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GROUNDWATER QUALITY ASSESSMENT FOR DRINKING PURPOSE IN GOHANA BLOCK OF SONIPAT DISTRICT, HARYANA

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Abstract
Water is necessary for drinking, irrigation and industrial purposes. Increasing population, urbanisation, industrialisation and agricultural practices put pressure on the availability and quality of water. The present study area Gohana block is located in Sonipat district of Haryana state. The geo-coordinates of the study area are latitudes 28.95^0 N to 29.18^0 N and longitudes 76.65^{0}E to 76.87^0 E and covers an area of 315.44 sq. km. Geologically alluvium and geomorphologically alluvial plain are present in the study area. The main objective was to assess groundwater quality for drinking purpose in the study area. In the study area fourteen groundwater samples were collected in 250 ml double capped plastic bottles. Geo-coordinates of sample locations were noted with the help of mobile GPS. Chemical analysis of fourteen groundwater samples were done using Tamilnadu Water Supply and Drainage (TWAD) Board,Chennai prepared Field Water Testing kit for twelve chemical parameters viz. pH, alkalinity, hardness, chloride, total dissolved solids (TDS), fluoride, iron, nitrite, nitrate, ammonia, phosphate and residual chlorine. Results of groundwater samples analysis were compared with BIS drinking water standards (IS 10500:2012) to know groundwater quality for drinking purpose. In the study area pH ranges 6.5 to 8, alkalinity 80 mg/l to 530 mg/l, hardness 130 mg/l to 1650 mg/l, chloride 20 mg/l to1500 mg/l, TDS 312 mg/l to 3768 mg/l, fluoride nil to 5 mg/l, iron nil to 3 mg/l, ammonia nil to 1 mg/l, nitrite 0.5 mg/l to 2 mg/l, nitrate 45 mg/l to 100 mg/l, phosphate nil to 1 mg/l and residual chlorine ranges nil to 0.2 mg/l.The study is highly useful for planning and monitoring of groundwater quality for drinking purpose in the study area.

Keywords
Groundwater, quality, drinking, assessment, Gohana, Sonipat, Haryana.

1. INTRODUCTION

On the Earth water is available in plenty but the useable especially drinking purpse is very less. Further increasing population, irrigation practices and industrial uses put pressure on the available fresh water. In urban areas surface and groundwater availability is decreasing day by day.Good quality water reduces health issues like fluorosis. Shekhar and Sarkar (2013), Spanos et al. (2014),Vijaya Lalitha et al.(2016), Asadi and Kumar (2017), Kaur et al. (2017), Khan and Jhariya (2017), Nourbakhsh and Yousef (2017), Zidi et al. (2017), Khelif and Boudoukha (2018) had done work on assessment of groundwater quality for drinking purpose in different areas.

2. STUDY AREA

Gohana block is located in Sonipat district between the latitudes 28.95^0 N to 29.18^0 N and longitudes 76.65^0 E to 76.87^0 E (Fig.1). The study area covers an area of 315.44 sq. km. Geologically alluvium and geomorphologically alluvial plain are present in the study area.

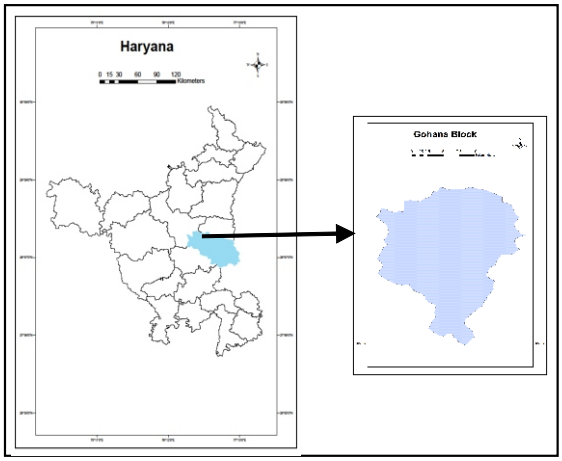

Figure1: Location map of the study area.

