

## Studies on Physico-chemical Parameters to Assess the Water Quality of Chandidongri Distt. Rajnandgaon for Drinking and Agriculture Purpose

S.N. BISWAS†, HEMLATA MOHABEY‡ and M.L. NAIK\*

*Department of Bioscience, Pandit Ravi Shankar University, Raipur, India*

Quality of water for its potential use depends on different physico-chemical parameters. In order to assess water quality of Chandidongri village of Chhattisgarh State, twenty water samples were collected from different sources *viz.*, open well, pond, hand pump, for three seasons, *i.e.*, rainy, winter and summer; moreover, simultaneously three samples of water were collected from nearby city area as control. Temperature, odour, colour, taste, turbidity, conductivity, TDS, total hardness and sodium absorption ratio (SAR) value were determined for the purpose. It was found that all the samples collected have physico-chemical parameters in the range recommended by ISI and WHO. The sodium absorption ratio value of water samples of village area of Chandidongri were lower in comparison to sodium absorption ratio value of water samples collected from city area and is excellent for irrigation.

**Key Words:** pH, Turbidity, Conductivity, TDS, Total hardness and SAR value.

### INTRODUCTION

Most of the human activities involving industrial and agricultural development and the inadequate management of land and water resources have, directly or indirectly, resulted in the degradation of hydrological environment<sup>1-3</sup>. Some of the major adverse effects have arisen from construction of reservoirs, surface water irrigation, deforestation, industrial and urban waste disposal. The impact is notable on the quality and quantity of ground water resources, the fertility of land and the stability of the land mass<sup>4,5</sup>. Water quality deterioration has made potable water resources scarcer and endangered for plant and animal life. The physico-chemical studies of handpump, open well and pond water of Chandidongri area, which is located 46 km away from the district headquarter Rajnandgaon inside national highway 6. At study area water handpumps and open wells is generally used for drinking and other domestic purposes. On account of inside N.H. 6 road,

---

† Scientific Officer, Forensic Science Lab (M.U.), Rajnandgaon-491 441, India.

‡ Principal, Digvijai College, Rajnandgaon-491 441, India.

people residing in the interior backward and adivasi area do not have access to safe drinking water. In the absence of fresh water supply, people residing in this area are forced to take bore wells water and pond water for their domestic and drinking purposes. The physico-chemical parameters of these water sources were studied in the present investigation.

## EXPERIMENTAL

Water samples were collected for one year, for three seasons, *i.e.*, summer, rainy and winter. Samples were collected from 20 points, sampling points were located depending on the availability of water sources, but were located within a radius about 5 km from Chandidongri. Water samples from city area (within the municipal boundary of Rajnadgaon city) were collected in polythene bottles from three points: handpump, open well and pond.

Analyses for physico-chemical parameters were done following mainly the standard methods<sup>6,7</sup>. Hardness values were determined as calcium and total hardness by EDTA titrimetric method. Sodium absorption ratio (SAR) was calculated using the following formula:

$$\text{SAR} = \frac{\text{Na}}{\sqrt{(\text{Ca} + \text{Mg})/2}}$$

## RESULTS AND DISCUSSION

The physico-chemical data of the different sources of water samples collected for three different seasons are shown in Table-1. The results of the samples vary with different nature of soil contamination. All metabolic and physico-chemical activities and life processes of aquatic organisms are generally influenced by water temperature. In the present study temperature ranged from 26 to 33°C. Colour in drinking water may be attributed to the presence of coloured organic matter, aquatic organisms and similar particulate matter detectable by the naked eyes. All the water samples were colourless except sample nos. 8, 12, 13, 15, 20 which appear light green due to the presence of micro-organisms, as collected from the pond of Chandidongri. The pH values in summer season were in the range 6.30 to 7.50. All the water samples of the study area have no objectionable taste and odour except pond water (sample no. 8). Maximum turbidity value for summer, rainy and winter season was found to be 40.8 NTU, 36.2 NTU and 26.2 NTU respectively and these are potable. Conductivity values of water samples of Chandidongri area, in all the three seasons, ranged 0.12–0.95 mmhos cm<sup>-1</sup>. Average conductivity value was minimum for rainy season while maximum values were recorded for summer season. TDS values in the water sample of Chandidongri area, in summer season, ranged between 90–608 mg L<sup>-1</sup>. In rainy season TDS values ranged 90–384 mg L<sup>-1</sup> while in winter TDS values ranged 90–442 mg L<sup>-1</sup>.

