



GROUNDWATER QUALITY ASSESSMENT FOR DRINKING PURPOSE IN KAITHAL BLOCK, HARYANA

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ABSTRACT

Water is important on the planet Earth for survival of living beings for drinking, irrigation and industrial uses. In the present developmental era anthropogenic activities is polluting water resources. Groundwater is more vulnerable to anthropogenic pollution due to irrigation and industrial activities. The present study area Kaithal block is located in Kaithal district of Haryana state. The geo-coordinates of the study area are latitudes 29.67° N to 29.97° N and longitudes 76.21° E to 76.55° E and covers an area of 486.92 sq. km. Geologically alluvium and geomorphologically alluvial plain are present in the study area. The main objective of the study was to assess groundwater quality for drinking purpose in the study area. In the study area ten groundwater samples were collected in 250 ml double capped plastic bottles from tube wells. Geo-coordinates of sample locations were noted with the help of mobile GPS. Chemical analysis of ten 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, fluoride, iron, nitrite, nitrate, ammonia, phosphate and residual chlorine. Results of groundwater samples analysis were compared with BIS (IS 10500:2012) drinking water standards to know groundwater quality for drinking purpose. In the study area pH ranges 7 to 8.5, alkalinity 270 mg/l to 570 mg/l, hardness 100 mg/l to 570 mg/l, chloride 50 mg/l to 420 mg/l, TDS 552 mg/l to 1584 mg/l, fluoride 0.5 mg/l to 3 mg/l, iron nil to 0.3 mg/l, ammonia nil to 1 mg/l, nitrite 0.2 mg/l to 0.5 mg/l, nitrate 75 mg/l to 100 mg/l, phosphate nil to 0.5 mg/l and residual chlorine 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.

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INTRODUCTION

Water is important for survival of living beings on the planet Earth for drinking, irrigation and industrial uses. Present developmental activities have put pressure on availability and quality of water especially groundwater. Groundwater is more vulnerable to anthropogenic pollution due to agricultural manures and industrial wastes. Sarala and Ravi Babu (2012), Singh and Kumar (2014), Annapoorna and Janardhana (2015), Punia et al. (2015), Nelly and Mutua (2016), Kaur et al. (2017),

Lalitha et al. (2017), Bunkar and Kumar (2019), Mohamad (2019) had work on groundwater quality assessment for drinking purpose in many areas.

STUDY AREA

Kaithal block is located in Kaithal district of Haryana state (Fig.1). The geo-coordinates of the study area are latitudes 29.670 N to 29.970 N and longitudes 76.210 E to 76.550 E and covers an area of 486.92 sq. km. Geologically alluvium and geomorphologically alluvial plain are present in the study area.

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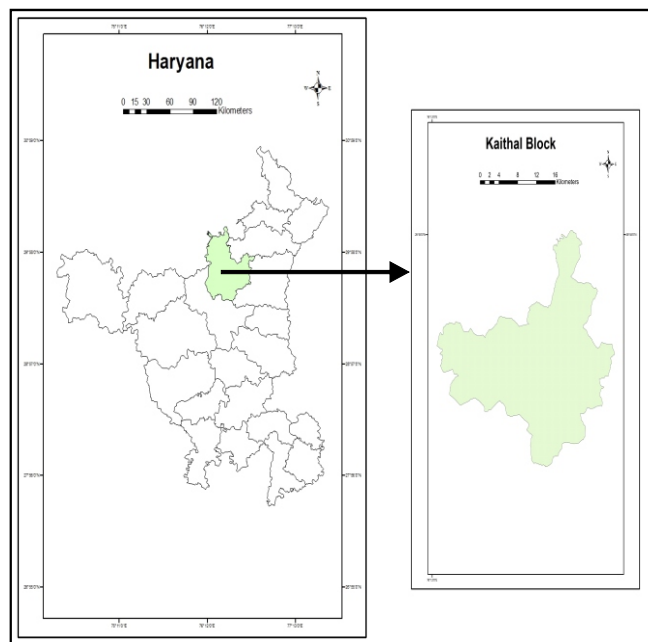


Fig.1: Location map of the study area.

