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### Physico-chemical studies on bore wells water of Godhra Taluka territory (Gujarat)

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#### ABSTRACT

Various samples of bore well water collected from different areas in and around the Godhra taluka territory of Panchamahals district (India) and analyzed for their physico-chemical characterizations. The results of this analysis were compared with the water quality standards of WHO and CPHEEO. In this analysis the various physico-chemical parameters such as  $P^H$ , Dissolve oxygen, TDS, Chloride, total alkalinity, calcium, magnesium hardness, sulphate, fluoride, nitrate and total hardness etc., were determined using standard procedures. The studies were in the Adivasi area and a total of 35 water samples from different 35 locations were collected and analyzed.

**Key Words :** Physico-chemical parameters, Bore well water, Water quality.

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#### INTRODUCTION

Water sources available for drinking and other domestic purpose must possess high degree of purity, free from chemical contamination and micro-organism. The potential and quality of bore well water, is an economic resource and essential component of our life, is getting deteriorated in major rural centers due to pollution caused by population explosion, ruralization and industrialization.[1,2] Studies on bore well water[3,4] here, we report the physico-chemical studies of bore wells water of Godhra territory, Gujarat and its some interior Adivasi area. Because of the geographical isolation and remoteness, people residing in the interior Adivasi area, mostly not have access to safe drinking water. In the absence of fresh water supply, the people are forced to take water from any sources that lies near their village. In most of interior Adivasi area, the bore well water is used for drinking purpose and other domestic purpose, Bore well water is generally good quality and it is difficult to pollute bore wells water. The use of fertilizers, pesticides and insecticides in rural area manure, lime, septic tank, refuse dumps etc. are the main source of bore wells water pollution.[5].

## MATERIALS AND METHODS

The study area, the Godhra territory is situated in 30 km around Godhra city, Gujarat.

Overall, 35 samples were collected from the bore wells of various places around of Godhra city. Various samples were collected in clean and dry polyethylene bottle from bore wells after running them for 5 minutes [6]. All the collection of samples are immediately preserved in dark boxes and processed for the different analysis within 6 to 12 hours after collection. In this present study various physical and chemical parameters of water samples were determined and the results were compared with the values of various water quality standards such as World Health Organization (WHO) and Central Public Health and Environment Engineering Organization (CPHEEO).

All the chemicals used were of AR grade. Double distilled water was used for the preparation of reagents and solutions. The major water quality parameters considered for the examination in this study are Temperature,  $P^H$ , dissolved oxygen (D.O.), total alkalinity, total dissolved solid (T.D.S.), calcium and magnesium, sulphate, nitrate, fluoride contents [7].

The Temperature of the samples was noted at their sampling points itself.  $P^H$ , T.D.S., D.O., Nitrate, values were measured by water analysis and manual method, calcium and magnesium hardness of water was estimated by complexometric titration method [8]. Chloride, fluoride, nitrate, sulphate content were determined by standard volumetric method [8,9].

## RESULTS AND DISCUSSION

The physico-chemical data of the bore wells water samples collected in May-10, January-11, August-11 are presented in Table 1-3. The results of the samples with different collecting places because of the different nature of soil contamination [8]. In the present study temperature ranged from 18-36°C.

The bore wells water have the alkaline  $P^H$  range of 7.3 to 8.4 and the values are well within the safe limit for drinking [10]. The  $P^H$  value of drinking water is an important index of acidity, alkalinity and resulting value of the acidic-basic interaction of a number of its mineral and organic components. In the Godhra territory, all water samples have normal  $P^H$ , if below than 6  $P^H$  that prescribes by APHA [11]. The present study showed dissolved oxygen ranged from 0.1 to 2.48 mg/L. According to WHO and Indian standard, T.D.S. value should be less than 500 mg/L for drinking water but present study T.D.S. ranged from 330 to 2200 mg/L, showing high values for the Kharsaliya railway station bore (Jitpur village) sampling station which may be attributed to the limestone area.

The chloride content ranges from 25 to 590 mg/L (mean-370 mg/L) natural water contains low chloride ions, i.e. finding indicates that most of samples are below the permissible limits of chloride in drinking water prescribed [12] by Indian Standard Index.

