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GROUNDWATER QUALITY IN SOUTHERN AREA OF KOREA DISTRICT OF CHHATTISGARH, INDIA

Harsha Tiwari [1], Krishna Kumar Kashyap [1], Manoj Kumar Ghosh [1], Rajendra Prasad Kushwaha [2]

[1] Department of Chemistry, Kalinga University, Nava Raipur
[2] Department of Chemistry, Govt GB College, Hardibazar

Corresponding Author
Harsha Tiwari,
h.tiwari0709@gmail.com

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ABSTRACT

The important of managing the different aspects of the water, including its quality, quantity, transport processes, utilization and management becomes apparent when the supply of water, especially portable water is limited. This article is intended to be an introduction of the subject of groundwater. This study investigates the groundwater quality in Korea district of Chhattisgarh based on preselected 13 sample points. During the 2023-24 seasons, a total of 13 groundwater samples were obtained and analysed for significant physicochemical parameters. Comparison of finding against drinking water quality requirements by Indian standards for the maximum appropriate level of quality of drinking water (BIS), ICMR, USEPA, and WHO; some samples were not found to be suitable for human use.

Keywords: Portable Water, Physicochemical Parameters, Groundwater Quality

1. INTRODUCTION

The Earth's freshwater resource consists mostly of ice, snow and groundwater. Rivers and lakes represent a very small portion of the global amount of freshwater. Earth's total resource of fresh water are estimated at about 107 cubic kilometres more than two hundred times the global annual renewable water resource provided by rain. This is because most groundwater resource has accumulated over centuries or even millennia. In some places they have experienced the climate in the past. These remarkable freshwater assets can be found even in present day desert zones. The overwhelming freshwater resource is the annually renewed input of precipitation around the globe. India is a tropical country with a wide diversity of climate, topography and vegetation. Although blessed with fairly high annual rainfall, it is not evenly distributed over time and space, resulting in a large part of the rainfall that escapes as runoff. (C. Sarala and P. Ravi Babu, 2012). Groundwater is an invisible, subsurface part of the natural water cycle in which evaporation, precipitation, seepage and discharge are the main components. The visible components are all strongly affected by climate and weather, and although they can contaminated quickly, they generally recover quickly too. The subsurface groundwater processes, by contrast, are much slower and longer lasting, ranging from years to millennia. These various time scales can however be used with careful management to build an integrated water supply system that is robust in the face of drought. People rely on water for their lives and their livelihoods. Demand for clean water continuously grows in line with the growth of the world population. People in many parts of the world lack the new, potable water they need to live; if they are to prosper, more secure and low cast water supplies are needed. Without groundwater it would be difficult to maintain secure water sources for drinking, industry and agriculture, the largest and most reliable of all fresh water resources. Groundwater is a very useful natural resource for economic growth and safe supply of drinking water in urban and rural areas (R. khan and D.C. Jharia, 2017).

The importance of groundwater in drinking and other uses has been studied significantly in its environmental aspects such as the transport of pollutants (M.K. Ghosh and S. Ghosh, 2013). The composition of groundwater is typically determined by geological formation and anthropogenic inputs (Yuan et al., 2018). In India, urbanisation, industrialization, agrochemicals, population stress, etc. Consider the quality of groundwater as extracted from the aquifer system (Pawar et al., 2006). A major cause of groundwater contamination is the rapid speed of industrialization that has become the hour-need for a developing country like India today. Industry effluents, domestic waste, dump sites; fertilisers have led to groundwater pollution by intrusion into the subterranean aquifer and pose potential risk to receptors (Z. O. Ojekunle et al., 2020). Nevertheless, global society, industrialization, urbanisation, population growth and unsuitable waste management are agents of groundwater quality degradation (A. Khan and Y. Rehman, 2017). As groundwater is often associated with geological materials containing soluble minerals, elevated amounts of dissolved salts are generally expected in groundwater relative to surface water. The type and concentration of salts depends on the geological formation, the source and movement of the water (WQA, 1992). When we talk about pollution of groundwater, we mean solutes dissolved in water that may make it unfit for our use or unfit for an environment that the water enters. Most natural waters contain at least a certain amount of dissolved substances that we consider to be contaminants. Groundwater pollution, also known as groundwater contamination, is not as easily classified as surface water pollution. Due to its existence, groundwater aquifers are vulnerable to pollution from sources that do not specifically impact surface water bodies, and it may be impossible to discern point vs. nonpoint source. Contaminants that contribute to groundwater contamination include a wide variety of chemicals, bacteria, and physical or sensory changes such as elevated temperature and discolouration. High concentrations of naturally occurring substances such as calcium, sodium, iron, fluoride, etc. may have negative effects on aquatic flora and fauna. Their concentration is crucial in deciding what a natural water component is, and what a contaminant is. Other substances that are natural and anthropogenic can cause turbidity and other negative effects (EPA, 2005). Chemical effluent polluted air, soil and water are associated with disease burden such as flurosis, diarrhoea , dysentery, typhoid, dengu, malaria, hepatitis, ability, cancer, gastroenteritis, liver and bowel infection, etc. (M.K. Ghosh et al., 2016). The quality of groundwater is of great importance in assessing the suitability of specific groundwater for a particular use (public water supply, irrigation, industrial applications, electricity generation etc. (V. Jena et al., 2012). The object of this paper is to examine the chemical composition of groundwater samples of Southern area of Korea District, Chhattisgarh, India

