Poll Res. 27 (3) : 425-430 (2008)

ASSESSMENT OF UNDERGROUND AQUATIC ENVIRONMENT AT MORADABAD (UTTAR PRADESH), INDIA

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ABSTRACT

Underground drinking water samples of IM2 hand pumps at twelve different sites at Moradabad were collected and analysed for physico-chemical water quality parameters following standard methodology of sampling and estimation to assess underground aquatic contamination at Moradabad. The estimated values were compared with drinking water quality standards prescribed by W.H.O. Drinking water was found to be severely polluted with reference to most of the parameters studied, while it was moderately contaminated with reference to other parameters. Chemical contaminants and iron in water were in alarming concentrations. The present study suggests that people dependent on source of study are prone to health hazards of contaminated drinking water and drinking water quality management is urgently needed.

KEY WORDS : Underground aquatic environment, Drinking water, Chemical contaminants, Solids, Iron concentration

INTRODUCTION

Water is absolutely essential for healthy living. It plays an indispensable role in the life of every species that survive in this world and is required by all living organisms for their existence. Improper management and reckless use of water systems are causing serious threats to the availability and quality of water (Jaiprakash 2007, Hussian 2005, Prasad 2007). Attention on water quality and its management has become a need of hour. The present study is carried out on underground drinking water quality at Moradabad.

Moradabad is a B class city of Uttar Pradesh having urban population more than 41 lacs. Moradabad is situated at the bank of Ram Ganga river and its altitude from the sea level is about 670 feet. It is extended from Himalaya in north to Chambal river in south. Moradabad is at 28° 20', 29° 15' N and 78° 4', 79° E. District Bijnor and Nainital are in the north, Rampur is in the east, Ganga river is in the west and district Buduan is in the north of district Moradabad. Moradabad has seen rapid industrialization during last few decades. The major industries are – Brassware, Steelware, Paper mills, Sugar mills, Crushers and Dye factories etc. Most of these industries are playing their usual role in multiplying underground water contamination (Sinha2004).

MATERIAL AND METHOD

Underground drinking water samples of India Mark II (IM2) hand pumps at twelve different sites were collected and analysed quantitatively following standard methodology of sampling and estimation (APHA 1995, Merck 1974, Bassett 1978). Three samples of each site were collected, estimated and the arithmatic mean of three values is reported in result. A blank was also run for volumetric titrations. All the chemical of Anal R grade were used. The specifications of instruments used are – Century CP 901 pH meter, Century nephelometer, RI conductivity meter, Hach 2010 (version 6.4) spectrophotometer. The estimated water quality physico-chemical parameters are – temperature, pH value, alkalinity, conductivity, turbidity, acidity, total hardness, calcium, magnesium, chloride, total solids, total dissolved solids, total suspended solids, dissolved oxygen, biological oxygen demand, chemical oxygen demand, silica and iron concentration. A brief description of sampling sites is given in Table 1.

RESULTS AND DISCUSSION

Site-wise evaluated values of different physico-chemical parameters with their prescribed W.H.O. standards are listed in Table 2 (W.H.O.1971). Site-

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wise variations of different parameters are presented in Fig.1 to Fig.12. A critical analysis of data presented in Table 2 and Fig.1 to Fig.12 revealed following facts regarding the underground aquatic environment of drinking water quality at Moradabad.

Water is found to be highly alkaline with higher values of pH and very high values of total alkalinity. The observed range of conductivity is 0.470-0.985 μS/cm and it is much higher than desirable limit. Water is not turbid at all the sites and turbidity values are within desirable limits. There is no prescribed limit of acidity but lower values are desirable which is observed only at site no.I, IV, X and XI. The estimated range of total hardness is 205–450 mg/L and the water of all the sites of study is very hard and unfit for usage. The concentration of calcium is higher than that of magnesium. Hence, it may be suggested that hardness of water is mainly due to salts of calcium. Drinking water is enriched with calcium and magnesium as essential micro-nutrients.

The amount of dissolved oxygen in underground water is irrelevant for assessment of water quality, however, water samples are deficient of dissolved oxygen. The observed range of biological oxygen demand and chemical oxygen demand are 8.0-13.0 mg/L and 15-40 mg/L respectively. These values suggest moderate concentration of organic matter and presence of high amount of oxidizable inorganic chemical pollutants in drinking water of study area. The amount of solids in drinking water samples at almost all the sites is high and water is contaminated with reference to this water quality parameter.

