800	840	570	280
Total alkalinity as CaCO <sub>3</sub>	680	260	160	200	250	680	830
Chloride (Cl <sup>-</sup> )	1250	1725	2360	1360	1300	1210	1360
Fluoride (F <sup>-</sup> )	3	11.7	0.5	0.6	0.5	1.1	1.5
Nitrate (NO <sub>3</sub> <sup>-</sup> )	80	80	50	150	600	50	25
Sulphate (SO <sub>4</sub> <sup>2-</sup> )	92	118	107	146	150	96	98
Carbonate as CaCO <sub>3</sub>	590	260	160	200	250	680	790
Bicarbonate as CaCO <sub>3</sub>	70	–	–	–	–	–	40
Carbonate hardness	650	260	160	200	250	680	520
Non-carbonate hardness	70	1850	1660	830	750	40	520
Ca hardness	76	340	132	92	64	60	96
Mg hardness	134.4	302.4	405.6	192	201.6	136.8	67.2

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Parameters	Site-8	Site-9	Site-10	Site-11	Site-12	Site-13
Colour	Colourless	Colourless	Colourless	Colourless	Colourless	Colourless
Odour	Odourless	Odourless	Odourless	Odourless	Odourless	Odourless
Temperature	30.3	30.2	30.2	30.2	30.3	30.4
pH	8.8	8.4	7.6	7.8	8.4	8.1
DO	5.7	5.5	6.5	6	6	5.3
Total dissolved solids (TDS)	4270	3920	6370	2170	2260	4480
Total hardness (TH)	580	650	1200	470	530	1230
Ca hardness as CaCO <sub>3</sub>	230	130	710	110	110	160
Mg hardness as MgCO <sub>3</sub>	350	520	490	360	420	1070
Total alkalinity as CaCO <sub>3</sub>	1110	550	380	240	470	350
Chloride (Cl <sup>-</sup> )	1200	1340	3020	450	540	1770
Fluoride (F <sup>-</sup> )	3.3	2	4	1.1	0.8	0.3
Nitrate (NO <sub>3</sub> <sup>-</sup> )	115	140	60	300	115	55
Sulphate (SO <sub>4</sub> <sup>2-</sup> )	85	78	127	43	45	90
Carbonate as CaCO <sub>3</sub>	980	530	380	240	450	350
Bicarbonate as CaCO <sub>3</sub>	130	20	–	–	20	–
Carbonate hardness	580	550	350	240	470	350
Non-carbonate hardness	580	100	820	230	60	880
Ca Hardness	92	52	284	44	44	64
Mg hardness	84	124.8	117.6	86.4	100.8	256.8

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Parameters	Site-14	Site-15	Site-16	Site-17	Site-18	Site-19
Colour	Colourless	Colourless	Colourless	Colourless	Colourless	Colourless
Odour	Odourless	Odourless	Odourless	Odourless	Odourless	Odourless
Temperature	30.4	30.4	30.2	30.2	30.4	30.4
pH	8.4	8	8	8.6	8	8
DO	5.5	6.1	6.4	6	6.3	6.4
Total dissolved solids (TDS)	1750	6720	7280	6930	7760	9000
Total hardness (TH)	200	2050	1730	2040	1580	1480
Ca hardness as CaCO <sub>3</sub>	50	340	410	90	170	250
Mg hardness as MgCO <sub>3</sub>	150	1710	1320	1950	1410	1230
Total alkalinity as CaCO <sub>3</sub>	540	290	410	200	310	180
Chloride (Cl <sup>-</sup> )	360	2740	2170	2490	3750	3750
Fluoride (F <sup>-</sup> )	2.6	1.2	0.9	1.2	1.3	2.2
Nitrate (NO <sub>3</sub> <sup>-</sup> )	90	325	360	85	30	140
Sulphate (SO <sub>4</sub> <sup>2-</sup> )	35	134	146	139	155	180
Carbonate as CaCO <sub>3</sub>	520	290	410	170	310	180
Bicarbonate as CaCO <sub>3</sub>	20	–	–	30	–	–
Carbonate hardness	200	290	410	200	310	180
Non-carbonate hardness	200	1760	1320	1840	1270	1300
Ca hardness	20	136	164	36	68	100
Mg hardness	36	410.4	316.8	468	338.4	295.2

