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## RESEARCH ARTICLE

### DETERMINATION OF WATER QUALITY INDEX OF WELL WATER RESOURCES IN DUDHANI VILLAGE, DADRA AND NAGAR HAVELI, INDIA

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#### ABSTRACT

A study has been carried out for the evaluation of water quality Index in Dudhani village. Open well water sample were taken from Chokipada, Ruepada, Tokarpada, Kalmadevi, Navapada and Boripada locations and observed for the chemical and biological parameters of pH, Color, TDS, Turbidity, Total Hardness, Total Alkalinity, Chloride, Sulphate, Nitrate, Calcium, Magnesium, Iron, Zinc, Fluoride, *E.Coli*, and Total coliform bacteria. Iron value was observed high in all the sampling locations. Biological test parameters found positive in location 1,2,3,4,5 and 6. As per the WQI Classification of water, Very poor water quality was Identified in all eight sampling location. Test results of Chemical and Biological parameters indicate the water purification requirement to enhance the water quality for drinking purpose.

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#### INTRODUCTION

In order to determine the well water quality and evaluation of WQI in Dudhani village water sources, well water of has been studied and classified as per the water quality index. Total 8 water samples from open well sources were analyzed for evaluation of water quality. Water samples were analyzed for pH, Color, TDS, Turbidity, Total Hardness, Total Alkalinity, Chloride, Sulphate, Nitrate, Calcium, Magnesium, Iron, Zinc, Fluoride, *E.Coli*, and Total coliform bacteria. The weighted arithmetic index method was used for determination of WQI.

**Table 1. Sampling location and GPS Identification**

Location No	Source	Name of Location	GPS
1	Open well	Chokipada	N 20° 10 ' 3° " E 73° 9' 25"
2		Chokipada	N 20° 10 ' 28" E 73° 9' 27"
3		Chokipada	N 20° 10 ' 4° " E 73° 9' 23"
4		Ruepada	N 20° 11' 39" E 73° 10 ' 25"
5		Tokarpada	N 20° 10 ' 56" E 73° 9' 29"
6		Kalmadevi	N 20° 9' 42" E 73° 9' 43"
7		Navapada	N 20° 9' 52" E 73° 9' 47"
8		Boripada	N 20° 10 ' 5" E 73° 9' 43"

#### MATERIALS AND METHODS

Total 8 Open well water samples were collected from Eight locations during the month of July-2016. Sampling site was tracked with GPS identifications. Water sample were collected and analyzed as per IS 10500(2012) specifications. Water quality was evaluated as per specifications given in Indian Standard guideline IS 10500 (2012) and APHA.

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## RESULTS AND DISCUSSIONS

Well water sample Chemical test parameters pH, Color, TDS, Total Hardness, Total Alkalinity, Chloride, Sulphate, Nitrate, Calcium, Magnesium, Zinc and Fluoride were found under the specification limit of IS 10500:2012.

**Table 2. Specification and Test Method**

Sr No	Test Parameter	Unit	Specification Limit	Method
1	pH Value	NA	6.5 to 8.5	IS3025(Part-11)
2	Color	Hazen	5 Max.	IS3025(Part-4)
3	Total Dissolved Solids	mg/L	500 Max.	IS3025(Part-16)
4	Turbidity	NTU	1 Max.	APHA 2130 B
5	Total Hardness	mg/L	200 Max.	IS3025(Part-21)
6	Total Alkalinity as Calcium Carbonate	mg/L	200 Max.	IS3025(Part-23)
7	Chloride as Cl	mg/L	250 Max.	IS3025(Part-32)
8	Sulphate as SO <sub>4</sub>	mg/L	200 Max.	IS3025(Part-24)
9	Nitrate as NO <sub>3</sub>	mg/L	45 Max.	IS3025(Part-34)
10	Calcium as Ca	mg/L	75 Max.	IS3025(Part-40)
11	Magnesium as Mg	mg/L	30 Max.	IS3025(Part-46)
12	Iron as Fe	mg/L	0.3 Max.	APHA (22ndEdi.)3500 FeB
13	Zinc as Zn	mg/L	5 Max.	AAS APHA (22ndEdi.)3111 B
14	Fluoride as F	mg/L	1 Max.	APHA (22nd)4500F D-Spands
15	E.Coli	/100 ml	Absent	IS1622:1981Edi.2.4(2003-05)
16	Total Coliform Bacteria	/100 ml	Absent	APHA(22ndEdi) 9221-D

**Table 3. Classification of Water Quality Index (WQI)**

WQI	Classification
0-25	Excellent water quality
26-50	Good water quality
51-75	Poor water quality
76-100	Very Poor water quality

