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RESEARCH ARTICLE

WATER QUALITY ANALYSIS OF FEW VILLAGES FROM GADHINGLAJ TAHSIL, (M.S.) INDIA

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ABSTRACT

The present investigation describes the hydrochemistry and microbial analysis of water from 27 villages of Gadhinglaj Tahsil. The work is carried out during the year 2013-2014. The variables analyzed such as pH, EC, Total alkalinity, Total hardness, Ca, Mg and Chloride as per standard methods. The microbial analysis was carried out to check its potability. On the basis of hydrochemistry water samples were found within the permissible limit while the significant amount of fecal coliforms occurred in all the samples make it unsafe for drinking so proper treatment and purification techniques should be adopted.

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INTRODUCTION

Water is an essential thing for all living organisms, without it there would be no life. Most of the metabolic activities take place in water medium. Wherever water exists in nature it always holds life. So study of the water is the study of life as well. Humans depend on water resources for all their needs of existence and survival. Ground water and other water sources become contaminated by various polluting things and making the water unfit for human use. Fecal coli forms are the microorganisms which are used as an indicator in measuring the sanitary condition and to determine quality of drinking water (Michigan water science center, 2007; EPA, 2007). The presence of heterotrophic bacteria and fecal coliforms in water may raise concern on its safety for human consumption (Oram, 2011). The Gadhinglaj tahsil is dependent on various water sources for drinking purpose so it is necessary to assess the water quality and to check either it is fit for consumption or not. Hence, the present investigation was undertaken.

MATERIALS AND METHODS

Study area

Gadhinglaj is a Tahsil of Kolhapur district from Maharashtra located at 16° 13' 26" N and 74° 26' 9" E having a population

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about 2,16,257 and distributed in to 90 small as well as large villages occupying about 48,094 ha of area (^aPatil *et al.*, 2015; ^bPatil *et al.*, 2015). There are number of drinking water sources like small and large water bodies along with an important river Hiranyakeshi, which is lifeline of the Tahsil, Dug wells and also bore wells.

Collection of samples

The samples of 27 villages from Gadhinglaj tahsil (Fig. 1) were collected in the month of September 2013. Samples were collected in an ice packed plastic container. The Physico-chemical and Microbial parameters were analyzed immediately at the laboratory.

Analysis of physico-chemical parameters

The standard methods recommended by APHA, AWWA and WPCF (2005) and Trivedi and Goel (1984) were used for analyzing physico-chemical parameters.

Analysis of Microbial Parameters

Most Probable Number (MPN) and Standard Plate Count (SPC) were estimated as per the methods of Greenberg *et al.* (1992). The bacterial colony counter was used to enumerate the colony. The fecal coli forms in the samples were enumerated using Membrane filtration technique with the help of Mac Conkeys agar in sterile petri plates.