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3. OBJECTIVE

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

4. MATERIALS AND METHODOLOGY

In the study area fourteen groundwater samples were collected in 250 ml double capped plastic bottles. Geo-coordinates of sample locations were noted with the help of mobile GPS. Chemical analysis of fourteen groundwater samples were done using Tamilnadu Water Supply and Drainage (TWAD) Board, Chennai prepared Field Water Testing kit for twelve chemical parameters viz. pH, alkalinity, hardness, chloride, total dissolved solids (TDS), fluoride, iron, nitrite, nitrate, ammonia, phosphate and residual chlorine (Table 1). Results of groundwater samples analysis were compared with BIS drinking water standards (IS 10500:2012) (Table 2) to know suitability of groundwater quality for drinking purpose.

Table 1: Results of groundwater samples analysis.

S. No.	Sample Location	Latitude	Longitude	pH	Alkalinity	Hardness (mg/l)	Chloride (mg/l)	TDS (mg/l)	Fluoride (mg/l)	Iron (mg/l)	Ammonia (mg/l)	Nitrite (mg/l)	Nitrate (mg/l)	Phosphate (mg/l)	Residual Chlorine (mg/l)(mg/l)
1	Puthi	29.07	76.69	7.5	250	400	250	1080	5	0	1	0.5	100	0	0.2
2	Chatia	29.08	76.88	8	290	160	50	600	5	0	0.5	1	100	0	0.2
3	Bhutana	29.19	76.62	7.5	450	450	200	1320	5	0	1	1	100	0	0
4	Lath	29.08	76.78	7	290	1650	1200	3768	1.5	0	1	0.5	75	0	0
5	Barota	29.12	76.74	7.5	220	450	100	924	1.5	0	0.5	0.5	100	1	0
6	Kheri	29.11	76.76	7	170	250	120	648	1.5	0	0.5	1	75	0.5	0
7	Bidhal-1	29.07	76.81	7.5	390	970	800	2592	5	3	0.5	0.5	75	0.5	0
8	Jhauli	29.09	76.80	7.5	200	220	150	684	2	0	0	0.5	75	0	0
9	Gamri	29.17	76.76	7.5	420	680	1500	3120	2	0	1	0.5	75	0	0
10	Baswan Khurd	29.09	76.68	7	270	300	20	708	0	0.3	1	2	45	0	0.2
11	Mahra	29.09	76.69	7.5	370	800	50	1464	1	0	1	0.5	100	0	0
12	Kailana Khas	29.17	76.76	7.5	300	270	30	756	5	0	0.5	0.5	75	0	0.2
13	Bidhal-2	29.07	76.80	7.5	530	150	60	888	3	0	0.5	1	100	0	0
14	Gohana	29.13	76.69	6.5	80	130	50	312	0.5	0	1	0.5	45	0	0

Table 2: BIS drinking water standards (IS 10500:2012).

S. No.	Characteristics	Potable		
		Desirable	Permissible	Non-Potable
1	pH	6.5 to 8.5	-	<6.5 and >8.5
2	Alkalinity (mg/l)	<200	200-600	>600
3	Total Hardness (mg/l)	<200	200-600	>600
4	Chloride (mg/l)	<250	250-1000	>1000
5	Total Dissolved Solids (TDS) (mg/l)	<500	500-2000	>2000
6	Fluoride (mg/l)	<1.0	1.0-1.5	>1.5
7	Iron (mg/l)	<0.3	-	>0.3
8	Ammonia (mg/l)	<0.5	-	>0.5
9	Nitrite (mg/l)	<1.0	-	>1.0
10	Nitrate (mg/l)	<45	-	>45
11	Phosphate (mg/l)	<1.0	-	>1.0
12	Residual Chlorine (mg/l)	<0.2	0.2-1.0	>1.0

5. RESULTS AND DISCUSSION

5.1 pH

In the study area pH ranges 6.5 to 8 (Table1, Fig.2). As per BIS (IS 10500:2012) drinking water standards pH is desirable between 6.5 to 8.5 and non-potable if less than 6.5 and more than 8.5 (Table 2). pH is desirable in all the fourteen groundwater samples (Puthi,Chatia, Bhutana, Lath, Barota, Kheri, Bidhal-1. Jhauli, Gamri, Baswan Khurd, Mahra, Kailana Khas, Bidhal-2, Gohana).

