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UGC CARE I

A CASE STUDY OF PHYSICO-CHEMICAL ANALYSIS OF UNDER GROUND DRINKING WATER OF RURAL AREAS OF(JIND BLOCK),JIND, HARYANA, INDIA.

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ABSTRACT

Water is an important natural resource for life and environment maintenance. In the recent decades the quality of water has been degraded due to its exhaustive exploitation. The major essential parameters of water quality is to be studied in the overall focus to maintain the development keeping in view of mankind at the focal point. The present study work was done for analysis of the various parameters of underground water in rural areas of Jind block,Haryana, India and to check its fitness for drinking. The main physico-chemical parameters viz. pH, TDS, electrical conductivity, total alkalinity, carbonate, bicarbonate, chloride ,fluoride, iron, sodium, potassium, total hardness calcium, magnesium, sulphate phosphate ions were investigated . The results are matched with drinking water quality standards prescribed by the Bureau of Indian Standard (BIS) and World Health Organisation (WHO). Groundwater sampling carried away from August to September 2024. Most of the water samples were found to have total dissolved solids, alkalinity & hardness values more than their permissible limit. The above studies is good for understanding the ground water quality and their suitable fitness or unfitness of water for drinking domestic use at various sites undertaken. It is concluded that water quality of water supply system in different location of Jind block is of medium quality and can be used for domestic purpose after suitable treatment. Suitable suggestion have been made to improve the quality of water.

INTRODUCTION

Water is the most precious gift of God in nature & creature. Life originated in water is also sustained by water, hence "Water is Mother for all living beings environment ". All living organisms i.e. animals as well as plants need fresh water to maintain their life processes. Some organisms need water for living in: still others cannot breed except in water. The amount of water required is different for different organisms. All living organisms contain 70% to 90% water in their bodies. About 70% of the human body is made up of water . Plant tissue also contains large amounts of water. Water is the most abundant, wonderful and essential natural resource present in the earth. Water is an excellent universal solvent because of its polar

Journal of East-West Thought
ISSN: *2168-2259 (online)*
(https://jetjournal.us/)
Volume 14, Issue 3 – Sep 2024
UGC CARE I

nature and high dielectric constant value. Purity of water is the necessity for the survival of life. The health burden of poor water quality is enormous. It is estimated that around 37.7 million people Bharat are affected by water boring diseases and only 1.5 million children are estimated to die of diarrhea alone and 73 million working days are lost due to water born disease each year. The estimated economic burden is $600 million per year. The problems of chemical contamination are also prevalent in India with 195813 habitations in the country are affected by poor water quality. Major chemical parameters of concern are floride and arsenic. iron is also emerging as a major problem in many areas. keeping in mind the above problems study was conducted for analysing the underground drinking water quality of the Jind block rural areas.

Review of literature

The average availability of water reduction is steadily with a growing population and it is estimated that by 2030 India will become a water stress nation. Ground water is the major source of water in our country with 85% of the population depending on it.(Giri and Singh 2014; Rakib and Bhuiyan 2014; kriest and Oschlies,2013) according to a report of water aid India has 16% of the world population and 4% of its press water resources. Estimates indicate that the surface and ground water availability is around 1869 billion cubic meters (BCM) of this, 40% is not available for use due to geological and topographical reasons. 420 BCM of fresh water is available due to rain and snow, most of which return to the sea via rivers. 92% groundwater is extracted in the agriculture sector; 5 and 3% respectively for industrial and domestic areas.(Komala et al., 2013; Kumar and Chopra 2012; lansdown et al.,2012) About 97.3% of water is salty and only 2.7% is present as fresh water out of which about 20% constituent groundwater. (Onda et al 2012 ;Rai et al 2012; simply ITL 2011 Simpi et al., 2011; Ensink et al., 2010) The negative effects on ground water quality are the results of man's activity at ground surface unintentionally, by agriculture, domestic and Industrial effluents, unexpectedly by sub- surface or surface disposal of sewage and industrial wastes. The quality of groundwater is of great importance in finding the suitability of particular ground water for a certain use (public water supply, irrigation, industrial applications, power generation etc). Generally most groundwater quality problems are caused by contamination, over exploitation or by both. The solution of problems are usually very expensive and time consuming and not always effective. Groundwater quality and quantity slowly and surely decline everywhere. Groundwater pollution is intrinsically difficult to detect , since problem is out of control. It is important to know the geochemistry of chemical-soil- groundwater interactions in order to access the fate and impact of pollutants discharge on to the ground. (Kumar and Sinha 2010;Gupta et al 2009: Premlata, 2009; APHA, 2005).

