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ORIGINAL ARTICLE

GROUND WATER QUALITY OF TWO VILLAGES OF DARYAPUR TALUKA, DIST. AMRAVATI, MAHARASHTRA, INDIA

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Abstract

In present investigation an attempt is made to assess the water quality of domestic sites (Tube well) in two villages namely Sasan and Shivar of Daryapur Taluka, Amravati District Maharashtra for its potability by comparing physico-chemical parameters with water standards given by WHO and ICMR. Results revealed that the values of pH, DO,TDS, Alkalinity, Total Hardness were seems to be exceeding the desirable limit of water standards while Chloride, COD and sulphate were remains within desirable limit in both sampling sites. Seasonally all water quality parameters were reported with an elevated concentration during summer while moderate concentration during rainy and less concentration during winter. Winter season values of water quality parameters like DO, Alkalinity, Chloride, Sulphate and COD were in accordance with desirable limit suggesting the good water quality whereas pH, TDS, Total hardness and Alkalinity up to certain extent can be the persistent problem of water quality of the region.

KEYWORDS: *water quality, physico-chemical parameters, tube well, water standards.ICMR, WHO.*

1. INTRODUCTION

Water is wonder of nature and naturally occurring essential requirement of all life supporting activities (Ayibatele 1992).Water supports life on earth and is require by all lives, from micro-organism to man but this natural resource have been deteriorates day by day in its quality due to unplanned urbanization and industrialization (Singh et al.,2002).The condition of the water body or water resource in relation to its particular uses is termed as water quality which can be defined in qualitative and quantitative terms. Water quality can be grouped into three broad categories: physical, chemical, and biological with respect to the water quality parameters. It is expressed in terms of the measured value (s) of one or more parameters in relation to their accepted or implied limits.

It is estimated that about 97.2% of water on earth is salty, 2.8% is present as fresh water from which about 20% constitutes highly valued groundwater due to certain properties not possessed by surface water (Goel, 2000). Only 1% part of surface and ground water resources is available on land for various purposes which include drinking, agriculture, domestic power generation, industrial consumption, transportation and waste disposal (Mishra et al. 2002, Gupta et al., 2009).In India, most of the population is dependent on ground water as the only

source of drinking water supply suppose to be much clean and free from pollution than surface water but due heavy industrialization and urbanization ground water quality deteriorates and creates health problems (Raja et al. ,2002 ; Patil et al.,2001). Ground water quality of open well and tube well water in has been assessed by several researchers (Reza and Singh ,2010; Tambekar and Neware ,2012; Rathod et al.,2011, Warhate et al.,2006; Taranekar, 1993; Rajankar et al. 2010) by using various aspects on the water quality parameters.

In present investigation an attempt is made to assess the water quality of domestic sites (Tube well) in two villages namely Sasan and Shivar of Daryapur Taluka, Amravati District Maharashtra in order to check the suitability of water for drinking purpose, to document the record of water quality data in terms of physico-chemical parameters such as pH, TDS (Total Dissolved Solids), DO (Dissolved Oxygen), Alkalinity, Total Hardness, Chloride, Sulphate and COD (Chemical Oxygen Demand).

2. MATERIAL AND METHODS

2.1 Sampling site

Two villages namely Sasan and Shivar of Daryapur Taluka, Amravati District Maharashtra were selected for study. These villages receives water supply for domestic use by tube wells provided by government agency of that area. The details of sampling sites with their respective codes followed throughout the study were given below in table 1.

Table 1: Sampling sites with code.

Sr.No.	Name of the Sampling site	Code
1	Sasan village (Tube Well)	T1
2	Shivar village (Tube Well)	T2

2.2 Collection of Water Samples and Analysis

Water samples for physico-chemical analysis were collected fortnightly during a month in previously cleaned polythene bottles. Water samples collected monthly between January 2011 and December 2011 from sampling site and analyzed on site and in laboratory as per the guidelines and standard methods prescribed by American Public Health Association (APHA 2005). The obtained monthly and seasonal analyzed values of physico-chemical parameters were compared with the ICMR (Indian Council of Medical Research) and WHO (World Health Organization) water standards for drinking water.