OBJECTIVE

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

MATERIALS AND METHODOLOGY

In the study area ten groundwater samples were collected in 250 ml double capped plastic bottles from tube wells (TW). Geo-coordinates of sample locations were noted with the help of mobile GPS. Chemical analysis of ten 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 chemical analysis of groundwater samples were entered in excel software and prepared bar graph for each chemical parameter. Results of groundwater samples analysis were compared with BIS (IS 10500:2012) drinking water standards (Table 2) to know groundwater quality for drinking purpose.

Table 1: Results of groundwater samples analysis in the study area.

S. No.	Sample Location	Latitude	Longitude	Source	pH	Alkalinity (mg/l)	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)
1	Padla	29.80	76.28	TW	7.5	370	570	380	1584	2	0.3	0.5	0.5	75	0	0
2	Budha Khera	29.83	76.25	TW	8	570	400	50	1224	0.5	0	1	0.5	100	0	0
3	Titram	29.72	76.40	TW	7.5	370	550	420	1340	1	0	0.5	0.2	100	0	0
4	Sangan	29.81	76.23	TW	7.5	310	330	50	828	2	0	0.5	0.5	100	0	0.2
5	Deod Kheri	29.76	76.44	TW	7	270	190	50	612	2	0	0.5	0.2	75	0	0
6	Sismore	29.72	76.48	TW	7	350	260	150	912	1.5	0	0.5	0.5	100	0.5	0
7	Sajuma	29.74	76.26	TW	8	420	340	100	1032	3	0	1	0.5	150	0	0
8	Nauch	29.94	76.45	TW	8	400	400	90	1068	2	0	0.5	0.2	100	0	0
9	Titram Mod	29.73	76.40	TW	8	400	260	90	900	2	0	0	0.5	100	0	0
10	Bhani Majra	29.79	76.46	TW	7.5	300	100	60	552	1.5	0	0	0.5	75	0	0

Table 2: Drinking water standards (BIS: 10500:2012).

S. No.	Parameters	Potable		Non-potable
		Desirable	Permissible	
1.	pH	6.5-8.5	-	<6.5 and >8.5
2.	Alkalinity (mg/l)	<200	200-600	>600
3.	Hardness (mg/l)	<200	200-600	>600
4.	Chloride (mg/l)	<250	250-1000	>1000
5.	Total Dissolved Solids (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)	<0.1	-	>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

RESULTS AND DISCUSSION

i. pH

In the study area pH ranges 7 to 8.5 (Table 1, 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 ten groundwater samples (Padla, Budha Khera, Titram, Sangam, Deod Kheri, Sismore, Sajuma, Nauch, Titram Mod, Bhani Majra).

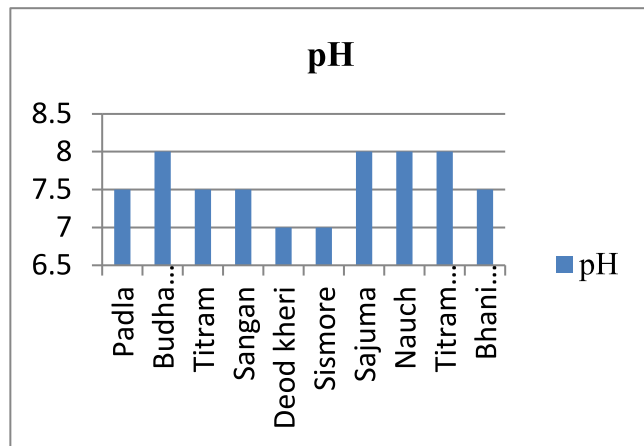


Fig. 2: pH in groundwater samples.

ii. Alkalinity

In the study area alkalinity ranges 270 mg/l to 570 mg/l (Table 1, 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 permissible in all ten groundwater samples (Padla, Budha Khera, Titram, Sangam, Deod Kheri, Sismore, Sajuma, Nauch, Titram Mod, Bhani Majra).