Alkalinity leads to corrosion and influences the chemical and biochemical reactions. Alkalinity was observed in the ranges 100 to 572 mg/L, within the permissible limit of 200 mg/L.

The concentration of calcium ranges from 32 to 176 mg/L with the maximum in the sample No. 20. The high concentration of Ca may be due to deposits of limestone, dolomite [11].

**Table – 1 Analysis Results of the samples collected in January-2010**

Sr. No.	Sampling Station	Village	Temp. °C	p <sup>H</sup>	T.D.S.	D.O.	Chloride Mg/l	Total Alkalinity Mg/l	Ca-Hardness Mg/l	Mg- Hardness Mg/l	Total Hardness Mg/l	Nitrate Mg/l	Fluoride Mg/l	Sulphate Mg/l
1	Kheda Falia bore	Ambali	19.0	7.58	1665.0	8.90	498.0	153.0	97.0	117.0	725.0	0.88	0.88	46.0
2	Vanta Faliya Nr- dairy	Asayadi	20.0	7.62	521.0	9.40	98.0	233.0	47.0	43.0	283.0	6.30	0.62	14.0
3	Anganvadi	Bamroli Khurd	20.0	7.70	883.0	12.40	352.0	288.0	38.0	36.0	243.0	5.31	0.44	14.0
4	Khant Faliya	Betiya	20.0	7.62	630.0	7.40	122.0	287.0	105.0	25.0	562.0	8.53	1.20	22.0
5	Maganpuri bore	Bhatpura	19.0	7.60	812.0	12.60	198.0	189.0	62.0	63.0	426.0	1.76	0.86	22.0
6	Bhat Faliya bore	Bhamiya	20.0	8.10	532.0	6.80	62.0	301.0	49.0	36.0	273.0	0.88	0.86	46.0
7	Panchayan Mandir	Bodidra(B)	20.0	7.81	548.0	7.40	142.0	301.0	47.0	28.0	246.0	7.93	0.86	8.0
8	Kuva Faliya	Dahikot	19.0	8.21	625.0	13.30	105.0	265.0	112.0	27.0	401.0	4.43	0.62	20.0
9	Tad Faliya	Goli	19.0	8.26	765.0	8.30	133.0	444.0	62.0	36.0	306.0	6.35	0.62	12.0
10	Luhar Faliya	Gollav	19.0	8.30	352.0	6.10	42.0	143.0	39.0	26.0	173.0	0.88	0.42	44.0
11	Navalsing Faliya	Gollav	20.0	8.08	392.0	9.40	49.0	120.0	38.0	13.0	145.0	1.77	0.46	46.0
12	Harijabva Faliya	Govindi	20.0	8.01	790.0	7.10	88.0	502.0	39.0	44.0	256.0	6.35	0.62	10.8
13	Vadinath Faliya	Harkundi	20.0	7.61	1525.0	2.20	462.0	443.0	63.0	136.0	681.0	4.43	1.42	76.0
14	Rathod R.S. House	Harkundi	19.0	7.60	680.0	11.20	113.0	342.0	83.0	52.0	413.0	2.65	1.20	38.0
