

## Physico-chemical Analysis of Selected Ground Water Samples of Rural Area of Bhopalgarh Tehsil, Jodhpur, Rajasthan

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**Abstract:** Groundwater quality of 40 villages of Bhopalgarh Tehsil, Jodhpur district, Rajasthan was analyzed to identify the nature of groundwater. The groundwater samples were collected in clean polyethylene one-liter cans and subjected for analysis in the laboratory. The physico-chemical parameters studied were pH, electrical conductivity, fluoride (F), chloride (Cl), sulphate, nitrate, total dissolved solids (TDS), Ca and Mg hardness and total hardness (TH). The findings revealed that some of the samples contained chemical constituent beyond permissible limits prescribed by Bureau of Indian Standards (BIS), which cause various hazardous effects. In this paper, regional groundwater contamination will broadly refer to the types of groundwater contamination that can be observed at the regional scale. Based on these results, it is recommended that any groundwater source in the study area should be tested before use for its portability and other domestic or industrial uses.

**Keywords:** Groundwater quality, Physico-chemical parameters, Bhopalgarh Tehsil,

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### I. Introduction

Water is the elixir of life and abounds on earth, but this vast natural resource has been depleted and turned into scarce commodity with increased usage catering to the needs of ever-expanding population. There is almost a global shortage of water and the world's most urgent and front rank problem today is supply and maintenance of clean drinking water. The climate change and spells of droughts have even stressed regional water tables<sup>1</sup>. The quality of groundwater is severely affected because of the wide spread pollution of surface water besides discharge of untreated waste water through bores and leaches from unscientific disposal of solid waste also contaminates groundwater, thereby reducing the quality of fresh water resources<sup>2</sup>. Groundwater may contain dissolved minerals and gases that give it the tangy taste<sup>3</sup>. The most common dissolved mineral substances are F<sup>-</sup>, Cl<sup>-</sup>, NO<sub>3</sub><sup>-</sup>, SO<sub>4</sub><sup>2-</sup>, Ca<sup>2+</sup>, Mg<sup>2+</sup> etc. The wide range of contamination sources is one of the main factors contributing to the need of groundwater quality assessment. Water from some hand-pumps, tube-wells and open-well contain very large amount of dissolved minerals which cannot be used by human and animal<sup>4</sup>. The present study was initiated to determine the concentration of contamination and assess the suitability of groundwater for various purposes.

Quality wise more than 25 % of the groundwater sources of Rajasthan have multiple problems, 16 % have excessive fluoride. 15 % have excessive nitrate and over 9 % have excess salinity. Thus, leaving merely 35 % sources as potable. Therefore, the continuous and periodical monitoring of water bodies for water quality is necessary. The wide range of contamination source is one of the main factors contributing to the need of groundwater Quality assessment.

### II. Study Area

Jodhpur district is among the largest districts in the state of Rajasthan. It is centrally situated in the western region of the state, and covers a total geographical area of 22850 Sq. Km. Jodhpur district lies between 26 degrees 0 minutes and 27 degrees 37 minutes north latitude and 72 degrees 55 minutes and 73 degrees 52 minutes east longitude. It is bounded by Nagaur in the east, Jaisalmer in the west, Bikaner in the north and Barmer and Pali in the South. The total length of the district from north to south is about 197 Km and from east to west it is about 208 Km. The district of Jodhpur lies at a height of 250-300 metres above sea level.

This district comes under the arid zone of the Rajasthan state. It covers 11.60 percent of the total area of the arid zone of the state. Some of the areas of the great Thar Desert in India also come within the district. The general slope of the terrain is towards west. Extreme heat in summer and cold in winter is the characteristic of the desert. Jodhpur is no exception.

There is no perennial river in the district. However, there are important rivers in the district viz. Luni River and Mithri River though their base is saline water. Main sources of irrigation besides rainwater are dug-wells and tube-wells. The highest-irrigated area in the district is in Bilara Tehsil followed by Bhopalgarh and Osian Tehsil.

### III. Methods And Materials

#### 2.1 Sampling Methods

In this study 40 water samples from different sites were collected from Bhopalgarh Tehsil, Jodhpur region, the water samples were extensively used for drinking and other domestic purpose. The samples were collected in high grade plastic bottles of one liter capacity after rinsing with Distilled water. The techniques and methods followed for collection, preservation, analysis and interpretation.

