STUDY OF GROUNDWATER QUALITY FOR DRINKING PURPOSE IN HANSI-I BLOCK, HISAR DISTRICT, HARYANA

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Abstract

Groundwater is a vital source of water for domestic, agricultural, and industrial utilization. Due to non availability of surface water everywhere people rely on groundwater because of availability. In arid to semi-arid regions of the world groundwater is the main source for drinking, iriigration and industrial utilization. In the present study groundwater quality in Hansi-I block has been studied for srinking purpose. In this study, 18 groundwter samples were collected from different locations in the study area. Groundwater samples were analysed for 12 chemical parameters- pH, TDS, Cl, Zn, K, HCO3, CO3, Ca, Mg, Fe, TH, and Mn. BIS 10500:2012 drinking water standards were used for assessment of suitability of groundwater for drinking purpose. In the study area pH ranges 6.9 to 8.3 and desirable at all the groundwater samples.TDS ranges 118 mg/l to 2640 mg/l. TDS is desirable in groundwater samples -Dhnderi School (214 mg/l), Daple (118 mg/l), Sainipura (171 mg/l), Bhidfarm (450 mg/l), Sisai (270 mg/l), bhatla (308 mg/l), Chanak (175 mg/l), Masoodpur (149 mg/l), Dhata (209 mg/l), Sindhar (146 mg/l), Rajli (268 mg/l), Sulakhni (153 mg/l), permissibe in Dhani Qutub (1165 mg/l), Lalpura (1360 mg/l), Majood Temple (1525 mg/l), Ghiraye (1075 mg/l) and non-potable in Civil Hospital (2640 mg/l), Khanpur (2295 mg/l).Manganese ranges 0.02 mg/l to 0.15mg/l and desirable in all groundwater samples. In the study area zinc ranges 4.96 mg/l to 64.82 mg/l. In the study area zinc is non-potable in groundwater samples at Dhnderi School (64.82 mg/l), Daple (62.43mg/l), Dhani Qutub (60.71 mg/l), Civil Hospital (58.23 mg/l), Lalpura (57.09 mg/l), Sainipura (55.62 mg/l), Bhidfarm (53.67 mg/l), Sisai (49.53 mg/l), Bhatla (45.70 mg/l), Chanak (38.94 mg/l), Majood Temple (35.49 mg/l), Masoodpur (29.27 mg/l), Dhata (24.68 mg/l), Khanpur (20.68 mg/l), Sindhar (15.81 mg/l), permissible in Rajli (11.74 mg/l), Ghiraye (7.84 mg/l) and desirable in Sulakhni (4.96 mg/l) groundwater sample. Iron ranges 0.07 mg/l to 0.92 mg/l. Iron is desirable in groundwater samples in Masoodpur (0.29 mg/l), Dhata (0.20 mg/l), Khanpur (0.14 mg/l), Sindhar (0.20 mg/l), Rajli (0.20 mg/l), Ghiraye (0.07 mg/l), Sulakhni (0.07 mg/l) and non-poyable in groundwater samples in Dhnderi School (0.92 mg/l), Daple (0.89 mg/l), Dhani Qutub (0.71 mg/l), Civil Hospital (0.77 mg/l), Lalpura (0.72 mg/l), Sainipura (0.72 mg/l), Bhidfarm (0.64 mg/l), Sisai (0.71 mg/l), Bhatla (0.53 mg/l), Chanak (0.33 mg/l) and Majood Temple (0.36 mg/l). In the study area chloride ranges 2.7 mg/l to 38.2 mg/l and desirable in all the groundwater samples. Hardness ranges 2.8 mg/l to 32.2 mg/l and desirable in all the groundwater samples. In the study area potassium ranges 2.9 to 65 mg/l and desirable in all groundwater samples except Civil Hospital (18.4 mg/l), Lalpura (14.6 mg/l), Majood Temple (65 mg/l), Khanpur (19.3 mg/l), Sulakhni (14.1 mg/l) groundwater samples in which potassium is non-potable. In the study area bicarbonate ranges 0.2 mg/l to 0.5 mg/l and desirable in all the groundwater samples. In the study area carbonate ranges nil to 0.1 mg/l and desirable in all the groundwater samples. In the study area calcium ranges 1.87 mg/l to 21.47 mg/l and desirable in all the groundwater samples. In the study area magnesium ranges 0.93 mg/l to 10.73 mg/l. and desirable in all the groundwater samples. The study is highly useful for planning of groundwater quality for drining purpose in the study area.

