Review Of Research
Vol. 4 | Issue. 2 | Nov. 2014
Impact Factor : 2.1002 (UIF)
ISSN:-2249-894X
Available online at www.lbp.world

ORIGINAL ARTICLE

ASSESSMENT OF GROUND WATER QUALITY OF DUG WELLS IN 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 (Dug well) in two villages namely Mahimapur and Shivar of Daryapur Taluka, Amravati District Maharashtra 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). The results obtained on various physico-chemical parameters reveals that the monthly observed values of pH, DO, TDS, Alkalinity, Total Hardness in both D1 and D2 sampling sites exceeds as well as remains under the desirable limit of water standards of ICMR and WHO during some of the months. Parameters like Chloride, COD and sulphate were remains within desirable limit in both sampling sites throughout the year. On comparing the seasons, winter season water quality suppose to be the good except some parameters like Total hardness, Alkalinity which exceeds the desirable limit during all seasons indicates persistent problem of water quality. Hence there is a need of treatment of water for its potability.

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

1. INTRODUCTION

Water is very precious and valuable natural resource required by all organisms for all life supporting activities (Ayibatele 1992). As water influences various activities of all lives from microorganism to man it is very necessary to maintain the quality of water in terms of qualitative and quantitative measures. Water quality can be defined as the suitability of water in order to sustain various uses or processes (Meybeck et al., 1996) and is influenced by different natural factors like biological, geological, hydrological, meteorological, and topographical factors. 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 water quality parameters in relation to their desirable or prescribed limits. The deterioration of this natural resource is mainly contributed by unplanned urbanization and industrialization (Singh et al., 2002), extraneous use of fertilizers (Shamruk et al. 2001, Zang et al., 1996) in agriculture (Maticie, 1999) and certain mining activities (Harzog, 1996; Lin et al.,2003).

Indian population is mainly dependent on ground water as a source for drinking purpose thus it must be clean and pollution free as compare with surface water but now a days most of the ground waters are seems to be affected which creates health problems (Raja et al. ,2002 ; Patil et al.,2001). Assessment and evaluation of ground water quality of open well, dug well and tube well has been carried out by several researchers in India (Bhargava, 1983; Ramkrishnaiah et al., 2009; Reza and Singh ,2010; Mufid al-Hadithi, 2012; Mangukiya et al., 2012 and Dhakate et al., 2013). However studies on ground waters of Maharashtra has also been carried out by many researchers (Tambekar and Neware ,2012; Rathod et al.,2011, Warhate et al.,2006; Taranekar, 1993; Rajankar et al. 2010) which reveals disturbed water quality in their respective area of study.

In present investigation an attempt is made to assess the water quality of domestic sites (Dug well) in two villages namely Mahimapur and Shivar of Daryapur Taluka, Amravati District Maharashtra 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 Mahimapur and Shivar of Daryapur Taluka, Amravati District Maharashtra were selected for study. These villages utilize water of dug 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	Mahimapur village (Dug Well)	D1
2	Shivar village (Dug Well)	D2

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 2012 and December 2012 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 5.92 to 7.4 in the month of May and December respectively in sampling site D1 whereas in sampling site D2 it ranges from 5.91 to 7.4 in the month of May and November respectively (Table 2&3). Seasonal mean values of pH during different seasons in both sampling sites shows combination of both acidic and alkaline nature of water. However it remains under the prescribed 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 effects of TDS on drinking water quality mainly due to the factors like excessive hardness, taste; mineral depositions and corrosion. The fortnightly mean value of TDS ranges from 390 mg/l to 653 mg/l in the month of October and May respectively in sampling site D1 whereas in sampling site D2 it ranges from 408 mg/l to 598 mg/l in the month of November and May respectively (Table 2&3). Seasonal variations of TDS values in both sampling sites shows higher concentration during summer followed by rainy and less in winter season. Winter season values of both sampling sites favors the desirable limit value 500 mg/l of WHO for drinking water (Table 4 & Fig.2).