Low concentration of silica as SiO_2 in water is desirable which is not observed at all the sites. The estimated range of iron concentration in water is 0.8–2.15 mg/L which is much higher than permissible limit. The change of water colour on standing is due to oxidation of iron in its lower oxidation state by atmospheric oxygen. High iron concentration in drinking water is quite alarming.

CONCLUSION

On the basis of above discussion it may be concluded that underground water at Moradabad is very alkaline, very hard and highly contaminated with reference to almost all the physico-chemical parameters studied. Hardness of water is mainly due to salts of calcium and is unfit for drinking and other domestic purposes. Presence of moderate concentration of organic matter and high amount of oxidizable inorganic chemical pollutants suggest the high level of contamination of drinking water. The water is enriched with calcium and magnesium as

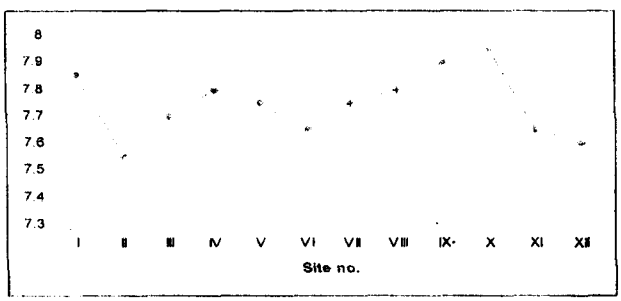

Fig. 1. Site-wise variation of pH value

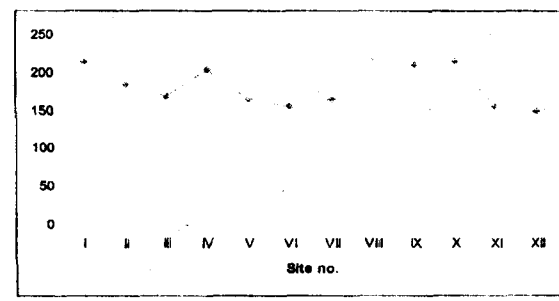

Fig. 2. Site-wise variation of Alkalinity in mg/L

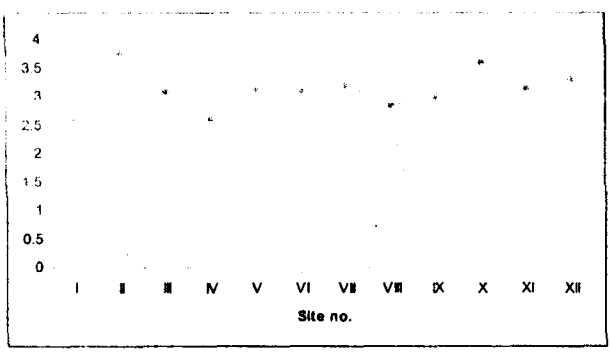

Fig. 4. Site-wise variation of Turbidity in NTU

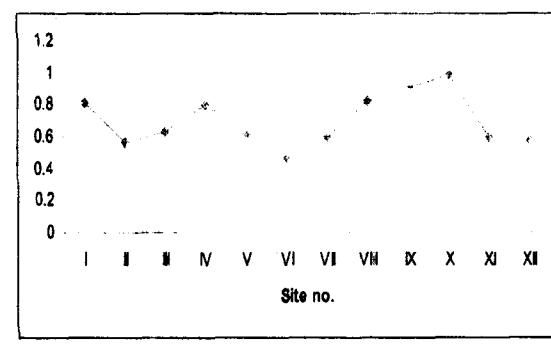

Fig. 3. Site-wise variation of Conductivity in μS/cm

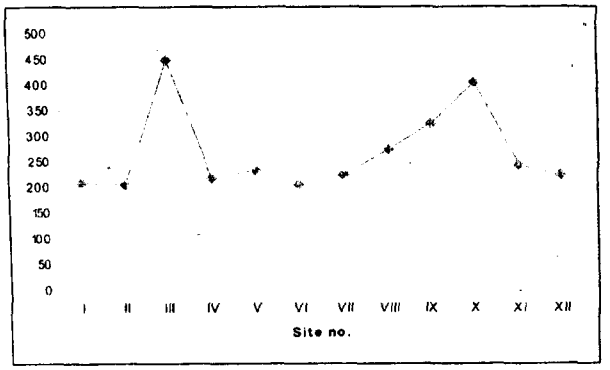

Fig. 5. Site-wise variation of Total Hadness in mg/L