15	Rathod R.M. House	Harkundi	20.0	7.80	612.0	4.80	98.0	265.0	82.0	44.0	382.0	0.88	0.86	28.0
16	Rathod V.M. House	Harkundi	20.0	7.92	763.0	7.80	132.0	341.0	93.0	56.0	472.0	0.88	1.28	44.0
17	Harkundi Gamtal	Harkundi	19.0	7.35	736.0	8.30	132.0	365.0	92.0	53.0	473.0	2.65	0.46	38.0
18	Chotravala Faliya	Harkundi	19.0	7.57	809.0	7.10	249.0	248.0	59.0	46.0	345.0	3.54	0.82	14.0
19	Varia Sakuntlaben House	Isrodiya	18.0	7.60	853.0	8.50	178.0	532.0	38.0	53.0	321.0	1.77	1.42	14.0
20	Kharsaliya Railway Station	Jitpur	19.0	7.63	2100.0	6.20	680.0	72.0	173.0	110.0	888.0	2.65	1.28	58.0
21	School bore	Kankan-pur	18.0	7.69	562.0	5.60	63.0	326.0	89.0	6.0	246.0	7.94	1.20	22.0
22	Pratap Khatu Baria bore	Kevdiya	19.0	9.50	502.0	6.20	72.0	286.0	46.0	36.0	273.0	9.53	0.72	6.0
23	Patel Faliya bore	Ladpur	20.0	7.80	532.0	9.40	81.0	300.0	53.0	48.0	325.0	4.76	0.62	14.0
24	Ladpur Gamtal bore	Ladpur	19.0	7.31	985.0	7.40	201.0	582.0	49.0	21.0	209.0	3.54	1.62	22.0
25	Talav Faliya bore	Nadisar	18.0	8.10	1090.0	6.10	42.0	483.0	93.0	42.0	400.0	11.11	1.06	22.0
26	Popatpura Gamtal bore	Popatpura	19.0	7.75	723.0	9.40	128.0	298.0	53.0	66.0	403.0	4.43	1.08	22.0
27	Talav Faliya bore	Rampur -Jodka	19.0	7.82	465.0	7.10	55.0	293.0	33.0	42.0	248.0	7.94	1.08	20.0
28	Govt. bore	Raisingpura	19.0	7.65	500.0	8.30	98.0	183.0	83.0	6.0	243.0	6.35	0.86	14.0
29	Thakor Faliya bore	Samli	18.0	7.63	623.0	5.60	124.0	153.0	53.0	59.0	369.0	9.74	1.04	14.0
30	Sarpanch Faliya bore	Sarsav	18.0	7.85	621.0	4.80	70.0	420.0	46.0	12.0	169.0	3.54	1.48	20.0
31	Kandachpura bore	Tuwa	19.0	8.01	556.0	7.30	80.0	222.0	73.0	12.0	226.0	6.35	0.42	58.0
32	Dairy bore	Vatlav	19.0	7.96	595.0	12.20	113.0	320.0	67.0	36.0	328.0	7.94	0.62	12.0
33	Ninama Faliya bore	Vavdi Khurd	19.0	7.03	472.0	13.30	65.0	282.0	39.0	15.0	163.0	6.35	1.22	46.0
34	Amrapura bore	Veganpur	20.0	7.60	621.0	8.90	164.0	283.0	53.0	32.0	256.0	11.11	1.14	14.0
35	Chhapra road bore	Veraiya	20.0	7.96	573.0	9.40	98.0	301.0	43.0	25.0	216.0	14.79	0.88	28.0