2.3 Statistical analysis

The data obtained in triplicate were analyzed by SPSS statistical package (Window version 17) and Microsoft software Excel 2007 and represented as mean values with standard deviation in figures and tables.

3. RESULTS AND DISCUSSION

3.1 pH

pH is one of the most important parameter that shows acid-base neutralization and water softening. The fortnightly mean value of pH ranges from 5.8 to 7.34 in the month of May

and December respectively in sampling site T1 whereas in sampling site T2 it ranges from 5.9 to 7.33 in the month of May and December respectively (Table 2&3). Seasonal mean values of pH in both sampling sites during different season's shows acidic nature of water and below the limit value 7.0 – 8.5 of ICMR for drinking water (Table 4 & Fig.1).

3.2 Total Dissolved Solids (TDS)

TDS is a direct measure of organic and inorganic substances dissolved in waters especially inorganic substances that are dissolved in water. The fortnightly mean value of TDS ranges from 765 mg/l to 878 mg/l in the month of March and September respectively in sampling site T1 whereas in sampling site T2 it ranges from 789 mg/l to 901 mg/l in the month of May and December respectively (Table 2&3). A seasonal variation of TDS values in both sampling sites during all seasons exceeds the desirable limit value 500 mg/l of WHO for drinking water (Table 4 & Fig.2). Hence unsuitable for drinking purpose.

3.3 Dissolved Oxygen (DO)

It is one of the basic parameters in water, important for the metabolic activities of all aerobic aquatic organisms. The fortnightly mean value of DO ranges from 2.2 mg/l to 4.7 mg/l in the month of May and December respectively in sampling site T1 whereas in sampling site T2 it ranges from 2.3 mg/l to 4.8 mg/l in the month of May and December respectively (Table 2&3). Seasonal mean values of DO in both sampling sites were below the desirable range 5.0 mg/l of ICMR (Table 4 & Fig.3).

3.4 Alkalinity

Alkalinity of water is a measure of its capacity to neutralize acids and provides an index for the nature of salts present in the water samples. The fortnightly mean value of Alkalinity ranges from 96 mg/l to 142 mg/l in the month of September and February respectively in sampling site T1 whereas in sampling site T2 it ranges from 99 mg/l to 140 mg/l in the month of September and February respectively (Table 2&3). Seasonal variations in the mean values of Alkalinity in both the sampling sites shows its suitability during rainy and winter season except summer season for drinking water as the desirable range of ICMR is 120 mg/l (Table 4 & Fig.4)

3.5 Total Hardness

Hardness is most commonly associated with the ability of water to precipitate soap. Chemically, hardness is often defined as the sum of polyvalent cation ($Ca^{++}$and Mg^{++}) concentrations dissolved in the water. The fortnightly mean value of Total hardness ranges from 320 mg/l to 539 mg/l in the month of November and May respectively in sampling site T1 whereas in sampling site T2 it ranges from 326 mg/l to 535 mg/l in the month of November and June respectively (Table 2&3). A seasonal mean value of Total hardness exceeds the desirable range 300 mg/l of ICMR during all seasons in both the sampling sites which is unsuitable for drinking purpose (Table 4 & Fig.5).

3.6 Chloride

Naturally, chlorides occur in all type of waters, chloride in the groundwater contributed by the minerals like, mica, apatite, and hornblende (Das and Malik1998). The fortnightly mean value of Chloride ranges from 156.36 mg/l to 276.51 mg/l in the month of November and February respectively in sampling site T1 whereas in sampling site T2 it ranges from 148.89 mg/l to 265.8 mg/l in the month of November and February respectively (Table 2&3). A seasonal mean value of Chloride exceeds the desirable range 250 mg/l of ICMR during summer seasons except winter and rainy season in both the sampling sites. (Table 4 & Fig.6).