#### 2.2 Analysis Methods

Samples were brought in to the laboratory and physico-chemical parameters like pH, Electrical conductivity, TDS, Alkalinity, Hardness, Fluoride, Chloride, and Nitrate were measured. Standard methods were adopted for the study of water samples. pH, Electrical conductivity, Fluoride and Nitrate were measured by portable meters and rest of the samples were analyzed by volumetric methods and the results are compared with BIS standards.

#### 2.3 Location of sampling stations

The samples were collected from villages of Bhopalgarh Tehsil, Jodhpur region namely Artiya Kallan(B<sub>1</sub>), Artiya Khurd(B<sub>2</sub>), Asop(B<sub>3</sub>), Baghoriya(B<sub>4</sub>), Bandra(B<sub>5</sub>), Basni Cholawatan(B<sub>6</sub>), Bhopalgarh(B<sub>7</sub>), Birani(B<sub>8</sub>), Burkiya(B<sub>9</sub>), Chhapla(B<sub>10</sub>), Chokri Kallan(B<sub>11</sub>), Chokri Khurd(B<sub>12</sub>), Darmi(B<sub>13</sub>), Gaderi(B<sub>14</sub>), Gharasni(B<sub>15</sub>), Heeradesar(B<sub>16</sub>), Hingoli(B<sub>17</sub>), Jhalamalia(B<sub>18</sub>), Kagal(B<sub>19</sub>), Kalawas(B<sub>20</sub>), Khangta(B<sub>21</sub>), Khawaspura(B<sub>22</sub>), Kumbhara(B<sub>23</sub>), Kuri(B<sub>24</sub>), Madpuriya(B<sub>25</sub>), Mangeriya(B<sub>26</sub>), Mindoli(B<sub>27</sub>), Nadatoda(B<sub>28</sub>), Nadsar(B<sub>29</sub>), Nandiya Prabhawati(B<sub>30</sub>), Palri Ranawata(B<sub>31</sub>), Palri Siddha(B<sub>32</sub>), Rajlani(B<sub>33</sub>), Ramchowki(B<sub>34</sub>), Ramrawas Kallan(B<sub>35</sub>), Rarod(B<sub>36</sub>), Ratkuriya(B<sub>37</sub>), Rudiya(B<sub>38</sub>), Salwa Khurd(B<sub>39</sub>), Ustran(B<sub>40</sub>).

### IV. Result And Discussion

The result obtained from analysis of water sample from different places of Bhopalgarh Tehsil, Jodhpur district are given in Table 2. A comparison of due physico-chemical characteristics of ground water samples has been made with BIS drinking water standards.

**Table 1: BIS standards of permissible and excessive limits of various parameters**

S. No.	Parameters	Permissible limit	Excessive limit
1.	pH	6.5	8.5
2.	TDS	500	2000
3.	Alkalinity	200	600
4.	Calcium	75	200
5.	Magnesium	30	150
6.	TH	300	600
7.	Fluoride	0.5	1.5
8.	Chloride	250	1000
9.	Nitrate	45	100
10.	Sulphate	200	400

**Here: - [BIS-Bureau of Indian standards]**

**Table 2: Groundwater quality in relation to physico-chemical parameters at Bhopalgarh Tehsil, Jodhpur district**

S. No.	location	pH	E.C	TDS	Alkalinity	CaH	MgH	TH	F	Cl
1.	B <sub>1</sub>	8.6	2270	1300	134	46	44	295	1.00	433
2.	B <sub>2</sub>	8.5	2300	1334	171	48	47	315	0.84	454
3.	B <sub>3</sub>	8.1	5630	3283	415	60	49	350	1.68	1312
4.	B <sub>4</sub>	7.9	1530	827	354	56	27	250	0.00	248
5.	B <sub>5</sub>	8.8	2620	1429	342	14	55	260	1.56	489
6.	B <sub>6</sub>	8.7	1480	800	342	20	28	165	1.04	199
7.	B <sub>7</sub>	8.0	1250	673	342	22	28	170	0.48	227
8.	B <sub>8</sub>	8.4	1700	958	281	22	35	200	0.52	305
9.	B <sub>9</sub>	8.5	6950	3987	415	44	173	820	0.24	1659
10.	B <sub>10</sub>	8.8	1200	661	366	32	29	200	1.76	142
11.	B <sub>11</sub>	8.4	4930	2760	281	72	131	720	1.36	1248
12.	B <sub>12</sub>	7.9	5000	2841	537	132	124	840	1.92	1177