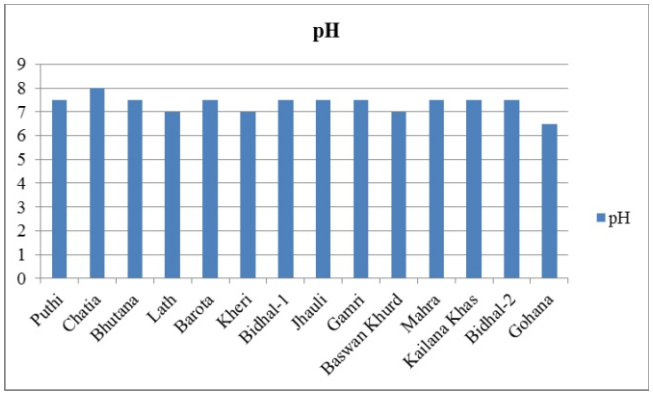

Figure 2: pH in groundwater samples.

5.2 ORIGIN AND DISTRIBUTION

In India, forested areas have long been set aside and preserved due to the religious convictions of the local communities. This practice dates back many centuries. Indian society is made up of several cultures, each of which has its customs for protecting the environment and the animals that live there. India is full of sacred trees, particularly in the areas inhabited by native populations. India's first Inspector General of Forests, Brandis, admitted that sacred forests existed (Brandis, 1897). The sacred groves have a historical.

5.3 Alkalinity

In the study area alkalinity ranges 80 mg/l to 530 mg/l (Table1, Fig.3). As per BIS (IS 10500:2012) drinking water standards alkalinity is desirable if less than 200 mg/l, permissible between 200 mg/l-600 mg/l and non-potable if more than 600 mg/l (Table 2). Alkalinity is desirable in one groundwater sample (Gohana) and permissible in thirteen groundwater samples (Puthi, Chatia, Bhutana, Lath, Barota, Kheri, Bidhal-1, Jauli, Gamri, Baswan Khurd, Mahra, Kailana Khas, Bidhal-2).

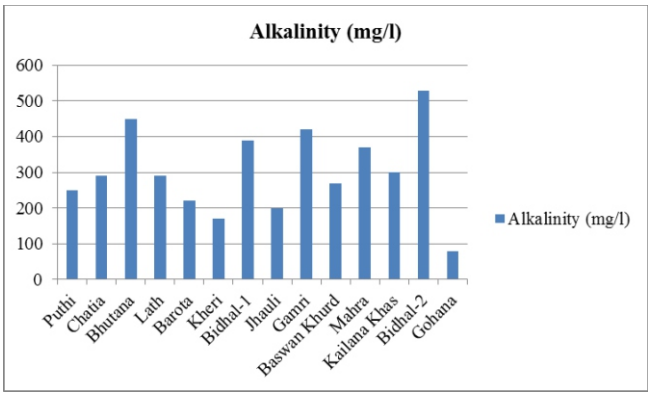

Figure 3: Alkalinity in groundwater samples.

5.4 Hardness

In the study area hardness ranges 130 mg/l to 1650 mg/l (Table1, Fig.4). As per BIS (IS 10500:2012) drinking water standards hardness is desirable if less than 200 mg/l, permissible between 200 mg/l - 600 mg/l and non-potable if more than 600 mg/l (Table 2). Hardness is desirable in three groundwater samples (Chatia,Bidhal-2,Gohana), permissible in seven groundwater samples (Puthi, Bhutana, Barota, Kheri, Jhauli, Baswan Khurd, Kailana Khas) and non-potable in four groundwater samples (Lath, Bidhal-1, Gamri, Mahra).

