



GROUNDWATER QUALITY ASSESSMENT FOR DRINKING PURPOSE IN CHARKHI DADRI CITY IN HARYANA

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Abstract

Water is necessary for survival of living beings. Groundwater is a vital renewable resource. It is 1.7% of the global water quantity. In India, about 90% rural population and 30% urban population depend on groundwater for drinking and domestic requirements. In the present study, groundwater quality has been assessed for drinking purpose in Charkhi Dadri city. Twenty four groundwater samples were collected from different locations in the study area. The collected groundwater samples were analyzed for chemical parameters-pH, TDS, Cl, HCO₃, CO₃, Mn, Zn, Fe, Mg, Ca and K. The results of chemical analysis of groundwater samples were compared with BIS 10500:2012 drinking water standards. In the study area pH ranges 6.5 to 7.8 and desirable at all the groundwater sample locations, TDS ranges 190 mg/l to 2850 mg/l and non-potable at two sample locations-Near Arvind Hospital (2770 mg/l) and Prem Nagar, Delhi Bypass (2850 mg/l) while desirable at other sample locations in the study area, chloride ranges 10.2 mg/l to 200 mg/l and desirable at all the sample locations, carbonate ranges nil to 0.2 mg/l and desirable at all the sample locations, bicarbonate ranges 0.2 mg/l to 0.7 mg/l and desirable at all the sample locations, total hardness ranges 9 mg/l to 64.5 mg/l and desirable at all the sample locations, calcium ranges 3 mg/l to 21.5 mg/l and desirable at all the sample locations, magnesium ranges 6 mg/l to 43 mg/l and permissible at eight sample locations i.e. Champapuri (35.67 mg/l), Near Ganpati Garden (33.33 mg/l), Shiv Mandir, Main Market (33 mg/l), JVM College Stadium (33.33 mg/l), Easy Day (43 mg/l), Near Municipal Council (38 mg/l), Old Hanuman Mandir (38 mg/l), Gwariya Kua (33 mg/l) while at rest of the sample locations it is desirable, potassium ranges nil to 77.4 mg/l and desirable at all the sample locations, manganese ranges nil to 0.73 mg/l and desirable at Mahendragarh Bypass (nil), Near Jhadu Singh Chowk (0.09 mg/l), Near Bala Wala Mandir (0.03 mg/l), Ram Leela Ground (0.1 mg/l), Gwariya Kua (0.03 mg/l) and permissible at Near Arvind Hospital (0.15 mg/l), Near Loharu Chowk (0.18 mg/l), Near Ganpati Garden (0.12 mg/l), Geeta Bhawan (0.16 mg/l), Near Municipal Council (0.15 mg/l), Mejbaan Hotel Chowk (0.2 mg/l) while non-potable at Prem Nagar, Delhi Bypass (0.31 mg/l), Back side Champa puri (0.63 mg/l), Near Rawaldhi Bypass (0.73 mg/l), Champapuri (0.42 mg/l), Hanuman Mandir, Ghikara Chowk (0.58 mg/l), JVM College Stadium (0.51 mg/l), New Sabji Mandi (0.4 mg/l), Easy Day (0.38 mg/l), Old Shiv Mandir (0.4 mg/l), Kabaddi Market Road (0.42 mg/l), zinc ranges 0.58 mg/l to 7.62 mg/l and desirable in all groundwater samples except at Easy Day (5.12 mg/l), Near Municipal Council (7.62 mg/l), Old Hanuman Mandir (6.21 mg/l) where it is permissible, iron ranges 0.07 mg/l to 0.43 mg/l and desirable in all the groundwater samples except in groundwater samples at JVM College Stadium (0.33 mg/l) and Gwariya Kua (0.43 mg/l) in which it is non-potable. The study is highly useful for planning of groundwater supply for drinking purpose in the study area.

Keywords

Groundwater, quality, desirable, permissible, non-potable, Charkhi Dadri, Haryana.

