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A Physico-Chemical Study of Water Quality Parameter of Drinking Water of Rural Areas Aleva, Jind, Haryana, (India)

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ABSTRACT
Water is the most abundant, wonderful, precious gift of the nature and is one of the substance essential for sustaining life and environment. Water function as a solvent for wide variety of chemical substances and facilitates industrial cooling and transportation. Water has acted as driving force for every civilization and is a part of all basic human needs, including food drinking water,sanitation, health, energy and shelter. Without water we can have no society, no economy, no culture and no life. Water quality has been deteriorated over the last few decades due to its over exploitation. The study of water quality is based on essential parameter analysis, when the overall focus is sustainable development keeping mankind at the focal point. To assess the fitness of drinking water in the present study was conducted to analyse the various parameters of underground water in rural area of (Alva block) Jind ,Haryana, India. Physico-Chemical parameters viz., TDS,pH, fluoride, nitrate , sodium potassium ,calcium magnesium, bicarbonate, sulphate, phosphate, hardness and alkalinity were investigated. The result were compared with drinking water quality standard prescribed by the Bureau of Indian Standards (BIS). Groundwater sampling carried out in January 2024 to February 2024. Most of the water samples were found to have the total dissolved solids alkalinity and the hardness value more than their permissible level. Of these parameter might have health problems and so they need attention. The above studies are helpful to understand the groundwater quality and their subsquito and fitness or unfetness of water for drinking & domestic purposes at various sites undertaken. it is estimated that the water quality of water supply system in different area of ALEVA is of medium quality and can be used for domestic use after suitable treatment. Suitable suggestion have been made to improve the quality of water.

I. INTRODUCTION

What is considered as the one of the panch mahatatv; Agni, vayu, Prithvi, Aakash and jal (water). Water is considered as the one of the nutrient although it have no calorific value. It enters into structural composition of cell and its essential component of diet (Baloch et a.,2000). It is essential for all metabolism in body and contribute to heat regulation by perspiration. Degradation of water quality creates the water scarcity and limits its available for human use and ecosystem and their by impact the optimum management of water resources (Rao and Mamta,2004). Right quality and availability of sufficient quantity of water is necessary infrastructure for promoting better quality of life.A daily per capita consumption of 2 liters water by a person wearing approximately 60 kg is generally assumed (WHO 1996).

Gleick (1999) estimated 50 LP CD as a true minimum to sustain life in moderate climatic condition and average activity level water has always been one of the most precious commodities. Water is the mother of life. Charak Sanhita Sutrasthansm (196) also States the importance of water:

"Jalamekam vidham sarvam patayaindram nabhastalat,Tatapatatpatitam caiva desakalsvapeksate."

It is considered that the lord Indra direct The fall of water from heaven according to the activities performed by mortals the water while falling from the sky acquire property depending upon time and space (Krishnamurti ,R. 1996). The importance of water can be understood by the fact of many great civilization in the past sprang up along or near the water body in India and abroad. Clean, fresh, drinking water is essential to human and other living beings. Our natural environment supply as clean drinking water. Provision of regular supply of clean drinking water is a breath right of all citizens of a country . Access to safe drinking water has improved steadily and substantially over the last

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decades in almost every part of the world (Lomborg.2001). Pure water means differently for different people. Home owners are primary concerned with the domestic water problem related to colour, order, taste and safety to family health. Chemist and engineer want to minimize scale deposition and pipe erosion. Farmer or interested in irrigationally (chemical, physical and osmotically) pure water. Water meeting these conditions is termed as "potable" meaning that it is to be consumed in any desirable amount without concern for adverse effect on health (AWWA ,1990). Although roughly 66% of surface is covered by water; what is scare, as most is salt water. Less than 2.5% of all the earth water is fresh water; most of it locked in ice cap and only a fraction of that is available to supply the multitude of human uses. Water is used in both productive and consumptive activities and contributed to rural and urban livelihood in complex way. Groundwater is the major source of water in our country about 85% of population depend on it (Giri and Singh,et al. 2014). Inverter high concentration of nitrate in groundwater has been related to the excessive use of nitrogen fertilizer in agriculture and high amount of organic waste generated by the human population (Katariya, 2004).