Table – 2 Analysis Results of the samples collected in May-2011

Sr. No.	Sampling Station	Village	Temp. °C	p <sup>H</sup>	T.D.S.	D.O.	Chloride Mg/l	Total Alkalinity Mg/l	Ca-Hardness Mg/l	Mg- Hardness Mg/l	Total Hardness Mg/l	Nitrate Mg/l	Fluoride Mg/l	Sulphate Mg/l
1	Kheda Falia bore	Ambali	35.0	7.31	1260.0	8.30	380.0	150.0	98.0	98.0	680.0	0.88	0.88	46.0
2	Vanta Faliya Nr- dairy	Asayadi	33.0	7.67	470.0	8.90	84.0	210.0	42.0	38.0	269.0	6.35	0.62	10.0
3	Anganvadi	Bamroli Khurd	35.0	7.68	868.0	11.20	281.0	280.0	38.0	32.0	231.0	4.43	0.42	10.0
4	Khant Faliya	Betiya	34.0	8.09	730.0	7.10	102.0	278.0	98.0	28.0	531.0	7.94	1.16	20.0
5	Maganpuri bore	Bhatpura	33.0	8.00	936.0	12.40	160.0	152.0	57.0	62.0	421.0	2.65	0.82	16.0
6	Bhat Faliya bore	Bhamiya	32.0	8.40	482.0	6.10	54.0	308.0	44.0	38.0	279.0	0.88	0.82	44.0
7	Panchayan Mandir	Bodidra(B)	34.0	8.00	668.0	6.80	132.0	292.0	40.0	30.0	232.0	6.35	0.82	8.0
8	Kuva Faliya	Dahikot	33.0	7.65	710.0	12.40	96.0	256.0	96.0	30.0	390.0	5.31	0.60	20.0
9	Tad Faliya	Goli	32.0	7.38	792.0	8.90	118.0	398.0	52.0	32.0	294.0	6.35	0.60	10.0
10	Luhar Faliya	Gollav	33.0	7.80	360.0	6.10	28.0	136.0	32.0	27.0	162.0	1.77	0.44	40.0
11	Navalsing Faliya	Gollav	35.0	8.40	330.0	9.40	82.0	102.0	32.0	20.0	132.0	1.77	0.44	40.0
12	Harijabva Faliya	Govindi	32.0	8.10	680.0	7.30	79.0	466.0	32.0	38.0	240.0	5.31	0.60	12.0
13	Vadinath Faliya	Harkundi	33.0	8.30	1480.0	4.80	292.0	421.0	58.0	120.0	567.0	3.54	1.18	56.0
14	Rathod R.S. House	Harkundi	33.0	7.95	480.0	11.20	98.0	328.0	70.0	46.0	410.0	1.77	1.16	34.0
15	Rathod R.M. House	Harkundi	33.0	7.96	540.0	4.20	82.0	239.0	74.0	42.0	362.0	1.77	0.88	22.0
16	Rathod V.M. House	Harkundi	32.0	8.00	635.0	7.10	118.0	321.0	92.0	42.0	473.0	0.88	1.22	38.0
17	Harkundi Gamtal	Harkundi	32.0	7.90	530.0	8.20	135.0	366.0	52.0	48.0	467.0	0.88	0.42	28.0
18	Chotravala Faliya	Harkundi	32.0	7.70	344.0	7.10	213.0	224.0	58.0	54.0	342.0	2.65	0.88	14.0
19	Varia Sakuntlaben House	Isrodiya	32.0	7.80	680.0	8.50	149.0	503.0	38.0	42.0	310.0	0.88	1.22	12.0
20	Kharsaliya Railway Station	Jitpur	33.0	7.90	1850.0	6.10	512.0	102.0	119.0	96.0	610.0	1.77	1.28	58.0
21	School bore	Kankan-pur	34.0	7.70	340.0	5.60	54.0	328.0	90.0	10.0	230.0	6.35	1.22	20.0
22	Pratap Khatu Baria bore	Kevdiya	32.0	8.71	605.0	6.20	52.0	272.0	48.0	32.0	262.0	6.35	0.62	8.0
23	Patel Faliya bore	Ladpur	34.0	7.85	384.0	8.92	62.0	292.0	42.0	39.0	329.0	2.65	0.62	16.0
24	Ladpur Gamtal bore	Ladpur	33.0	7.40	850.0	7.10	120.0	521.0	48.0	19.0	209.0	2.65	1.48	20.0
25	Talav Faliya bore	Nadisar	33.0	8.00	1180.0	6.80	38.0	472.0	90.0	42.0	392.0	7.94	1.06	20.0
26	Popatpura Gamtal bore	Popatpura	32.0	8.00	792.0	9.40	102.0	280.0	48.0	62.0	410.0	2.65	1.08	20.0
27	Talav Faliya bore	Rampur -Jodka	33.0	8.12	480.0	7.30	60.0	292.0	32.0	38.0	236.0	4.43	1.08	22.0
28	Govt. bore	Raisingpura	35.0	8.12	463.0	8.20	89.0	172.0	74.0	10.0	236.0	4.43	0.86	12.0
29	Thakor Faliya bore	Samli	34.0	7.90	666.0	5.60	103.0	144.0	50.0	43.0	334.0	7.94	1.04	16.0
30	Sarpanch Faliya bore	Sarsav	33.0	8.10	504.0	4.80	63.0	392.0	44.0	10.0	156.0	2.65	1.42	20.0
31	Kandachpura bore	Tuwa	32.0	8.10	582.0	7.80	64.0	198.0	72.0	12.0	200.0	4.43	0.42	56.0
32	Dairy bore	Vatlav	32.0	8.12	610.0	13.30	101.0	312.0	62.0	36.0	310.0	6.35	0.62	10.0
33	Ninama Faliya bore	Vavdi Khurd	33.0	7.90	324.0	12.60	61.0	272.0	38.0	12.0	156.0	6.35	1.20	38.0
34	Amrapura bore	Veganpur	32.0	7.82	683.0	9.40	142.0	272.0	45.0	28.0	250.0	9.74	1.14	12.0
35	Chhapra road bore	Veraiya	32.0	7.98	392.0	9.40	92.0	292.0	40.0	22.0	200.0	11.11	0.86	22.0