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 2.1 mg/l to 4.6 mg/l in the month of May and November respectively in sampling site D1 whereas in sampling site D2 it ranges from 2.1 mg/l to 4.7 mg/l in the month of May and November respectively (Table 2&3). Seasonal mean values of DO in both sampling sites were increased from summer followed by rainy and higher in winter season. Seasonal values in both sampling sites for DO 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 105 mg/l to 235 mg/l in the month of October and April respectively in sampling site D1 whereas in sampling site D2 it ranges from 101 mg/l to 245 mg/l in the month of October and April respectively (Table 2&3). Seasonal variations in the mean values of Alkalinity were increased from winter followed by rainy and higher in summer season in both the sampling sites. However winter season values suggest its suitability 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 534 mg/l to 738 mg/l in the month of November and May respectively in sampling site D1 whereas in sampling site D2 it ranges from 512 mg/l to 749 mg/l in the month of September and May 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 165 mg/l to 266.05 mg/l in the month of November and April respectively in sampling site D1 whereas in sampling site D2 it ranges from 170 mg/l to 256 mg/l in the month of November and April respectively (Table 2&3). A seasonal mean value of Chloride do not exceeds the desirable range 250 mg/l of ICMR during rainy and winter seasons except summer 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 128 mg/l to 233 mg/l in the month of November and May respectively in sampling site D1 whereas in sampling site D2 it ranges from 109 mg/l to 249 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 16.5 mg/l to 23.4 mg/l in the month of October, December and June respectively in sampling site D1 whereas in sampling site D2 it ranges from 17 mg/l to 21 mg/l in the month of October, December and May respectively (Table 2&3). A seasonal mean variation in values of COD in both sampling sites favors the desirable range 20 mg/l of ICMR indicating the suitability of water for drinking purpose (Table 4 & Fig.8).

In present investigation results obtained on various physico-chemical parameters reveals that the monthly observed values of pH, DO, TDS, Alkalinity, Total Hardness in both D1 and D2 sampling sites exceeds as well as remains under the desirable limit of water standards during some of the months. Parameters like Chloride, COD and sulphate were remains within desirable limit in both sampling sites throughout the year. On considering the seasons, winter season water quality suppose to be the good except some parameters like Total hardness, Alkalinity which exceeds the desirable limit during all seasons indicates persistent problem of water quality which might be attributed to the geology and hydrology of the region (Tiwary et al. 1995; Tiwary and Dhar1994). However some parameters such as Alkalinity, TDS, pH and DO were reported with higher concentrations in both sampling sites during summer followed by rainy seasons might be due to climatological factors (Kant and Kachroo 1971) and anthropogenic activities (Singh, 1992). Observations reported on ground water quality of dug wells 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 finds similarity with present investigation. Similar findings were also reported by Taranekar (1993) and Rajankar et al.(2010) on assessment of ground water quality of Mansar and Bhandara region respectively, which can be correlate with present study up to certain extent.

4. CONCLUSION

It can be concluded that the dug well water quality in both sampling sites is affected mainly by the Alkalinity and Total hardness. However some parameters like TDS, pH and DO are of major concern during seasons due to their fluctuating concentrations. Hence there is a need of treatment of water for its potability.

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Table 2: Fortnightly water analysis of sampling site D1 during a year 2011.

WQP	Jan	Feb	Mar	Apr	May	June
pH	6.8 ±0.26	6.4 ±0.14	6.2 ±0.17	6.1 ±0.21	5.92 ±0.15	6 ±0.20
TDS	505 ±11.8	548 ±9.14	539 ±10.61	580 ±8.07	653 ±11.10	511 ±8.80
DO	4.3 ±0.42	2.8 ±0.31	2.6 ±0.28	2.2 ±0.26	2.1 ±0.32	3.8 ±0.36
Alkalinity	158 ±4.29	230 ±7.86	216 ±5.90	235 ±8.71	224 ±5.23	180 ±4.69
TH	588 ±11.48	637 ±8.69	640 ±7.28	725 ±11.06	738 ±8.55	535 ±6.41
Chloride	201.19 ±4.6	257.63 ±6.4	244.17 ±7.0	266.05 ±6.8	252.44 ±7.5	198.68 ±5.8
Sulphate	192 ±7.89	210 ±9.05	225 ±10.11	225 ±9.75	233 ±8.96	175 ±8.55
COD	18.5 ±1.54	19 ±1.13	20 ±1.42	20 ±1.38	21 ±1.46	23.4 ±1.77