II. Review of literature

Pollution of groundwater resources due to the geological condition has become a matter of serious concerned (Rao and Mamta,2004). Most of the critical quality related problem of groundwater in India are cited as geogenic largely due to measure inorganic pollutant like Fluoride and Arsenic. Arsenic problem prevails in 3136 habitations and fluoride is endemic in 36,988 habitations (DdWS,2004). Arsenic contamination of groundwater invariably arise from the natural geological and environmental conditions. Arsenic arise in many over and mineral and is frequently present in combination with iron and magnet oxide: under various natural condition it can be rented soluble and related to the groundwater. Groundwater with high fluoride content inspired mostly in calcium- deficient ground water in many basement acquifer, such as granite and gneis in geothermal water and in some sedimentary basin. 20 state (about 200 district) in India have been identify as endemic to fluorescis due to abundance in natural occurring chloride bearing mineral. The fluorecis problem is sever in India as almost 80% of rural population depend on untreated ground water for portable water supplies (Rao and Mamatha ,2004). Factor contributing to access fluoride in groundwater in rural reason of India is over exploitation of groundwater resources for agriculture and drinking water purpose. Though iron content in drinking water may not affect the human system as a simply dietary overload in the long run pro longed accumulation of iron in the body may result in heam chromatosis where tissue are damaged. It is total of 106019 sq km (about 31%) of Rajasthan comes under saline groundwater. Arsenic in groundwater has been reported in shallow aquifers from 61 block in a districts of West Bengal. The impact of anthropogenic activity has been so expensive that the water bodies have lost their self purification capacity to a large extent (Sood et al. 2008). Over 1 billion people in the world lack access to safe water supply exposure to environmental health risk in early childhood lead to permanent growth faltering, lowerd immunity and increase mortality. Poor water sanitation and inadequate water resource management account for half of the causative factor behind childhood and maternal underweight and hence child growth (World Bank 2008). Approximately 3.01% of deaths (1.7 million) and the 3.7% of disability adjusted life years (54.2 millions) worldwide are attributable to unsafe water, poor sanitation and hygiene (WHO 2005). Currently it is estimated the two third of people in Asia still lives without any access to drinking water (WHO 2004). Water quality deterioration mein occur due to source of fickle pollution including grading cattle natural animal population septic tank field system recruitional recreational users and summer storm activity etc .(Crabil et al. 1999) cal polution off drinking water cars water boring disease which wise spread over enter population of cities (et al., 2002). Review of literature shows that no study have been Undertaken in the study area in regard of Physico-chemical characteristic of ground drinking water yet. Show the objective of the study is to investigate and analyse the quality of drinking water in (ALEVA BLOCK) Jind, Haryana, India. Some of the areas of sample sites have been observed high value of nitrate, due to the large use of nitrogen fertilizer in agriculture.

Study area and sampling

20 sample work collected in post Monsoons (January and February 2024). The samples were collected in pre treated and labelled plastic bottles (1.5L) and immediate preserved and analyzed following standard protocols given in APSA (APSA 1992). Each bottle was washed with 2% nitric acid and then rinsed three time with distilled water .The sampling places were referred as

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the station (A-1 to A-20). Different sampling location are given in Table 1.

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

Sr. No.	Sample Site	Source	Code	Depth
1	Alewa	Submersible	A-1	165
2	Badhana	submersible	A-2	255
3	Bighana	Submersible	A-3	50
4	Bohalwala	Handpump	A-4	148
5	Chudhpur	Submersible	A-5	75
6	Dalamwala	Submersible	A -6	220
7	Deohala	Handpump	A-7	450
8	Dhiluwala	Submersible	A-8	75
9	Durana	Handpump	A-9	88
10	Gohian	Handpump	A-10	60
11	Hasanpur	Submersible	A-11	135
12	Jiwanpur	Handpump	A-12	250
13	Katwal	Submersible	A-13	95
14	Khanda	Handpump	A-14	220
15	Kheri bulanwali	Submersible	A-15	170
16	Kheri Naguran	Handpump	A-16	150
17	Khunga	Handpump	A-17	120
18	Kuchrana kalan	Handpump	A-18	150
19	Kuchrana khurd	Handpump	A-19	156
20	Majra Pergan	Submersible	A-20	350