INTRODUCTION

Groundwater is the amount of water found below the earth's surface in soil pores and cracks of rocks. As the groundwater is more or less available at all places, it is highly exploitable natural resource. Further, in arid to semi-arid regions of the world, it is the only source of water used for drinking, irrigation and industrial activities. Assessment of groundwater quality for drinking purpose is necessary to avoid the ill effects on human health. Many workers (Khazaei et al. (2004), Balakrishnan (2011), Al-Hadithi, Mufid. (2012), Bhatia, A. K., (2012), Kumar, Manjeshand Kumar, Ramesh (2013), Meride and Bamlakuayenew (2016), Nelly and Mutua (2016)) studied the groundwater quality for drinking purpose in at various locations.

STUDY AREA

Charkhi Dadri city lies in the southwestern part of Haryana. Charkhi Dadri city is situated between latitudes $28^{\circ}34'36''$ N to $28^{\circ}37'3''$ N and longitudes $76^{\circ}14'32''$ E to $76^{\circ}17'34''$ E and covering approximately 14.65 km² area. Physiographic point of view, Charkhi Dadri is a flat plain area with an average elevation of 213 m.

OBJECTIVE

The main objective of the study was to assess the groundwater quality for drinking purpose in the study area.

METHODOLOGY

In the study area 24 groundwater samples were collected in 250 ml plastic bottles from different sample sources like hand pump and tube well. Groundwater samples were analysed for pH, total dissolved solids (TDS), chloride (Cl), carbonate (CO₃), bicarbonate (HCO₃), total hardness (TH), calcium

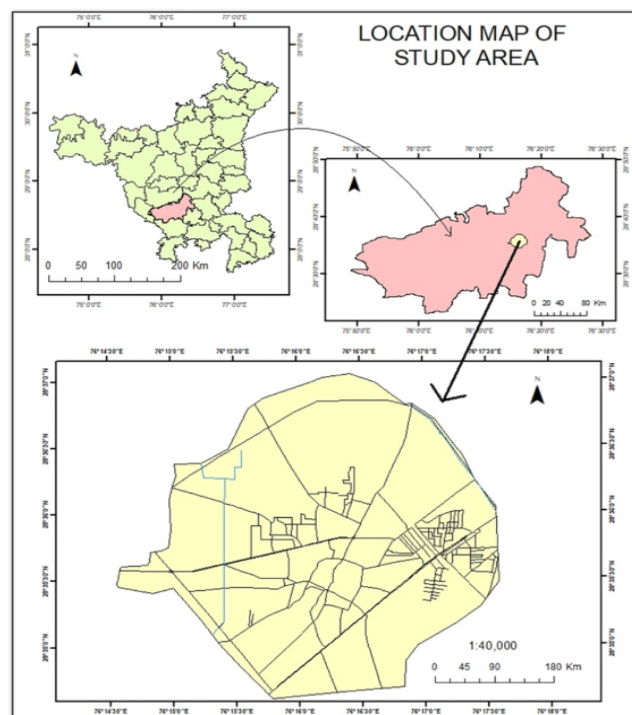


Fig.1: Location map of the study area.

(Ca), magnesium (Mg), potassium (K), manganese (Mn), zinc (Zn) and iron (Fe) (Table 1). BIS 10500:2012 drinking water standards were used to determine the suitability of groundwater samples for drinking purpose (Table 2). Chemical parameter wise bar graphs were prepared to present the scenario of chemical parameter at different groundwater sample locations.

Table 1: Results of chemical analysis of groundwater samples.