Journal of East-West Thought
ISSN: *2168-2259 (online)*
(*https://jetjournal.us/*)
Volume 14, Issue 3 – Sep 2024
UGC CARE I

Study area and Sampling

70 water sample work collected in August- September 2024. These samples were collected in pretreated in labelled plastic bottles (1.5 L) and were immediately preserved and analysed following the standard protocol given in APHA (APHA,2005). The bottle was vast with 2% nitric acid and then arranged three times with distilled water and sample water concerned before use. The sampling places are referred to as stations (J-1 – J-22). The different sampling locations are given in Table 1

Sr. No.	Sample Site	Source	Code	Depth
1	Ahirka	Submersible	J-1	120
2	Anoopgarh	Handpump	J-2	70
3	Azrafgarh	Submersinle	J-3	110
4	Assan	Handpump	J-4	180
5	Bagalwa	Submersible	J-5	85
6	Behbalpur	Submersible	J -6	100
7	Barodi	Submersible	J-7	110
8	Barsana	Handpump	J-8	48
9	Barsola	Handpump	J-9	95
10	Bharukhera	Well	J-10	50
11	Bibipur	Hanpump	J-11	120
12	Birbarban	Submersible	J-12	180
13	Bishanpura	Well	J-13	120
14	Brahkalan	Handpump	J-14	34
15	Brar khera	Handpump	J-15	30
16	Chabri	Submersible	J-16	100
17	Dariyawala	Well	J-17	30
18	Dhigana	Handpump	J-18	250
19	Gimana	Submersible	J-19	120
20	Gobindpura	Submersible	J-20	247
21	Gulkani	Submersible	J-21	245
22	Habatpur	Submersible	J-22	160

Journal of East-West Thought
ISSN: *2168-2259 (online)*
(https://jetjournal.us/)
Volume 14, Issue 3 – Sep 2024

UGC CARE I

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

			Prescribed by				
			BIS(IS 10500-91)		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)	30	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	EC ds	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
T-1	27.1	7.78	0.918	575	412	95	75	208 280	211	1.9	918	6	77	2	18 0.34
T-2	27.2	7.84	0.807	523	560	72	32	191 290	333	3.5	220	5	87	6	34 0.24
T-3	27.9	8.62	1.207	717	660	83	78	255 395	175	1.5	360	21	74	3	39 0.26

Journal of East-West Thought
ISSN: *2168-2259 (online)*
(*https://jetjournal.us/*)
Volume 14, Issue 3 – Sep 2024
UGC CARE I

