ASSESSMENT OF GROUNDWATER QUALITY FOR DRINKING PURPOSE IN KALAYAT BLOCK, KAITHAL DISTRICT, HARYANA

Anup Kumar[1]*, Baru Ram[2], Naresh Kumar[2] and V.S. Arya[3]

[1,3]Haryana Space Applications Centre (HARSAC), Hisar
[2]Deptt. of Geology, Kurukshetra University, Kurukshetra

Abstract

Water is important for survival of life. Monitoring of drinking water quality is necessary for checking water related health problems. Anthropogenic activities have deteriorated quality of surface water and groundwater. Excessive use of groundwater for irrigation and industrial uses lead to the declining of groundwater depth and quality deterioration. The present study area Kalayat block is located in Kaithal district, Haryana. Kaithal block in Kaithal district. The geo-coordinates of the study area are latitudes 29.55^0 N to 29.79^0 N and longitudes 76.17^0E to 76.39^0E and covers an area of 342.68 sq. km. Geologically alluvium and geomorphologically alluvial plain are present. The main objective was to study groundwater quality for drinking purpose in the study area. In the study area nine groundwater samples were collected in 250 ml double capped plastic bottles from tube wells and hand pump. Geo-coordinates of sample locations were noted with the help of mobile GPS. Chemical analysis of nine 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 6.5 to 9, alkalinity 150 mg/l to 600 mg/l, hardness 140 mg/l to 1120 mg/l, chloride 30 mg/l to 730 mg/l, TDS 396 mg/l to 2904 mg/l, fluoride 1.0 mg/l to 5.0 mg/l, iron nil in all the nine groundwater samples, ammonia nil to 2.0 mg/l, nitrite 0.2 mg/l to 1.0 mg/l, nitrate 45 mg/l to 100 mg/l, phosphate nil in all the nine groundwater samples and residual chlorine nil to 0.2 mg/l. The study is highly useful for planning and monitoring of groundwater quality in the study area.

INTRODUCTION

Water is important for survival of life on the planet Earth. Excessive use of water drinking due to increasing population, industrialization and agriculture practices leads to decline of availability of water per capita. Monitoring of drinking water quality is necessary to check the water related health problems like fluorosis, methemoglobinemia. Aghazadeh et al. (2010), Spanos et al. (2014), Hanumantharao et al. (2019), Kumar et al. (2015), Punia et al. (2015), Choudhary et al. (2016), Vijaya Lalitha et al. (2017), Sinha et al. (2018) studied groundwater quality for drinking purpose in different types of areas.

STUDY AREA

Kalayat block is located in Kaithal district, Haryana (Fig.1). The geo-coordinates of the study area are latitudes 29.550 N to 29.790 N and longitudes 76.170E to 76.390E and covers an area of 342.68 sq. km. Geologically alluvium and geomorphologically alluvial plain are present.

Fig.1: Location map of the study area.

OBJECTIVE

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

MATERIALS AND METHODOLOGY

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

Table1: 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	Simla	29.64	76.22	TW	7	200	140	50	468	5	0	0	0.5	100	0	0
2	Batta	29.69	76.29	TW	8	390	480	500	1371	5	0	2	1.0	100	0	0
3	Kurar	29.72	76.19	TW	7.5	310	300	100	852	5	0	1	0.2	45	0	0
4	Dubbal	29.74	76.22	TW	7.5	280	200	300	936	3	0	0	0.2	75	0	0.2
5	Kailram	29.71	76.36	TW	8	380	390	180	1140	3	0	0.5	0.5	75	0	0
6	Mator	29.62	76.26	TW	8	600	1120	700	2904	1	0	1	0.5	75	0	0
7	Vajir Nagar	29.68	76.34	HP	6.5	150	150	30	396	2	0	1	0.5	100	0	0
8	Kheri Lamba (I)	29.69	76.23	TW	7	200	970	730	2280	1.5	0	0.5	0.2	45	0	0
9	Kheri Lamba (ii)	29.69	76.23	TW	9	550	300	400	1500	5	0	0	0.5	75	0	0

