ASSESSMENT OF GROUNDWATER QUALITY FOR DRINKING PURPOSE IN ADAMPUR BLOCK, HISAR DISTRICT, HARYANA

Anup Kumar[1]* and Khush Lata[2]

[1]*Haryana Space Applications Centre (HARSAC), CCS HAU Campus, Hisar
[2]HARSAC and GJU S&T, Hisar

Abstract

In arid to semi-arid regions of the world groundwater is the only source for domestic, irrigation and industrial utilisation. In south-western part of Haryana groundwater is the main source for drinking purpose. In the present study groundwater quality has been assessed for drinking purpose in Adampur block in Hisar district of Haryana. In the study area 23 groundwater samples were collected from different locations. Groundwater samples were analysed for chemical parameters of groundwater quality. BIS 10500:2012 drinking water standards were used to assess the suitability of groundwater for drinking purpose. In the study area pH of groundwater samples ranges 6.84 to 8.5 which is desirable, TDS ranges 130 mg/l - 4119 mg/l and desirable at Siswal (130 mg/l), Chuli Kalan (160 mg/l), Mahalsara (260 mg/l), Kabrel (485 mg/l), permissible at Daroli (1440 mg/l), Modakheda (1895 mg/l), Bhodia Kheda (1290 mg/l), Kalirawan (1477 mg/l), Asrawan (1416 mg/l), Adampur Town 3 (1495 mg/l) and non-potable at Near Daroli Minor (3035 mg/l), Dhani Mohbattpur (4445 mg/l), Adampur Town 1 (2019 mg/l), Sadalpur (3539 mg/l), Chibarwal (3773 mg/l), Khairmpur (4082 mg/l), Mothsra (2017 mg/l), Ladwi (4119 mg/l), Kohli (3880 mg/l), Adampur Town 2 (2850 mg/l), Ghudsal (2004 mg/l), Bagla (2019 mg/l). In the study area calcium ranges 2.47 mg/l - 57 mg/l which is desriable in all the groundwater samples. Magnesium ranges 1.2 mg/l - 26.6 mg/l and desirable in all the groundwater samples. Sodium ranges 8.9 mg/l - 80 mg/l and desirable in all the groundwater samples except permssible in groundwater samples at Near Daroli Minor (51.50 mg/l), Dhani Mohbattpur (61.60 mg/l), Chibarwal (74.60 mg/l), Khairmpur (67.60 mg/l), Ladwi (80 mg/l), Kohli (55.90 mg/l). Potassium ranges 2 mg/l - 14.3 mg/l and desiarble in all the groundwater samples except Bhodia Kheda (14.30 mg/l), Adampur Town 3 (13.5 mg/l), Bagla (12.90 mg/l) in which it is non-potabe. Carbonate ranges nil to 0.2 mg/l. In the study area carbonate is desirable in all the groundwater samples. Bicarbonate ranges 15 mg/l - 140 mg/l and desirable in all the groundwater samples. Chloride ranges 1.5 mg/l - 88 mg/l which is desirable in all the groundwater samples. Zinc ranges 0.002 mg/l - 0.33 mg/l and desirable in all the groundwater samples. Iron ranges nil to 0.007 mg/l and desirable in all the groundwater samples.The study is highly useful for planning groundwater for drinking purposes in the study area.

INTRODUCTION

Water is a vital natural resource in the world that is required by all living creatures. On the Earth;s surface 71 % is water, of which only 3% of total water is fresh while 97 % is salt water. It makes around 75% of the human body and any shortfall in this amount can be dangerous. Poor water quality can contribute to health problems. Good quality water is beneficial for health and reduce chances of health issues. In arid to semi-arid regions of the world groundwater is the main source for drinking purpose. Assessment of groundwater quality in different types of areas were done by many workers (Malini et al. (2003), Gupta et al. (2009), Kumar and Kumar (2011), Kundu (2012), Sarala and Babu (2012), Goyal (2013), Singha et al. (2015), Asheberom et al. (2016), Bali. and

