The Academic
International Journal of Multidisciplinary Research

An Online Peer Reviewed / Refereed Journal
Volume 4 | Issue 5 | May 2026
ISSN: 2583-973X (Online), SJIF IF: 5.6
Website: www.theacademic.in

A Case Study of Water -Quality Parameterd of Under Ground Drinking Water of Pillukhera Block (Rural Areas), Jind, Haryana, India

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DOI : https://doi.org/10.5281/zenodo.20589588

ARTICLE DETAILS

Research Paper

Accepted: 17-05-2026

Published: 10-06-2026

Keywords:

TDS, TH, TA, pH, industrialization, Maharashtra

ABSTRACT

Water is best of all things in the universe. It most abundant, universal, wonderful solvent and precious gift of God in nature. Water is an essential best natural resource for encourage life and environment. Water has major role in economical, agricultural and industrial growth of human beings. Water quality has been deteriorated due to its exhaustive exploitation over the last few decades. Analyse the water quality essential parameter should be studied when over all focus ion endurable development keeping mankind at the Target point. The present study was started to examine the various parameters of underground water in rural areas of Pillukheda Block, Jind, Haryana, India and to scrutinise its purity for drinking.To explored the present water quality various physicochemical Parameters explored. EC, TDS, TH, TA, pH, fluoride, nitrate, phosphate sulphate, Sodium, Potassium, Magnesium, Calcium, carbonate, bicarbonate nitrate and Iron values were found experimentally. The results were correlated with drinking water quality standard prescribed by the Bureau of Indian Standard (BIS) and WHO. The sampling of groundwater carried out in February and March 2024. Mostly water samples were found to have total hardness, alkalinity,TDS (salinity) & other parameters values greater than their permissible limit. Parameters high value might have health problem and so they need precautions. The above explorations are helpful to understand the

groundwater quality and their successive suitability or non suitability of water various sampling site chosen. It is found that the water quality of water supply system in different region of PILLUKHERA is of medium quality and can be used for domestic purpose after suitable treatment. Successive suggestion have been made to increase the quality of water.

INTRODUCTION

Water has always been one of the most precious commodities. Water has acted as driving force every civilization and is a part of the all basic human needs, including drinking water, sanitation, health, energy and shelter .Without water we can have no society, no economy ,no cultural life . The vedic civilization is the oldest civilization that have throw light on the fact that the people of even that period have given more importance to proper and efficient water supply Water is being used in all religious ritual cereamonies since Ancient Indian because it is believed that the pure divine and well provided waters convey the offerings to the Gods. Importance of water can be understood by the fact that many great civilization in past spring up along or near the water body in India and abroad the development of water resource has been used as a yardstick for so economic and health status of many nation worldwide including India clean fresh drinking water is essential to human and other life forms. The term industry of water supply have been increasing due to increasing industrialisation on one side and population explosion on the other. Moreover large part of limited quality of supply of water is polluted by sewage, Industrial waste and wise range of synthetic chemicals. Water is used in productive and conjunctive activity and contribute to the rural and urban livelihood in the complex ways. Crop and livestock production, agro processing, fishing, ecosystems, recreation and human health all are influenced by the quality and quantity of available water. Productive and consumptives uses about one third of the world population lives in countries those are facing high water stress resulting from increasing demand ,what are use has been growing at more than twice the rate of population increasing during this century and already a number of regions of water short. Today 31 country accounting for less than 8% of world's population is chronic fresh water shortage among these country likely to run shortage of water in next 25- 30 years are Ethiopia, India, Kenya, Nigeria and Peru. Tibetan already face chronic water problems. According to the population action International, based upon the UN Medium Population Projection of 1998, more than 2.8 million people in 48 country will face water stress and scarcity condition by 2025 and by 2050 the number of countries tha means about 40% of projected Global population of 9.4 billion(Gardner- Outlaw Engleman,1997;UNFPA ,1997). The availability of water and its productive

capacity are further trained by climatic change land degradation deterioration of quality and the need to preserve environment and flow to protect aquatic and terrestrial ecosystem (Janmaat, 2004;Murgai et al.,2001; Postal ,1999). According to a report of water aid India has 16% of world population and 4% of its fresh water resources. Calculations indicate that the surface and groundwater availability is around 1869 billion cubic meter BCM, out of this 40% is not available for use due to geological and topographical reason. Around 4000 BCM of fresh water is available due to rain and snow, most of which return to the sea rivers. Approximately 92% of underground water is used in agriculture sector; 5 and 3% for industrial and domestic sector respectively. (Komala et al.,2013,; Kumar and Chopra ,2012; Lansdown et al.,2012).