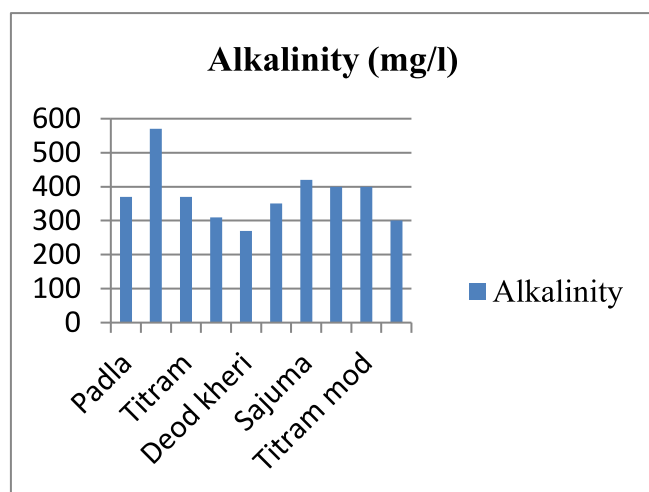


Fig. 3: Alkalinity in groundwater samples.

iii. Hardness

In the study area hardness ranges 100 mg/l to 570 mg/l (Table 1, 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 two groundwater samples (Deod Kheri, Bhani Majra) and permissible in eight groundwater samples (Padla, Budha Khera, Titram, Sangam, Sismore, Sajuma, Nauch, Titram Mod).

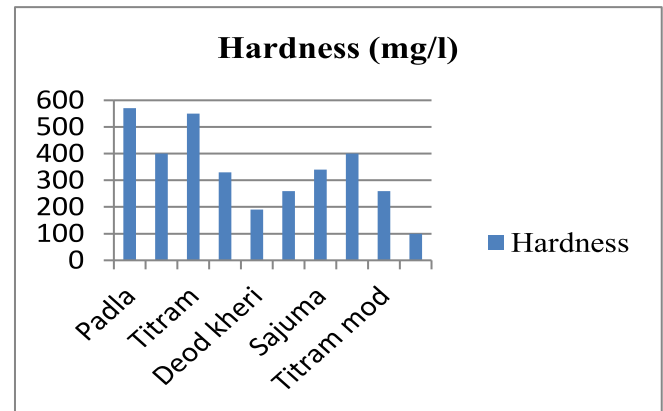


Fig. 4: Hardness in groundwater samples.

iv. Chloride

In the study area chloride ranges 50 mg/l to 420 mg/l (Table 1, 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 eight groundwater samples (Budha Khera, Sangam, Deod Kheri, Sismore, Sajuma, Nauch, Titram Mod, Bhani Majra) and permissible in two groundwater samples (Padla, Titram).

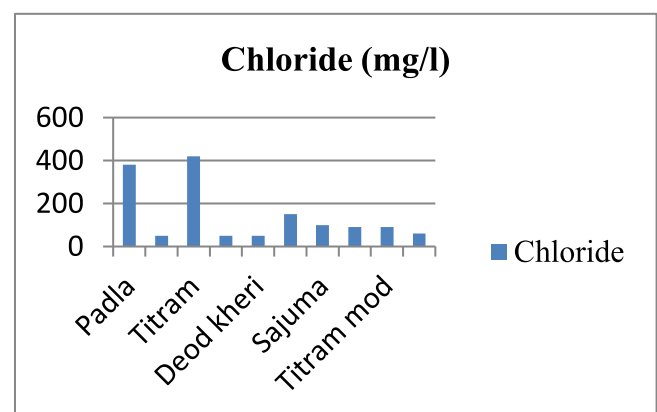


Fig. 5: Chloride in groundwater samples.

v. Total Dissolved Solids (TDS)

In the study area TDS ranges 552 mg/l to 1584 mg/l (Table 1, 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 permissible in all ten groundwater samples (Padla, Budha Khera, Titram, Sangam, Deod Kheri, Sismore, Sajuma, Nauch, Titram Mod, Bhani Majra).