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

Sl. 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 6.5 to 9 (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 eight groundwater samples (Simla, Batta, Kurar, Dubbal, Kailram, Mator, Vajir Nagar, Kheri Lamba (i) and non-potable in one groundwater sample (Kheri Lamba (ii)).
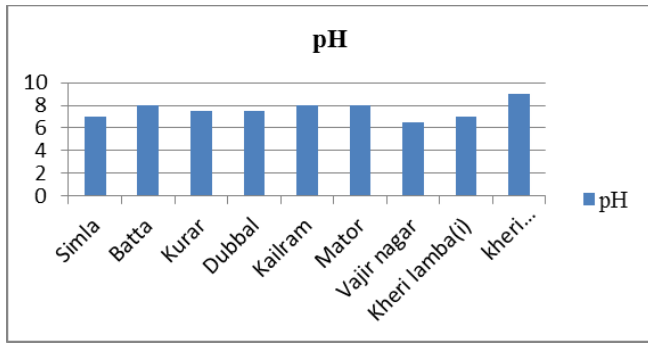

Fig.2: pH in groundwater samples.

ii. Alkalinity

In the study area alkalinity ranges 150 mg/l to 600 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 desirable in one groundwater sample (Vajir Nagar) and permissible in eight groundwater samples (Simla, Batta, Kurar, Dubbal, Kailram, Mator, Kheri Lamba (i) and Kheri Lamba (ii)).
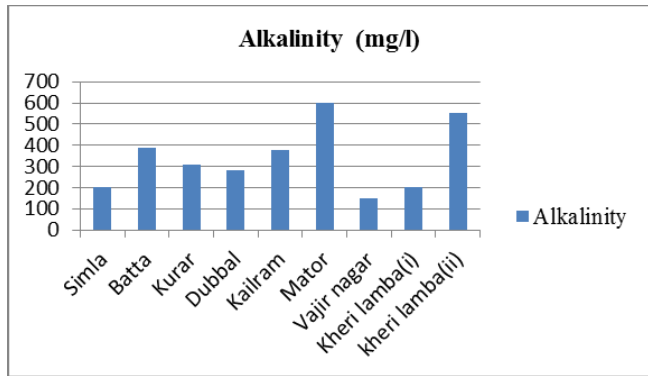
Fig.3: Alkalinity in groundwater samples .

iii. Hardness

In the study area hardness ranges 140 mg/l to 1120 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 (Simla, Vajir Nagar),permissible in five groundwater samples (Batta, Kurar, Dubbal, Kailram, Kheri Lamba (ii) and non-potable in two groundwater samples (Mator, Kheri Lamba (i)).

iv. Chloride

In the study area chloride ranges 30 mg/l to 730 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 four groundwater samples (Simla, Kurar, Kailram,Vajir Nagar) and permissible in five groundwater samples (Batta, Dubbal, Mator, Kheri Lamba (i), Kheri Lamba (ii)).
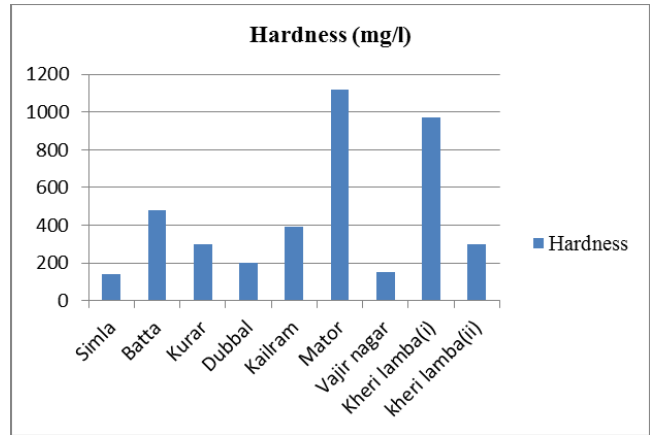

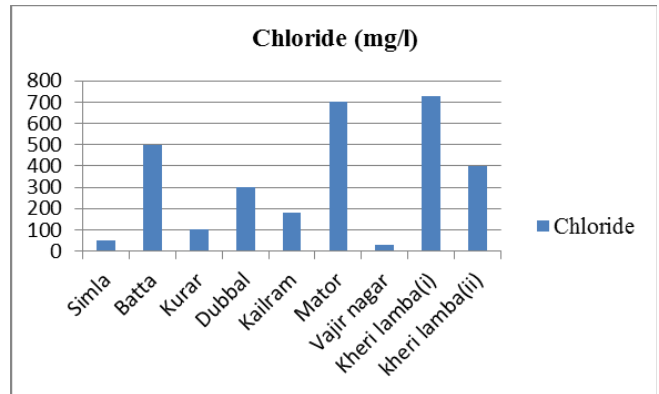**Fig.4: Hardness in groundwater samples.**