Review of literature

Agarwal et al (1997) study the groundwater quality of India. They worked on the problem of high Fluoride concentration in groundwater resources is one of the most important toxicological and geo environmental issues in India about million people in village are consuming water have high fluoride.(Choubias,1998; Susheela,1999). Tatawati and Chandel (2008) have examined the ground water quality of Jaipur City, Rajasthan. And extensive study of the modelling of Buckingham canal water quality is available in literature (Abbasi et al., 2002). The study by Jayashri et al.(2002) was conducted on the water quality assessment of the Purna river in Buldhana district, Maharashtra. (Jha and Tignath, 2009) have studies the assessment and impact of surface water environment in and around Jabalpur city, Madhya Pradesh. Analyzed by Singh (1975) Singh and Shekhar (1976),Singh et al., (1987) concluded that agrochemicals pollute ground water. Government of India evaluation survey was conducted in 1999 found that 142000 habitations consume the excessive quantity of fluoride, iron, nitrate, arsenic and saline water. Rao and Mamatha, 2004 have found that all of the India's 14 major River system are severely polluted ,mostly from the 50 million cubic metre of untreated sewage discharge into them per year. Namara et al, 2010 have conducted studies on water treatment and distribution system, concluded that lack of proper operations and maintenance purity of drinking water can be a source of disease outbreak affecting the large population." It has been concluded that problem of water Scarlett management and what related disaster will intensive due to increasing population and rising the demand for water for agriculture as well as other uses, and is a greater climatic variability and climatic change." Use of waste water in agriculture increase nitrate contamination of groundwater (Chilton et al., 1998) metal and other contamination in soil and threaten agriculture sustainability (Chang et al., 2002). After the revision of literature, it has been determined to deeply study on physical chemical analysis of underground water,

Jind District ,Haryana. The man objective of the study is to examine the quality of drinking underground water in PILLUKHERA BLOCK (Rural area), Haryana, India.

MATERIALS AND METHODS

In the study area 20 sample from different sites of villages were collected from handpumps, wells, submersible & borewells. The samples were examined in laboratory for various Physico -chemical characteristics and some other heavy metals. The standard method (APHA) used for analysis of groundwater quality parameters. AR grade standard chemicals were used in analysing the samples. Atomic Absorption Spectrophotometer (model 3100) Perkins Elemer USA were used for determination of heavy metals. PH and conductivity meter were used to Hydrogen ion concentration (pH), electrical conductance (EC),total dissolved solid (TDS)& salinity of groundwater samples. Total hardness (TH) and Calcium (Ca^{2+}) were found titrimetrically using standard Disodium ethylene diamine Tetra acetate (Na2EDTA)salt. Magnesium (Mg^{2+}) concentration calculated taking the difference between the TH and Calcium values. Chloride(Cl-) was calculated using standard silver nitrate (AgNO3) solution while sulphate, phosphate and iron was analyse using the spectrophotometer.

RESULT AND DISCUSSION

The calculated respective value of water quality parameters of samples are illustrated in Table 3. All the results are compared to standard permissible limit recommended by the Bureau of Indian Standard(BIS), Indian Council of medical Research(ICMR) and World Health organisation(WHO) listed in the Table 2.

Study area and sampling

In February- March 2024 sampling work completed in Pillukheda rural block. 20 samples were collected in well labelled and pre treated plastic bottles (1.5 L.)and immediately preserved and analysed by using standard protocol given in APHA. (APHA,2005). 2% nitric acid used to wash each bottle and rinsed three time with distilled water. The sampling places are referred sites (P-1-P-20). The different sampling location are given in Table 1.

Table 1. Sampling site source code and depth of water samples

Sr. No.	Sample Site	Source	Code	Depth
1	Ahlan Jogi Khera	Submersible	P-1	120
2	Amrawali Khera	submersible	P-2	120