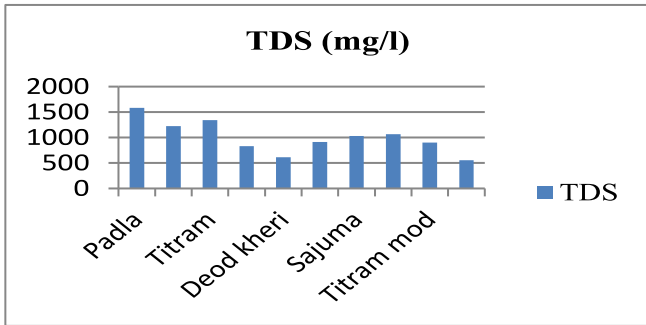


Fig. 6: TDS in groundwater samples.

vi. Fluoride

In the study area fluoride ranges 0.5 mg/l to 3 mg/l (Table 1, 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 one groundwater sample (Budha Khera), permissible in three groundwater samples (Titram, Sismore, Bhani Majra) and non-potable in six groundwater samples (Padla (2 mg/l), Sangam (2 mg/l), Deod Kheri (2 mg/l), Sajuma (5 mg/l), Nauch (2 mg/l), Titram Mod (2 mg/l)).

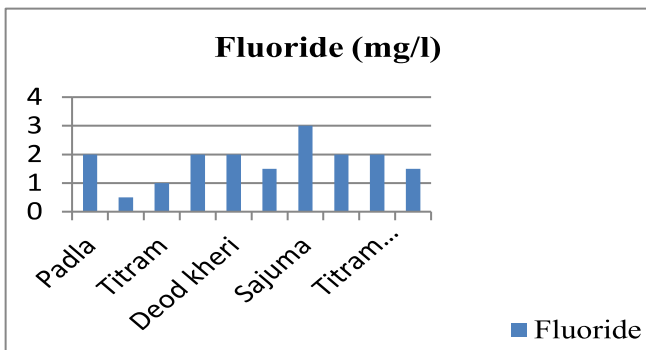


Fig. 7: Fluoride in groundwater samples.

vii. Iron

In the study area iron ranges nil to 0.3 mg/l (Table 1, Fig.8). As per BIS (IS 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 (Table 2). Iron is desirable in all ten groundwater samples (Padla, Budha Khera, Titram, Sangam, Deod Kheri, Sismore, Sajuma, Nauch, Titram Mod, Bhani Majra).

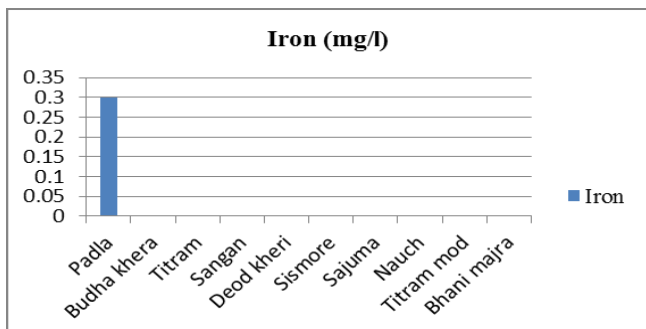


Fig. 8: Iron in groundwater samples.

viii. Ammonia

In the study area ammonia ranges nil to 1 mg/l (Table 1, 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 eight groundwater samples (Padla, Titram, Sangam, Deod Kheri, Sismore, Nauch, Titram Mod, Bhani Majra) and non-potable in two groundwater samples (Budha Khera (1 mg/l), Sajuma (1 mg/l)).