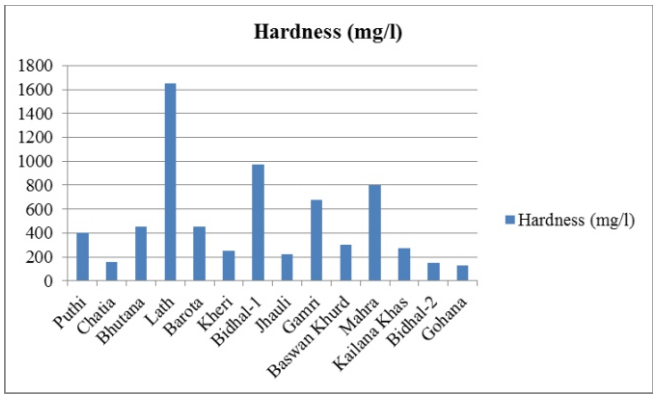

Figure 4 : Hardness in groundwater samples.

5.5 Chloride

In the study area chloride ranges 20 mg/l to 1500 mg/l (Table1, Fig.5). As per BIS (IS 10500:2012) drinking water standards chloride is desirable if less than 250 mg/l, permissible between 250 mg/l - 1000 mg/l and non-potable if more than 1000 mg/l (Table 2). Chloride is desirable in ten groundwater samples (Chatia, Bhutana, Barota, Kheri, Jhauli, Baswan Khurd, Mahra, Kailana Khas, Bidhal-2, Gohana), permissible in two groundwater samples (Puthi, Bidhal-1) and non-potable in two groundwater samples (Lath.Gamri).

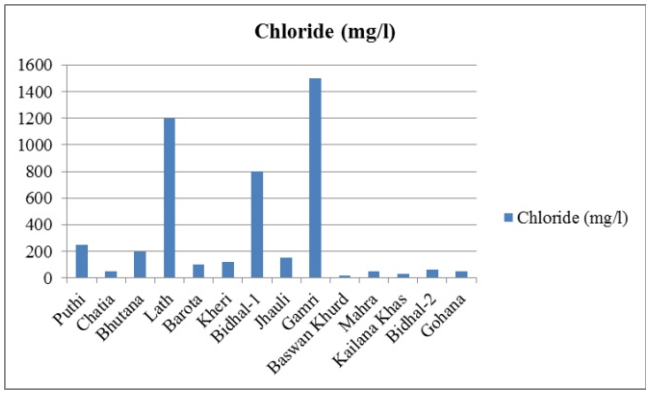

Figure 5: Chloride in groundwater samples.

5.6 Total Dissolved Solids (TDS)

In the study area TDS ranges 312 mg/l to 3768 mg/l (Table1, Fig.6). As per BIS (IS 10500:2012) drinking water standards TDS is desirable if less than 500 mg/l, permissible between 500 mg/l -2000 mg/l and non-potable if more than 2000 mg/l (Table 2). TDS is desirable in one groundwater sample (Gohana), permissible in ten groundwater samples (Puthi, Chatia, Bhutana, Barota, Kheri, Jhauli, Baswan Khurd, Mahra, Kailana Khas, Bidhal-2) and non-potable in two groundwater samples (Lath, Gamri).

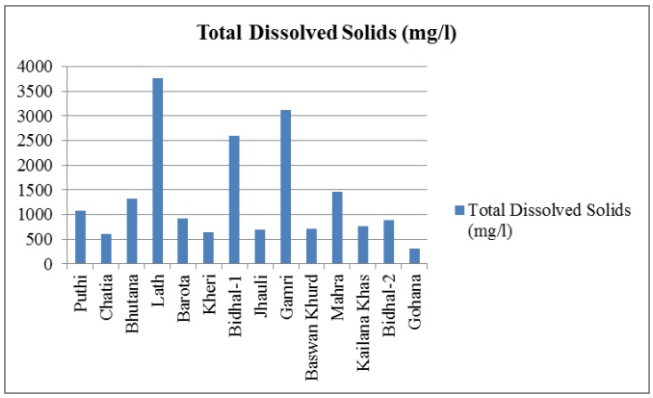

Figure 6: TDS in groundwater samples.