13.	B <sub>13</sub>	8.0	4530	2551	403	56	45	325	2.64	1135
14.	B <sub>14</sub>	7.9	3620	2049	391	84	54	430	1.24	794
15.	B <sub>15</sub>	8.1	6050	3478	305	112	63	540	1.56	1617
16.	B <sub>16</sub>	7.9	3650	2102	342	64	45	345	1.80	865
17.	B <sub>17</sub>	8.0	7050	4064	317	220	63	810	1.68	2000
18.	B <sub>18</sub>	8.6	2100	1257	598	16	13	95	3.92	213
19.	B <sub>19</sub>	8.4	2700	1593	317	22	18	130	0.84	546
20.	B <sub>20</sub>	8.5	2200	1235	195	56	49	340	0.48	411
21.	B <sub>21</sub>	7.9	1830	1104	146	86	60	460	1.56	277
22.	B <sub>22</sub>	8.4	850	477	183	20	19	130	0.40	121
23.	B <sub>23</sub>	8.4	3000	1663	207	82	50	410	0.32	702
24.	B <sub>24</sub>	8.8	1920	1152	683	138	22	435	0.40	191
25.	B <sub>25</sub>	8.8	2300	1255	317	22	27	165	2.04	454
26.	B <sub>26</sub>	8.0	3000	1679	391	52	62	385	1.76	716
27.	B <sub>27</sub>	7.9	4230	2418	171	152	58	620	1.20	1248
28.	B <sub>28</sub>	8.8	1270	534	244	20	32	180	0.00	220
29.	B <sub>29</sub>	7.9	1950	1098	317	36	44	270	0.72	383
30.	B <sub>30</sub>	8.9	4600	2571	708	16	33	175	6.68	823
31.	B <sub>31</sub>	7.8	3700	2121	378	96	40	405	2.04	851
32.	B <sub>32</sub>	8.7	1650	984	464	16	13	95	2.20	191
33.	B <sub>33</sub>	8.4	1850	980	305	20	22	140	1.00	312
34.	B <sub>34</sub>	8.3	2300	1234	232	40	34	240	1.24	468
35.	B <sub>35</sub>	8.8	5970	3442	720	32	51	290	4.72	1319
36.	B <sub>36</sub>	8.0	4800	2823	342	74	68	465	1.52	1206
37.	B <sub>37</sub>	8.7	4790	2812	452	36	39	250	1.04	993
38.	B <sub>38</sub>	8.4	4450	2637	330	42	50	310	3.16	1057
39.	B <sub>39</sub>	8.0	500	287	195	36	7	120	0.60	43
40.	B <sub>40</sub>	8.0	3200	1821	268	96	46	430	1.24	823

**Here: - All parameters are in mg/L Except pH and EC (mhos/cm). CaH-- Calcium hardness, MgH- Magnesium hardness, TH- Total hardness and EC- Electrical conductance**

#### 4.1 pH

The pH values of groundwater varied from (7.8-8.9). The minimum pH was observed in Pali Ranawata village and maximum pH was detected in Nandiya Parbhawati village. pH is the negative exponent of H<sup>+</sup> concentration. According to BIS standards, best and ideal pH value for human consumption is 7.0, but it may vary from 6.9-8.5 Thus, all the samples tested were slightly alkaline; the groundwater samples are within the permissible limits.

#### 4.2 Electrical conductance (EC)

EC is the capacity of water to carry ions, so it depends on the presence of ions and their concentration. It is well known that electrical conductance is a good measure of dissolved solids and excessive presence of sodium in water is not only unsafe for irrigation but also makes the soil uncultivable. In present investigation, the electrical conductivity of water samples varies from 500-7050 mhos/cm. The U.S salinity laboratory classified ground water on the basis of electrical conductivity is up to 250 mhos/cm as excellent; 250-750 as good; 750-2250 as fair and > 2250 μ mhos/cm as poor. Based on this classification, only one water sample belong to good category, thirteen water samples belong to fair category and rest of the samples are poor.