TABLE-1  
PHYSICAL PARAMETERS OF WATER FROM CHANDIDONGRI AND CONTROL  
AREAS IN DIFFERENT SEASONS

S.No.	Sites	Seasons	pH	Turbidity	Conductivity	T.D.S.	TH
1.	Chandidongri, mine pond (I)	1. Summer	7.10	1.2	0.44	280	44
		2. Rainy	7.20	1.25	0.46	294	46
		3. Winter	7.05	1.30	0.46	294	38
2.	Chandidongri, Ranitalab Dam	1. Summer	7.09	8.4	0.14	90	36
		2. Rainy	7.00	8.6	0.16	102	44
		3. Winter	7.10	8.0	0.14	90	40
3.	Chandidongri, mine pond (II)	1. Summer	7.10	5.30	0.15	96	20
		2. Rainy	7.05	5.80	0.15	96	17
		3. Winter	7.05	5.86	0.15	96	20
4.	Chandidongri, Ranitalab	1. Summer	6.60	40.8	0.19	121	42
		2. Rainy	6.80	36.2	0.20	128	42
		3. Winter	6.60	26.2	0.90	121	26
5.	Chandidongri, open well of factory	1. Summer	6.70	3.1	0.28	179	56
		2. Rainy	6.80	3.2	0.28	179	52
		3. Winter	6.70	3.1	0.26	166	49
6.	Chandidongri, open well of Sarpanch	1. Summer	6.90	2.70	0.16	102	70
		2. Rainy	7.05	2.70	0.14	90	40
		3. Winter	7.05	2.50	0.12	77	44
7.	Chandidongri, open wall of Babakutia	1. Summer	6.50	Nil	0.32	204	64
		2. Rainy	6.20	Nil	0.30	192	68
		3. Winter	6.20	0.01	0.28	179	67
8.	Birutola, Talab	1. Summer	6.80	19.3	0.34	218	54
		2. Rainy	6.70	19.8	0.32	204	54
		3. Winter	6.70	19.0	0.30	192	58
9.	Birutola, handpump in front of Vishnudas house	1. Summer	6.80	3.6	0.63	430	212
		2. Rainy	6.50	5.4	0.60	384	202
		3. Winter	6.50	3.6	0.60	384	198
10.	Birutola, Govt. open well	1. Summer	6.80	0.01	0.62	397	112
		2. Rainy	6.80	0.00	0.59	378	102
		3. Winter	6.00	0.00	0.69	384	103
11.	Birutola, handpump	1. Summer	6.60	7.3	2.28	379	108
		2. Rainy	6.80	7.2	0.24	154	102
		3. Winter	6.60	7.2	0.24	154	102
12.	Birutola, open well of Lekhrum	1. Summer	7.05	2.2	0.53	339	270
		2. Rainy	6.60	0.6	0.52	333	260
		3. Winter	7.00	0.6	0.34	218	255

S.No.	Sites	Seasons	pH	Turbidity	Conductivity	T.D.S.	TH
13.	Khobradihi, handpump	1. Summer	6.70	9.5	0.24	218	150
		2. Rainy	6.70	9.0	0.35	124	108
		3. Winter	6.70	9.0	0.34	204	132
14.	Khobradihi, open well of Budhram	1. Summer	6.50	2.0	0.50	320	128
		2. Rainy	6.30	2.0	0.50	320	130
		3. Winter	6.30	2.0	0.50	320	118
15.	Sadak-Banzari, handpump in front Thakurram house	1. Summer	6.30	17.8	0.40	256	132
		2. Rainy	6.10	17.8	0.40	256	132
		3. Winter	6.30	26.5	0.40	256	125
16.	Sadak-Banzari, Govt. open well	1. Summer	6.60	2.8	0.28	179	74
		2. Rainy	6.60	3.0	0.29	186	76
		3. Winter	6.60	3.0	0.28	179	63
17.	Sadak-Banzari, handpump near Dhaba	1. Summer	7.50	21.8	0.28	128	66
		2. Rainy	7.10	21.8	0.20	128	60
		3. Winter	7.50	21.8	0.20	128	52
18.	Patekohara, handpump near G.E. road	1. Summer	6.50	4.8	0.22	141	74
		2. Rainy	7.10	4.8	0.22	141	80
		3. Winter	7.10	4.8	0.22	141	61
19.	Chandidongri, handpump in front of Sarpanch house	1. Summer	7.05	2.4	0.25	160	56
		2. Rainy	6.90	Nil	0.25	160	54
		3. Winter	6.90	Nil	0.25	160	51
20.	Chandidongri, open well of Jogindar Dhaba	1. Summer	6.30	0.6	0.38	243	32
		2. Rainy	6.70	0.0	0.38	243	30
		3. Winter	6.70	0.0	0.38	243	27
21.	Rajnandgaon, handpump of Vardhaman Nagar	1. Summer	7.40	3.2	1.05	672	340
		2. Rainy	7.80	0.0	1.10	704	360
		3. Winter	7.10	0.0	1.05	672	330
22.	Ranjandgaon, open well of Jain School, Vardhaman nagar	1. Summer	7.30	1.9	0.85	544	300
		2. Rainy	7.30	0.0	0.85	544	310
		3. Winter	7.30	0.0	0.85	544	185
23.	Rajnandgaon, Ranisagar Pond	1. Summer	8.70	25.1	0.82	524	60
		2. Rainy	8.80	25.1	0.82	524	66
		3. Winter	9.00	25.1	0.82	524	52