Sharma (2016), Dwivedi and Tripathi (2016), Sarita and Rani (2016), Singh et al. (2018), Shamna and Ullas (2020)).
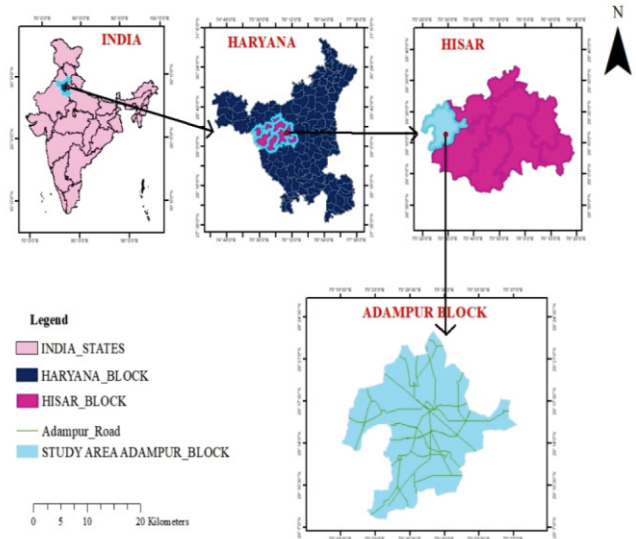
STUDY AREA

Adampur is a town situated in Hisar district in Haryana. Adampur town is situated at 29.2832°N - 75.43°E. Total geographical area of Adampur block is 367 km^2. As per Census 2011, population of the Adampur block was 1,46,542. Geomorphologically the study area falls under Indo-Gangetic plain. The entire study area is a nearly flat alluvial plain with minor sand dunes. Climate in the study area is characterized by high temperature and average rainfall.

OBJECTIVE

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

METHODOLOGY

In the study area 23 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), calcium (Ca), magnesium (Mg), potassium (K), sodium, zinc (Zn) and iron (Fe) (Table 1). BIS 10500:2012 drinking water standards were used to determine

Fig. 1: Location map of the study area.

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 in the study.

S. No.	Sample Location	Latitude	Longitude	Source	pH	TDS (mg/l)	Na (mg/l)	K (mg/l)	Mg (mg/l)	Ca (mg/l)	CO$_3$ (mg/l)	HCO$_3$ (mg/l)	Cl (mg/l)	Zinc (mg/l)	Iron (mg/l)
1	Siswal	29°13'5.86"N	75°28'50.48"E	Hand pump	8.50	130	34.90	5.00	1.20	2.47	0.10	15	2.00	0.045	0.001
2	Daroli	29°16'29.55"N	75°24'2.34"E	Hand pump	7.40	1440	28.20	2.40	9.33	18.67	0.00	15	2.20	0.010	0.000
3	Chulikalan	29°15'43.33"N	75°22'1.59"E	Tube well	8.10	160	15.80	5.90	1.28	2.50	0.20	25	1.50	0.002	0.000
4	Near Daroli Minor	29°15'19.49"N	75°27'9.78"E	Tube well	7.10	3035	51.50	2.50	16.60	33.40	0.00	40	48.00	0.011	0.000
5	Dhani Mohbattpur	29°13'12.27"N	75°26'43.05"E	Hand pump	7.04	4445	61.60	8.30	26.60	53.40	0.00	100	76.00	0.330	0.007
6	Modakheda	29°12'59.14"N	75°25'29.30"E	Hand pump	7.29	1895	18.00	10.40	12.00	24.00	0.00	20	36.00	0.014	0.000
7	Adampur Town 1	29°16'20.06"N	75°27'57.99"E	Tube well	7.20	2019	32.50	2.00	14.00	28.00	0.00	40	16.00	0.006	0.000
8	Sadalpur	29°18'45.72"N	75°26'58.99"E	Tube well	7.05	3539	48.40	2.30	21.30	43.00	0.00	40	46.00	0.027	0.000
9	Chibarwal	29°21'4.67"N	75°25'57.14"E	Tube well	7.13	3773	74.60	2.40	17.00	34.70	0.00	100	64.00	0.036	0.000
10	Bhodia Kheda	29°21'59.46"N	75°29'20.09"E	Tube well	7.20	1290	20.00	14.30	12.00	25.00	0.10	60	16.00	0.046	0.002
11	Khairmpur	29°19'11.28"N	75°31'23.94"E	Tube well	6.90	4082	67.60	6.00	26.00	57.00	0.00	60	88.00	0.024	0.000
12	Kalirawan	29°16'33.12"N	75°32'51.92"E	Tube well	7.23	1477	27.80	2.40	17.00	34.00	0.00	70	32.00	0.093	0.002
13	Asrawan	29°16'21.43"N	75°36'0.08"E	Tube well	7.38	1416	39.40	4.70	10.00	20.00	0.00	60	12.00	0.032	0.000
14	Mothsra	29°15'35.71"N	75°34'12.18"E	Tube well	7.40	2017	38.90	2.70	14.00	28.00	0.00	40	16.00	0.041	0.000
15	Ladwi	29°13'44.76"N	75°33'2.18"E	Tube well	7.23	4119	80.00	3.30	16.60	34.00	0.00	100	30.00	0.095	0.005
16	Mahalsara	29°15'33.90"N	75°32'45.64"E	Tube well	7.67	260	29.10	5.40	3.58	7.20	0.10	30	2.50	0.022	0.000
17	Kohli	29°16'57.07"N	75°31'4.22"E	Tube well	6.93	3880	55.90	2.00	20.10	40.00	0.00	40	60.00	0.053	0.002
18	Adampur Town 2	29°16'52.83"N	75°29'0.39"E	Tube well	7.05	2850	38.90	2.40	20.00	40.00	0.00	60	5.00	0.017	0.000
19	Khara Barwala	29°17'48.08"N	75°27'2.51"E	Tube well	6.84	900	8.90	8.00	6.80	14.70	0.00	90	9.00	0.048	0.000
20	Adampur Town 3	29°16'59.00"N	75°27'58.94"E	Tube well	7.23	1495	23.30	13.50	9.16	18.30	0.00	60	24.00	0.032	0.000
21	Ghudsal	29°10'15.79"N	75°25'36.06"E	Tube well	7.06	2004	24.70	2.80	13.30	27.00	0.00	40	34.00	0.019	0.000
22	Bagla	29°10'53.28"N	75°30'39.86"E	Tube well	8.05	2019	40.50	12.90	3.00	7.00	0.20	140	12.00	0.006	0.000
23	Kabrel	29°11'20.34"N	75°28'47.58"E	Tube well	7.80	485	36.70	7.50	5.80	11.24	0.10	50	5.50	0.008	0.000