**Table – 3 Analysis Results of the samples collected in August-2011**

Sr. No.	Sampling Station	Village	Temp. °C	p <sup>H</sup>	T.D.S.	D.O.	Chloride Mg/l	Total Alkalinity Mg/l	Ca-Hardness Mg/l	Mg- Hardness Mg/l	Total Hardness Mg/l	Nitrate Mg/l	Fluoride Mg/l	Sulphate Mg/l
1	Kheda Falia bore	Ambali	27.0	7.91	1480.0	8.90	582.0	168.0	105.0	101.0	689.0	0.88	0.86	58.0
2	Vanta Faliya Nr- dairy	Asayadi	25.0	7.82	590.0	9.40	102.0	265.0	56.0	46.0	292.0	7.94	0.60	12.0
3	Anganvadi	Bamroli Khurd	25.0	7.54	890.0	12.60	362.0	292.0	45.0	38.0	246.0	7.94	0.42	14.0
4	Khant Faliya	Betiya	26.0	7.95	720.0	7.80	124.0	298.0	115.0	22.0	562.0	8.53	1.20	28.0
5	Maganpuri bore	Bhatpura	27.0	7.96	970.0	13.30	214.0	192.0	65.0	68.0	420.0	0.88	0.88	22.0
6	Bhat Faliya bore	Bhamiya	25.0	8.31	440.0	7.10	69.0	301.0	52.0	38.0	262.0	1.77	0.82	56.0
7	Panchayan Mandir	Bodidra (B)	26.0	7.90	612.0	7.80	162.0	312.0	58.0	32.0	260.0	8.53	0.86	10.0
8	Kuva Faliya	Dahikot	25.0	7.60	640.0	13.30	118.0	264.0	112.0	32.0	412.0	5.31	0.62	28.0
9	Tad Faliya	Goli	27.0	7.95	820.0	9.40	145.0	410.0	66.0	42.0	314.0	7.94	0.60	14.0
10	Luhar Faliya	Gollav	26.0	8.40	420.0	6.80	64.0	148.0	40.0	30.0	192.0	1.77	0.44	46.0
11	Navalsing Faliya	Gollav	25.0	8.33	340.0	10.20	91.0	126.0	42.0	18.0	145.0	2.65	0.46	44.0
12	Harijabva Faliya	Govindi	27.0	8.40	810.0	7.80	92.0	503.0	40.0	48.0	256.0	5.31	0.62	12.0
13	Vadinath Faliya	Harkundi	26.0	8.36	1624.0	4.80	381.0	448.0	68.0	130.0	630.0	5.31	1.28	56.0
14	Rathod R.S. House	Harkundi	26.0	8.10	630.0	12.40	114.0	352.0	102.0	52.0	420.0	3.54	1.20	40.0
15	Rathod R.M. House	Harkundi	25.0	8.12	720.0	4.80	104.0	269.0	92.0	48.0	392.0	1.77	0.88	34.0
16	Rathod V.M. House	Harkundi	26.0	7.90	790.0	7.80	145.0	344.0	98.0	66.0	472.0	1.77	1.28	44.0
17	Harkundi Gamtal	Harkundi	24.0	7.63	680.0	8.90	160.0	372.0	98.0	58.0	492.0	3.54	0.46	38.0
18	Chotravala Faliya	Harkundi	25.0	7.68	840.0	7.30	241.0	242.0	62.0	52.0	360.0	4.43	0.82	20.0
19	Varia Sakuntlaben House	Isrodiya	26.0	7.61	790.0	8.90	182.0	572.0	42.0	58.0	340.0	2.65	1.22	16.0
20	Kharsaliya Railway Station	Jitpur	24.0	7.58	2260.0	6.20	590.0	180.0	176.0	98.0	890.0	1.77	1.28	56.0
21	School bore	Kankan-pur	25.0	7.69	680.0	6.10	68.0	381.0	102.0	12.0	248.0	8.53	1.28	28.0
22	Pratap Khatu Baria bore	Kevdiya	26.0	8.63	604.0	6.10	68.0	282.0	58.0	40.0	273.0	11.11	0.72	8.0
23	Patel Faliya bore	Ladpur	25.0	7.80	545.0	10.10	79.0	309.0	58.0	52.0	320.0	4.43	0.62	20.0
24	Ladpur Gamtal bore	Ladpur	25.0	7.30	900.0	7.80	182.0	572.0	58.0	28.0	219.0	4.43	1.62	22.0
25	Talav Faliya bore	Nadisar	26.0	8.15	1200.0	6.20	52.0	492.0	109.0	48.0	420.0	11.11	1.08	22.0
26	Popatpura Gamtal bore	Popatpura	25.0	7.80	680.0	8.90	128.0	312.0	69.0	68.0	440.0	5.31	1.08	22.0
27	Talav Faliya bore	Rampur -Jodka	26.0	7.82	562.0	7.80	66.0	312.0	44.0	42.0	260.0	8.53	1.08	28.0
28	Govt. bore	Raisingpura	25.0	7.64	482.0	7.80	100.0	186.0	92.0	12.0	246.0	7.94	0.88	16.0
29	Thakor Faliya bore	Samli	26.0	7.64	630.0	8.90	122.0	159.0	66.0	62.0	383.0	11.11	1.08	16.0
30	Sarpanch Faliya bore	Sarsav	25.0	8.12	592.0	5.90	81.0	405.0	52.0	18.0	169.0	4.43	1.48	28.0
31	Kandachpura bore	Tuwa	25.0	8.20	632.0	7.40	82.0	212.0	79.0	18.0	240.0	7.94	0.44	56.0
32	Dairy bore	Vatlav	26.0	8.00	580.0	12.60	119.0	328.0	73.0	42.0	340.0	6.35	0.62	14.0
33	Ninama Faliya bore	Vavdi Khurd	26.0	7.85	432.0	13.30	68.0	286.0	42.0	16.0	168.0	9.74	1.22	44.0
34	Amrapura bore	Veganpur	24.0	7.61	712.0	9.40	158.0	292.0	55.0	32.0	260.0	11.11	1.18	16.0
35	Chhapra road bore	Veraiya	27.0	7.90	582.0	10.20	99.0	312.0	48.0	28.0	220.0	11.11	0.88	34.0