**Table 4. Analysis test results of Location 1**

No	Chemical Test Parameter	Test Result	Relative weight (WiA)	Quality rating (QiA)	Weighted Qi value
1	pH Value	7.09	0.12	6.00	0.71
2	Color, Hazen	4	0.20	80.00	16.00
3	Total Dissolved Solids, mg/L	269	0.002	53.80	0.11
4	Turbidity, NTU	0.39	1.00	39.00	39.00
5	Total Hardness as CaCO <sub>3</sub> ,mg/L	161	0.01	80.50	0.40
6	Total Alkalinity , mg/L	101	0.01	50.50	0.25
7	Chloride as Cl, mg/L	14	0.004	5.60	0.02
8	Sulphate as SO <sub>4</sub> , mg/L	70.1	0.01	35.05	0.18
9	Nitrate as NO <sub>3</sub> , mg/L	0.31	0.02	0.69	0.02
10	Calcium as Ca, mg/L	34.10	0.01	45.47	0.61
11	Magnesium as Mg, mg/L	14.23	0.03	47.43	1.58
12	Iron as Fe, mg/L	0.41	3.33	136.67	455.56
13	Zinc as Zn, mg/L	0.51	0.20	10.20	2.04
14	Fluoride as F, mg/L	0.64	1.00	64.00	64.00
	Average Value		0.42		41.46
	WQI		97.7		
	Microbiological Test Parameter	Result			
15	E.Coli , /100 ml	Present			
16	Total Coliform Bacteria, /100	Present			

**Table 5. Analysis test results of Location 2**

No	Chemical Test Parameter	Test Result	Relative weight (WiA)	Quality rating (QiA)	Weighted Qi value
1	pH Value	7.11	0.12	7.33	0.86
2	Color, Hazen	2	0.20	40.00	8.00
3	Total Dissolved Solids, mg/L	274	0.002	54.80	0.11
4	Turbidity, NTU	0.51	1.00	51.00	51.00
5	Total Hardness as CaCO <sub>3</sub> ,mg/L	221	0.01	110.50	0.55
6	Total Alkalinity , mg/L	110	0.01	55.00	0.28
7	Chloride as Cl, mg/L	17	0.004	6.80	0.03
8	Sulphate as SO <sub>4</sub> , mg/L	25.6	0.01	12.80	0.06
9	Nitrate as NO <sub>3</sub> , mg/L	0.27	0.02	0.60	0.01
10	Calcium as Ca, mg/L	74.1	0.01	98.80	1.32
11	Magnesium as Mg, mg/L	18.11	0.03	60.37	2.01
12	Iron as Fe, mg/L	0.32	3.33	106.67	355.56
13	Zinc as Zn, mg/L	0.51	0.20	10.20	2.04
14	Fluoride as F, mg/L	0.39	1.00	39.00	39.00
	Average Value		0.42		32.92
	WQI		77.6		
	Microbiological Test Parameter	Result			
15	E.Coli , /100 ml	Present			
16	Total Coliform Bacteria, /100	Present			

Test results of well water sample determined the high Iron value in location 1,2,3,4,5,6,7 and 8, biological test parameter found positive in water sample of Location 1,2,3,4,5 and 6. High turbidity was observed in Location 5. WQI was evaluated 97.7, 77.6, 81.4, 83.4, 100.7, 87.8, 84.2 and 86.9 for Location 1,2,3,4,5,6,7 and 8 respectively which Identified Very poor water quality for drinking purpose.

**Table 6. Analysis test results of Location 3**

No	Chemical Test Parameter	Test Result	Relative weight (WiA)	Quality rating (QiA)	Weighted Qi value
1	pH Value	6.81	0.12	-12.67	-1.49
2	Color, Hazen	2	0.20	40.00	8.00
3	Total Dissolved Solids, mg/L	141	0.0020	28.20	0.06
4	Turbidity, NTU	0.41	1.00	41.00	41.00
5	Total Hardness as CaCO <sub>3</sub> ,mg/L	88	0.01	44.00	0.22
6	Total Alkalinity , mg/L	71	0.01	35.50	0.18
7	Chloride as Cl, mg/L	8	0.004	3.20	0.01
8	Sulphate as SO <sub>4</sub> , mg/L	12	0.01	6.00	0.03
9	Nitrate as NO <sub>3</sub> , mg/L	0.11	0.02	0.24	0.01
10	Calcium as Ca, mg/L	28.61	0.01	38.15	0.51
11	Magnesium as Mg, mg/L	3.11	0.03	10.37	0.35
12	Iron as Fe, mg/L	0.37	3.33	123.33	411.11
13	Zinc as Zn, mg/L	0.64	0.20	12.80	2.56
14	Fluoride as F, mg/L	0.21	1.00	21.00	21.00
	Average Value		0.42		34.54
	WQI		81.4		
	Microbiological Test Parameter	Result			
15	E.Coli , /100 ml	Present			
16	Total Coliform Bacteria, /100	Present			