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Parameters	Site-20	Site-21	Site-22	Site-23	Site-24	Site-25
Colour	Colourless	Colourless	Colourless	Colourless	Colourless	Colourless
Odour	Odourless	Odourless	Odourless	Odourless	Odourless	Odourless
Temperature	30.4	30.2	30.4	30.3	30.3	30.2
pH	8.3	7.9	8.1	8.4	8.2	8.6
DO	6.4	6.2	6.5	6	5.9	5.7
Total dissolved solids (TDS)	7920	7800	6600	5440	5920	7700
Total hardness (TH)	2320	2120	1380	710	670	650
Ca hardness as CaCO <sub>3</sub>	580	250	500	110	110	90
Mg hardness as MgCO <sub>3</sub>	1740	1870	880	600	560	560
Total alkalinity as CaCO <sub>3</sub>	240	170	270	540	890	450
Chloride (Cl <sup>-</sup> )	3600	3120	2480	2020	2160	2010
Fluoride (F <sup>-</sup> )	0.6	1.6	2.2	1.3	3.6	3.5
Nitrate (NO <sub>3</sub> <sup>-</sup> )	90	190	150	90	120	180
Sulphate (SO <sub>4</sub> <sup>2-</sup> )	158	156	132	109	118	154
Carbonate as CaCO <sub>3</sub>	240	170	270	520	890	410
Bicarbonate as CaCO <sub>3</sub>	–	–	–	20	–	40
Carbonate hardness	240	170	270	540	670	450
Non-carbonate hardness	2080	1950	1110	170	670	200
Ca hardness	232	100	200	44	44	36
Mg hardness	417.6	448.8	211.2	144	134.4	134.4

The significant increase in calcium and magnesium concentration might be due to the fact of high evaporating rate or due to the increased rate of decomposition<sup>8</sup>. Total hardness varied from 200 mg/L to 2110 mg/L. Hardness is caused due to the presence of calcium and magnesium carbonate and bicarbonates. Calcium hardness was observed in the range from 50 mg/L to 850 mg/L and the value of magnesium ranged from 280 mg/L to 1950 mg/L while the carbonate and non-carbonate hardness range from 160 mg/L to 680 mg/L and 40 mg/L to 2080 mg/L, respectively. There is no adverse effect on the health due to this hardness. TDS varies from 1750 mg/L to 9000 mg/L, which shows that the value of solids in water is very high. It may be due to particles suspended in water such as slit, soil erosion and waste discharge. During the period of study, the value of chloride ranged from 360 mg/L to 3750 mg/L, high chloride content in the samples may be due to high evaporation rate. The value of sulphate varied from 43 mg/L to 180 mg/L. Nitrate in the samples varied from 30 mg/L to 600 mg/L. The permissible value of nitrate is 100 mg/L and above this concentration, water is harmful and causes a disease like methamoglobinemia in infants. The concentration of nitrate ions increases with the increase in the depth of ground water because the upper level of nitrate is consumed by the plants. Fluoride concentration varied in all the water samples from 0.3 mg/L to 11.7 mg/L. The permissible limit of fluoride is 1.5 mg/L.

### **Recommendations**

The conclusion drawn is that the concentrations of nitrate, fluoride, chloride, TDS, TH are higher than the permissible limits. It has also been found that the water of Jhunjhunu area is hard and it is contaminated with calcium and magnesium hardness. Hence, water is not potable and may cause serious problems to health. Therefore, there is a need to improve the water quality, especially with respect to fluoride, nitrate and total dissolved solids due to which many people of this area are suffering from dental enamel, methamoglobinemia and gastro-intestinal troubles.

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