INTRODUCTION

Groundwater is the water that exists in the surface of the earth and fills all voids in soils and geologic strata. Groundwater in the upper portion of 2 km of the Earth's surface is estimated to contain 22.6 million cubic km. The most often used groundwater reservoirs are unconsolidated (sand and gravel) or carbonate hard rock reservoirs and mostly found in alluvial plains, valleys, coastal plains and high-temperature deserts. Groundwater is highly expoited for drinking, irrigation and industrial purposes. Suitability of groundwater for drinking purpose must be assessed to avoid health issues. Many workers (Chatterjee et al. (2010), Singh and Khan (2011), Adhikary et al. (2012), Konkey et al. (2014), Logeshkumaran et al. (2015), Nagalakshmi et al. (2016), Ali and Ali (2018), Tiwari et al. (2018), Deepika et al. (2020), Gaikwad et al. (2020), Vaiphei et al. (2020)) studied groundwater quality for drinking purpose in different types of terrains.
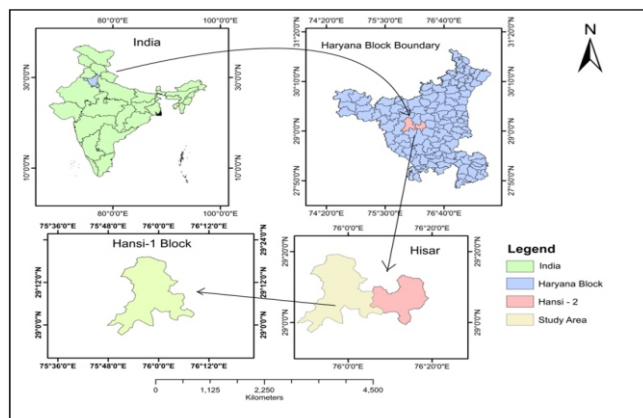
Fig.1: Location map of the study area.

STUDY AREA

Hansi-1 block is situated in Hisar district of Haryana. The block is located between the latitudes 28° 57' 57"N - 29° 19' 13"N and longitudes 75° 47' 50"E - 76° 8' 89" E and covers 588 sq km. The average annual rainfall is 460 mm and subtropical steppe climate. Geomorphologically the area is part of alluvial plain of Indo-Ganfteic plain.

OBJECTIVE

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

Table 1: Results of chemical analysis of groundwater samples.

S. No.	Sample Location	pH (mg/l)	TDS (mg/I0)	Mn (mg/l)	Zn (mg/l)	Fe (mg/l)	Cl (mg/l)	TH (mg/l)	K (mg/l)	HCO$_3$ (mg/l)	CO$_3$ (mg/l)	Ca (mg/l)	Mg (mg/l)
1	Dhnderi School	7.5	214	0.08	64.82	0.92	4.5	4.1	5.1	0.4	0	2.73	1.37
2	Daple	7.6	118	0.06	62.43	0.89	4	2.8	3.8	0.2	0	1.87	0.93
3	Dhani Qutub	7.05	1165	0.05	60.71	0.71	11.3	7	9.8	0.4	0	4.67	2.33
4	Civil Hospital	7.2	2640	0.05	58.23	0.77	38.2	32.2	18.4	0.4	0	21.47	10.73
5	Lalpura	7.7	1360	0.04	57.09	0.72	24.2	13	14.6	0.4	0	8.67	4.33
6	Sainipura	7.9	171	0.04	55.62	0.72	4.5	2.9	4.4	0.5	0.1	1.93	0.96
7	Bhidfarm	7.5	450	0.03	53.67	0.64	3.8	6.1	10.9	0.4	0.1	4.06	2.03
8	Sisai	7.2	270	0.03	49.53	0.71	30.5	16	4.3	0.4	0.1	10.66	5.33
9	Bhatla	7.5	308	0.15	45.70	0.53	4	6.8	4.3	0.4	0	4.53	2.26
10	Chanak	7.6	175	0.03	38.94	0.33	6.5	3	11.6	0.2	0	2	1
11	Majood Temple	7.1	1525	0.03	35.49	0.36	8	14.5	65	0.37	0	9.66	4.83
12	Masoodpur	7.9	149	0.02	29.27	0.29	3.6	4.9	3.4	0.3	0	3.67	1.63
13	Dhata	7.8	209	0.02	24.68	0.20	4.1	3	6.2	0.2	0	2	1
14	Khanpur	7.5	2295	0.06	20.68	0.14	52.4	12.8	19.3	0.35	0	8.53	4.27
15	Sindhar	8.3	146	0.05	15.81	0.20	4.5	3	2.9	0.5	0	2	1
16	Rajli	7.2	268	0.02	11.74	0.20	2.7	4.6	6.1	0.2	0	3.06	1.53
17	Ghiraye	6.9	1075	0.02	7.84	0.07	2.9	3.7	4.8	0.3	0	2.46	1.23
18	Sulakhni	7.5	153	0.03	4.96	0.07	16.4	6.2	14.1	0.24	0	4.13	2.07