**Table 7. Analysis test results of Location 4**

No	Chemical Test Parameter	Test Result	Relative weight (WiA)	Quality rating (QiA)	Weighted Qi value
1	pH Value	7.04	0.12	2.67	0.31
2	Color, Hazen	2	0.20	40.00	8.00
3	Total Dissolved Solids, mg/L	188	0.0020	37.60	0.08
4	Turbidity, NTU	0.11	1.00	11.00	11.00
5	Total Hardness as CaCO <sub>3</sub> ,mg/L	120	0.01	60.00	0.30
6	Total Alkalinity , mg/L	93	0.01	46.50	0.23
7	Chloride as Cl, mg/L	11.2	0.004	4.48	0.02
8	Sulphate as SO <sub>4</sub> , mg/L	17.2	0.01	8.60	0.04
9	Nitrate as NO <sub>3</sub> , mg/L	0.19	0.02	0.42	0.01
10	Calcium as Ca, mg/L	32	0.01	42.67	0.57
11	Magnesium as Mg, mg/L	5.52	0.03	18.40	0.61
12	Iron as Fe, mg/L	0.41	3.33	136.67	455.56
13	Zinc as Zn, mg/L	0.72	0.20	14.40	2.88
14	Fluoride as F, mg/L	0.16	1.00	16.00	16.00
	Average Value		0.42		35.40
	WQI		83.4		
	Microbiological Test Parameter	Result			
15	E.Coli , /100 ml	Present			
16	Total Coliform Bacteria, /100	Present			

**Table 8. Analysis test results of Location 5**

No	Chemical Test Parameter	Test Result	Relative weight (WiA)	Quality rating (QiA)	Weighted Qi value
1	pH Value	7.18	0.12	12.00	1.41
2	Color, Hazen	2	0.20	40.00	8.00
3	Total Dissolved Solids, mg/L	159	0.0020	31.80	0.06
4	Turbidity, NTU	1.06	1.00	106.00	106.00
5	Total Hardness as CaCO <sub>3</sub> ,mg/L	51	0.01	25.50	0.13
6	Total Alkalinity , mg/L	41	0.01	20.50	0.10
7	Chloride as Cl, mg/L	9.4	0.004	3.76	0.02
8	Sulphate as SO <sub>4</sub> , mg/L	11.3	0.01	5.65	0.03
9	Nitrate as NO <sub>3</sub> , mg/L	0.18	0.02	0.40	0.01
10	Calcium as Ca, mg/L	11.2	0.01	14.93	0.20
11	Magnesium as Mg, mg/L	6.52	0.03	21.73	0.72
12	Iron as Fe, mg/L	0.41	3.33	136.67	455.56
13	Zinc as Zn, mg/L	0.53	0.20	10.60	2.12
14	Fluoride as F, mg/L	0.24	1.00	24.00	24.00
	Average Value		0.42		42.74
	WQI		100.7		
	Microbiological Test Parameter	Result			
15	E.Coli , /100 ml	Present			
16	Total Coliform Bacteria, /100	Present			

Table 9. Analysis test results of Location 6

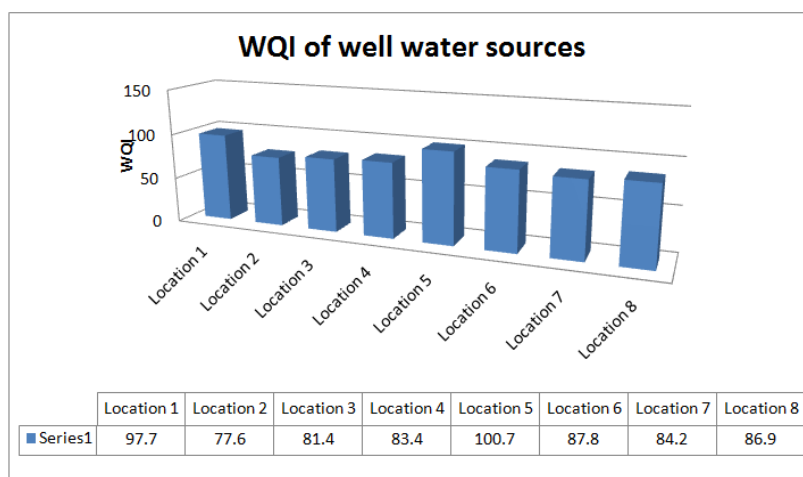
No	Chemical Test Parameter	Test Result	Relative weight (WiA)	Quality rating (QiA)	Weighted Qi value
1	pH Value	7.01	0.12	0.67	0.08
2	Color, Hazen	2	0.20	40.00	8.00
3	Total Dissolved Solids, mg/L	210	0.0020	42.00	0.08
4	Turbidity, NTU	0.62	1.00	62.00	62.00
5	Total Hardness as CaCO <sub>3</sub> ,mg/L	125	0.01	62.50	0.31
6	Total Alkalinity , mg/L	131	0.01	65.50	0.33
7	Chloride as Cl, mg/L	9.1	0.004	3.64	0.01
8	Sulphate as SO <sub>4</sub> , mg/L	13.7	0.01	6.85	0.03
9	Nitrate as NO <sub>3</sub> , mg/L	0.14	0.02	0.31	0.01
10	Calcium as Ca, mg/L	31.1	0.01	41.47	0.55
11	Magnesium as Mg, mg/L	12.14	0.03	40.47	1.35
12	Iron as Fe, mg/L	0.38	3.33	126.67	422.22
13	Zinc as Zn, mg/L	0.66	0.20	13.20	2.64
14	Fluoride as F, mg/L	0.24	1.00	24.00	24.00
	Average Value		0.42		37.26
	WQI		87.8		
	Microbiological Test Parameter	Result			
15	E.Coli , /100 ml	Present			
16	Total Coliform Bacteria, /100	Present			