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

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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
U-1	27.5	7.52	1.289	195	312	165	92	108 180	211	1.9	818	7	67	3	28 0.34
U-2	28.4	7.64	1.424	532	360	92	33	121 130	123	3.8	720	5	87	8	45 0.33
U-3	29.7	8.26	2.534	757	460	63	64	275 395	375	1.1	560	11	34	6	59 0.46
U-4	28.4	7.47	0.467	665	310	78	85	230 470	455	2.7	401	29	99	3	63 0.57
U-5	28.5	8.85	2.524	835	465	85	86	240 525	520	1.3	312	9	23	2	75 0.65
U-6	27.7	7.68	1.678	608	395	118	97	254 550	675	1.6	276	12	73	6	32 0.75
U-7	29.4	7.59	1.343	638	378	197	186	277 605	703	1.5	456	40	356	4	31 0.50
U-8	27.3	8.33	1.895	582	215	65	89	372 135	837	4.3	210	20	259	4	27 0.28
U-9	28.9	7.09	2.123	643	310	115	71	288 355	175	0.7	446	48	563	5	14 1.29
U-10	29.8	7.43	1.691	748	430	78	42	290 585	280	0.7	563	37	74	3	68 0.36
U-11	26.7	8.82	1.430	365	200	124	93	313 220	440	1.9	516	46	55	7	76 0.60
U-12	27.5	7.55	1.890	654	340	78	160	225 370	340	2.6	614	59	90	7	89 0.74
U-13	29.7	8.12	1.674	775	325	89	73	237 460	390	1.8	332	26	186	4	23 1.42
U-14	28.6	7.75	2.129	885	415	54	45	143 180	270	1.8	226	79	284	5	31 0.30
U-15	29.4	8.47	1.176	512	375	88	76	253 240	210	2.7	258	5	96	8	55 0.48
U-16	26.3	7.52	0.986	634	330	82	87	368 220	595	2.5	154	31	75	3	27 0.36
U-17	29.3	7.77	0.897	689	392	75	39	172 114	891	2.3	398	28	97	4	43 0.76
U-18	28.4	7.92	1.258	580	350	98	81	289 325	543	2.4	420	71	247	4	65 0.86
U-19	29.7	7.48	2.899	827	450	23	62	195 236	425	1.8	560	42	364	8	49 0.34
U-20	26.9	7.61	2.562	534	530	88	83	110 340	325	2.2	601	38	98	9	31 0.82

III. MATERIALS AND METHODS

Portable water analyzer kit (wtw multi 340/SET) was used to measure for water quality parameter on sampling sites, these were pH water temperature (WT) dissolved Oxygen (DO) and electrical conductivity(EC). Other all parameters (TDS, TH,TA,Ca^{2+},Mg^{2+},Na^+,K^+,$SO4^{2-}$,$PO4^{3-}$, chloride, fuoride ,nitrate etc.)were determined by using standard method recommended in manual of APHA)AWWA/WEF(APHA1992). All reagent used for analysis were AR grade and double distilled water use for preparation of solutions. In

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the present study Minimum, Maximum Average and Standard deviation have been calculated for each pair of water quality parameters by using Excel spreadsheet for experimental data .The standard formulae used in the calculation for statistical parameter as follow (BIS ,2012) detail of method are summarized in Table 2.