Fig. 5: Chloride in groundwater samples.

v. Total Dissolved Solids

In the study area TDS ranges 396 mg/l to 2904 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 desirable in two groundwater samples (Simla, Vajir Nagar), permissible in five groundwater samples (Batta, Kurar, Dubbal, Kailram, Kheri Lamba (ii) and non-potable in two groundwater samples (Mator, Kheri Lamba (I)).
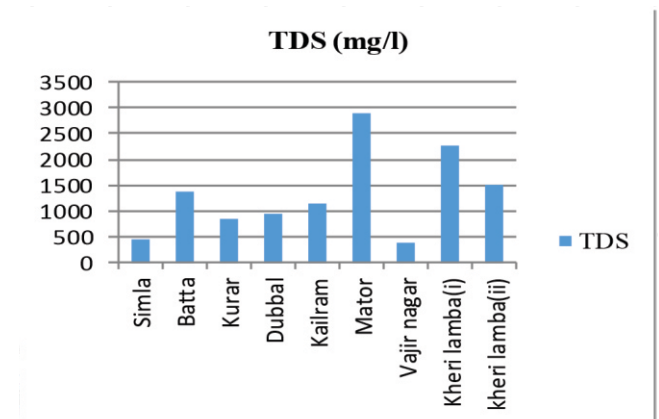

Fig. 6: TDS in groundwater samples.

vi. Fluoride

In the study area fluoride ranges 1.0 mg/l to 5.0 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 permissible in two groundwater samples (Mator, Kheri Lamba (i) and non-potable in seven groundwater samples (Simla, Batta, Kurar, Dubbal, Kailram,Vajir Nagar, Kheri Lamba (ii)).
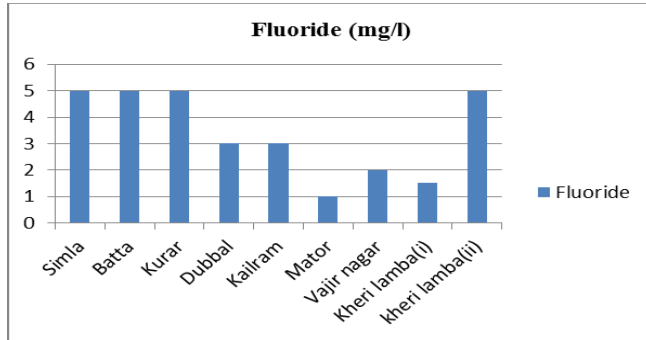

Fig. 7: Fluoride in groundwater samples.

vii. Iron

In the study area iron is nil in all the nine groundwater samples (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 the nine groundwater samples (Simla, Batta, Kurar, Dubbal, Kailram, Mator, Vajir Nagar, Kheri Lamba (i), Kheri Lamba (ii)).
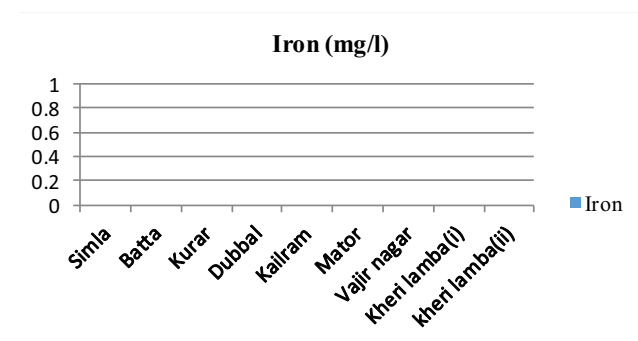

Fig. 8: Iron in groundwater samples.