Location	pH	TDS (mg/l)	Cl (mg/l)	CO ₃ (mg/l)	HCO ₃ (mg/l)	TH (mg/l)	Ca (mg/l)	Mg (mg/l)	K (mg/l)	Mn (mg/l)	Zn (mg/l)	Fe (mg/l)
Near Arvind Hospital	6.7	2770	76.7	0	0.7	34	11.33	22.67	3.7	0.15	0.58	0.12
Prem Nagar, Delhi Bypass	6.8	2850	121.5	0	0.4	35	11.67	23.33	3.4	0.31	0.75	0.08
Back side Champa puri	6.9	265	59	0	0.3	29	9.67	19.33	77.4	0.63	0.97	0.16
Near Rawaladhi Bypass	7.2	270	29.5	0	0.5	26.5	8.83	17.67	2.3	0.73	1.06	0.07
Champapuri	6.7	265	89.5	0	0.3	53.5	17.83	35.67	39.6	0.42	1.24	0.16
Hanuman Mandir, Ghikara Chowk	7	245	61.5	0	0.2	24	8	16	43.9	0.58	1.28	0.14
Near Loharu Chowk	7	240	39.6	0.1	0.3	25.4	8.47	16.93	53.5	0.18	1.41	0.19
Near Ganpati Garden	6.8	255	75	0	0.5	50	16.67	33.33	11.4	0.12	1.54	0.04
Aryan Model School	7.4	220	14.8	0	0.4	42.5	14.17	28.33	3.5	0.3	1.71	0.1
Shiv Mandir, Main Market	7	230	45	0.2	0.4	49.5	16.5	33	61.9	0.5	1.81	0.29
Geeta Bhawan	6.9	260	50	0	0.5	24	8	16	8.3	0.16	1.87	0.22
JVM College Stadium	7.2	190	200	0	0.3	50	16.67	33.33	1.7	0.51	1.87	0.33
Mahendragarh Bypass	7.3	265	10.2	0.1	0.2	12.6	4.2	8.4	0	0	0.81	0.24
New Sabji Mandi	7	195	19	0	0.3	9	3	6	6.3	0.4	2.16	0.29
Easy Day	6.5	255	46.2	0	0.4	64.5	21.5	43	16.3	0.38	5.12	0.26
Near Municipal Council	6.8	270	195	0	0.6	57	19	38	13.5	0.15	7.62	0.27
Old Shiv Mandir	7.2	230	25	0	0.2	22	7.33	14.67	6.8	0.4	2.13	0.24
Near Jhadu Singh Chowk	7.8	225	48.5	0	0.3	13.7	4.56	9.13	16.8	0.09	2.14	0.25
Old Hanuman Mandir	6.8	260	50	0	0.4	57	19	38	29.9	0.28	6.21	0.27
Near Bala Wala Mandir	7	235	55	0	0.2	33	11	22	33.6	0.03	2.29	0.25
Kabaddi Market Road	6.9	240	41.6	0	0.3	32.5	10.83	21.67	20.6	0.42	2.21	0.21
Ram Leela Ground	6.9	245	47	0	0.3	25.5	8.5	17	23.2	0.1	2.26	0.28
Gwariya Kua	6.4	255	95	0	0.2	49.5	16.5	33	58.9	0.03	2.67	0.43
Mejbaan Hotel Chowk	7.6	255	72	0.1	0.5	16.5	5.5	11	1.3	0.2	2.31	0.28

Table 2: BIS (10500:2012) Drinking Water Standards.