#### 4.3 Total dissolved solids (TDS):

TDS indicate the nature of water quality for salinity. The water samples in the study area fall in the range of 287-4064 mg/L According to WHO specification, TDS up to 500 mg/L is highest desirable and up to

1000 mg/L is under maximum permissible category. Thus, based on the concentration of TDS, ground water can be classified as follows: up to 500 mg/L as desirable for drinking, up to 1000 mg/L as permissible for drinking and up to 3000 mg/L as useful for irrigation. 10 samples are useful for drinking purpose only and remaining samples are not fit for drinking.

#### **4.4 Alkalinity**

The ground water contains sustained amounts of dissolved carbon dioxide, bicarbonates and hydroxides. These are main sources of alkalinity, which can be conveniently evaluated by acid titration. In the present study, alkalinity ranges between 134-720 mg/L according to BIS classification, 29 samples are in optimum permissible limit and 11 are out of permissible limit.

#### **4.5 Ca and Mg hardness**

Minimum concentration of CaH was recorded in Bandra village i.e. 14 mg/L and maximum in Hingoli village i.e. 220 mg/L. Thus calcium content of all the samples was found to be below the permissible limit (75-200 mg/L). Minimum value of MgH was observed in Salwa Khurd i.e. 7 mg/L and maximum in Burkiya village i.e. 173 mg/L.

#### **4.6 Total hardness (TH)**

In the present study, the hardness of water samples ranged from 95 to 840 mg/L. The water samples of the study area are classified according to hardness (BIS), which revealed that sample no. 9, 11, 12, 17 are beyond the permissible limit.

#### **4.7 Fluoride (F<sup>-</sup>)**

Long term use of groundwater of drinking has resulted in the onset of widespread fluorosis, from mild forms of dental fluorosis to crippling skeletal fluorosis. High fluoride concentrations in ground water of the study area correlate positively with alkalinity (bicarbonate concentration) and pH. The concentration of fluoride in the study area varies from 0.00 to 6.68 mg/L. The fluoride value of the water samples is well within the permissible limit of BIS for 19 samples, whereas 8 samples have low value of fluoride and 13 samples have high value of fluoride (above 1.5 mg/L) and, thus not safe for drinking purpose.

#### **4.8 Chloride (Cl<sup>-</sup>)**

Excessive chloride gives a salty taste to water and people, who are not accustomed to high chlorides may be subjected to lenitive effects. The chloride content in the study area ranged between 43 to 2000 mg/L. The BIS permissible limit of chloride for drinking water is 250 to 1000 mg/L. 19 samples belong to permissible limit, 11 samples have high value and 10 samples have low value than the permissible limit.

#### **4.9 Nitrate (NO<sub>3</sub><sup>-</sup>)**

The Nitrate content in water sources of present study area ranged from 10 mg/L to 445 mg/L at The origin of nitrate in ground water is primarily from fertilizers, septic systems and manure storage or spreading operations. Nitrate is one of the most frequent ground water pollutants in rural areas it needs to be regulated in drinking water basically because excess level can cause Methemoglobinemia or Blue baby Disease. It is a disease, which reduces capacity of blood to carry oxygen for proper functioning of human body. Stomach Cancer is another disease caused by nitrite produced by nitrate.

#### **4.10 Sulphate (SO<sub>4</sub><sup>2-</sup>)**

Health concerns regarding sulphate in drinking water have been raised because of reports that diarrhea is associated with the ingestion of water with high level of sulphate<sup>7</sup>. In the present study, sulphate range from 0 to 452 mg/L According to BIS classification, 28 samples are below permissible limit, 10 samples belong to permissible limit and 2 samples are out of permissible limit.

### **V. Conclusion**

From the following study of groundwater of Bhopalgarh Tehsil, Jodhpur region, it can be observed that the pH of water is within the permissible limit while most of the parameters like TDS, Alkalinity, Ca hardness, Mg hardness, Chloride, Fluoride, and Nitrate have the values more than the permissible limit. So it is concluded that groundwater of Bhopalgarh Tehsil, Jodhpur region is highly contaminated and thus a regular and periodical monitoring of water is suggested.

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