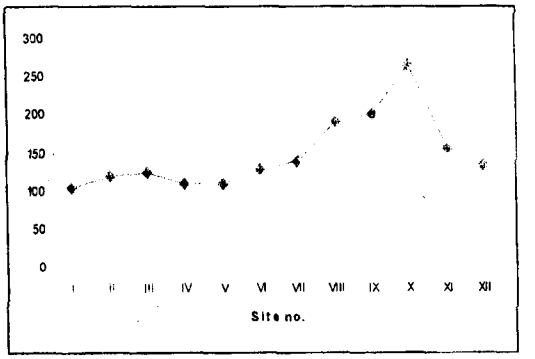

Fig. 6. Site-wise variation of Calcium in mg/L

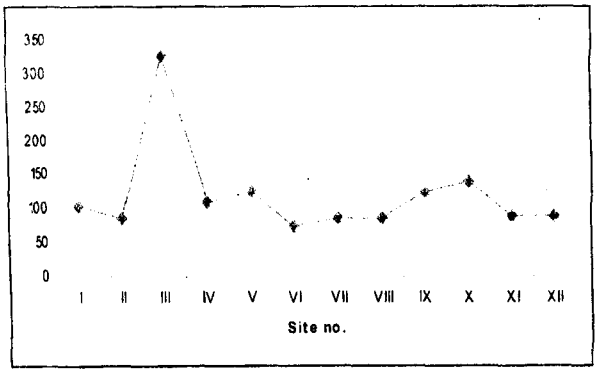

Fig. 7. Site-wise variation of Magnesium in mg/L

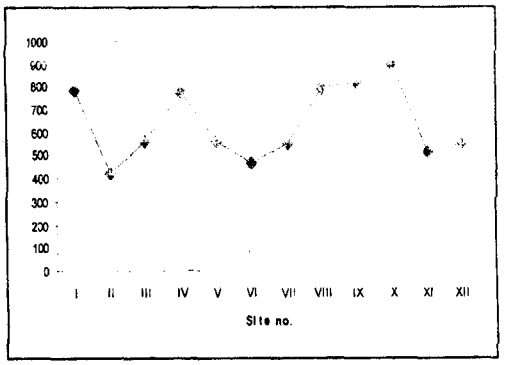

Fig. 8. Site-wise variation of Total Solids in mg/L

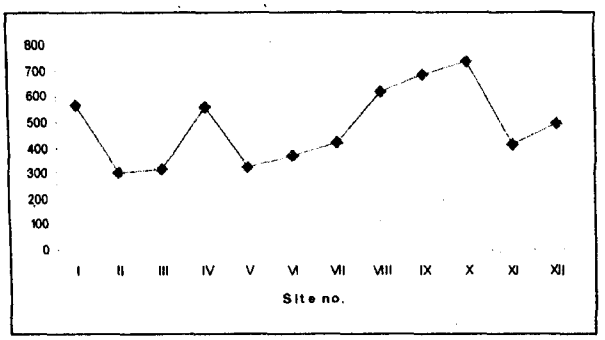

Fig. 9. Site-wise variation of Total Dissolved Solids in mg/L

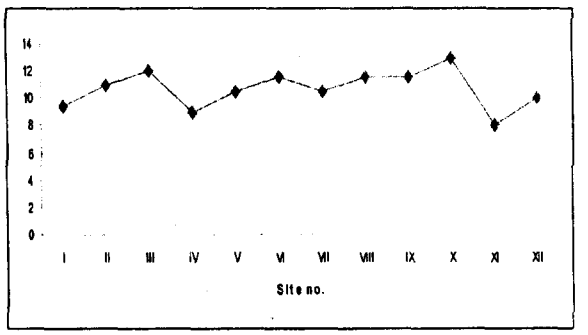

Fig. 10. Site-wise variation of Biological Oxygen Demand in mg/L

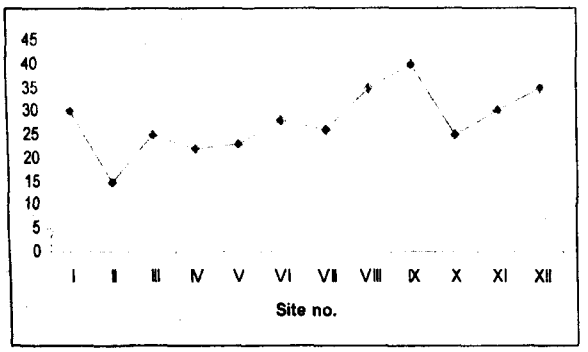

Fig. 11. Site-wise variation of Chemical Oxygen Demand in mg/L

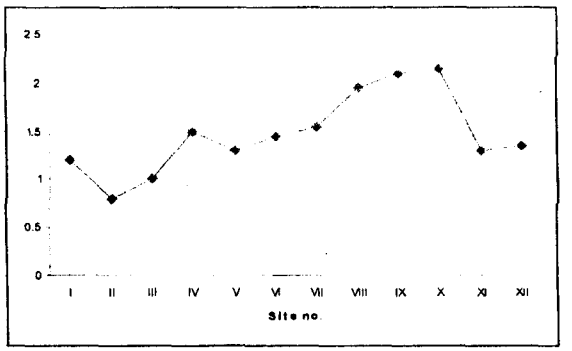

Fig. 12. Site-wise variation of Iron in mg/L

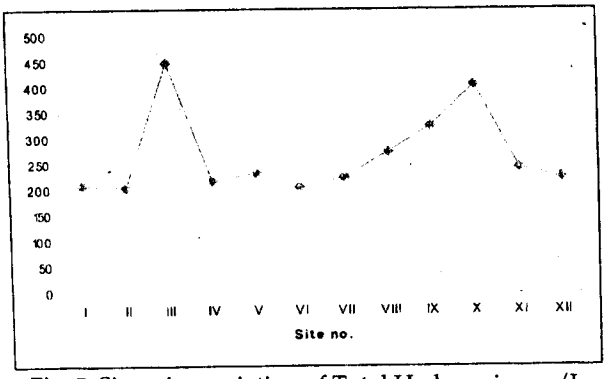

Fig. 5. Site-wise variation of Total Hadness in mg/L

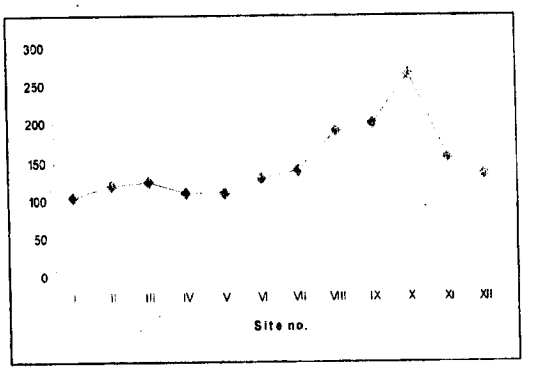

Fig. 6. Site-wise variation of Calcium in mg/L

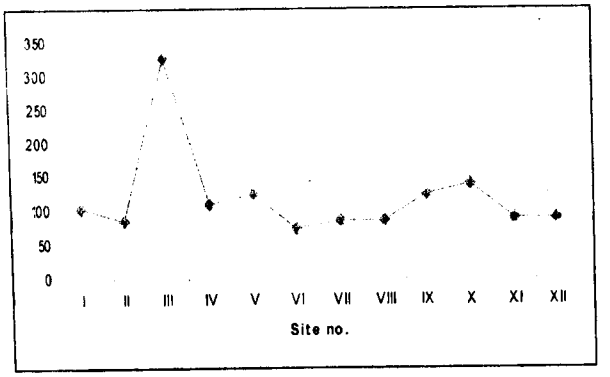

Fig. 7. Site-wise variation of Magnesium in mg/L

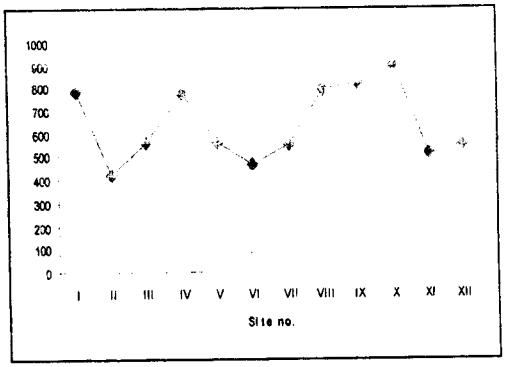

Fig. 8. Site-wise variation of Total Solids in mg/L

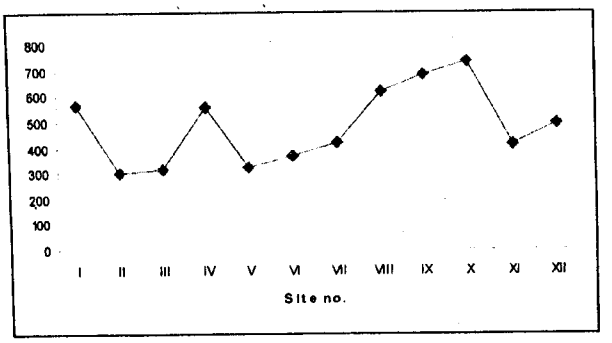

Fig. 9. Site-wise variation of Total Dissolved Solids in mg/L

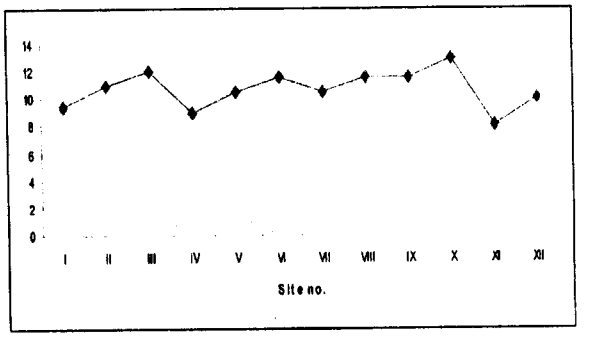

Fig. 10. Site-wise variation of Biological Oxygen Demand in mg/L

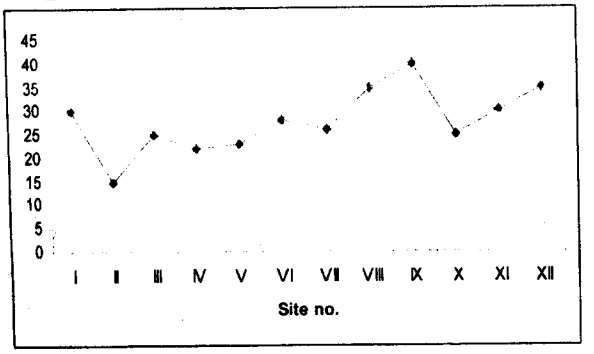

Fig. 11. Site-wise variation of Chemical Oxygen Demand in mg/L

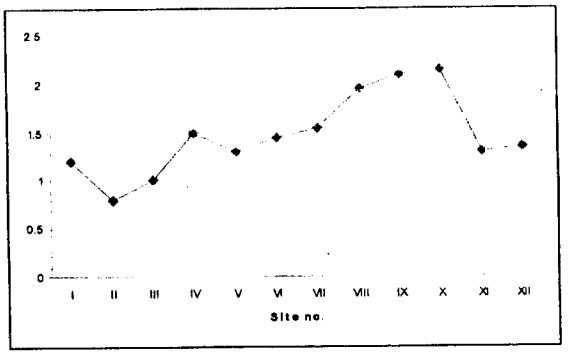

Fig. 12. Site-wise variation of Iron in mg/L