Table 2: BIS 10500:2012 Drinking Water Standards.

Sl. No.	Parameters	Potable		Non potable
		Desirable	**Permissible**	
1	pH	6.5 to 8.5	No Relaxation	-
2	Total Hardness (mg/l)	< 200	200-600	> 600
3	Iron (mg/l)	< 0.3	No Relaxation	-
4	Chlorine (mg/l)	< 250	250-1000	> 1000
5	Total Dissolved Solid (mg/l)	< 500	500-2000	> 2000
6	Bicarbonates (mg/l)	< 500	-	> 500
7	Calcium (mg/l)	< 75	75-200	> 200
8	Magnesium (mg/l)	< 30	30-100	> 100
9	Manganese (mg/l)	< 0.1	0.1-0.3	> 0.3
10	Sodium (mg/l)	<50 mg/l	50-200 mg/l	>200 mg/l
11	Potassium (mg/l)	<12 mg/l	-	-
12	Zinc (mg/l)	<5	5-15	>15

METHODOLOGY

In the study area 18 groundwater samples were collected in 250 ml plastic bottles from different sample sources like hand pump, dug well and tube well. Groundwater samples were analysed for pH, total dissolved solids (TDS), magnesium (Mg), chloride (Cl), carbonate (CO_3), bicarbonate (HCO_3), potassium (K), calcium (Ca), manganese (Mn), total hardness (TH), iron (Fe) and zinc (Zn) (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.

RESULTS AND DISCUSSION

i. pH

In the study area pH ranges 6.9 to 8.3. As per BIS 10500: 2012 drinking water standards pH 6.5 to 8.5 is desirable. In the study area pH is desirable at all the groundwater samples.
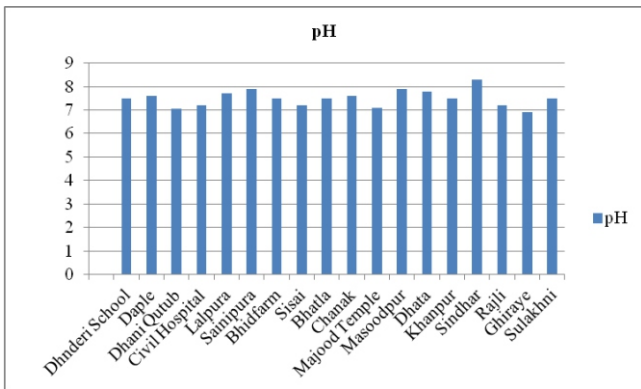
Fig. 2: Sceanrio of pH in groundwater samples in the study area.

ii. Total Dissolved Solids (TDS)

In the study area TDS ranges 118 mg/l to 2640 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 desirable in groundwater samples -Dhnderi School (214 mg/l), Daple (118 mg/l), Sainipura (171 mg/l), Bhidfarm (450 mg/l), Sisai (270 mg/l), bhatla (308 mg/l), Chanak (175 mg/l), Masoodpur (149 mg/l), Dhata (209 mg/l), Sindhar (146 mg/l), Rajli (268 mg/l), Sulakhni (153 mg/l), permissibe in Dhani Qutub (1165 mg/l), Lalpura (1360 mg/l), Majood Temple (1525 mg/l), Ghiraye (1075 mg/l) and non-potable in Civil Hospital (2640 mg/l), Khanpur (2295 mg/l).