Total hardness values in the Chandidongri area in summer season ranged from 17 to 270 ppm and minimum value was recorded for the water of mine pond in winter season and maximum value was observed in summer for the open well of Birutola. On the other hand, control area total hardness values ranged more than 52 ppm and going up to as high as 340 ppm. The minimum value was recorded for pond (Ranisagar) water sample in winter season while the maximum value

was recorded in summer for hand pump. As per classification<sup>8</sup> samples nos. 1, 2, 3, 4, 20 come under very soft category, samples no. 5, 6, 7, 8, 10, 11, 13, 14, 15, 16, 17, 18, 19 and 23 come under average soft category, only sample no. 9 falls under the average hardness and rest of the samples nos. 12, 21 and 22 are under the hard category. Calcium hardness in the water samples shown in Table-2 from Chandidongri area in summer season ranged from 4 to 152 ppm. Calcium value measured in control area was minimum, 35 ppm in winter for pond water while maximum, 200 ppm was recorded in summer for a handpump water sample. Magnesium hardness ranged from 12 to 118 ppm in the Chandidongri area water samples for summer. In control area magnesium values measured for three water samples ranged from 17 to 180 ppm. Sodium, estimated as di-sodium oxide ( $\text{Na}_2\text{O}$ ), was present in all the water samples (Table-2), both from Chandidongri areas within the range 2 ppm to 88.7 ppm. In control area for summer sodium ranged between 132.2 ppm to 160.6 ppm. which recorded maximum from pond water. Sodium absorption value  $< 10$  expresses low sodium hazard ( $S_1$ ) and is considered excellent water for irrigation.

TABLE-2  
SODIUM ABSORPTION RATIO (SAR) AND ITS PARAMETERS IN WATER SAMPLES  
FROM CHANDIDONGRI AND CONTROL AREAS

S.N.	Sites	EC	TDS	Na ppm	Na epm	Ca ppm	Ca epm	Mg ppm	Mg epm	SAR
1.	Chandidongri, mine Pond (I)	440	282	02	0.087	16	0.7984	28	2.3032	0.07
2.	Chandidongri, Ranitalab Dam	140	90	42	1.827	24	1.1976	12	0.9871	1.75
3.	Chandidongri, mine pond (II)	150	96	19	0.8265	04	0.1996	16	1.3161	0.94
4.	Chandidongri, Ranitalab	190	122	11.5	0.5002	12	0.5988	30	2.4678	0.406
5.	Chandidongri, open well of factory	280	179	70.3	3.0558	34	1.6966	22	1.8097	2.31
6.	Chandidongri, open well of Sarpanch	250	160	45.8	1.9923	30	1.4970	40	3.2904	1.29
7.	Chandidongri, open well of Babakutia	320	205	73.6	3.2016	50	2.4950	14	1.1516	2.37
8.	Birutola pond	340	218	54.0	2.349	40	1.9960	14	1.1516	1.879
9.	Birutola, handpump in front of Vishnudas house	630	403	49.6	2.1576	120	5.9880	92	7.5679	0.82
10.	Birutola, Govt. open well	620	397	62.1	2.7013	58	2.8942	54	4.4420	1.41

S.N.	Sites	EC	TDS	Na ppm	Na epm	Ca ppm	Ca epm	Mg ppm	Mg epm	SAR
11.	Birutola, handpump Ram Mandir	280	179	29.5	1.2832	50	2.4950	58	4.7710	0.67
12.	Birutola, open well of Lekhram	950	608	88.7	3.8584	152	7.5848	118	9.7066	1.31
13.	Khobradihi, handpump	340	218	35.4	1.5399	76	3.7924	74	6.0872	6.69
14.	Khobradihi, open well of Budhram	500	320	63.0	2.7405	76	3.7924	52	4.2775	1.36
15.	Sadak-banzarz, handpump of Thakurram house	400	256	32.0	1.3920	62	3.0938	70	5.7580	0.66
16.	Sadak-banzari, Govt. open well	280	179	17.1	0.7438	28	1.3972	46	3.7839	0.46
17.	Sadak-banzari, handpump near dhaba	200	128	34.6	1.5051	22	1.0978	44	3.6194	0.98
18.	Patekohara, handpump near G.E. road	220	141	25.7	1.1179	60	2.9940	14	1.1516	0.79
19.	Chandidongri, handpump of Sarpanch house	250	160	35.7	1.5529	44	2.1956	12	0.9871	1.23
20.	Chandidongri, open well of Jogindar Dhaba	380	243	46.8	2.0385	16	0.7984	16	1.3161	1.98
21.	Rajnadgaon, handpump of Vardhaman Nagar	1050	672	132.2	5.7507	200	9.9800	140	11.5160	1.75
22.	Rajandgaon, open well of Jain School	850	544	142.0	6.1770	120	5.9880	180	14.8060	1.91
23.	Rajnandgaon, Ranisagar Pond	820	525	160.6	6.9860	40	1.9960	20	1.6452	5.17