T-4	28.8	7.25	1.051	626	710	78	86	250	315	2.0	201	19	89	7	31
								220							0.31
T-5	29.5	8.76	1.724	533	465	75	93	230	420	1.8	212	8	93	2	25
								225							0.35
T-6	27.7	7.83	1.762	1402	595	118	97	294	255	1.8	376	22	93	5	15
								290							0.00
T-7	28.3	7.77	2.153	1228	678	197	216	477	203	1.8	156	30	156	3	41
								405							1.00
T-8	29.7	8.43	1.695	1562	615	105	80	542	107	4.8	210	20	159	6	59
								525							0.31
T-9	27.0	7.47	1.863	1673	710	115	75	368	275	0.8	146	28	163	4	34
								255							0.49
T-10	28.8	7.77	1.261	945	430	88	49	360	320	0.9	363	17	124	6	32
								265							0.28
T-11	26.3	8.79	2.420	1355	1200	224	79	453	340	1.0	116	26	255	4	56
								320							0.50
T-12	28.8	7.82	2.710	1674	840	58	100	435	290	2.0	214	49	190	7	23
								130							0.50
T-13	26.3	8.81	1.124	1785	625	59	95	347	380	1.8	332	36	196	8	21
								650							1.20
T-14	29.0	7.30	1.779	789	415	44	39	293	470	1.5	126	69	84	5	21
								480							0.00
T-15	27.3	8.91	1.472	812	475	58	81	343	100	2.5	358	7	66	4	7
								340							0.43
T-16	26.5	7.46	1.225	734	330	62	52	258	295	2.5	254	5	175	2	22
								320							0.00
T-17	28.1	7.65	0.902	689	392	65	88	262	271	2.9	298	18	57	3	23
								274							0.26
T-18	29.2	7.70	0.901	580	350	78	67	129	243	2.5	120	41	147	6	55
								495							0.26
T-19	27.9	7.72	1.606	827	350	83	48	295	365	1.5	260	22	164	7	29
								316							0.22
T-20	26.8	7.46	1.251	534	530	98	96	250	425	2.6	301	18	58	3	21

Journal of East-West Thought
ISSN: *2168-2259 (online)*
(*https://jetjournal.us/*)
Volume 14, Issue 3 – Sep 2024
UGC CARE I

								410							0.42
T-21	28.5	7.93	0.757	856	485	98	39	280	250	2.8	212	17	78	6	28
								495							0.28
T-22	27.7	7.46	1.662	1292	585	146	82	125	235	1.8	176	21	56	1	25
								480							0.32

MATERIALS AND METHODS

Twenty two samples were collected from the source site of hand pumps, tubewells/submersible and wells in the villages. Potable water analyzer kit(WTW Multy 340/SET) to calculate 3 water quality parameters on the site these were (pH) water temperature (WT)and electrical conductivity (EC). Other parameters were found by using the standard method recommended in the manual of APHA /AWWA/ WEF (APHA1992). All AR grade reagents were used and distilled water used preparation of solutions. Atomic absorption spectrophotometer (model 3100) Perkin Elemer USA was used for determination of heavy metals. pH, TDS and EC were measured by using conductivity meter. Total alkalinity estimated titrimetrically using HCl. Total hardness, calcium (Ca^{2+}) and magnesium (Mg^{2+}) ions were analysed using titrimetrically, standard Disodium ethylene diamine tetracetates salt (Na2EDTA). Chloride (Cl') ions concentration was determined using standard silver nitrate ($AgNO_3$) solution ,while sulphate (SO_4^{2-}) was analyzed with the help of spectrophotometer. In the present study maximum, minimum, average and standard deviation have been calculated for each pair of water quality parameter by using Excel spreadsheet for the experimental data.

RESULTS AND DISCUSSION

Respective values of all the water quality parameters in water samples are listed in Table 3. All the results are compared with the standard permissible limit prescribed by the Bureau of Indian Standard (BIS), Indian Council of medical Research (ICMR) and World Health Organisation (WHO)were wrote in Table given above. Testical parameters of the groundwater sample of the study area are summrised in Table given above.

pH

The pH is used to calculate the acidity and alkalinity of water and the concentration of hydrogen ions in water. The pH value of all groundwater is determined to be in the range of 7.41 to 8.48. the highest value is 8.48 is observed at station J-10 (Bhairu Kheda) and lowest value of 7.41 is observed at station J-1. Intermo PH value ground water samples are well within the prescribed limit of WHO (BIS 2012). The high value of PH above the prescribed limit affects the mucus membrane of cells.