viii. Ammonia

In the study area ammonia ranges nil to 2.0 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 five groundwater samples (Simla, Dubbal, Kailram, Kheri Lamba (i), Kheri Lamba (ii) and non-potable in four groundwater samples (Batta, Kurar, Mator, Vajir Nagar).
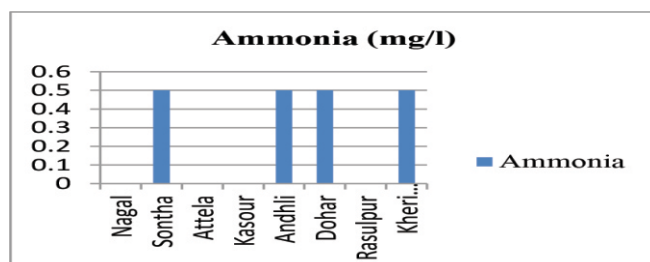

Fig. 9: Ammonia in groundwater samples.

ix. Nitrite

In the study area nitrite ranges 0.2 mg/l to 1.0 mg/l (Table 1, Fig.10). As per BIS (IS10500:2012) 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 the nine groundwater samples (Simla, Batta, Kurar, Dubbal, Kailram, Mator,Vajir Nagar, Kheri Lamba (i), Kheri Lamba (ii)).
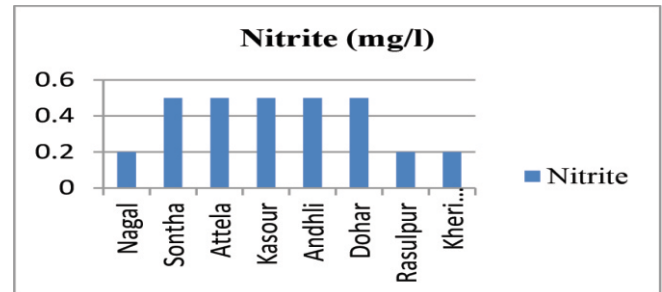

Fig.10: Nitrite in groundwater samples.

x. Nitrate

In the study area nitrate ranges 45 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 moer than 45 mg/l (Table 2). Nitrate is desirable in two groundwater samples (Kurar, Kheri Lamba (i)) and non-potable in seven groundwater samples (Simla, Batta, Dubbal, Kailram, Mator, Vajir Nagar, Kheri Lamba (ii)).
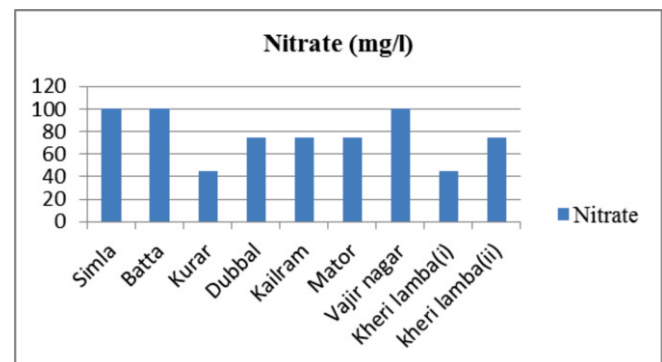

Fig. 11: Nitrate in groundwater samples.

xi. Phosphate

In the study area phosphate is nil in all the nine groundwater samples (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 the nine groundwater samples (Simla, Batta, Kurar, Dubbal, Kailram, Mator,Vajir Nagar, Kheri Lamba (i), Kheri Lamba (ii)).

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 0.2 mg/l-1.0 mg/l and non-potable if more than 1.0 mg/l (Table 2). Residual Chlorine is desirable in eight groundwater samples (Simla, Batta, Kurar, Kailram, Mator, Vajir Nagar, Kheri Lamba (i), Kheri Lamba (ii)) and permissible in one groundwater sample (Dubbal).
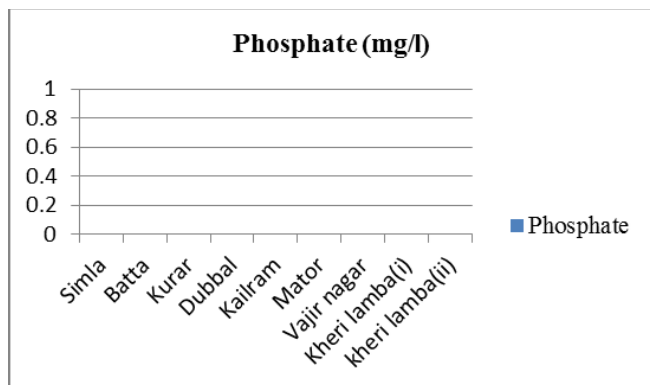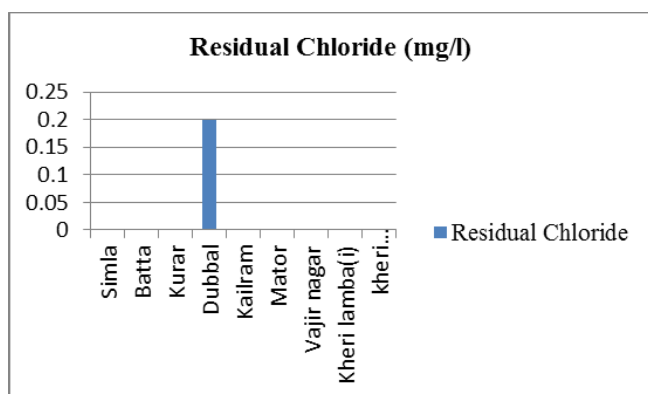
Fig.12: Phosphate in groundwater samples.