3	Beri Khera	Handpump	P-3	200
4	Bhag Khera	Handpump	P-4	30
5	Bhambewa	Handpump	P-5	30
6	Bhartana	Submersible	P -6	100
7	Budha Khera	Handpump	P-7	60
8	Dharoli	Submersible	P-8	30
9	Dhathrath	Handpump	P-9	70
10	Gangoli	Handpump	P-10	53
11	Hadhwa	Handpump	P-11	30
12	Hoshiyarpura	Handpump	P-12	120
13	Jamine	Handpump	P-13	180
14	Kalwa	Handpump	P-14	70
15	Kharak Gager	Handpump	P-15	30
16	Ludana	Handpump	P-16	30
17	Mandi Khurd	Handpump	P-17	30
18	Mrkhi	Submersible	P-18	180
19	Pillukhera	Handpump	P-19	30
20	Rajana Kalan	Submersible	P-20	100

Analytic methods, BIS, ICMR, & WHO parameters for drinking water

			BIS(IS 10500-91)		Prescribed by ICMR		WHO
S. No.	Parameter	Method employed	Desirable limit	Max. permissible limit	Desirable limit	Max. permissible limits	WHO
1	Ph	Digital pH meter	6.5-8.5	No relaxation	7.0-8.5	6.5-9.2	6.5-8.5
2	TDS(mg/L)	Digital TDS Meter	500	2000	500	1500-3000	1000
3	TH(mg/L)	Titrimetric (EDTA)	300	600	300	600	500

4	Ca^{+2}(mg/L)	Titrimetric (EDTA)	75	200	75	200	200
5	Mg^{+2}(mg/L)	Titrimetric (EDTA)	30ttggt	100	50	-	50
6	Cl^{-}(mg/L)	Titrimetric ($AgNO_3$)	250	1000	200	1000	200
7	Turbidity(mg/L)	Nephelometry	1	5	1	5	5
8	So_4^{-2}(mg/L)	Spectrometric Method	200	400	200	400	400
9	No^{3-}(mg/L)	Spectrometric Method	45	100	20	100	10
10	Po_4^{-3}(mg/L)	Spectrometric Method	-	-	-	-	-
11	Na/K(mg/L)	Flame photometer	-	-	-	-	-
12	Fe^{+3}(mg/L)	Spectrometric Method	0.3	1.0	0.1	1.0	1.0
13	F^{-}(mg/L)	APHA-Method	1.0	1.5	1	1.5	1.5
14	As(mg/L)	APHA-Method	0.0	0.05	0.0	0.05	0.05

Experimental Data

Code	Temp. ‘c	pH	ECds	TDS mg/L	TH mg/L	Ca^{+} mg/L	Mg^{2+} mg/L	TA Hco^{3-} mg/L	Cl- mg/L	F- mg/L	Na+ mg/L	K^{+} mg/L	So_4^{2-} mg/L	Po_4^{2-} mg/L	No_{3-} Hco3- mg/L
P-1	28.5	8.82	0.628	415	112	55	82	228480	211	1.9	418	37	57	6	38 0.25
P-2	27.4	7.79	1.857	322	420	52	47	121390	133	2.4	420	35	43	4	44 1.36
P-3	27.7	7.46	0.677	277	360	83	65	145495	275	2.1	560	31	64	7	69 0.48
P-4	28.4	7.3	0.55	365	660	58	35	240	315	2.1	501	39	75	8	61

		8	1					420							1.58
P-5	28.5	9.8	0.39	2435	365	65	87	260	420	2.3	212	29	23	6	65
		5	4					1425							0.66
P-6	28.7	7.7	1.27	148	285	118	67	264	455	2.6	276	72	66	8	35
		7	2					490							1.76
P-7	27.4	7.5	1.95	1238	478	297	226	487	403	1.5	256	40	256	6	51
		9	3					305							0.55
P-8	28.3	7.2	1.43	1382	485	65	39	272	207	3.8	210	50	289	8	49
		4	5					425							1.24
P-9	29.9	7.5	0.68	2643	610	415	76	298	275	2.7	246	48	163	5	44
		9	3					365							2.28
P-10	27.8	8.4	1.47	458	740	68	42	390	320	1.9	263	47	174	7	52
		2	1					465							0.34
P-11	28.7	8.7	0.83	465	300	224	74	623	440	1.9	416	66	55	9	86
		2	0					320							2.65
P-12	29.5	7.5	1.39	654	120	78	270	125	2390	1.9	514	49	190	6	53
		4	0					530							0.28
P-13	28.7	8.7	1.92	3775	325	79	53	117	480	2.6	232	46	186	8	41
		3	4					480							2.47
P-14	27.6	9.5	0.27	435	4375	64	56	143	270	1.6	726	79	284	3	51
		7	9					380							0.38
P-15	27.4	8.4	1.65	612	475	88	96	263	400	1.3	158	44	196	6	62
			6					540							2.47
P-16	28.3	8.5	2.36	534	220	92	58	368	395	1.5	154	31	95	8	61
		5	1					310							1.05
P-17	29.3	7.74	2.927	549	392	65	85	282	771	2.6	198	48	87	6	53
								314							0.75
P-18	28.4	7.93	1.488	260	410	98	61	539	643	1.4	320	61	147	4	55
								125							1.86
P-19	27.7	7.45	1.499	477	650	73	42	245	565	2.3	360	52	264	8	79
								436							0.35