3.7 Sulphate

Sulphate is utilized by all living organisms in the form of both mineral and organic sulphates. The fortnightly mean value of Sulphate ranges from 101 mg/l to 251 mg/l in the month of August and May respectively in sampling site T1 whereas in sampling site T2 it ranges from 109 mg/l to 241 mg/l in the month of August and May respectively (Table 2&3). A seasonal mean value of Sulphate remains in the desirable range 250 mg/l of WHO during all seasons indicating suitability of water for drinking purpose (Table 4 & Fig.7).

3.8 Chemical Oxygen Demand (COD)

COD is a measure of the oxygen equivalent of the organic matter content of a sample that is susceptible to oxidation by a strong chemical oxidant (WHO, 1984). COD is a widely used index of waste water quality which relates to the oxygen required for complete oxidation of samples.

The fortnightly mean value of COD ranges from 17 mg/l to 21 mg/l in the month of September and April respectively in sampling site T1 whereas in sampling site T2 it ranges from 17 mg/l to 22 mg/l in the month of September and April respectively (Table 2&3). A seasonal mean variation in values of COD in both sampling sites during all seasons favors the desirable range 20 mg/l of ICMR indicating the suitability of water for drinking purpose (Table 4 & Fig.8).

Present study on ground water quality of tube wells of two villages indicates the problematic scenario about water quality with respect to the physico-chemical parameters studied. The monthly observed values of pH, DO,TDS, Alkalinity, Total Hardness were seems to be exceeding the desirable limit of water standards while Chloride, COD and sulphate were remains within desirable limit in both sampling sites. However some of the parameters like chloride, COD were reported with elevated concentration during summer months and exceeds the desirable limit. Seasonally all water quality parameters were reported with an elevated concentration during summer while moderate concentration during rainy and less concentration during winter. Winter season values of water quality parameters like DO, Alkalinity, Chloride, Sulphate and COD were in accordance with desirable limit suggesting the good water quality whereas pH, TDS, Total hardness and Alkalinity up to certain extent can be the persistent problem of water quality of the region. Variations in the monthly and seasonal values might be due to the anthropogenic activities (Singh, 1992), geology and hydrological activities (Tiwary et al. 1995; Tiwary and Dhar1994). More or less similar findings were reported by Tambekar and Neware (2012) while assessing the ground water quality of Amravati District, Warhate et al.(2006) on assessment of ground water quality of mining affected areas of

Yavatmal District. Also the findings of Taranekar (1993) and Rajankar et al.(2010) on assessment of ground water quality of Mansar and Bhandara region respectively, can be correlate with present study.

4. CONCLUSION

The observations made on the water quality parameters suggests that tube well water is affected by the pH, TDS, Alkalinity, Total hardness up to greater extent monthly as well as seasonally. Therefore there is a need of treatment of water for its potability with proper monitoring and implementation before supply.

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Table 2: Fortnightly water analysis of sampling site T1 during a year 2012.

WQP	Feb	Mar	Apr	May	June	July
pH	6.4 ±0.19	6.2 ±0.21	6.1 ±0.20	5.8 ±0.22	6.3 ±0.24	6.5 ±0.21
TDS	812 ±22.37	765 ±19.63	828 ±21.56	874 ±22.18	832 ±23.44	845 ±21.89
DO	2.7 ±0.14	2.8 ±0.16	2.6 ±0.13	2.2 ±0.14	4.1 ±0.23	3.9 ±0.20
Alkalinity	142 ±5.61	132 ±4.98	136 ±4.75	129 ±5.30	98 ±4.23	101 ±4.58
TH	432 ±11.23	441 ±10.05	526 ±9.08	539 ±11.21	535 ±8.05	436 ±8.19
Chloride	276.51 ±4.23	251.23 ±3.98	266.01 ±4.08	252.41 ±4.16	203.11 ±5.01	212.5 ±5.11
Sulphate	213±5.51	223 ±5.62	238 ±4.98	251 ±5.66	168 ±4.07	160 ±3.89
COD	18±0.96	20 ±1.05	21 ±1.03	20 ±0.98	18.5 ±0.89	19.5 ±1.07

*All values are in mg/l except pH, ±SD n=3

Contd.