Journal of East-West Thought
ISSN: *2168-2259 (online)*
(https://jetjournal.us/)
Volume 14, Issue 3 – Sep 2024
UGC CARE I

Electrical conductance

Electrical conductivity is the method of capacity of a substance to conduct the electric current. Most of the salt in water are present in their ionic form and capable of conducting current and conductivity is a good indicator to calculate groundwater quality. In the present study area, EC values varied between 0.871dS to 2.604dS. EC is a useful parameter of water quality for indicating salinity hazards. Conductivity is the capacity of water to conduct an electric current of the dissolved ions act as conductors in the solution. The major positively charged ions are calcium(Ca^{2+}), magnesium (Mg^{2+}) Sodium (Na^{+}) , potassium(K^{+}) and the major negatively charged ions chloride (Cl^{-}), sulphate (SO_4^{2-}), carbonate (CO_3) and bicarbonates (HCO_3-) good conductors in solutions. Nitrate and phosphate are minor contributed to the conductivity, yet they are very important biologically. Salinity is a useful parameter to measure the amount of salt in the water. Dissolved ions increase salinity as well as conductivity, both essential processes are related to each other. Salinity is an ecological factor which affects organisms that live in water bodies and the growth of plants that will grow either in water bodies or on the landford by the groundwater (BIS 2012; Rani et al.,2003).

Total dissolved solid (TDS)

In the present study TDS of groundwater samples were found in the range of 540 to 1643mg/ L. For domestic purposes the maximum permissible limit of TDS is 1000 mg /L recommended by WHO. The maximum value of TDS is 1643 mg/L is recorded at station J- 13(Bishanpura village). In the ground water samples all are not saline except J -7,J -8,J -11,J -13,J-14, J -18, J -19,J-20, J -21 and J_22 . The high value of TDS by itself does not show that the water presents a health hazard.The concentration of dissolved ions may cause the water to corrosive,salty tasty results in scale formation (BIS, 2012).

Totel hardness (TH)

The sum of concentrations of alkaline earth metal cations such as (Ca+) and (Mg2+) is the total hardness. Total hardness is the total solubility of calcium and magnesium salts present in water express as its CaCO3 equivalent. The total hardness in the study case is in the range of 48 milligram to 675 mg/ L. WHO guideline value (total hardness range 300 to 600 mg /L) shows that the several samples particularly J -7, J -8, J -11, J -13, J-14, J -19 exceeded the maximum limit for drinking water. Calcium content of water in the present study was found in the range of 45 mg/L to 139 mg/L. Similarly magnesium content where it ranges from 32 mg/ L to 106 mg/ L. Ca and Mg both are essential minerals for the living organism. Recommendation by WHO have been made or maximum and minimum limit of calcium(75 - 200 ppm) and magnesium(~50ppm) in the drinking water.

Journal of East-West Thought
ISSN: *2168-2259 (online)*
(https://jetjournal.us/)
Volume 14, Issue 3 – Sep 2024
UGC CARE I

Total alkalinity (TA)

The Total Alkalinity of the groundwater samples was found in the range of 130 mg/L to 720 mg /L. Water sample source site J-11 is recorded normal value and within the guideline as recommended by whole total alkalinity 200 mg/L. Other 21 sample values exceeded WHO recommendations. Total alkalinity in natural water is only due to bicarbonate. Very high value of alkalinity for water of sample site J-12 is due to high by carbonate (720 mg/ L) and Sulphate content in the reported sample.

Chloride/ Fluoride

The content of chloride in the present water study was found in the range of mg /L to 518 mg /L. The concentration of chloride higher than 200 mg/L is considered to be risky for human consumption and causes uncomfortable taste of water. The fluoride content of water samples found in the range of 0.3 mg/L to 5.0 mg/L. In some water samples fluoride concentration were found higher than the permissible range 0.6-1.5 mg/L . A very high fluoride concentration was found in the sample J-1,J -3 ,J -4 ,J- 5 ,J-6, J-10 ,J-14, J -15 J 16, J- 19, J-20 & J 22 might be due to the presence of fluoride bearing minerals in the region. Some cases of dental and skeleton fluorosis were observed in the study area of some villages.