*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

July	Aug	Sept	Oct	Nov	Dec	Water Std.
6.4 ±0.19	6.6 ±0.23	6.7 ±0.21	6.8 ±0.28	7.3 ±0.25	7.4 ±0.23	**7-8.5(ICMR)**
505 ±9.56	478 ±11.23	458 ±7.90	390 ±12.1	430 ±10.4	455 ±11.8	**500 (WHO)**
3.1 ±0.31	4.2 ±0.39	3.9 ±0.35	3.5 ±0.47	4.6 ±0.41	4.6 ±0.46	**5.00 (ICMR)**
144 ±5.89	175 ±6.63	195 ±4.09	105 ±4.47	108 ±5.10	118 ±5.68	**120 (ICMR)**
515 ±7.10	525 ±6.79	572 ±5.63	554 ±10.02	534 ±8.42	550 ±9.16	**300 (ICMR)**
208.31 ±6.10	181.3 ±5.98	175.21 ±5.47	181 ±4.91	165 ±5.13	188.56 ±4.86	**250 (ICMR)**
152 ±8.08	164 ±7.99	168 ±9.03	145 ±7.05	128 ±7.16	196 ±8.35	**250 (WHO)**
18.5 ±1.08	17 ±0.99	18.5 ±1.01	16.5 ±1.14	17 ±1.08	16.5 ±1.11	**20 (ICMR)**

Table 3: Fortnightly water analysis of sampling site D2 during a year 2011.

WQP	Jan	Feb	Mar	Apr	May	June
pH	6.7 ±0.83	6.4 ±0.46	6.3 ±0.69	6.2 ±0.48	5.91 ±0.36	6.1 ±0.87
TDS	481 ±8.77	552 ±12.5	541 ±10.03	581 ±11.79	598 ±11.42	584 ±9.83
DO	4.4 ±0.27	2.9 ±0.31	2.7 ±0.28	2.3 ±0.33	2.1 ±0.30	3.9 ±0.38
Alkalinity	218 ±6.98	228 ±10.23	226 ±9.08	245 ±9.86	224 ±10.41	171 ±8.89
TH	694 ±11.3	647 ±8.16	648 ±11.0	738 ±12.6	749 ±11.8	547 ±7.9
Chloride	227.18 ±3.9	242.15 ±4.1	230.23 ±4.5	256.35 ±5.1	247.11 ±3.8	188.63 ±5.6
Sulphate	185 ±5.49	214 ±8.51	220 ±6.23	225 ±7.56	249 ±8.80	177 ±6.69
COD	17.5 ±0.97	18 ±1.22	19 ±1.58	20 ±0.97	21 ±1.94	19 ±1.81