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 mg/l	500-2000 mg/l	>2000 mg/l
3	Calcium (Ca)	<75 mg/l	75-200 mg/l	>200 mg/l
4	Magnesium (Mg)	<30 mg/l	30-100 mg/l	-
5	Bicarbonate (HCO3)	<500 mg/l	-	>500 mg/l
6	Sodium (Na)	<50 mg/l	50-200 mg/l	>200 mg/l
7	Potassium (K)	<12 mg/l	-	-
8	Iron (Fe)	<0.3 mg/l	No relaxation	>0.3 mg/l
9	Zinc (Zn)	<5 mg/l	5-15 mg/l	>15 mg/l
10	Chloride (Cl)	<250 mg/l	250-1000 mg/l	>1000 mg/l

RESULTS AND DISCUSSION

i. pH

The pH range of groundwater samples lies between 6.84 to 8.5. 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. The highest pH was observed at Siswal (8.5) while lowest pH was observed at Khara Barwala (6.84).
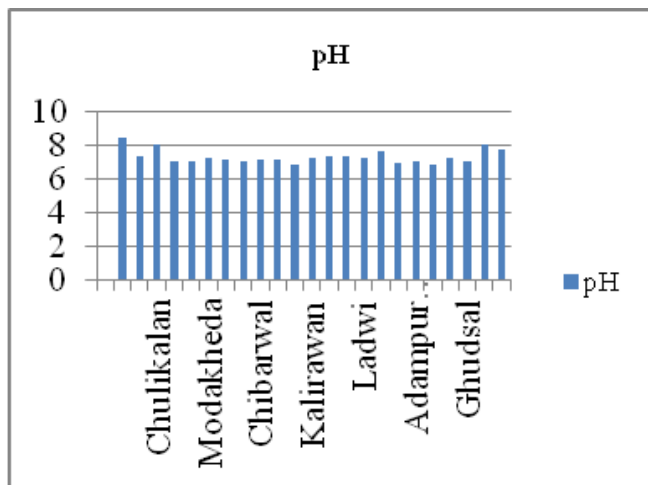
Fig. 2: Scenario of pH in groundwater samples in the study area.

ii. Total Dissolved Solids (TDS)