iii. Manganese (Mn)

In the study area manganese ranges 0.02 mg/l to 0.15mg/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. In the study area manganse is desirable in all groundwater samples.\

iv. Zinc (Zn)

In the study area zinc ranges 4.96 mg/l to 64.82 mg/l. As per BIS 10500:2012 drinking water standards zinc is desirable if
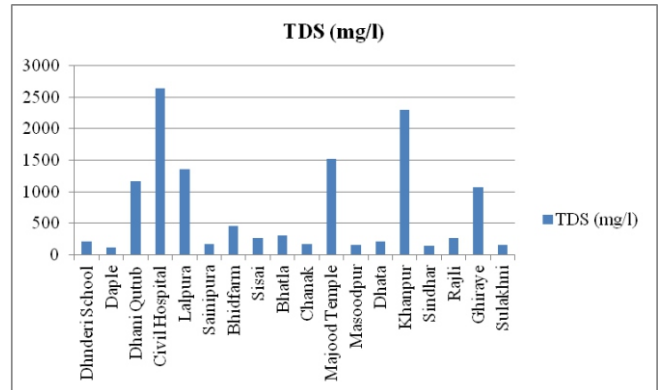

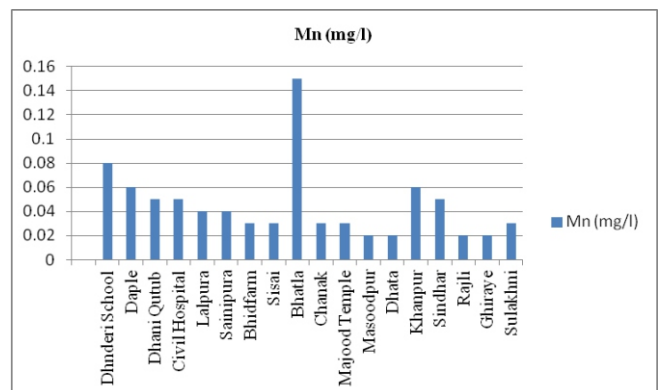**Fig.3: Sceanrio of TDS in groundwater samples in the study area.**

Fig.4: Sceanrio of manganese in groundwater samples in the study area.

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 non-potable in groundwater samples at Dhnderi School (64.82 mg/l), Daple (62.43mg/l), Dhani Qutub (60.71 mg/l), Civil Hospital (58.23 mg/l), Lalpura (57.09 mg/l), Sainipura (55.62 mg/l), Bhidfarm (53.67 mg/l), Sisai (49.53 mg/l), Bhatla (45.70 mg/l), Chanak (38.94 mg/l), Majood Temple (35.49 mg/l), Masoodpur (29.27 mg/l), Dhata (24.68 mg/l), Khanpur (20.68 mg/l), Sindhar (15.81 mg/l), permissible in Rajli (11.74 mg/l), Ghiraye (7.84 mg/l) and desirable in Sulakhni (4.96 mg/l) groundwater sample.
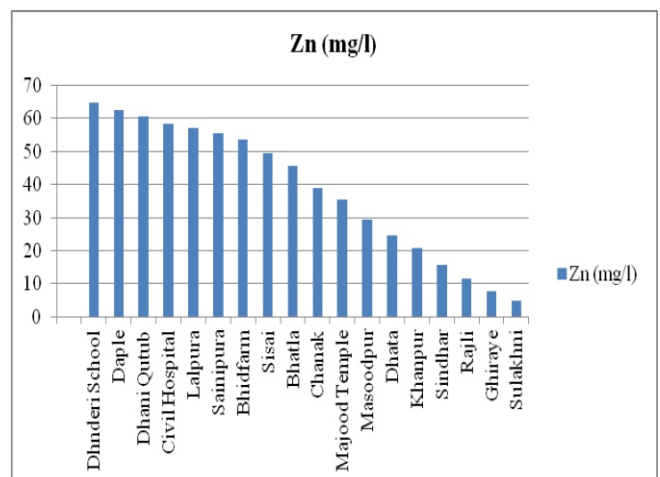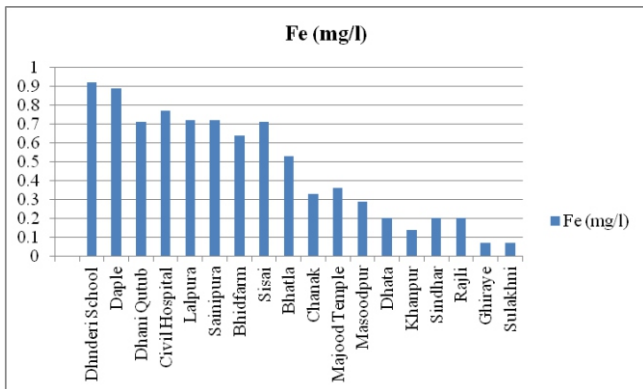