Table 1. A brief description of sampling sites

S.No.	Number and Name of site	Location of site	Depth of boaring	Type of source	Apparent water quality	Use of water
1	I, IM2 Hand pump at Preet Vihar	6 Km south-west to Moradabad collectorate	Approx. 35 meter	Only source of water	Odourless,turns yellowish on standing	Drinking, domestic purposes
2	II, IM2 Hand pump at Balmiki basti	2 km east to site no. I	Approx.33 meter	Only source of water	Colourless, odourless	Drinking, bathing etc.
3	III, IM2 Hand pump at Balmiki Shiv Mandir, Khushalpur	5 km south–west to Moradabad collectorate	Approx. 35 meter	Only source of water	Colourless, odourless	Drinking, laundering
4	IV, IM2 Hand pump at Ambedkar park, Alkhnanda colony	0.5 km north to site no. III	Approx. 33 meter	Only source of water	Colour of water turns yellowish-brown on standing	Drinking, bathing
5	V, IM2 Hand pump at Bank colony	1.5 km north to site no. III	Approx.36 meter	Only source of water	Colourless, odourless	Drinking, domestic purposes
6	VI, IM2 Hand pump at Prathmik Vidyalay, Khushalpur	0.5 km south to site no. V	Approx.35 meter	Only source of water	Colourless, odourless	Drinking, domestic purposes
7	VII, IM2 Hand pump at Community Centre, Budhi Vihar	1.5 km north to Mandi Samiti	Approx.34 meter	Only source of water	Colourless, fishy smell	Drinking, domestic purposes