*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

July	Aug	Sept	Oct	Nov	Dec	Water Std.
6.5 ±0.74	6.6 ±0.66	6.7 ±0.71	6.9 ±0.49	7.4 ±1.02	7.3 ±0.96	**7-8.5(ICMR)**
510 ±10.44	516 ±12.10	523 ±10.81	414 ±8.46	408 ±9.81	445 ±8.67	**500 (WHO)**
3.3 ±0.32	4.3 ±0.41	4 ±0.46	3.8 ±0.22	4.7 ±0.29	4.5 ±0.26	**5.00 (ICMR)**
154 ±9.06	123 ±8.68	112 ±7.98	101 ±6.73	115 ±7.12	120 ±7.55	**120 (ICMR)**
521 ±9.5	532 ±9.02	512 ±10.79	554 ±11.06	531 ±12.10	541 ±10.92	**300 (ICMR)**
198.97 ±4.8	178.22 ±5.12	177.54 ±4.98	176 ±4.81	170 ±4.08	192.56 ±5.04	**250 (ICMR)**
148 ±5.87	109 ±6.16	116 ±6.09	138 ±5.33	230 ±5.12	205 ±5.83	**250 (WHO)**
18.5 ±1.52	18 ±1.69	18.5 ±1.85	17 ±0.88	18 ±1.06	17 ±1.18	**20 (ICMR)**

Table 4: Seasonal mean variation in water quality parameters of sampling site D1 and D2

	Sampling site D1			Sampling site D2			
WQP	**Summer**	**Rainy**	**Winter**	**Summer**	**Rainy**	**Winter**	**Water Std.**
pH	6.155 ±0.17	6.425 ±0.31	7.075 ±0.32	6.20 ±0.18	6.47 ±0.26	7.07 ±0.33	**7-8.5(ICMR)**
TDS	580 ±44.8	488 ±24.6	445 ±48.1	568 ±22.6	533.25 ±34.2	437 ±33.5	**500 (WHO)**
DO	2.425 ±0.29	3.75 ±0.46	4.25 ±0.51	2.5 ±0.31	3.87 ±0.42	4.35 ±0.38	**5.00 (ICMR)**
Alk.	226.25 ±7.0	173.5 ±21.4	122.25 ±24.4	230.75 ±8.3	140 ±27.2	138.5 ±53.6	**120 (ICMR)**
TH	685 ±46.7	536.75 ±24.8	556.5 ±22.7	695.5 ±48.1	528 ±15.0	580 ±76.5	**300 (ICMR)**
Chl.	255.07 ±7.9	190.87 ±15.2	183.93 ±15.1	243.96 ±9.4	185.84 ±10.1	191.43 ±25.6	**250 (ICMR)**
Sul.	223.25 ±8.3	164.75 ±9.6	165.25 ±33.9	227 ±13.2	137.5 ±31.3	189.5 ±38.9	**250 (WHO)**
COD	20 ±0.70	19.35 ±2.79	17.12 ±0.94	19.5 ±1.11	18.5 ±0.40	17.37 ±0.47	**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