Fig.5: Sceanrio of zinc in groundwater samples in the study area.

v. Iron (Fe)

In the study area iron ranges 0.07 mg/l to 0.92 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 groundwater samples in Masoodpur (0.29 mg/l), Dhata (0.20 mg/l), Khanpur (0.14 mg/l), Sindhar (0.20 mg/l), Rajli (0.20 mg/l), Ghiraye (0.07 mg/l), Sulakhni (0.07 mg/l) and non-poyable in groundwater samples in Dhnderi School (0.92 mg/l), Daple (0.89 mg/l), Dhani Qutub (0.71 mg/l), Civil Hospital (0.77 mg/l), Lalpura (0.72 mg/l), Sainipura (0.72 mg/l), Bhidfarm (0.64 mg/l), Sisai (0.71 mg/l), Bhatla (0.53 mg/l), Chanak (0.33 mg/l) and Majood Temple (0.36 mg/l).

Fig.6: Sceanrio of iron in groundwater samples in the study area.

vi. Chloride (Cl)

In the study area chloride ranges 2.7 mg/l to 38.2 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. in the study area chloride is desirable in all the groundwater samples.
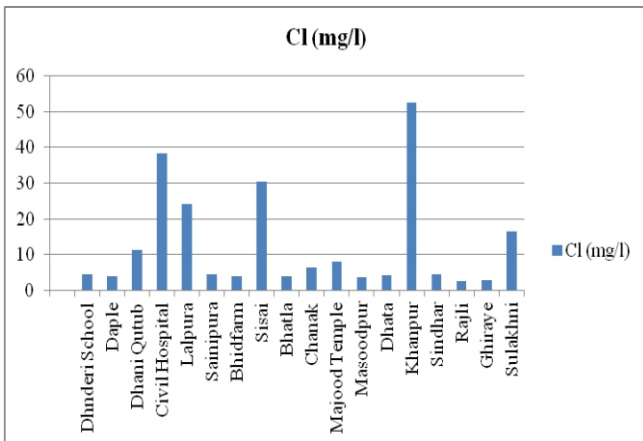

Fig.7:Sceanrio of chloride in groundwater samples in the study area.

vii. Total Hardness (TH)

In the study area total hardness ranges 2.8 mg/l to 32.2 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 in all the groundwater samples.
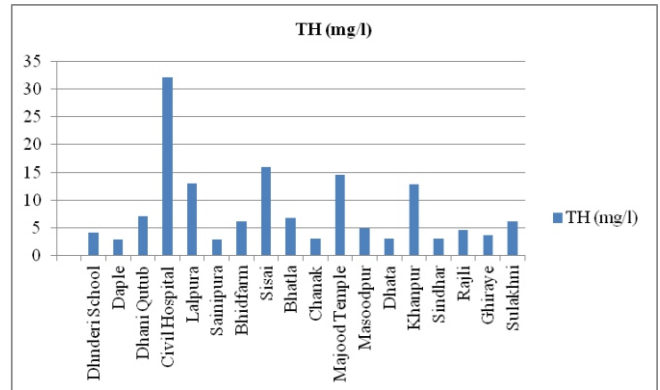

Fig.8: Sceanrio of total hardness in groundwater samples in the study area.

viii. Potassium (K)