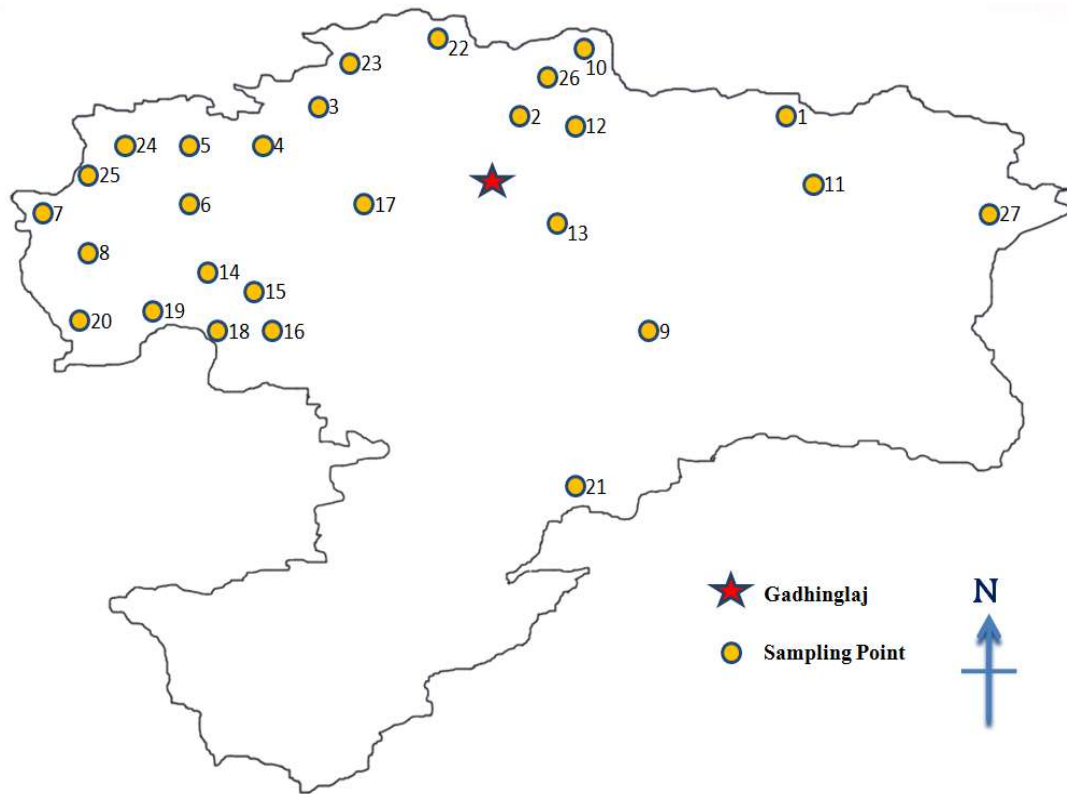


Fig. 1. Study area

Total coliforms were enumerated (using pour plate and serial dilution technique) on a Nutrient Molten agar medium.

RESULTS AND DISCUSSION

Physico-chemical and microbial parameters are presented in Table 1 and 2.

Total Hardness

Hardness of water prevents lather formation with soap and increases its boiling point. Calcium and Magnesium are the principal cations which imparts hardness (Jadhav *et al.*, 2012). In the present study, the content of total hardness for bore well ranges from 190 mg L⁻¹ (Aurnal) to 342 mg L⁻¹ (Mutnal), for river 34 mg L⁻¹ (Belgundi) to 118 mg L⁻¹ (Nilaji), for reservoir 120 mg L⁻¹ (Hanimnal) to 450 mg L⁻¹ (Malatwadi) and for dug well 328 mg L⁻¹ (Kadalage) to 528 mg L⁻¹ (Madyal).

Calcium hardness

Calcium is one of the most abundant cation present in freshwater which imparts hardness. It is essential for cardiac function, nervous system and in the coagulation of blood (Khurshid and Baseer, 1997). The high amount of calcium present in drinking water leads to the encrustation in water supply structure and it affects adversely on domestic use. The level of calcium for bore well ranges from 44.11 mg L⁻¹ (Badyachiwadi) to 82.18 mg L⁻¹ (Naukud), for river 8.54 mg L⁻¹ (Gijawane) to 40.12 mg L⁻¹ (Bhadgaon), for reservoir 27.18 mg L⁻¹ (Kadgaon) to 114.26 mg L⁻¹ (Malatwadi) and for dug well 110.70 mg L⁻¹ (Kadalage) to 220.80 mg L⁻¹ (Madyal).

Magnesium

Magnesium is essential for photosynthesis as the component of chlorophyll molecule present in some plants. Generally magnesium is associated with calcium in all types of water and its concentration remains lower than the calcium. Monthly variations in magnesium values for bore well ranges from 14.99 mg L⁻¹ (Hasurchampu) to 63.61 mg L⁻¹ (Mutnal), for river 5.23 mg L⁻¹ (Atyal) to 53.73 mg L⁻¹ (Koulage), for reservoir 19.41 mg L⁻¹ (Hanimnal) to 69.51 mg L⁻¹ (Koulage) and for dug well 64.51 mg L⁻¹ (Koulage) to 85.78 mg L⁻¹ (Madyal).

Chloride

Chloride is an important parameter for assessing the drinking water quality. It controls salinity of water. Chloride plays an active role in photolysis of water and phosphorylation in green plants. The chloride values for bore well ranges from 19.88 mg L⁻¹ (Karambali) to 113.60 mg L⁻¹ (Mutnal), for river 17.04 mg L⁻¹ (Hiralage) to 62.48 mg L⁻¹ (Nilaji), for reservoir 17.04 mg L⁻¹ (Kadagaon) to 110.20 mg L⁻¹ (Malatwadi) and for dug well 63.00 mg L⁻¹ (Kadalage) to 82.00 mg L⁻¹ (Madhyal). High amount of chloride in water may be due to organic wastes of animal origin and domestic washes (Patil *et al.* 2013).