WQP= Water Quality Parameters, TDS= Total Dissolved Solids, DO= Dissolved Oxygen, TH=Total Hardness, COD=Chemical Oxygen Demand

Aug	Sept	Oct	Nov	Dec	Jan	Water Std.
6.6 ±0.23	6.7 ±0.21	6.8 ±0.26	7.12 ±0.23	7.34 ±0.27	6.7 ±0.25	**7-8.5(ICMR)**
818 ±22.16	878 ±23.01	838 ±18.63	875 ±20.08	861 ±19.80	851 ±20.65	**500 (WHO)**
4.3 ±0.22	3.6 ±0.21	3.5 ±0.18	4.4 ±0.21	4.7 ±0.19	4.2 ±0.22	**5.00 (ICMR)**
108 ±4.19	96 ±4.81	105 ±6.01	111 ±5.12	119 ±4.94	128 ±5.09	**120 (ICMR)**
458 ±9.90	498 ±9.16	334 ±7.89	320 ±8.14	461 ±7.50	478 ±8.91	**300 (ICMR)**
188.09 ±4.78	191.21 ±4.65	188 ±5.03	156.36 ±5.22	198.2 ±5.43	238.5 ±5.21	**250 (ICMR)**
101 ±4.44	118 ±4.86	168 ±4.08	229 ±3.90	198 ±4.06	189 ±3.87	**250 (WHO)**
18 ±0.96	17 ±0.90	17.5 ±0.92	18 ±0.99	19 ±1.09	18 ±0.91	**20 (ICMR)**

Table 3: Fortnightly water analysis of sampling site T2 during a year 2012.

WQP	Feb	Mar	Apr	May	June	July
pH	6.4 ±0.23	6.3 ±0.21	6.1 ±0.20	5.9 ±0.21	6.1 ±0.18	6.5 ±0.20
TDS	822 ±18.33	793 ±21.40	823 ±19.63	854 ±19.89	851 ±17.62	848 ±19.05
DO	2.8 ±0.11	2.8 ±0.13	2.7 ±0.14	2.3 ±0.11	4.2 ±0.21	3.9 ±0.19
Alkalinity	140 ±6.31	125 ±5.20	136 ±6.08	131 ±6.45	105 ±5.10	111 ±5.34
TH	440 ±12.81	456 ±13.05	478 ±12.96	501 ±12.07	535 ±12.06	421 ±11.25
Chloride	265.8±7.76	238.54±7.51	248.66±8.03	248.78±7.88	199.35±6.79	201.11±6.08
Sulphate	189 ±5.61	218 ±6.08	225 ±6.04	241 ±6.11	177 ±5.84	162 ±5.16
COD	18.5 ±0.93	19.5 ±1.06	22 ±1.01	20.5 ±1.04	19 ±0.95	19.5 ±0.98

*All values are in mg/l except pH, ±SD n=3

Contd.

WQP= Water Quality Parameters, TDS= Total Dissolved Solids, DO= Dissolved Oxygen, TH=Total Hardness, COD=Chemical Oxygen Demand