Table 10. Analysis test results of Location 7

No	Chemical Test Parameter	Test Result	Relative weight (WiA)	Quality rating (QiA)	Weighted Qi value
1	pH Value	7.02	0.12	1.33	0.16
2	Color, Hazen	2	0.20	40.00	8.00
3	Total Dissolved Solids, mg/L	212	0.0020	42.40	0.08
4	Turbidity, NTU	0.63	1.00	63.00	63.00
5	Total Hardness as CaCO <sub>3</sub> ,mg/L	123	0.01	61.50	0.31
6	Total Alkalinity , mg/L	130	0.01	65.00	0.33
7	Chloride as Cl, mg/L	8.3	0.004	3.32	0.01
8	Sulphate as SO <sub>4</sub> , mg/L	14.2	0.01	7.10	0.04
9	Nitrate as NO <sub>3</sub> , mg/L	0.11	0.02	0.24	0.01
10	Calcium as Ca, mg/L	28.62	0.01	38.16	0.51
11	Magnesium as Mg, mg/L	10.61	0.03	35.37	1.18
12	Iron as Fe, mg/L	0.36	3.33	120.00	400.00
13	Zinc as Zn, mg/L	0.61	0.20	12.20	2.44
14	Fluoride as F, mg/L	0.24	1.00	24.00	24.00
	Average Value		0.42		35.72
	WQI		84.2		
	Microbiological Test Parameter	Result			
15	E.Coli , /100 ml	Absent			
16	Total Coliform Bacteria, /100	Absent			

Table 11. Analysis test results of Location 8

No	Chemical Test Parameter	Test Result	Relative weight (WiA)	Quality rating (QiA)	Weighted Qi value A
1	pH Value	7.18	0.12	12.00	1.41
2	Color, Hazen	2	0.20	40.00	8.00
3	Total Dissolved Solids, mg/L	277	0.0020	55.40	0.11
4	Turbidity, NTU	0.21	1.00	21.00	21.00
5	Total Hardness as CaCO <sub>3</sub> ,mg/L	163	0.01	81.50	0.41
6	Total Alkalinity , mg/L	172	0.01	86.00	0.43
7	Chloride as Cl, mg/L	12.5	0.004	5.00	0.02
8	Sulphate as SO <sub>4</sub> , mg/L	20.1	0.01	10.05	0.05
9	Nitrate as NO <sub>3</sub> , mg/L	0.22	0.02	0.49	0.01
10	Calcium as Ca, mg/L	41.33	0.01	55.11	0.73
11	Magnesium as Mg, mg/L	15.63	0.03	52.10	1.74
12	Iron as Fe, mg/L	0.41	3.33	136.67	455.56
13	Zinc as Zn, mg/L	0.74	0.20	14.80	2.96
14	Fluoride as F, mg/L	0.24	1.00	24.00	24.00
	Average Value		0.42		36.89
	WQI		86.9		
	Microbiological Test Parameter	Result			
15	E.Coli , /100 ml	Absent			
16	Total Coliform Bacteria, /100	Absent			



**Fig. 1. WQI of well water sources**

## Conclusion

Open well water sample of Dudhani village location were analyzed in the month of July 2016 and compared with the IS 10500:2012 specification for drinking water. WQI was calculated with using weighted arithmetic index method. Analytical test results conclude that iron value was observed beyond the specification limit in all the water sample. Microbiological test parameters found positive in location 1 to 6. WQI classified very poor water quality in all the locations. Presented paper indicates the water quality of Dudhani village and on the basis of test results it is highly recommended to develop water treatment facility in Dudhani village and further study of other water resources is required for understanding the risk assessment.

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