Total alkalinity

Alkalinity in water is due to carbonates, bicarbonates and hydroxides. It gives buffering power to water. The high quantity of alkalinity is not harmful to human being while it gives bitter taste to water. The total alkalinity value for bore well fluctuates from 8.00 mg L⁻¹ (Lingnur) to 96.00 mg L⁻¹

(Beknal), for river 10.00 mg L⁻¹ (Inchnal and Gijawane) to 98.00 mg L⁻¹ (Yeinapur), for reservoir 46 mg L⁻¹ (Kadgaon) to 74 mg L⁻¹ (Malatwadi) and for dug well 63.00 mg L⁻¹ (Kadalage) to 82.00 mg L⁻¹ (Madyal).

The pH value for bore well fluctuates from 7.31 (Beknal) to 8.75 (Hasurchampu), for river 6.97 (Belgundi) to 8.65 (Bhadgaon), for reservoir 7.16 (Shendri) to 7.19 (Hanimnal) and for dug well 7.41 (Jakhewadi) to 7.52 (Madyal).

Table 1. Physico-chemical analysis

Sr. No.	Villages	Sources	Chloride	Total Alkalinity	Mg Hardness	Ca Hardness	Total Hardness	EC	pH
1	Mutnal	Bore well	113.60	054	63.61	80.20	342	0.82	7.34
2	Aurnal	Bore well	42.60	030	33.50	52.13	190	1.15	7.23
3	Badyachiwadi	Bore well	42.60	054	43.71	44.11	224	0.40	8.38
4	Vadrage	Bore well	99.40	074	47.88	52.93	250	0.77	8.44
5	Beknal	Bore well	28.40	096	51.95	80.20	294	0.75	7.31
6	Lingnur (Kasaba)	Bore well	39.76	008	49.79	45.08	250	0.57	7.90
7	Shippur	Bore well	56.80	090	63.13	80.20	340	0.89	7.60
8	Karambali	Bore well	19.88	046	32.49	72.18	210	0.38	7.69
9	Naukud	Bore well	29.88	056	42.49	82.18	210	0.58	7.67
10	Hasurchampu	River	42.06	046	14.99	34.58	240	0.28	8.75
11	Nilaji	River	62.48	040	19.32	38.49	118	0.40	7.33
12	Dundage	River	48.28	020	15.53	24.06	088	0.50	8.6
13	Bhadgaon	River	42.50	066	14.52	40.12	100	0.27	8.65
14	Atyal	River	19.88	014	05.23	18.44	040	0.29	6.98
15	Belgundi	River	17.04	014	12.83	21.17	034	0.25	6.97
16	Inchnal	River	17.04	010	09.62	19.53	090	0.27	6.99
17	Gijawane	River	17.06	010	16.84	08.54	052	0.27	7.37
18	Yeinapur	River	17.04	098	20.05	10.19	062	0.33	7.26
19	Koulage	River	34.08	050	53.73	13.67	110	0.56	7.39
20	Hiralage	River	17.04	050	20.05	10.19	060	0.30	7.5
21	Malatwadi	Reservoir	110.20	074	69.71	114.26	450	0.71	7.46
22	Hanimnal	Reservoir	56.80	050	19.41	40.10	120	0.49	7.91
23	Shendri	Reservoir	99.40	064	59.71	104.26	350	0.81	7.16
24	Kadgaon	Reservoir	17.04	046	48.12	27.18	160	0.43	7.87
25	Jakhewadi	Dug well	71.00	090	74.67	120.70	428	0.89	7.41
26	Madyal	Dug well	82.00	111	85.78	220.80	528	0.98	7.52
27	Kadalage	Dug well	63.00	080	64.57	110.70	328	0.79	7.43