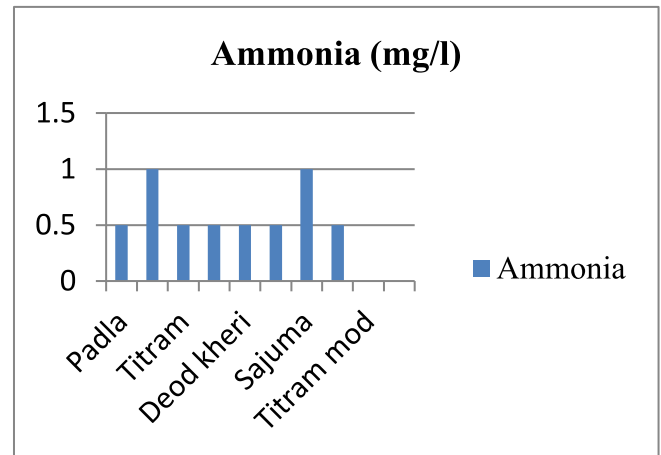


Fig. 9: Ammonia in groundwater samples.

ix. Nitrite

In the study area nitrite ranges 0.2 mg/l to 0.5 mg/l (Table 1, 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 all ten groundwater samples (Padla, Budha Khera, Titram, Sangam, Deod Kheri, Sismore, Sajuma, Nauch, Titram Mod, Bhani Majra).

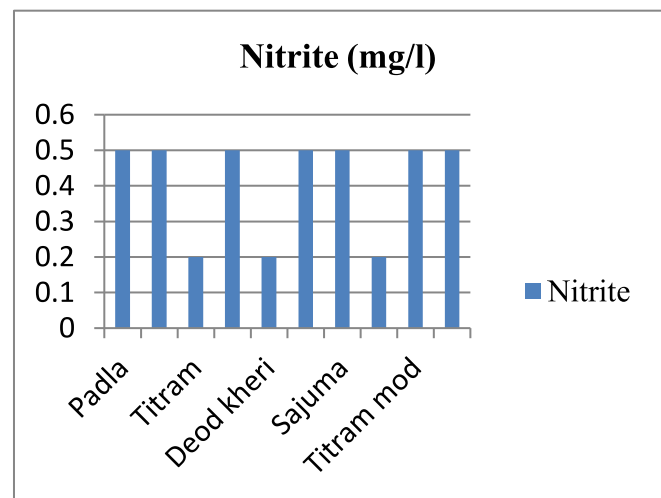


Fig.10: Nitrite in groundwater samples.

x. Nitrate

In the study area nitrate ranges 75 mg/l to 100 mg/l (Table 1, 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 45 mg/l (Table 2). Nitrate is non-potable in all ten groundwater samples (Padla, Budha Khera, Titram, Sangam, Deod Kheri, Sismore, Sajuma, Nauch, Titram Mod, Bhani Majra).

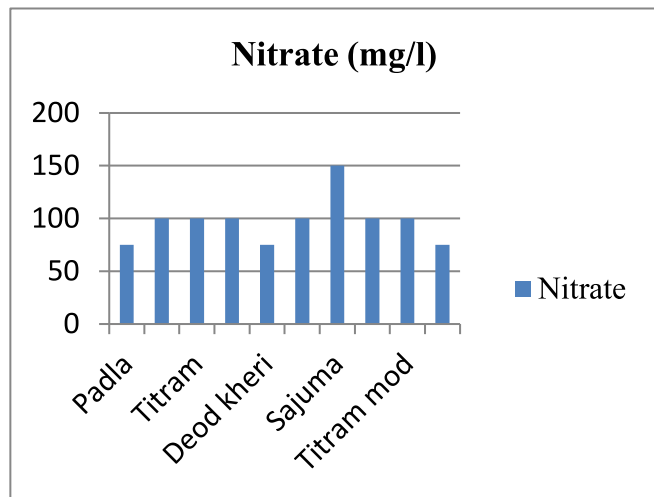


Fig. 11: Nitrate in groundwater samples.

xi. Phosphate

In the study area phosphate ranges nil to 0.5 mg/l (Table 1, Fig.12). As per BIS (IS 10500:2012) drinking water 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 ten groundwater samples (Padla, Budha Khera, Titram, Sangam, Deod Kheri, Sismore, Sajuma, Nauch, Titram Mod, Bhani Majra).