Aug	Sept	Oct	Nov	Dec	Jan	Water Std.
6.7 ±0.22	6.7 ±0.21	6.9 ±0.19	7.15 ±0.23	7.33 ±0.21	6.6 ±0.19	**7-8.5(ICMR)**
823 ±20.07	789 ±18.55	901 ±21.33	881 ±19.09	872 ±19.16	858 ±18.80	**500 (WHO)**
4.4 ±0.20	3.8 ±0.21	3.6 ±0.16	4.4 ±0.18	4.8 ±0.19	4.3 ±0.17	**5.00 (ICMR)**
108 ±4.88	99 ±4.12	105 ±3.89	116 ±4.01	121 ±4.11	133 ±4.15	**120 (ICMR)**
448 ±11.86	400 ±10.82	344 ±11.81	326 ±10.77	456 ±10.84	468 ±11.06	**300 (ICMR)**
179.1 ±6.18	176.24 ±6.28	188.66 ±5.87	148.89±5.09	208.41 ±5.96	222.6 ±5.10	**250 (ICMR)**
109 ±4.89	120 ±4.91	159 ±5.16	126 ±5.08	191 ±6.03	182 ±5.59	**250 (WHO)**
18.5 ±0.89	17 ±0.92	18 ±0.93	18 ±0.98	19.5 ±1.07	19 ±1.05	**20 (ICMR)**

Table 4: Seasonal mean variation in water quality parameters of sampling site T1 and T2

	Sampling site T1			Sampling site T2			
WQP	**Summer**	**Rainy**	**Winter**	**Summer**	**Rainy**	**Winter**	**Water Std.**
pH	6.125±0.22	6.52±0.15	6.99±0.25	6.175±0.19	6.5±0.24	6.99±0.27	**7-8.5(ICMR)**
TDS	819.75±38.9	843.25±22.2	856.25±13.5	823±21.5	827.75±24.8	878±15.6	**500 (WHO)**
DO	2.57±0.23	3.97±0.26	4.2±0.44	2.65±0.21	4.07±0.24	4.27±0.43	**5.00 (ICMR)**
Alk.	134.75±4.8	100.75±4.5	115.75±8.6	133±5.61	105.75±4.4	118.75±10.0	**120 (ICMR)**
TH	484.5±48.3	481.75±37.9	398.25±71.6	468.75±22.9	451±51.4	398.5±63.9	**300 (ICMR)**
Chl.	261.54±10.4	198.72±9.7	195.265±29.3	250.44±9.7	188.95±11.3	192.14±27.7	**250 (ICMR)**
Sul.	231.25±14.4	136.75±28.0	196±21.94	218.25±18.8	142±28.2	164.5±25.1	**250 (WHO)**
COD	19.75±1.09	18.25±0.90	18.125±0.54	20.12±1.29	18.5±0.94	18.62±0.65	**20 (ICMR)**

*All values are in mg/l except pH, ±SD n=4 ,

WQP= Water Quality Parameters, TDS= Total Dissolved Solids, DO= Dissolved Oxygen, Alk.=Alkalinity, TH=Total Hardness, Chl.=Chloride, Sul.=Sulphate, COD=Chemical Oxygen Demand