In the study area TDS ranges 130 mg/l - 4119 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 at Siswal (130 mg/l), Chuli Kalan (160 mg/l), Mahalsara (260 mg/l), Kabrel (485 mg/l), permissible at Daroli (1440 mg/l), Modakheda (1895 mg/l), Bhodia Kheda (1290 mg/l), Kalirawan (1477 mg/l), Asrawan (1416 mg/l), Adampur Town 3 (1495 mg/l) and non-potable at Near Daroli Minor (3035 mg/l), Dhani Mohbattpur (4445 mg/l), Adampur Town 1 (2019 mg/l), Sadalpur (3539 mg/l), Chibarwal (3773 mg/l), Khairmpur (4082 mg/l), Mothsra (2017 mg/l), Ladwi (4119 mg/l), Kohli (3880 mg/l), Adampur Town 2 (2850 mg/l), Ghudsal (2004 mg/l), Bagla (2019 mg/l).
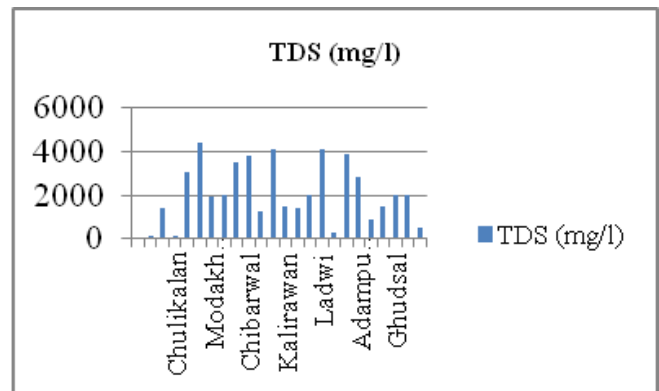
Fig.3:Scenario of TDS in groundwater samples in the study area.

iii. Calcium (Ca)

In the study area calcium ranges 2.47 mg/l - 57 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. In the study area calcium is desirable in all the groundwater samples.
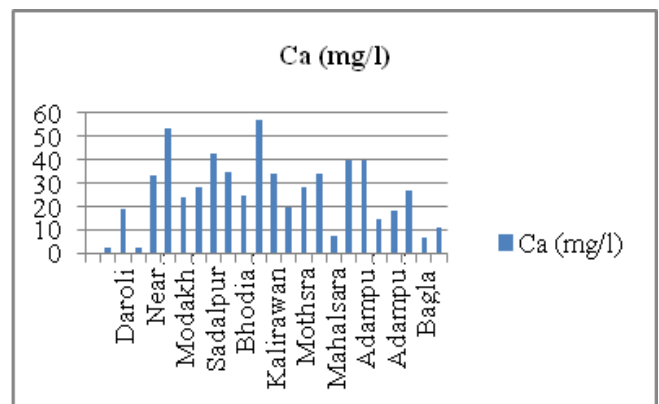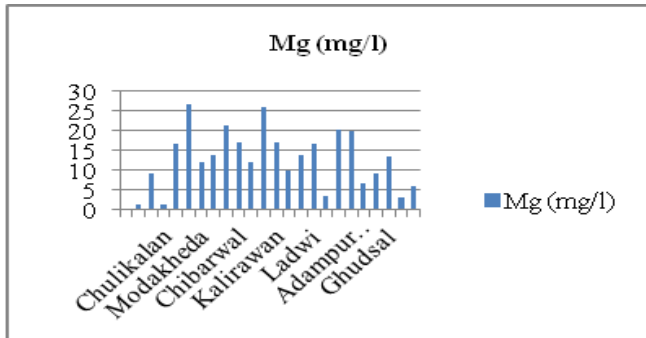
Fig. 4: Scenario of calcium (Ca) in groundwater samples in the study area.

iv. Magnesium (Mg)

In the study area magnesium ranges 1.2 mg/l - 26.6 mg/l. As per BIS 10500:2012 drinking water standards magnesium is
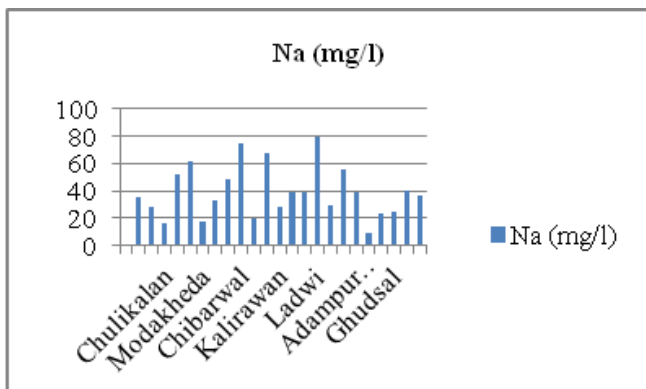
desirable if less than 30 mg/l, permissible 30 mg/l - 100 mg/l and non-potable if more than 100 mg/l. In the study area magnesium is desirable in all the groundwater samples.