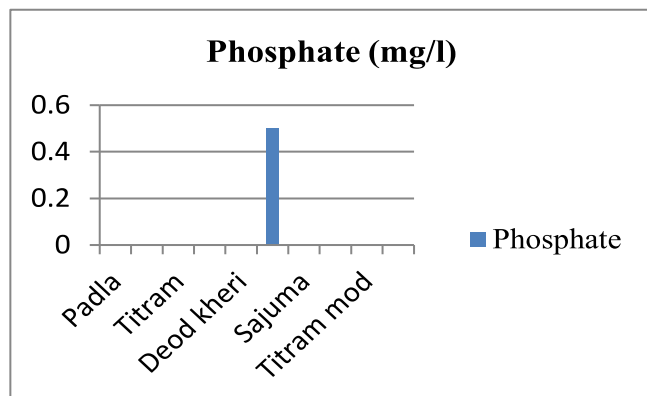


Fig. 12: Phosphate in groundwater samples.

xii. Residual Chlorine

In the study area residual chlorine ranges nil to 0.2 mg/l (Table 1, Fig.13). As per BIS (IS 10500:2012) drinking water standards residual chlorine is desirable if less than 0.2 mg/l, permissible between 0.2mg/l-1.0 mg/l and non-potable if more than 1.0 mg/l (Table 2). Residual Chlorine is desirable in nine groundwater samples (Padla, Budha Khera, Titram, Deod Kheri, Sismore, Sajuma, Nauch, Titram Mod, Bhani Majra) and permissible in one groundwater sample (Sangam).

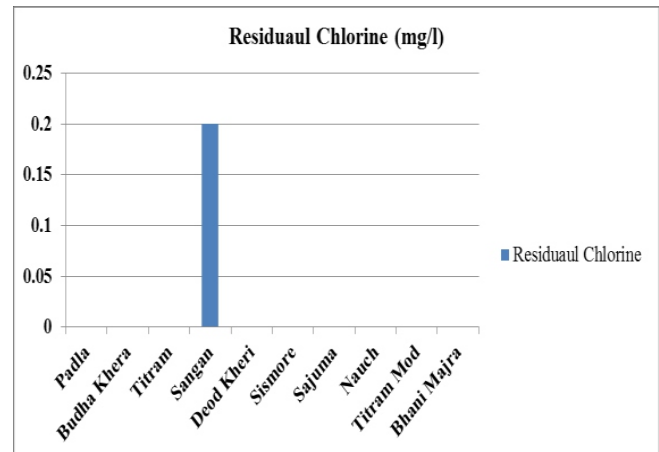


Fig.13: Residual Chlorine in groundwater samples.

CONCLUSIONS

In the study area pH, iron, nitrite and phosphate are desirable in all ten groundwater samples. Alkalinity is permissible in all the ten groundwater samples. Hardness is desirable in two groundwater samples and permissible in eight groundwater samples. Chloride is desirable in eight groundwater samples and permissible in two groundwater samples. TDS is permissible in all ten groundwater samples. Fluoride is desirable in one groundwater sample, permissible in three groundwater samples and non-potable in six groundwater samples. Ammonia is desirable in eight groundwater samples and non-potable in two groundwater samples. Nitrate is non-potable in all ten groundwater samples. Residual Chlorine ranges is desirable in nine groundwater samples and permissible in one groundwater sample. The study is highly useful for planning and monitoring of groundwater quality for drinking purpose in the study area.

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