SAR varies from 0.07 to 5.17, *i.e.*, all values less than 10, whereas specific conductance ranges from 140 to 1050  $\mu\text{m}$  (Fig. 1). Analysis further shows that water samples nos. 2, 3, 4, 17, 18 belong to C<sub>1</sub> (low salinity hazard groups), samples nos. 12, 21, 22 and 23 are categorized under C<sub>3</sub>, (medium high salinity group) while rest of the samples fall within the C<sub>2</sub> (medium salinity hazard group). The above classification and interpretation suggest that all the water samples of the study area are well within the acceptable limits recommended by WHO and ISI ICMR<sup>9-11</sup> and American salinity for drinking as well as agriculture purpose<sup>12</sup>. Continuous monitoring of water quality is required in Chandidongri area to assure potability of drinking water.

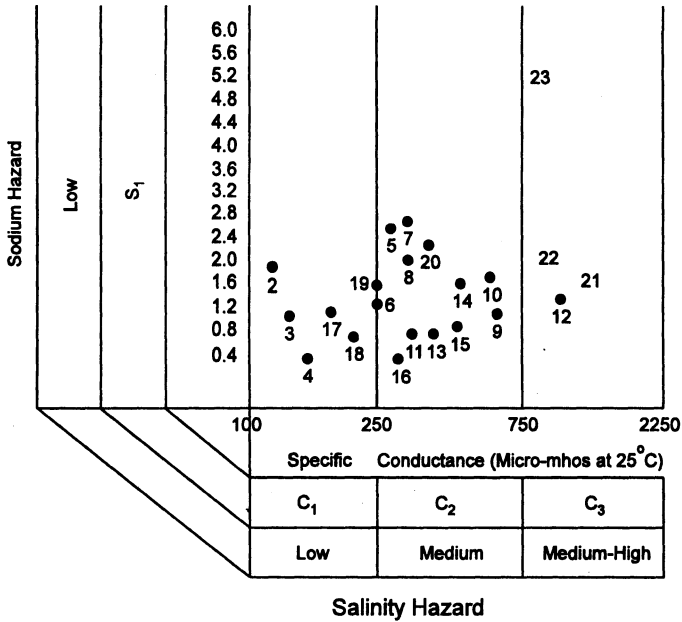


Fig. 1 Salinity hazard of water samples from different sampling sites

**ACKNOWLEDGEMENTS**

The authors are highly grateful to the Director, Geology and Mining Department, Raipur (C.G.) and Bioscience Department, Pt. Ravishankar University, Raipur (C.G.) for providing necessary laboratory facilities and helpful suggestions for this work.

**REFERENCES**

1. K.R. Karanth, *Ground Water News*, 23 (1987).
2. ———, *Hydrology*, Tata McGraw-Hill, New Delhi, p. 458 (1993).
3. D.K. Todd., *Ground Water Hydrology*, 2nd Edn., John Wiley & Sons, New York, p. 535 (1980).
4. J.D. Hem, *Study and Interpretation of the Chemical Characteristics of Natural Water*, U.S. Geol. Surv. Water Supply Paper-2254, p. 264 (1985).
5. H. Bourwer, *Ground Water Hydrology*, McGraw-Hill, New York (1978).
6. APHA-AWWA-WPCF, *Standard Methods for the Examination of Water and Waste Water*, 17<sup>th</sup> Edn., American Public Health Association, Washington, DC (1989).
7. A.I. Vogel, *Text Book of Quantitative Inorganic Analysis*, 4<sup>th</sup> Edn., ELBS, London (1978).
8. G. Matthes, *The Properties of Ground Water*, John Wiley & Sons, New York (1984).
9. World Health Organisation, *Guidelines for Drinking Water Quality*, Vols. 1 & 2, WHO, Geneva, p. 335 (1984).
10. ISI, *Specification for Drinking Water*, IS: 10500, India Standard Institution (Indian Bureau of Standards), New Delhi (1983).
11. ICMR, *Manual of Standard for Drinking Water Supplies*, Report No. 4427, New Delhi, India (1975).
12. L.A. Richards, *Diagnosis and Improvement of Saline and Alkali Soils*, U.S. Dept. Agri. Hand Book, No. 60, p. 160 (1954).