In the study area potassium ranges 2.9 to 65 mg/l. As per BIS 10500:2012 drinking water standards total hardness is desirable if less than 12 mg/l and non-potable if more than 12 mg/l. In the study area potassium is desirable in all groundwater samples except Civil Hospital (18.4 mg/l), Lalpura (14.6 mg/l), Majood Temple (65 mg/l), Khanpur (19.3 mg/l), Sulakhni (14.1 mg/l) groundwater samples in which potassium is non-potable.
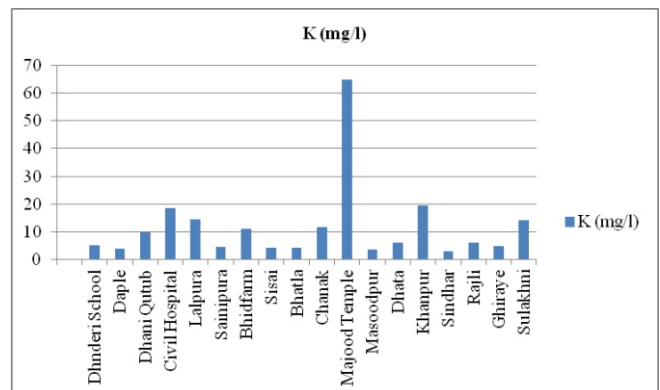

Fig. 9: Sceanrio of total hardness in groundwater samples in the study area.

ix. Bicarbonate (HCO₃)

In the study area bicarbonate ranges 0.2 mg/l to 0.5 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. In the study area bicarbonate is desirable in all the groundwater samples.
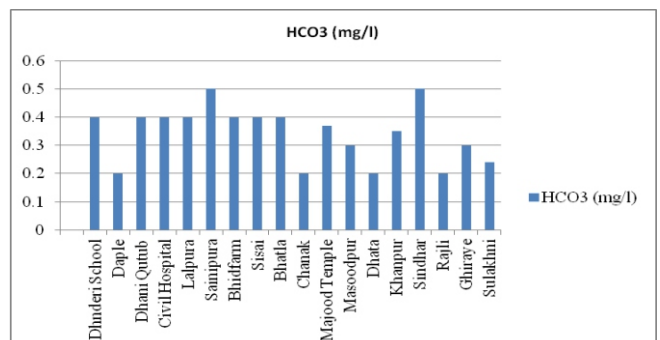

Fig.10: Sceanrio of carbonate in groundwater samples in the sstudy area.

x.Carbonate (CO₃)

In the study area carbonate ranges nil to 0.1 mg/l. In the study area carbonate is desirable in all the groundwater samples.
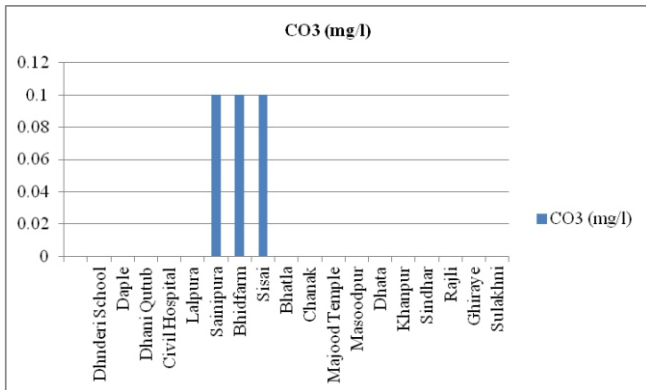

Fig.11:Sceanrio of carbonate in groundwater samples in the sstudy area.

xi.Calcium (Ca)

In the study area calcium ranges 1.87 mg/l to 21.47 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 in all the groundwater samples.
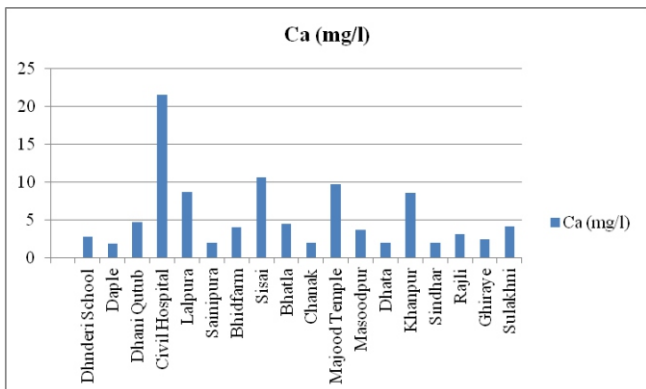