Water containing high calcium is not suitable for washing, bathing, and in the boilers and linked to the formation of concretion in the body and may cause gas to intestinal diseases and stone formation. So, calcium is needed for the body in small quantities though water provide only part of total requirement.[13]

Magnesium is a beneficial meta but toxic at high concentration, cause hardness of exerts a cathartic and diuretic action.[11] The concentration of magnesium range from 10 to 130 mg/L with high in sample No. 13 and in some samples in exceed the desirable limit of 30 mg/L prescribed by BIS but lies within the maximum permissible limit at 75 mg/L.

Total Hardness, indicates calcium and magnesium content ranges 156 to 890 mg/L (mean-138 mg/L) shown high value in the sample No.-20. Hardness of water is not health hazards but its value should remain below permissible limit to restore the test of water.[10]

Nitrate nitrogen is one of the major constituents of organism along with carbon and hydrogen as amino acids, protein and organic compounds, present in bore wells water.[14] In the present study nitrate nitrogen level should lower values then the prescribed values.

In the present study Fluoride ranged from 0.42 to 1.62 mg/L. Mostly sample having the permissible limits of fluoride in drinking water prescribed[12] by Indian standard Index.

In the present study sulphate ranged from 6 to 76 mg/L. High concentration of sulphate along with sodium and magnesium in drinking water can leads to gastrointestinal irritation and respirations illness. (Samples Analysis Data – Table 1, 2, 3)

## CONCLUSION

The important physico-chemical parameters of bore well water samples collected from 35 locations in Godhra territory. It was observed that the P<sup>H</sup>, Fluoride are normal in mostly sampling station, but T.D.S., total alkalinity, total hardness, chloride, nitrate, sulphate, calcium, magnesium are high for the water samples from many sampling stations. Only very few samples showed values above the desirable limits by Indian standard Index.

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