Table 2. Microbial analysis

Sr. No.	Villages	Sources	SPC CFU/ml	Total Coliform by MFT cfu/100ml	Fecal Coliform/100ml	MPN/100ml
1	Mutnal	Bore well	44,000 X10 ⁵	024	09	028
2	Aurnal	Bore well	13,200 X10 ⁵	108	33	124
3	Badyachiwadi	Bore well	32,200 X10 ⁵	030	14	043
4	Vadrage	Bore well	37,500 X10 ⁵	042	19	060
5	Beknal	Bore well	35,800 X10 ⁵	040	18	054
6	Lingnur (Kasaba)	Bore well	52,400 X10 ⁵	016	07	028
7	Shippur	Bore well	56,100 X10 ⁵	018	07	032
8	Karambali	Bore well	1,38,100 X10 ⁵	065	22	086
9	Naukud	Bore well	68,200 X10 ⁵	020	09	029
10	Hasurchampu	River	1,22,400 X10 ⁵	108	30	112
11	Nilaji	River	2,00,300 X10 ⁵	110	27	124
12	Dundage	River	4,53,000 X10 ⁵	119	43	134
13	Bhadgaon	River	9,78,300 X10 ⁵	120	42	140
14	Atyal	River	7,00,100 X10 ⁵	112	30	122
15	Belgundi	River	9,00,200 X10 ⁵	127	40	139
16	Inchnal	River	8,80,200 X10 ⁵	124	43	140
17	Gijawane	River	8,48,000 X10 ⁵	110	28	118
18	Yeinapur	River	6,28,400 X10 ⁵	117	37	134
19	Koulage	River	5,32,100 X10 ⁵	110	33	120
20	Hiralage	River	7,77,100 X10 ⁵	112	40	121
21	Malatwadi	Reservoir	1,58,000 X10 ⁵	070	22	086
22	Hanimnal	Reservoir	64,800 X10 ⁵	019	08	023
23	Shendri	Reservoir	1,63,500 X10 ⁵	066	26	079
24	Kadgaon	Reservoir	1,12,100 X10 ⁵	078	34	084
25	Jakhewadi	Dug well	31,200 X10 ⁵	043	20	057
26	Madyal	Dug well	36,100 X10 ⁵	039	17	043
27	Kadalage	Dug well	34,100 X10 ⁵	032	16	045

SPC = Standard plate count, cfu = Colony forming unit,

MFT = Membrane filtration technique, MPN = Most probable number

pH

pH is an important indicator which shows acidic and alkaline nature of water. It is positively correlated with photosynthetic activity.

Electric Conductivity

EC is an important physical parameter. It explains the ionic state of water. EC is a measure of solubility and it is an excellent indicator of total dissolved solids. The variation in

electrical conductance, ranges for bore well from 0.28 mho cm^{-1} (Hasurchampu) to 1.15 mho cm^{-1} (Aurnal), for river 0.25 mho cm^{-1} (Belgundi) to 0.56 mho cm^{-1} (Koulage), for reservoir 0.43 mho cm^{-1} (Kadgaon) to 0.81 mho cm^{-1} (Shendri) and for dug well 0.79 mho cm^{-1} (Koulage) to 0.98 mho cm^{-1} (Madyal).

Table 3. Drinking water standards of WHO (1963), ICMR (1975) & BIS (1991)

Parameters	WHO	ICMR	BIS
Total Hardness	500	300	500
Calcium	75	75	75
Magnesium	50	50	50
Chloride	200	250-1000	200
Alkalinity	75	-----	-----
pH	6.5-8.5	7-8.5	7 to 8
E.C.	0.300	0.300	0.300

SPC; MPN; Total coliform and Fecal coliform

The standard Plate count, Total coliforms, fecal coliforms and Most Probable Number were analyzed for the samples are presented in Table 2. The SPC was ranged from 13,200 to 9,78,300 ($\times 10^5$) cfu/ml. Total coliforms ranged from 16 to 127 cfu/100 ml of water sample. The fecal coliforms ranged from 07 to 43 /100 ml while MPN ranged from 23 to 140 /100 ml of water sample. Significant number of fecal coliforms was found in all the samples and it was significantly higher than the WHO limit (0) for drinking water. So the all samples may raise concern about the safety.

Conclusion

Physico-chemistry of all water samples revealed that the water is suitable for drinking and domestic purposes while, a significant presence of fecal coliform may raise concern on the safety for its consumption.

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