P-20	27.9	7.62	1.722	424	750	58	93	140	425	2.2	501	48	78	7	51
P-21	28.9	7.83	1.342	337	668	72	91	340	228	1.4	432	57	72	8	1.82
								162							58
								234							0.32

pH

Determination of acidity or alkalinity of water and the concentration of hydrogen ion in water samples were found help of pH. Over long term exposure to pH above the permissible value affects the mucus membrane of cell. The pH of all water sample is found in the range of 7.65- 8.47 with a mean value of 8.07, standard deviation 0.23 indicating alkaline nature of water. Hghest value of pH is 8.47(P-17) and lowest value7.65 of (P-16). The pH value all samples are within the permissible limit of WHO. There is no abnormal change in groundwater samples.

Electrical conductivity (EC)

Electrical conductivity is the measure of capacity of a substance to conduct the electric current and the concentration of the dissolved in the solution. Most of the salts in water are present in ionic form and capable of conducting current is a good indicator to evaluate ground water quality. EC is an useful characteristic measure of water quality for indicating salinity health problems.

In the present study area; ISI value varied in the range of 0.238 to 2.080 dS. Sodium (Na^+), Potassium(K^+) Magnesium (Mg^{2+}) and Calcium (Ca^{2+}) are the major positively charged ions contribute in electrical conductivity of water. Sulphate ($SO4''$) , carbonate ($CO3'$), chloride (Cl') & bicarbonate ($HCO3'$)are major negative charged ions. Phosphate ($PO4'''$) and nitrate ($NO3'$) have small contribution in conductivity, yet they have biological importance. Amount of salt present in solution is measured in the form of salinity. Because dissolved ions increase the salinity as well as conductivity and both are corelated to each other. Salinity is an ecological factor ,which influence the organism that live in water body and the growth of plant will grow either in water body or in the land fed by the groundwater (BIS, 2012 ;Rani et al. 2003).

Total dissolved solids (TDS)

Total Disolved Solids in the study area range from 247 to1288 mg/L. The prescribed value of total dissolves solid is 1000 mg/ L (WHO). Maximum value of 1288 mg/ L is recorded at site P-17 and lowest values of 247 mg/ L. It is concluded that all the groundwater sample are not saline except the water of

stations P-1 and P-17.The concentration of dissolved ions may cause the water to be corrosive ,salty or brackish taste, result in scale formation (BIS, 2012).

Total hardness (TH)

Total hardness in the present study case ranged from 97 to700 mg/ L. WHO recommended range of total hardness is 300-600 mg/ L. It indicates that the water sample P-17 exceeded the maximum limited value for drinking water. The sum of concentration of alkaline earth metal cations as (Ca^{2+}) and (Mg^{2+}) is known as total hardness . Total hardness is the sum of total soluble Magnesium and Calcium salt present in water represented as its CaCO3 equivalent. The sulphates & chlorides of calcium and magnesium are also including in the total hardness. In natural water mostly predominant bicarbonates ions are mainly associated with Calcium to lesser degree with Magnesium and still less with the Sodium and Potassium . The content of Calcium in the present study was found in the range of 20 to140 mg/ L Magnesium content varied from 11 to 84 milligram per litre. Both Calcium and Magnesium are essential for the living beings . WHO recommendations have been made for the maximum & minimum level of calcium (75- 200 ppm) and magnesium `~50 ppm in drinking water (Rani et al. 2003).

Total alkalinity (TA)

Total alkalinity of the present study case range from 100 to 410 mg/ L. The sample sites P-5, P -9, P-13 and P-15 recorded normal value and within the guideline prescribed by the WHO (18 &19) for total alkalinity 200 mg/L. The total alkalinity in nature is attributed to bicarbonate (Sriniwas et al.2000). High value of alkalinity of P -18 (Morkhi village) is 410 mg/L.is due to bicarbonate (410 ppm) as well as sulphate content in the studied sample.