Nitrate

The concentration of nitrate ions in the present study was found in the range of 4 mg/ L to 90 mg /L. Nitrate values are commonly found as either nitrate (NO_3') or as nitrate nitrogen (NO_3-N). The maximum contamination level MCL in drinking water as nitrate is 45 mg/L and the MCL as (NO_3') is 10 mg /L . The MCL is the highest level of nitrate NO_3' or NO_3-N that is allowable in public drinking water supply by the U.S. environmental protection agency (EPA). I concentration of nitrate in water can cause met hemoglobinemmia or Blue baby syndrome a condition found specially in infants less than 6 months. In this case the stomach acid of an infant is not as strong as in old children and adults. This causes and increase in bacteria that can easily convert nitrate to nitrite very high value of nitrate in water samples J -2 (Anupgarh), J -7(Brodi) and J -13 (Bisan pura Haryana).

Iron

The content of iron in the present study was found within the allowable value as recommended by the NDWQS and WHO. The present study explained that all sampling sites contained the metal content in the normal range 0.01to 0.5 mg/L except J -13 (Bishanpura Haryana village). It has been found that iron is one of the most abundant elements in nature ranking fourth by weight in Earth crust. All kinds of water including groundwater have a sufficient quantity of iron. the metal has gotten little attention as a health hazard .It is

Journal of East-West Thought
ISSN: *2168-2259 (online)*
(https://jetjournal.us/)
Volume 14, Issue 3 – Sep 2024
UGC CARE I

still considered as a nuisance in exceeding quantity for drinking as well as in industrial purposes.

Sodium/ potassium ions

The value of sodium ions all samples except in drinking water samples was found in the range of 45 mg/ L to 241 mg/L. All samples accept J -3, J-6, J -7, J 8, J -13 ,J -15 ,J- 18 & J -22 Arvind in the range given by WHO and BIS (200 mg / L.) The concentration of potassium ions in the water samples were found in the range of 3mg/L to 52 mg /L. The recommended value of potassium ions by WHO is 15 mg/L. In a healthy person a high level of potassium up to (3700 mg / day) possesses no harmful effects because Potassium is rapidly excreted. A very high dose of potassium results in chest tightness nausea, vomiting, diarrhea, hyperkalemia ,shortness of breath and heart failure (BIS, 2012).

Sulphate

Natural water contain sulfate ions and most of these ions are also soluble in water many sulphate ions are produced by the oxidation process of their ores,and they also present in Industrial wastes . In the present study the concentration of sulphate ions was found in the range of 28 mg /L to 236mg/L. The method to calculate groundwater quality of sulphate is by UV spectrophotometer, as per IS:10500-2012. Desirable limit for sulphate is 200 mg/L and 400 mg/L in permissible limit.

Phosphate

Phosphorus is an essential plant nutrient and most open control plant growth in the fresh water. The content of phosphate ions in water samples was found in the range of 0.8 mg/L to 5.4 mg/L. Normaly ground water contains only a minimum phosphorus level because of the low solubility of native phosphate minerals and the ability of soils to retain phosphate.

Turbidity

The suspension of particles in water interfering with the passage of light is called turbidity. The turbidity is caused by a wide variety of suspended particles dissolved in water. That turbidity can be found either by its effect on transmission of light which is termed as turbidity- meter or by its effect on the scattering of light which is called as nephelometry. As per IS:10500-2012, the acceptable and permissible limits are 1 and 5 NTU respectively.

Conclusion

The present work is an attempt to evaluate the drinking water quality most of the sample analysed were found contaminated at the due to one or more parameters only pH values of all samples were in the permissible range. Certain parameters in all samples cross the WHO limits. Water sample source site J18

(Ghimana villagers were found cancer affected.) Has been observed that large use of artificial carcinogenic chemicals like high concentration of nitrogenous fertilizer in the agriculture sector, insecticide, pesticide and other hazardous chemicals). Drinking water contains 1.5 PPM Arsenic. Such cases are also noted in other villages of Jind District, Haryana ,India . Cancer cases increase day by day due to polluted air water and food contents. In a nutshell from the results it is suggested the drinking water must be treated before supply for domestic purposes.

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