Fig. 5: Scenario of magnesium (Mg) in groundwater samples in the study area.

v. Sodium (Na)
In the study area sodium ranges 8.9 mg/l -80 mg/l. As per BIS 10500:2012 drinking water standards sodium is desirable if less than 50 mg/l, permissible 50 mg/l - 200 mg/l and non-potable if more than 200 mg/l. In the study area sodium is desirable in all the groundwater samples except permssible in groundwater samples at Near Daroli Minor (51.50 mg/l), Dhani Mohbattpur (61.60 mg/l), Chibarwal (74.60 mg/l), Khairmpur (67.60 mg/l), Ladwi (80 mg/l), Kohli (55.90 mg/l).
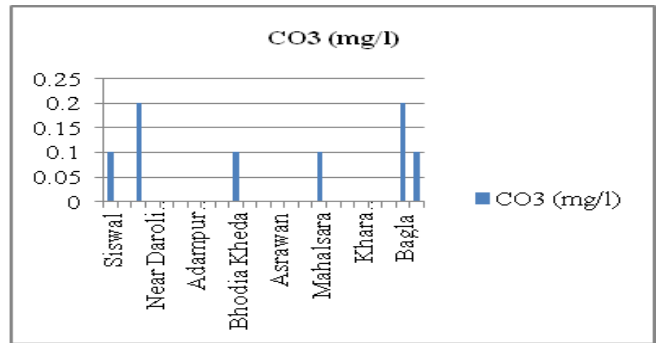

Fig. 6: Scenario of sodium (Na) in groundwater samples in the study area.

vi. Potassium (K)
In the study area potassium ranges 2 mg/l - 14.3 mg/l. As per BIS 10500:2012 drinking water standards sodium 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 the groundwater samples except Bhodia Kheda (14.30 mg/l), Adampur Town 3 (13.5 mg/l), Bagla (12.90 mg/l) in which it is non-potable.
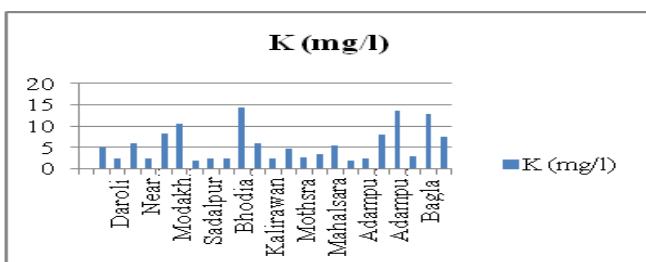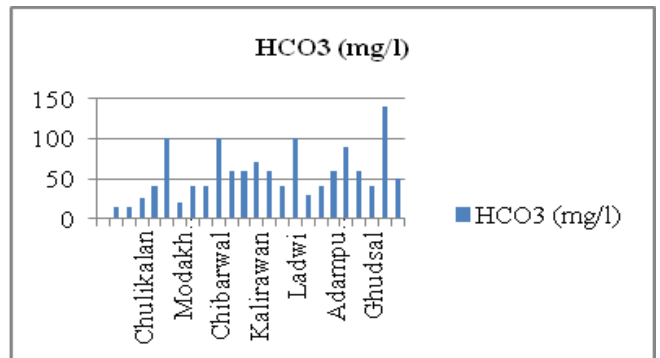

Fig. 7: Scenario of Potassium (K) in groundwater samples in the study area .

Fig. 8: Scenario of Carbonate (CO$_3$) in groundwater samples in the study area.

vii. Carbonate (CO$_3$)
In the study area carbonate ranges nil to 0.2 mg/l. In the study area carbonate is desirable in all the groundwater samples.