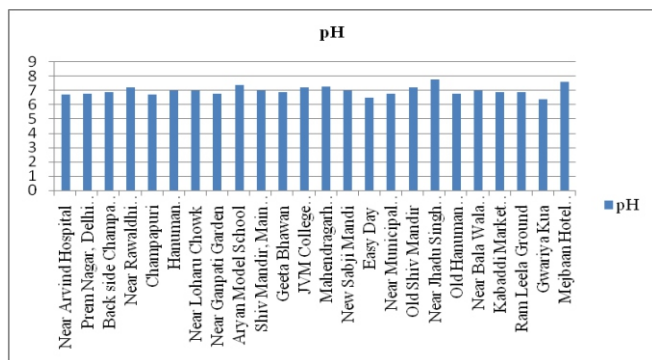
S. No.	Characteristics	Desirable	Permissible	Non-Potable
1	pH	6.5-8.5	No relaxation	--
2	Total Dissolved Solids (TDS)	<500 ppm	500-2000 ppm	>2000 ppm
3	Calcium(Ca)	<75 ppm	75-200 ppm	>200 ppm
4	Magnesium(Mg)	<30 ppm	30-100 ppm	--
5	Bicarbonate(HCO ₃)	<500 ppm	--	>500 ppm
6	Potassium(K)	<12 ppm	--	--
7	Iron(Fe)	<0.3 ppm	No relaxation	>0.3 ppm
8	Manganese(Mn)	<0.1 ppm	0.1-0.3 ppm	>0.3 ppm
9	Zinc(Zn)	<5 ppm	5-15 ppm	>15 ppm
10	Chloride(Cl)	<250 ppm	250-1000 ppm	>1000 ppm
11	Ammonia	<.5 ppm	No relaxation	>.5 ppm

I. pH

In the study area pH ranges 6.5 to 7.8. As per BIS 10500: 2012 drinking water standards pH 6.5 to 8.5 is desirable. Hence, in the study area pH is desirable at all the sample locations.

ii. Total Dissolved Solids (TDS)

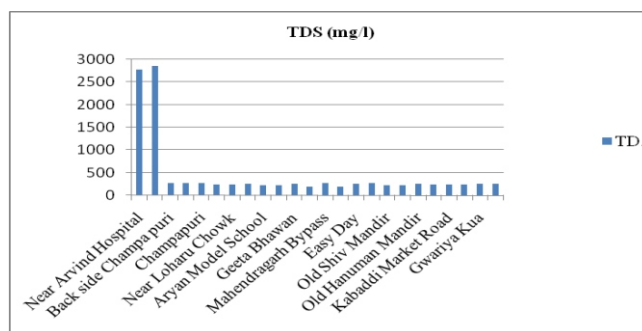
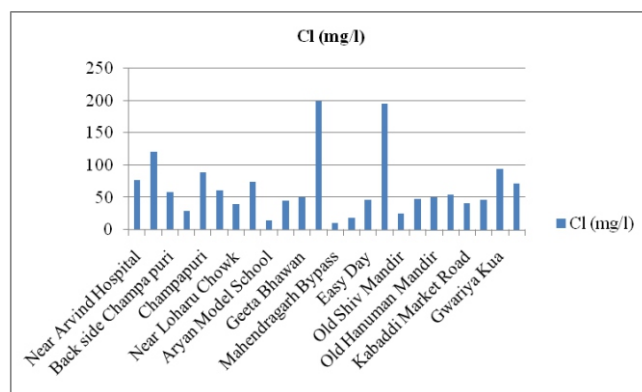
In the study area TDS ranges 190 mg/l to 2850 mg/l. As per BIS 10500:2012 drinking water standards TDS is desirable if less than 500 mg/l, permissible 500 mg/l - 2000 mg/l and non-potable if more than 2000 mg/l. TDS is non-potable at two sample locations-Near Arvind Hospital (2770 mg/l) and Prem Nagar, Delhi Bypass (2850 mg/l) while desirable at other sample locations in the study area.

**Fig. 2: Scenario of pH at samples locations in the study area.****iii. Chloride**

In the study area chloride ranges 10.2 mg/l to 200 mg/l. As per BIS 10500:2012 drinking water standards chloride is desirable if less than 250 mg/l, permissible 250 mg/l - 1000 mg/l and non-potable if more than 1000 mg/l. As per BIS 10500:2012 drinking water standards chloride is desirable at all the sample locations.

iv. Carbonate

In the study area carbonate ranges nil to 0.2 mg/l. In the study area carbonate has been found in four samples only (Near Loharu Chowk (0.1 mg/l), Shiv Mandir, Main Market (0.2 mg/l), Mahendragarh Bypass (0.1 mg/l), Mejbaan Hotel Chowk (0.1 mg/l). In the study area carbonate is desirable at all the sample locations.