5.7 Fluoride

In the study area fluoride ranges nil to 5 mg/l (Table1, Fig.7). As per BIS (IS 10500:2012) drinking water standards fluoride is desirable if less than 1.0 mg/l, permissible between 1.0 mg/l -1.5 mg/l and non-potable if more than 1.5 mg/l (Table 2). Fluoride is desirable in two groundwater samples (Baswan Khurd, Gohana), permissible in four groundwater samples (Lath, Barota, Kheri, Mahra) and non-potable in eight groundwater samples (Puthi, Chatia, Bhutana, Bidhal-1, Jhauli, Gamri, Kailana Khas, Bidhal-2).

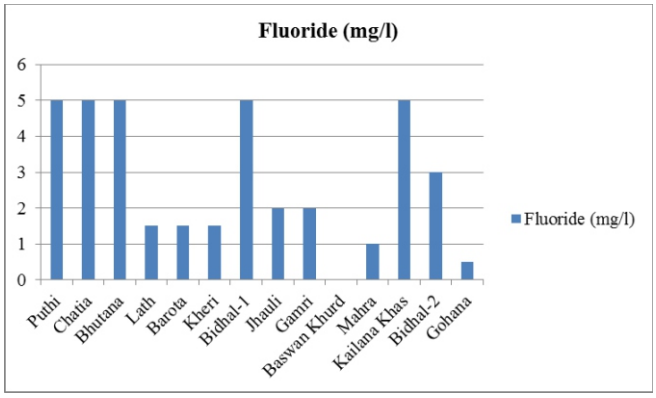

Figure 7:Fluoride in groundwater samples.

5.8 Iron

In the study area iron ranges nil to 3 mg/l (Table1, Fig.8). As per BIS (IS 10500:2012) drinking water standards iron is desirable if less than 0.3mg/l and non-potable if more than 0.3 mg/l (Table 2). Iron is desirable in thirteen groundwater samples (Puthi, Chatia, Bhutana, Lath, Barota, Kheri, Jhauli, Baswan Khurd, Mahra, Kailana Khas, Bidhal-2, Gohana) and non-potable in one groundwater sample (Bidhal-1).

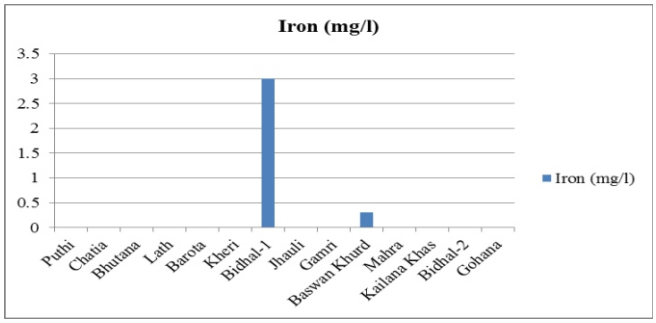

Figure 8:Iron in groundwater samples.

5.9 Ammonia

In the study area ammonia ranges nil to 1 mg/l (Table1, Fig.9). As per BIS (IS 10500:2012) drinking water standards ammonia is desirable if less than 0.5 mg/l and non-potable if more than 0.5 mg/l (Table 2). Ammonia is desirable in seven groundwater samples (Chatia, Barota, Kheri, Bidhal-1, Jhauli, Kailana Khas, Bidhal-2) and non-potable in seven groundwater samples (Puthi, Bhutana, Lath, Gamri, Baswan Khurd, Mahra, Gohana).