8	VIII, IM2 Hand pump at Balmiki Basti, Majhola	1.0 km north to site no. VII	Approx.33 meter	Only source of water	Colourless, odourless	Drinking, bathing
9	III, IM2 Hand pump at Shiv Mandir, Buddh Vihar	2.5 km east to site no. III	Approx. 33 meter	Only source of water	Colour of water turns pale yellow on standing	Drinking, domestic purposes
10	IV, IM2 Hand pump at Police station, Mandi Samiti	7.0 km south to Moradabad collectorate	Approx. 34 meter	Only source of water	Colour of water turns yellowish- brown on standing	Drinking, bathing
11	XI, IM2 Hand pump at Prathmik Kanya Vidyalay, Majhola	1.0 km north-east to site no.X	Approx.34 meter	Only source of water	Colourless, odourless	Drinking only
12	V, IM2 Hand pump at Putlighar square, Majhola	1.0 km east to site no. X	Approx. 33 meter	Only source of water	Colour of water turns yellow on standing	Drinking, washing

Table 2. Site-wise evaluated values of different physico-chemical parameters with their W.H.O. standards.

S. No.	Parameters	Site no.I	Site no.II	Site no.III	Site no.IV	Site no.V	Site no.VI	Site no.VII	Site no.VIII	Site no.IX	Site no.X	Site no.XI	Site no.XII	W.H.O. Std.
1	Temperature (^{0}C)	24.5	24.2	24.0	23.0	22.5	23.5	25.0	24.0	23.5	24.7	23.5	25.0	-
2	pH	7.85	7.55	7.70	7.80	7.75	7.65	7.75	7.80	7.9	7.95	7.65	7.60	7.0-8.0
3	Alkalinity (mg/L)	215	185	170	205	165	155	165	220	210	215	155	150	100.0
4	Condutivity (μS/cm)	0.815	0.570	0.635	0.800	0.620	0.470	0.600	0.825	0.915	0.985	0.595	0.585	0.300