IV. RESULT AND DISCUSSION

The respective value of all water quality parameters in water samples are illustrated in the Table 3. The results of all samples are compared with the standard permissible limit recommended by the Bureau of Indian Standard (BIS) Indian Council of Medical Research(ICMR) and World Health Organisation (WHO) depicted in the Table 2. Statistical parameter of the groundwater sample of study sites are summarised in Table 4 .

pH

The pH indicates the intensity of acidity and alkalinity and measure the hydrogen and concentration in water. The pH ranges from 1 to 14. Neutral water has pH of 7.The pH is related and labile to change with temperature and pressure. The pH value of all ground water sample is found to be in the range of 7.20 to 8.63. the highest value of 8.63 is observed at the station A-19(kuchrahana khurd) where is lowest values 7.20 observed at A-4. The PH value of the groundwater samples are well within the acceptable limit of WHO (BIS ,2012) except A-19. The mean value of pH was 7.89. Standard deviation 0.36 indicating slightly alkaline nature of water. There is no anmulus change in groundwater samples. Long term exposure to more than pH 8.50 permissible limit affects the mucus membrane of cells.

Electrical conductance

Electrical conductivity signify the the major of capacity of a substance to conduct the electric current. Most of the salts in water are present in the ionic form and capable of conducting current. Conductance is a good indicator to assess ground water quality. EC is a useful parameter of water quality for indicating salinity hazards. In the study area, EC values varied between 0.801 to 3.870 dS with a mean value of 1.676 dS and standard deviation 0.758. Major positively charged in our Sodium(Na+),Calcium (Ca^{2+}), Potassium(K^{+})& Magnesium (Mg^{2+}) contribute in electrical conductivity of water. Major negatively charged in our chloride(Cl'), sulphate (SO4"), carbonate (CO_3")& bicarbonate (HCO_3'). Nitrate NO3'and phosphate(PO_4^{3-}) are minor contributed to the conductivity but they are very important biologically. Salinity is a good indicator to assess the concentration of salt in drinking water. Salinity is an ecological factor which influence organism that live in water body and the growth of plant that will grow either in water body or on the land fed by the groundwater (BIS 2012 ,Rani et al., 2003).

Total dissolved solids (TDS)

In the present study case groundwater sample show the variation of TDS between 553 to 2440 mg/L. For domestic use maximum permissible limit of total dissolved solid is 1000 mg/L,(permissible limit of WHO). Maximum value of 2240 mg/l, recorded at the site, A-19 and minimum value of 553 milligram per litre is recorded at A-2 site. Samples number A-6 to A-9, A-11 to A-13 ,A-18 ,A -19 were found to be saline. The high concentration of dissolved solids and may cause the water to be corrosive, salty brackish taste, result in scale formation (BIS, 2012).

Total hardness (TH)

Total hardness of water play vital role in domestic sector for drinking ,bathing and washing purposes. Total hardness is the sum of concentration of alkaline earth metal cation Ca^{2+} and Mg^{2+}. Total Hardness is the total soluble Magnesium and Calcium salt present in the water expressed as its CaCO3 equivalent. TH also include sulphates ,chlorides of calcium and magnesium. In most natural water predominant ions are those of bicarbonate associated mainly with calcium to lesser degree with the magnesium and still less with sodium and potassium. Extremely hard water consumption causes hypertension and increases the risk for stroke, left ventricle hypertrophy, osteoporosis, renal stone and asthma. In the present study total hardness analyzed in water samples were found in the range of 260 to 1350 mg/L. But ,the WHO guideline value of TH ranges 300 to 600 mg/L indicate that all samples A-7,A- 9, A-11,A-12,A-13, A -18, A-19 exceeded the maximum limit for drinking water. Calcium content of water in present study was found in the range of 52 to 288 mg/L. Similarly, Mg content varied from 32 to151mg/L. Ca and Mg both are essential minerals for living organisms. Recommendations have been made for the maximum & minimum level of Ca (75 – 200 pp and Mg (~50 ppm) in drinking water (Rani et al. 2003).

Total alkalinity (TA)

Total alkalinity mainly arise due to carbonate, bicarbonate, hydroxide etc. Alkalinity of

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water sample was very from 195-870 mg/L with a mean value of 382 and standard deviation 158. Water of sampling site A-2 recorded normal value and within the guideline of prescription range of WHO & BIS for total alkalinity (200 mg/L) with permissible limit 600 mg/L. Totel alkalinity in natural water is attributed due to bicarbonate (Srinivas et al.,2000). Very high value alkalinity for water of sampling site A-19 is due to high bicarbonate (870ppm) and sulfate contents in the reported sample.