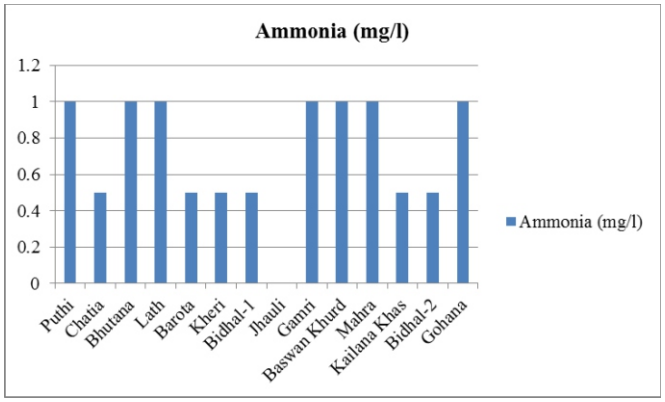

Figure 9:Ammonia in groundwater samples.

5.10 Nitrite

In the study area nitrite ranges 0.5 mg/l to 2 mg/l (Table1, Fig.10). As per BIS (IS 10500:2012) drinking water standards nitrite is desirable if less than 1.0 mg/l and non-potable if more than 1.0 mg/l (Table 2). Nitrite is desirable in thirteen groundwater samples (Puthi, Chatia, Bhutana, Lath, Barota, Kheri, Bidhal-1, Jhauli, Gamri, Mahra, Kailana Khas, Bidhal-2, Gohana) and non-potable in one groundwater sample (Baswan Khurd).

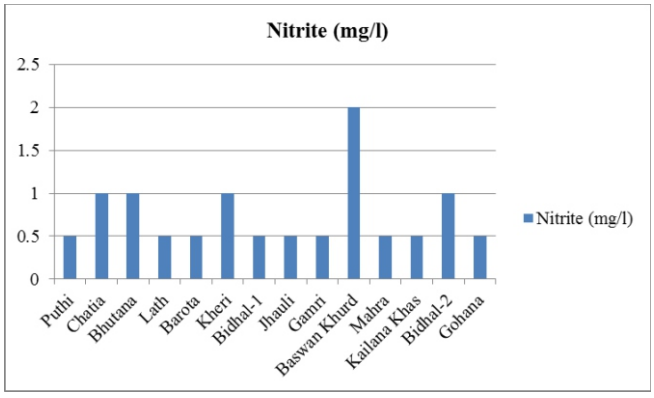

Figure 10:Nitrite in groundwater samples.

5.11 Nitrate

In the study area nitrate ranges 45 mg/l to 100 mg/l (Table1, Fig.11). As per BIS (IS 10500:2012) drinking water standards nitrate is desirable if less than 45 mg/l and non-potable if more than 45mg/l (Table 2). Nitrate is desirable in two groundwater samples (Baswan Khurd, Gohana) and non-potable in twelve groundwater samples (Puthi,Chatia, Bhutana, Lath, Barota, Kheri, Bidhal-1, Jhauli, Gamri, Mahra, Kailana Khas, Bidhal-2).

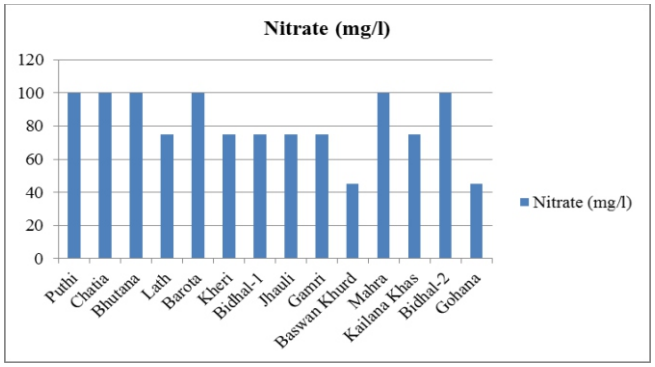

Figure 11: Nitrate in groundwater samples.