**Fig.3: Scenario of TDS at sample locations in the study area.****Fig.4: Scenario of chloride (Cl) at sample locations in the study area.****v. Bicarbonate**

In the study area bicarbonate ranges 0.2 mg/l to 0.7 mg/l. As per BIS 10500:2012 drinking water standards bicarbonate is desirable if less than 500 mg/l and non-potable if more than 500 mg/l. Thus, in the study area bicarbonate is desirable at all the sample locations.

vi. Total Hardness

In the study area total hardness ranges 9 mg/l to 64.5 mg/l. As per BIS 10500:2012 drinking water standards total hardness is desirable if less than 200 mg/l, permissible 200 mg/l - 600 mg/l and non-potable if more than 600 mg/l. Thus, in the study area total hardness is desirable at all the sample locations.

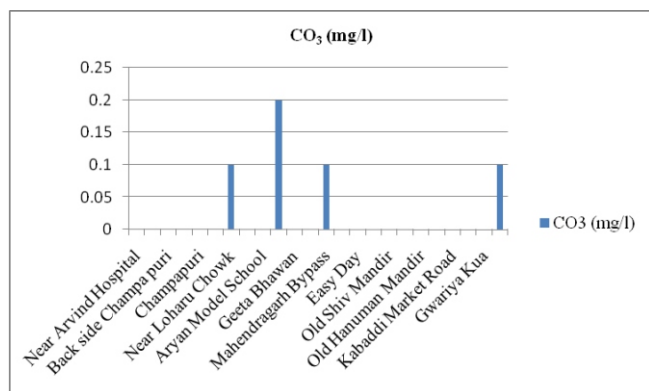


Fig. 5: Scenario of carbonate at sample locations in the study area .

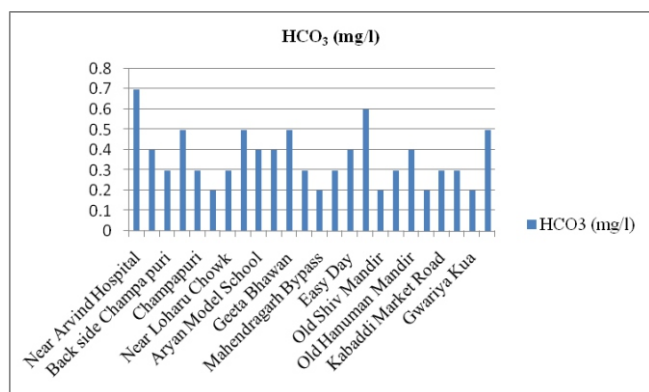


Fig.6: Scenario of bicarbonate at sample locations in the study area.

vii. Calcium

In the study area calcium ranges 3 mg/l to 21.5 mg/l. As per BIS 10500:2012 drinking water standards calcium is desirable if less than 75 mg/l, permissible 75 mg/l - 200 mg/l and non-potable if more than 200 mg/l. Thus, in the study area calcium is desirable at all the sample locations.

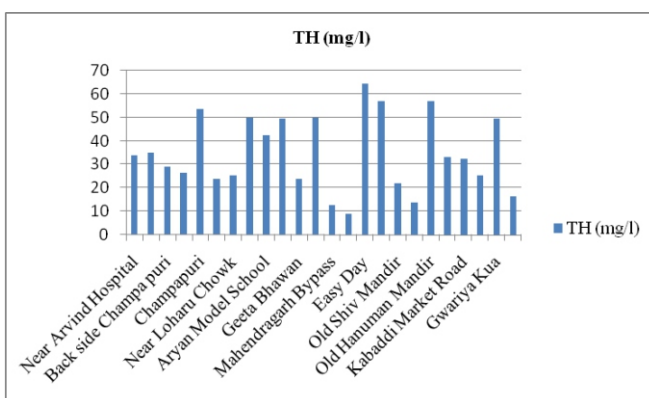


Fig.7: Scenario of total hardness at sample locations in the study .