5	Turbidity (NTU)	2.55	3.75	3.10	2.60	3.15	3.10	3.20	2.85	3.00	3.60	3.15	3.30	5.0
6	Acidity (mg/L)	55	350	105	50	205	80	235	215	200	55	65	85	-
7	Total Hardness (mg/L)	210	205	450	220	235	205	225	275	325	405	245	225	100.0
8	Calcium (mg/L)	105	120	125	110	110	130	140	190	200	265	155	135	100.0
9	Magnisium (mg/L)	105	85	325	110	125	75	85	85	125	140	90	90	30.0
10	Chloride (mg/L)	35	30	35	25	40	40	35	35	75	65	45	37	200.0
11	Total solids (mg/L)	785	420	565	775	560	470	550	790	820	900	515	550	500.0
12	Total dissolved solids (mg/L)	565	300	315	555	325	365	415	615	685	735	410	495	500.0
13	Total susdended solids (mg/L)	220	120	250	220	235	105	135	175	135	165	105	55	-
14	Dissolved oxygen (mg/L)	3.0	2.2	2.5	2.8	3.0	3.5	2.3	3.0	3.0	2.5	2.5	3.0	5.0
15	Biochemical oxygen demand (mg/L)	9.5	11.0	12.0	9.0	10.5	11.5	10.5	11.5	11.5	13.0	8.0	10.0	6.0
16	Chemical oxygen demand (mg/L)	30	15	25	22	23	28	26	35	40	25	30	35	10.0
17	Silica (mg/L)	22	20	20	25	30	26	28	25	30	35	25	28	-
18	Iron (mg/L)	1.2	0.8	1.0	1.5	1.3	1.45	1.55	1.95	2.10	2.15	1.30	1.35	1.0

essential micro-nutrients. High amount of iron in water causes staining of clothes, utensils and colour change on standing. The present study suggests that people dependendent on water of source of study are prone to health hazards of contaminated drinking water and water quality management is urgently needed in the catchment area of study.

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