Fig.9: Scenario of bicarbonate (HCO$_3$) in groundwater samples in the study area.
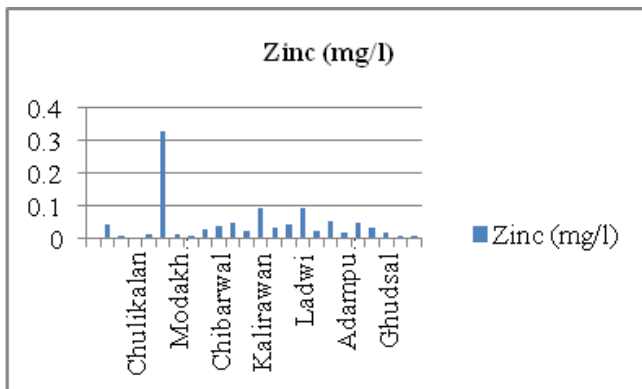
viii. Bicarbonate (HCO$_3$)
In the study area bicarbonate ranges 15 mg/l - 140 mg/l. As per BIS 10500:2012 drinking water standards bicarbonate is desirable if less than 500 mg/l and non-potable if more than 500 mg/l. In the study area bicarbonate is desirable in all the groundwater samples.
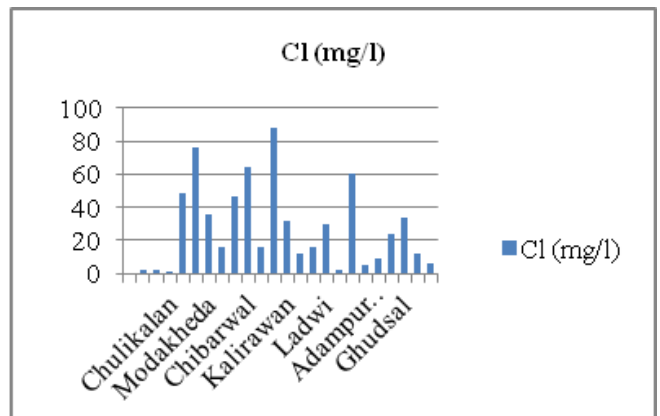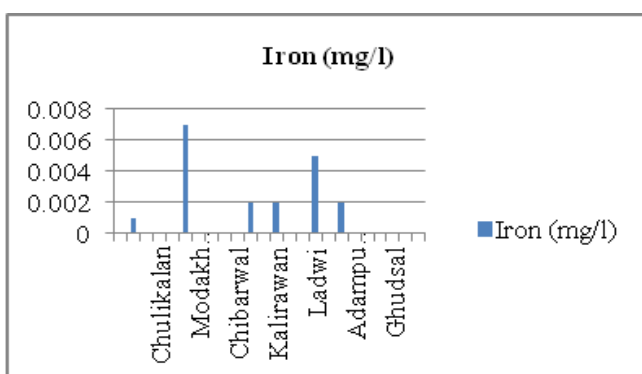

Fig.10: Scenario of Chloride (Cl) in groundwater samples in the study area.

x. Zinc (Zn)
In the study area zinc ranges 0.002 mg/l - 0.33 mg/l. As per BIS 10500:2012 drinking water standards zinc is desirable if 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 the groundwater samples.

Fig.11: Scenario of Zinc (Zn) in groundwater samples in the study area .

Fig. 12: Scenario of Iron (Fe) in groundwater samples in the study area.

xi. Iron (Fe)

In the study area iron ranges nil to 0.007 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.

CONCLUSIONS

In the study area pH, calcium, magnesium, carbonate, bicarbonate, chloride, zinc, iron are desirable in all the groundwater samples, TDS is desirable at Siswal (130 mg/l), Chuli Kalan (160 mg/l), Mahalsara (260 mg/l), Kabrel (485 mg/l), permissible at Daroli (1440 mg/l), Modakheda (1895 mg/l), Bhodia Kheda (1290 mg/l), Kalirawan (1477 mg/l), Asrawan (1416 mg/l), Adampur Town 3 (1495 mg/l) and non-potable at Near Daroli Minor (3035 mg/l), Dhani Mohbattpur (4445 mg/l), Adampur Town 1 (2019 mg/l), Sadalpur (3539 mg/l), Chibarwal (3773 mg/l), Khairmpur (4082 mg/l), Mothsra (2017 mg/l), Ladwi (4119 mg/l), Kohli (3880 mg/l), Adampur Town 2 (2850 mg/l), Ghudsal (2004 mg/l), Bagla (2019 mg/l), sodium is desirable in all the groundwater samples except permssible in groundwater samples at Near Daroli Minor (51.50 mg/l), Dhani Mohbattpur (61.60 mg/l), Chibarwal (74.60 mg/l), Khairmpur (67.60 mg/l), Ladwi (80 mg/l), Kohli (55.90 mg/l), potassium is desiarble in all the groundwater samples except Bhodia Kheda (14.30 mg/l), Adampur Town 3 (13.5 mg/l), Bagla (12.90 mg/l) in which it is non-potable. The study is highly useful for planning of groundwater for drinking purpose in the area.

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