Fig.1.: Seasonal variations in pH

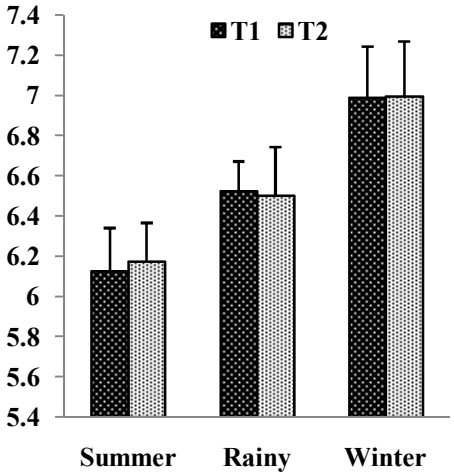

Fig.2.: Seasonal variations in TDS

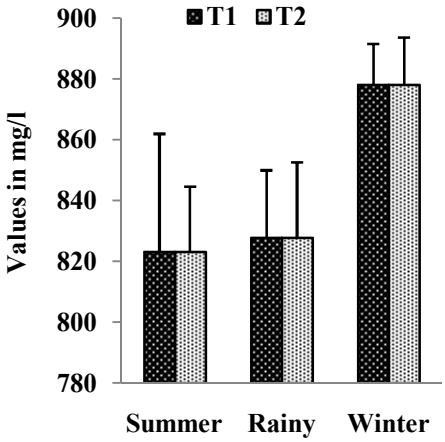

Fig.3.: Seasonal variations in DO

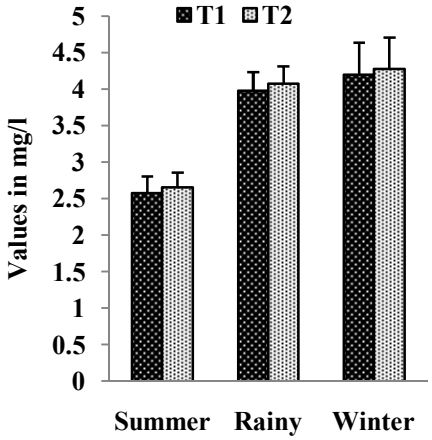

Fig.4.: Seasonal variations in Alkalinity

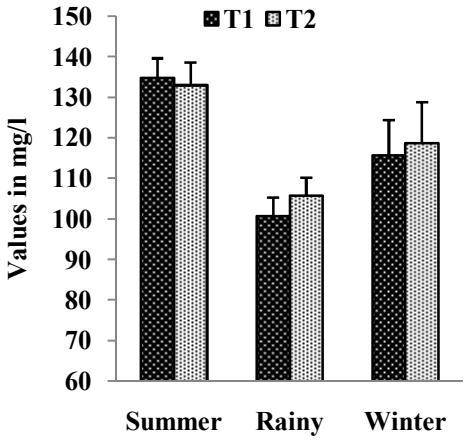

Fig.5.: Seasonal variations inTotal Hardness

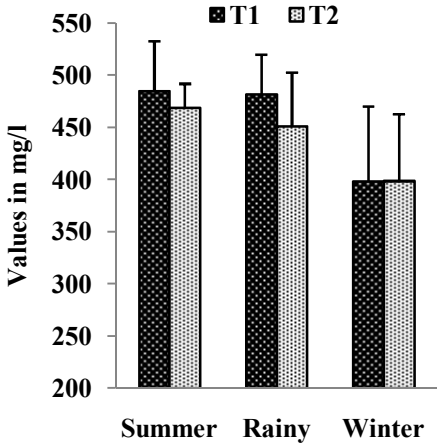

Fig.6.: Seasonal variations in Chloride

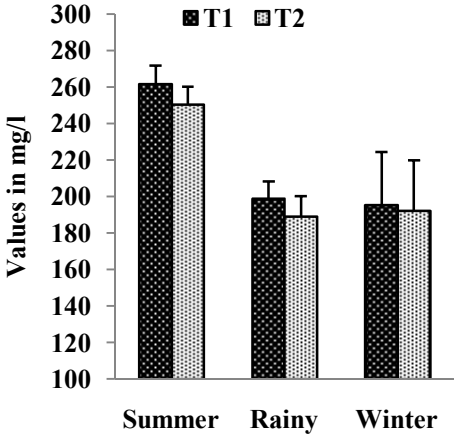

Fig.7.: Seasonal variations in Sulphate

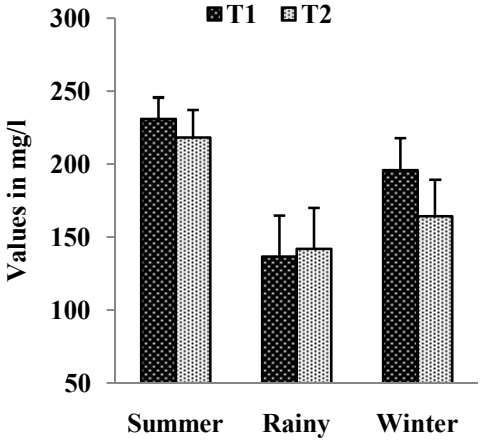

Fig.8.: Seasonal variations in COD