viii. Magnesium

In the study area magnesium ranges 6 mg/l to 43 mg/l. As per BIS 10500:2012 drinking water standards magnesium is desirable if less than 30 mg/l, permissible 30 mg/l - 100 mg/l and non-potable if more than 100 mg/l. Thus, in the study area magnesium is permissible at eight sample locations i.e. Champapuri (35.67 mg/l), Near Ganpati Garden (33.33 mg/l), Shiv Mandir, Main Market (33 mg/l), JVM College

Stadium (33.33 mg/l), Easy Day (43 mg/l), Near Municipal Council (38 mg/l), Old Hanuman Mandir (38 mg/l), Gwariya Kua (33 mg/l) while at rest of the sample locations it is desirable.

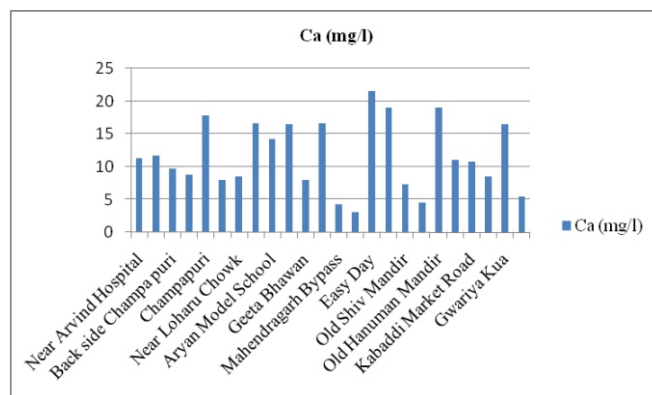


Fig.8: Scenario of calcium (Ca) at sample locations in the study.

ix. Potassium

In the study area potassium ranges nil to 77.4 mg/l. In the study area potassium is desirable at all the sample locations.

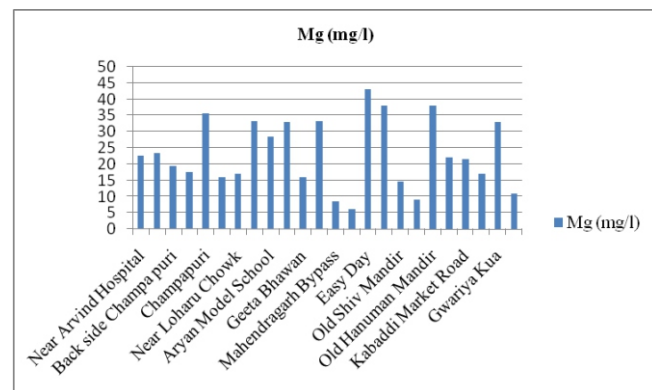


Fig.9: Scenario of magnesium (Mg) at sample locations in the study.

x. Manganese

In the study area manganese ranges nil to 0.73 mg/l. As per BIS 10500:2012 drinking water standards calcium is desirable if less than 0.1 mg/l, permissible 0.1 mg/l - 0.3 mg/l and non-potable if more than 0.3 mg/l. Manganese is desirable at Mahendragarh Bypass (nil), Near Jhadu Singh Chowk (0.09 mg/l), Near Bala Wala Mandir (0.03 mg/l), Ram Leela Ground (0.1 mg/l), Gwariya Kua (0.03 mg/l) and permissible at Near Arvind Hospital (0.15 mg/l), Near Loharu Chowk (0.18 mg/l), Near Ganpati Garden (0.12 mg/l), Geeta Bhawan (0.16 mg/l), Near Municipal Council (0.15 mg/l), Mejbhaan Hotel Chowk (0.2 mg/l) while non-potable at .Prem Nagar, Delhi Bypass (0.31 mg/l), Back side Champa puri (0.63 mg/l), Near Rawalddhi Bypass (0.73 mg/l), Champapuri (0.42 mg/l), Hanuman Mandir, Ghikara Chowk (0.58 mg/l), JVM College Stadium (0.51 mg/l), New Sabji Mandi (0.4 mg/l), Easy Day (0.38 mg/l), Old Shiv Mandir (0.4 mg/l), Kabaddi Market Road (0.42 mg/l).