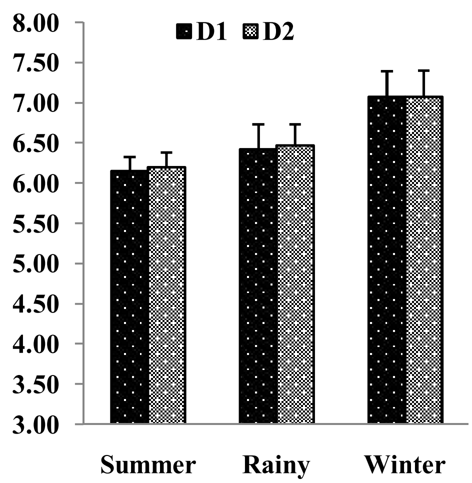

Fig.2.: Seasonal variations in TDS

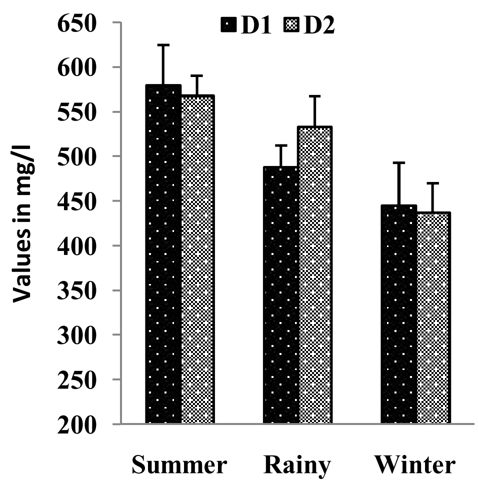

Fig.3: Seasonal variations in DO

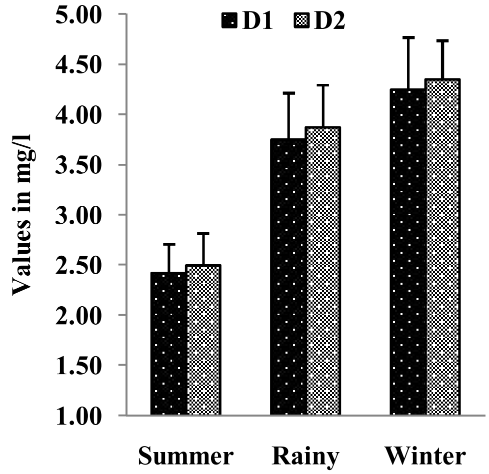

Fig.4.: Seasonal variations in Alkalinity

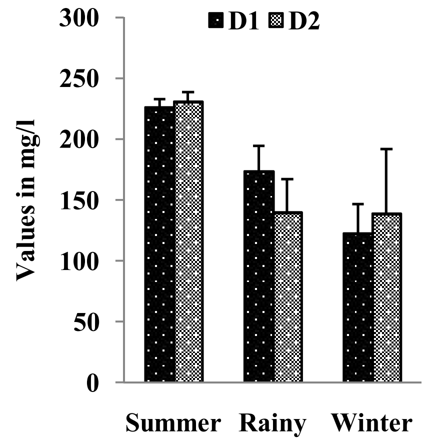

Fig.5.: Seasonal variations in Total Hardness

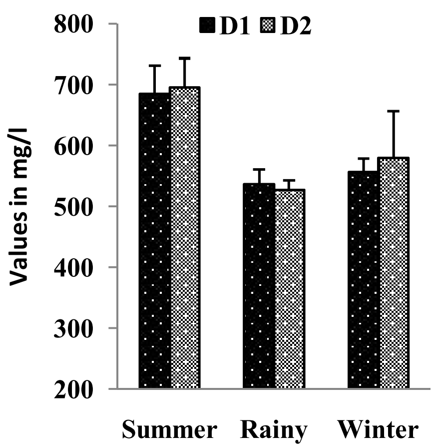

Fig.6.: Seasonal variations in Chloride

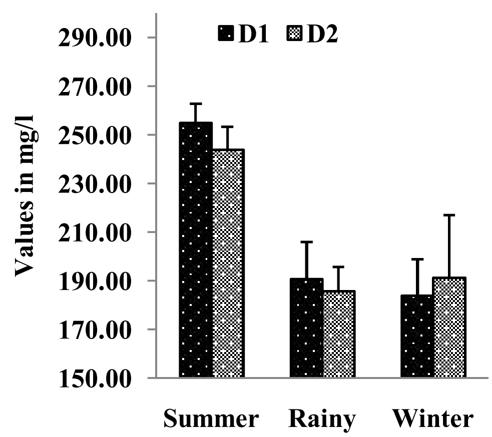

Fig.7: Seasonal variations in Sulphate

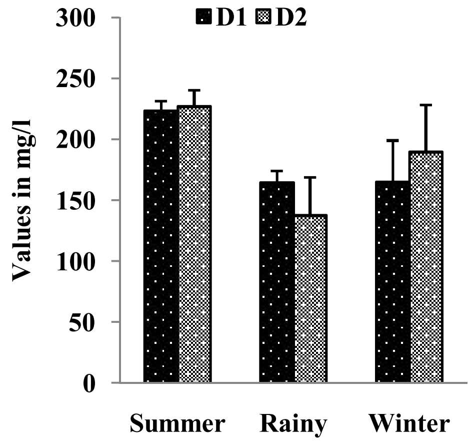

Fig.8.: Seasonal variations in COD