5.12 Phosphate

In the study area phosphate ranges nil to 1 mg/l (Table1, Fig.12). As per BIS (IS 10500:2012) drinking standards phosphate is desirable if less than 1.0 mg/l and non-potable if more than 1.0 mg/l (Table 2). Phosphate is desirable in all fourteen groundwater samples (Puthi,Chatia, Bhutana, Lath, Barota, Kheri, Bidhal-1, Jhauli,Gamri, Baswan Khurd, Mahra, Kailana Khas, Bidhal-2, Gohana).

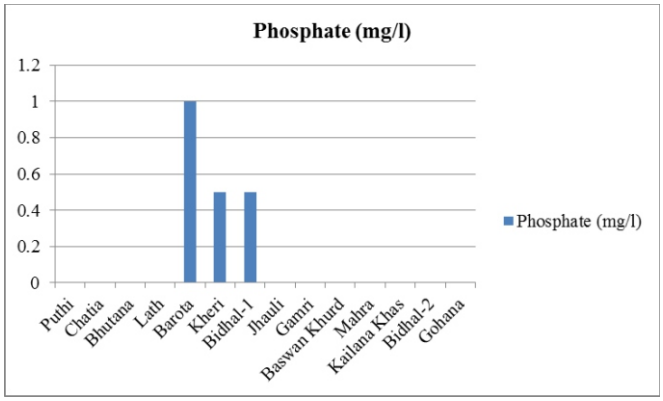

Figure 12: Phosphate in groundwater samples.

5.13 Residual Chlorine

In the study area residual chlorine ranges nil to 0.2 mg/l (Table1, Fig.13). As per BIS (IS 10500:2012) drinking water standards residual chlorine is desirable if less than 0.2 mg/l, permissible between 0.2 mg/l-1 mg/l and non-potable if more than 1.0 mg/l (Table 2). Residual Chlorine is desirable in ten groundwater samples (Bhutana, Lath, Barota, Kheri, Bidhal-1, Jhauli, Gamri, Mahra, Bidhal-2, Gohana) and permissible in four groundwater samples (Puthi,Chatia, Baswan Khurd, Kailana Khas).

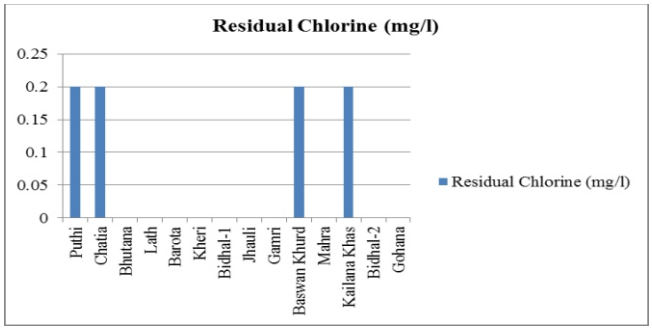

Figure 13: Residual Chlorine in groundwater samples.

6. CONCLUSIONS

In the study area pH is desirable in all fourteen groundwater samples. Alkalinity is desirable in one groundwater sample and permissible in thirteen groundwater samples. Hardness is desirable in three groundwater samples, permissible in seven groundwater samples and non-potable in four groundwater samples. Chloride is desirable in ten groundwater samples, permissible in two groundwater samples and non-potable in two groundwater samples. TDS is desirable in one groundwater sample, permissible in ten groundwater samples and non-potable in two groundwater samples. Fluoride is desirable in two groundwater samples, permissible in four groundwater samples and non-potable in eight groundwater samples. Iron is desirable in thirteen groundwater samples and non-potable in one groundwater sample. Ammonia is desirable in seven groundwater samples and non-potable in seven groundwater samples. Nitrite is desirable in thirteen groundwater samples and non-potable in one groundwater sample. Nitrate is desirable in two groundwater samples and non-potable in twelve groundwater samples. Phosphate is desirable in all the fourteen groundwater samples. Residual Chlorine is desirable in ten groundwater samples and permissible in four groundwater samples. The study is highly useful for planning and monitoring of groundwater quality for drinking purpose in the study area.

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