Chloride and Fluoride

The chloride content in the present study was resulted in the range of (45 to 310 mg/ L.) WHO & BIS prescribed chloride content of drinking water is (200 mg/L). The sample number P-3 to P-6 ,P -8, P -9, P-12 to P-16 have normal value of chloride concentration and all others 10 samples have value greater than the prescribed value. The observed value of the fluoride content in study samples very from 0.2 to 6.3 mg/ L with a mean value of 1.8 and standard deviation of fluoride is exceeding the permissible limit of BIS and WHO (0.5 to 1.5 mg /L). The sample number P-2, P-4, P-11, P-12, P-14 P-16 ,P-18 and P-19 have high value of Fluoride concentration due to the presence of fluoride bearing mineral in the region. Some case of dental or skeletal fluorosis were observed in the study areas of P-4 (Bhag Kheda) and P-12(Hoshiarpur) villages.

Nitrate

Nitrate values of groundwater samples very from 3 to 49 mg/L. The nitrate value are commonly reported either nitrate (NO3') or nitrate- nitrogen (NO3-N). Maximum contaminated level (MCL) of drinking water as nitrate is 45 mg/L,where as the MCL as NO3-N is 10 milligram per litre.The MCL is the highest of NO3 'or NO3-N that is available in drinking water supply by U.S. Environmental Protection Agency (EPA). High concentration of nitrate in drinking water can cause methemoglobinemia or Blue baby syndrome, a condition found specially in infant less than 6 months. High value of Nitrate is observed in P-20 sample (Rajana Kalan) village.

Iron ($Fe^{3}+$)

In the present study samples iron content was found within the guideline value as recommended by (NDWQS and WHO, BIS). The study examined that all sample sites have the metal content in normal range of (0.0 to 0.5 mg/L). Iron is one the most abundant element in nature ranking 4th by weight. It is observed that all kinds of water including ground water have suitable quantities of iron. Although the iron metal has little concerned on health problem but is still considered as a nuisance in exceeding quantities for domestic as well as industrial uses.

Sodium and potassium ions

In the present study the value of sodium in drinking water sample was found in the range of (63 to 261 mg/L). All the sample except P-1, P-2, P-10, P-11 & P-18 are within suggested the limit of (WHO, BIS 200 mg/ L). The concentration of potassium iron range from (3 to 65 mg/L). The prescribed value of potassium iron by(WHO is 15 mg/ L). All sample sites have normal value of potassium except P1, P2, P-7 ,P-16 and P-20 . A very high dose of potassium result in chest tightness, nausea, vomiting, diarrhea, hyperkalaemia, shortness of breathing, and heart failure (BIS 2012). In healthy persons, high level of potassium (up to 3700 mg/day) have no harmful impacts because Potassium is rapidly excreted.

Sulphate

In the present study case the range of sulphate content in drinking water samples is 20 to 141 mg/L. Natural water contains sulphate ions and mostly ions are soluble in water. Many sulphate ions are produce by oxidation of their ores.They are also present in Industrial wastes . The method to measure the quantity of sulphate is by UV spectrophotometer. As per IS :10500-2012 Desirable limit for Sulphate is 200 to 400 mg/ L in permissible limit.

Phosphate

The phosphate content in the present study case is in the range of 0.3 to 5.2 mg/L. Phosphorus is an essential plant nutrient and most often controls plant growth in freshwater. Generally ground water contains only a minimum phosphorus level because of low solubility of native phosphate minerals and the ability of soil to retain phosphate.

Turbidity

The suspended particles in water interfering with the passage of light is called turbidity. Turbidity is caused by wide variety of suspended particles. Turbidity can be found either by effect on transmission of light which is termed as turbidity- metre or by its effect on the scattering of light which is called as nephelometry. Aa per IS: 10500-2012 the acceptable and permissible limits 1& 5 NTU respectively.

Conclusion

The present work is an attempt to find the drinking water quality. Mostly samples analyzed were found contaminated either due to one or more parameters. Only Iron and PH value of all the samples were found in the permissible range. Certain parameters in a ll samples crossed the standard permissible limit of WHO & BIS. Arsenic is carcinogenic and is observed in one sample as 0.65 ppm(Morkhi , P-18), so it's presence is a serious threat. It is concluded from the result that the drinking water must be treated before supply to the public for domestic use.

Acknowledgement

One of the authors (J.P.Deshwal) is highly thankful to Principal Govt. PG College Narwana (Jind) for providing research facilities in the college campus.

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