xi. Zinc

In the study area zinc ranges 0.58 mg/l to 7.62 mg/l. As per BIS 10500:2012 drinking water standards zinc is desirable if

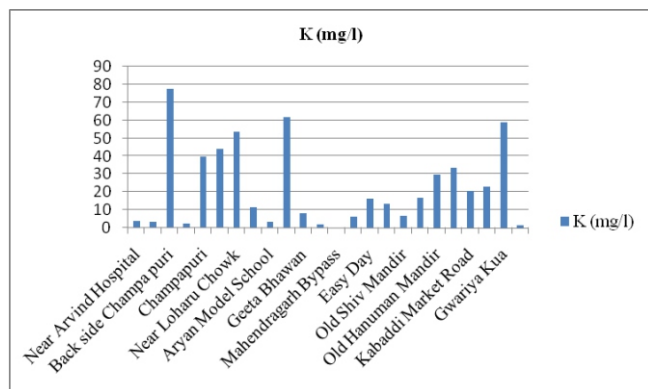


Fig.10: Scenario of potassium (K) at sample locations in the study.

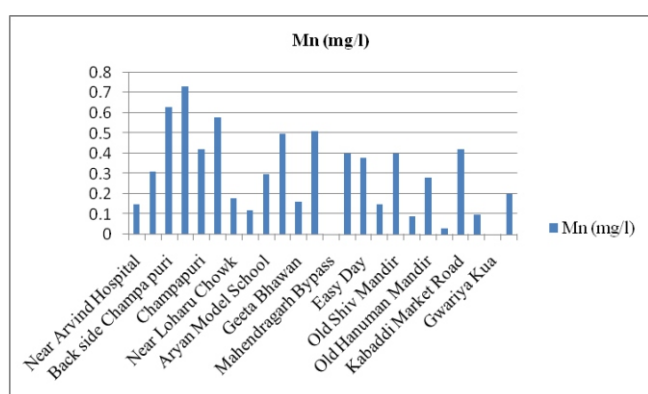


Fig.11: Scenario of manganese (Mn) at sample locations in the study.

less than 5 mg/l, permissible between 5 mg/l- 15 mg/l and non-potable if more than 15 mg/l. In the study area zinc is desirable in all groundwater samples except at Easy Day (5.12 mg/l), Near Municipal Council (7.62 mg/l), Old Hanuman Mandir (6.21 mg/l) where it is permissible.

xii. Iron

In the study area iron ranges 0.07 mg/l to 0.43 mg/l. As per BIS 10500:2012 drinking water standards iron is desirable if less than 0.3 mg/l and non-potable if more than 0.3 mg/l. In the study area iron is desirable in all the groundwater samples except in groundwater samples at JVM College Stadium (0.33 mg/l) and Gwariya Kua (0.43 mg/l) in which it is non-potable.

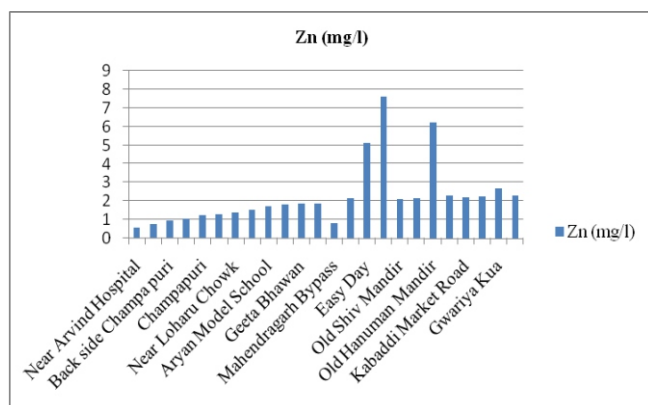


Fig.11: Scenario of manganese (Mn) at sample locations in the study.