Fig.12:Sceanrio of calcium in groundwater samples in the study area.

xii. Magnesium (Mg)

In the study area magnesium ranges 0.93 mg/l to 10.73 mg/l. As per BIS 10500:2012 drinking water standards magnesium is desirable if less than 30 mg/l, permissible 30 mg/l - 100
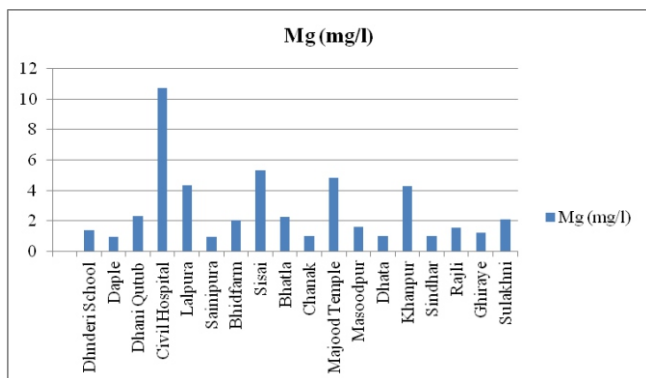

Fig.12:Sceanrio of magnesium in groundwater samples in the sstudy area.

mg/l and non-potable if more than 100 mg/l. Thus, in the study area magnesium is desirable in all the groundwater samples.

CONCLUSIONS

In the study area pH, manganese, chloride, total hardness, bicarbonate, carbonate, calcium, and magnesium are desirable at all the groundwater samples. TDS is desirable in groundwater samples -Dhnderi School (214 mg/l), Daple (118 mg/l), Sainipura (171 mg/l), Bhidfarm (450 mg/l), Sisai (270 mg/l), bhatla (308 mg/l), Chanak (175 mg/l), Masoodpur (149 mg/l), Dhata (209 mg/l), Sindhar (146 mg/l), Rajli (268 mg/l), Sulakhni (153 mg/l), permissibe in Dhani Qutub (1165 mg/l), Lalpura (1360 mg/l), Majood Temple (1525 mg/l), Ghiraye (1075 mg/l) and non-potable in Civil Hospital (2640 mg/l), Khanpur (2295 mg/l). Zinc is non-potable in groundwater samples at Dhnderi School (64.82 mg/l), Daple (62.43mg/l), Dhani Qutub (60.71 mg/l), Civil Hospital (58.23 mg/l), Lalpura (57.09 mg/l), Sainipura (55.62 mg/l), Bhidfarm (53.67 mg/l), Sisai (49.53 mg/l), Bhatla (45.70 mg/l), Chanak (38.94 mg/l), Majood Temple (35.49 mg/l), Masoodpur (29.27 mg/l), Dhata (24.68 mg/l), Khanpur (20.68 mg/l), Sindhar (15.81 mg/l), permissible in Rajli (11.74 mg/l), Ghiraye (7.84 mg/l) and desirable in Sulakhni (4.96 mg/l) groundwater sample.Iron is desirable in groundwater samples in Masoodpur (0.29 mg/l), Dhata (0.20 mg/l), Khanpur (0.14 mg/l), Sindhar (0.20 mg/l), Rajli (0.20 mg/l), Ghiraye (0.07 mg/l), Sulakhni (0.07 mg/l) and non-poyable in groundwater samples in Dhnderi School (0.92 mg/l), Daple (0.89 mg/l), Dhani Qutub (0.71 mg/l), Civil Hospital (0.77 mg/l), Lalpura (0.72 mg/l), Sainipura (0.72 mg/l), Bhidfarm (0.64 mg/l), Sisai (0.71 mg/l), Bhatla (0.53 mg/l), Chanak (0.33 mg/l) and Majood Temple (0.36 mg/l). Potassium is desirable in all groundwater samples except Civil Hospital (18.4 mg/l), Lalpura (14.6 mg/l), Majood Temple (65 mg/l), Khanpur (19.3 mg/l), Sulakhni (14.1 mg/l) groundwater samples in which potassium is non-potable. The study is highly useful for planning of groundwater quality for drining purpose in the study area.

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