Chloride/ Fluoride

Chloride content in present study was found in the range of 111 to 493 mg/L, with mean value of 259 & standard deviation 98.Chloride concentration higher than 200 mg/L is considered to be risky for the human consumption and cause unpleasant taste of water (Sharma et al. 2004). Fluoride contents ranged from 0 to 7.5 mg/L. In some of the water samples fluoride concentration were found higher than the permissible range 0.6 - 1.5 mg/L. High value of fluoride in the study areas A-6,A-7, A-8,A-17 and A-19) might be due to the presence of fluoride bearing mineral in the region. So that dental skeleton Fluorosis were observed in the study areas of A-8, A-17 and A-19.

Nitrate

The nitrate contents in the present study case was found in the range of 2 to 53 mg/L. Nitrate values are commonly reported as either nitrate (NO_3') or as nitrate- nitrogen (NO_3'--N). The maximum content level (MCL) in drinking water as nitrate is 45 mg/L, where is MCL as NO_3-N is 10 milligram per litre. MCL is the highest level of NO_3' or NO_3-N that is available in the public drinking water supply by the U.S. Environmental Protection agency (EPA).

High value of nitrate in water can cause methemoglobinemia or Blue baby syndrome, a condition found especially in infant less than 6 months. Stomach acid of infant is not as strong as in older children and adults discuss and increase in bacteria that can redeally convert nitrate to nitrite.

Iron (Fe^{3+})

Iron content in the present study was found with in the guideline value as recommended by NDWQS and WHO. The study revealed that all sampling site contain the metal content in normal range of 0.0 to 0.5 mg/L. All kind of water including groundwater have appreciable quantities of iron. Iron is one of the most abundant elements in nature ranking fourth by weight.

Sodium /Potassium ions

The value of sodium in drinking water sample was found in the range of 98-386 mg/L. Samples except (A-4,A-6 to A-9, A-11, A-13, A -14 A-15, A-16, A-17, A-18, A -19 & A-20) are in the range given by WHO/ BIS (200 mg/L). Potassium value range between 2 to 79 mg/L. The recommended limit of WHO is 15 mg/L. Very high value of potassium is due to potassium bearing mineral in the region (A-14). In healthy persons high level of potassium(upto 3700 mg/Day) possess no harmful effects because Potassium is readily excreted. A very high dose of potassium result in chest tightness, nausea ,vomiting, diarrhea, hyperkalaemia, shortness of breath and heart failure (BIS 2012).

Sulphate

Natural water contains sulphate ions and most of these ions are also soluble in water many sulphate ions are produced by the oxidation of their ores. They are also present in industrial wastes.The content of sulphate present study area range of 34 - 325 mg/L. The method to measure the quantity of sulphate is by UV spectrophotometer. As per IS :10500-2012 desirable limit for sulphate is 200 and 400 mg/L in Permissible limit.

Phosphate

Phosphorus is an essential plant nutrient and most often control plant growth in freshwater. The contents of phosphorus in present samples were found in the range of 0.0 to 7.0 mg/L. Normali ground water contain only minimum Phosphorus level because of the low solubility of native phosphate mineral and the ability of soil to retain phosphate.

Turbidity

Suspension of particle inverter interfering with the passage of light is called turbidity. Turbidity is called by wide variety of suspended turbidity can be measured either by its effect on the transition of light which is from the turbidity-metry or by its effect on the scattering of light which is termed as nephelometry .As per is 10500 -2012 the acceptable and permissible limit are 1 and 5 NTU respectively.

V. Conclusion

The present work is an attempt to access the drinking underground water quality. Most of sample analyzed were found contaminated either due to one or more parameters. Only pH and iron value of all sample work in permissible range certain parameter in all sample work cross the WHO guideline. Arsenic is carcinogenic is reported in A-1 is 0.946ppm. and there for its presence is a serious threat. After analyzed samples study area it was

concluded that drinking water must be treated before supply domestic use.

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