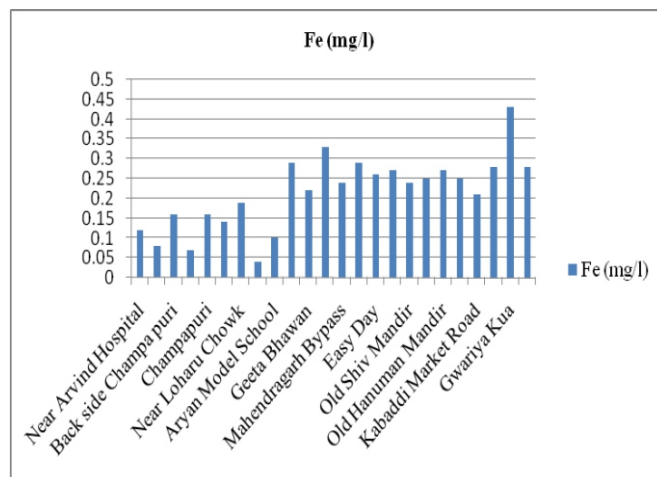


Fig. 13: Scenario of iron (Fe) at sample locations in the study.

CONCLUSIONS

In the study area pH, carbonate, bicarbonate, total hardness, calcium, potassium are desirable. TDS is non-potable at two sample locations-Near Arvind Hospital (2770 mg/l) and Prem Nagar, Delhi Bypass (2850 mg/l) while desirable at other sample locations in the study area.

Magnesium is permissible at eight sample locations i.e. Champapuri (35.67 mg/l), Near Ganpati Garden (33.33 mg/l), Shiv Mandir, Main Market (33 mg/l), JVM College Stadium (33.33 mg/l), Easy Day (43 mg/l), Near Municipal Council (38 mg/l), Old Hanuman Mandir (38 mg/l), Gwariya Kua (33 mg/l) while at rest of the sample locations it is desirable. Manganese is desirable at Mahendragarh Bypass (nil), Near Jhadu Singh Chowk (0.09 mg/l), Near Bala Wala Mandir (0.03 mg/l), Ram Leela Ground (0.1 mg/l), Gwariya Kua (0.03 mg/l) and permissible at Near Arvind Hospital (0.15 mg/l), Near Loharu Chowk (0.18 mg/l), Near Ganpati Garden (0.12 mg/l), Geeta Bhawan (0.16 mg/l), Near Municipal Council (0.15 mg/l), Mejbaan Hotel Chowk (0.2 mg/l) while non-potable at Prem Nagar, Delhi Bypass (0.31 mg/l), Back side Champa puri (0.63 mg/l), Near Rawalddhi Bypass (0.73 mg/l), Champapuri (0.42 mg/l), Hanuman Mandir, Ghikara Chowk (0.58 mg/l), JVM College Stadium (0.51 mg/l), New Sabji Mandi (0.4 mg/l), Easy Day (0.38 mg/l), Old Shiv Mandir (0.4 mg/l), Kabaddi Market Road (0.42 mg/l). Zinc is desirable in all groundwater samples except at Easy Day (5.12 mg/l), Near Municipal Council (7.62 mg/l), Old Hanuman Mandir (6.21 mg/l) where it is permissible. Iron is desirable in all the groundwater samples except in groundwater samples at JVM College Stadium (0.33 mg/l) and Gwariya Kua (0.43 mg/l) in which it is non-potable.

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