Fig.13: Residual Chlorine in groundwater samples.

CONCLUSIONS

In the study area pH is desirable in eight groundwater samples and non-potable in one groundwater sample. Alkalinity is desirable in one groundwater sample and permissible in eight groundwater samples. Hardness is desirable in two groundwater samples, permissible in five groundwater samples and non-potable in two groundwater samples. Chloride is desirable in four groundwater samples and permissible in five groundwater samples. TDS is desirable in two groundwater samples, permissible in five groundwater samples and non-potable in two groundwater samples. Fluoride is permissible in two groundwater samples and non-potable in seven groundwater samples. Iron, nitrite and phosphate are desirable in all the nine groundwater samples. Ammonia is desirable in five groundwater samples and non-potable in four groundwater samples. Nitrate is desirable in two groundwater samples and non-potable in seven groundwater samples. Residual Chlorine is desirable in eight groundwater samples and permissible in one groundwater sample. This study is highly useful for planning and monitoring of groundwater quality in the study area.

REFERENCES

Aghazadeh, Nosrat and Mogaddam, Asghar Asghari (2010): Assessment of groundwater quality and its suitability for drinking and agricultural uses in the Oshnavieh Area, Northwest of Iran, *Journal of Environment Protection*, 1(01):30-40.

Choudhary, Shabya, Ramteke, Shobhana, Rajhans, Keshaw Prakash, Sahu, Pravin Kumar, Chakradhari, Suryakant, Patel, Khageshwar Singh, Matini, Laurent (2016): Assessment of groundwater quality in Central India, *Journal of Water Resource and Protection*, 8:12-19.

Hanumantharao, C., Koteswararao, M., Kalyan, T. (2019): Groundwater quality assessment for drinking purpose in Vijayawada Region, Andhra Pradesh, India, *International Journal of Engineering and Advanced Technology*,8 (5):2147-2152.

Kumar, S. Krishna, Logeshkumaran, A., Magesh, N. S., Godson, Prince, S., Chandrasekar, N. (2015): Hydrogeochemistry and application of water quality index (WQI) for groundwater quality assessment, Anna Nagar, part of Chennai City, Tamil Nadu, India, *Applied Water Science*,5:335-343.

Punia, Sunita, Duddi, S. and Anju, M. (2015): Hydrochemistry and water quality assessment on groundwater of Bhiwani District, Haryana, India, *Pollution Research*, 34 (3):21-32.

Sinha, A.K., Kumar, Vinay and Singh, P.K. (2018): Groundwater quality assessment in a hard rock hilly terrain of Western India, *Journal of Pharmacognosy and Phytochemistry*, 7(1):51-61.

Spanos, Thomas, Ene, Antoaneta, Xatzixristou, Christina, Papaioannou, Agelos (2014): Assessment of groundwater quality and hydrogeological profile of Kavala area, Northern Greece, *Romanian Journal of Physics*, 60 (7-8):1139-1150.

Vijaya Lalitha, B. and Sai Tejaswini, K. (2017): A study on assessment of groundwater quality and its suitability for drinking in Vuyyuru, Krishna(dist.), Andhra Pradesh, *International Journal of Engineering Development and Research*, 5 (2):1662-1668.