Study Area

S.N.	Sample ID for Groundwater Samples	Name of Sampling location	Source
1	Ks1	Baikunthpur	Handpump
2	Ks2	Shivpur Churcha	Bore
3	Ks3	Amgaon	Handpump
4	Ks4	Nagpur	Well
5	Ks5	Chirimiri	Handpump
6	Ks6	Jilda	Bore
7	Ks7	Junapara	Handpump
8	Ks8	Miyapara	Handpump
9	Ks9	Bade Salhi	Well
10	Ks10	Manjhapara	Bore

11	Ks11	Bahalpur	Handpump
12	Ks12	Lalpur	Bore
13	Ks13	Manendraharh	Well

The district of Korea is located between 22 ° 56′ and 23 ° 48′ N, and 81 ° 56′ and 82 ° 47′ E. It is bounded on the north by Madhya Pradesh District of Sidhi, on the south by District of Korba, on the east by District of Surajpur, and on the west by District of Madhya Pradesh of Anuppur. District area is 5977 km2, 59.9 % of which is forest land. The district is a huge mass of rows of hills. The general height of the lower tableland is 550 m (1800 feet) above sea level. The Sonhat Plateau has a maximum elevation of 755 m (2477 f). The highest peak in the district is Deogarh, which is 1027 m (3370 feet) high.The climate is mild with a monsoon, a mild summer and a bearable winter. The district of Koriya consists of five subdivisions of Baikunthpur, Bharatpur, Chirmiri, Manendragarh and Sonhat, five tehsils and five Districts of Baikunthpur, Bharatpur, Khadgawan, Manendragarh and Sonhat, and Chirimiri Municipal Corporation. The district contains 653 villages, 5 Janpad Panchayats, 236 Panchayats garam, 2 Panchayats Nagar and 3 municipalities.

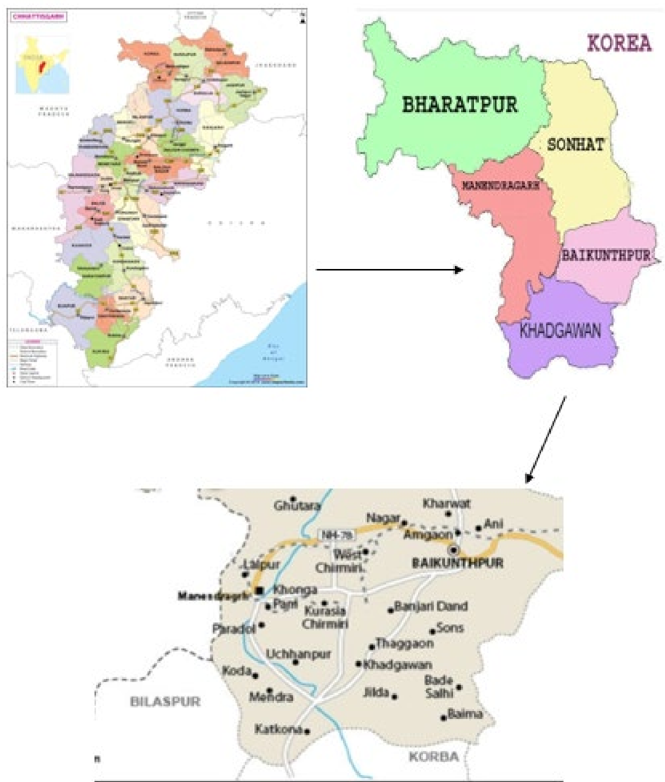

Figure 1 Southern area of Korea district

The headquarter of Korea district is in Baikunthpur Which is present in the southern part of this district. This district has SECL area is known as Bakunthpur area which extends from Churcha to katkona (Katora siding) and Katgondi. The entire part of Khadgawan and Baikunthpur tehsil in the southern area of this district and some portion of Manendragarh tehsil . According to the study area of this paper, these were sampled from the area which is present in table :-01

Chhattisgarh state average annual rainfall is 1292 mm. approximately 87 % State area is surrounded by hard rocks. In these rocks the supply of groundwater is mainly determined by topography and rainfall. The groundwater capacity is not consistent due to the varied topography and hydrogeological condition in the state, and it varies from one region to another. Korea district average annual rainfall is 1002.3 mm. Over the years the groundwater level in the region continues to drop due to overexploitation and excessive water extraction using bore wells, well and Handpums. Field visits and interactions with farmers have shown that the drilling of bore wells in search of water in the recent past is very high due to drilling.

Table 2 Chemical Parameters and their Methods used (APHA2005)

S.N.	Parameters	Methods
1	Temperature	Thermometric Method
2	pH	pH Meter
3	EC	Conductivity Meter
4	Turbidity	Nephelometer
5	TDS	HM Digital meter TDS-3
6	Total Alkalinity	Titration Method
7	Total Hardness	Titration Method
8	Ca^{2+}	Elico flame photometer
9	Mg^{2+}	Elico flame photometer
10	COD	Spectroquanta Merck COD Meter
11	BOD	BOD Merck BOD Meter
12	DO	Chemiline DO Meter
13	Cl^-	Titration against $AgNO_3$ Solution
14	F^-	Ion selective Electrode
15	Iron	ICP-AES
16	SO_4^{2-}	Turbidimetric Method
17	CO_3^{2-}	Titration Method
18	HCO_3^-	Titration Method
19	Na^+	Elico flame photometer
20	K^+	Elico flame photometer
21	As^{3+}	ICP-AES
22	Pb^+/Pb^{2+}	ICP-AES
23	Zn^{2+}	ICP-AES

2. MATERIALS AND METHODS

Survey & Sample Collection:- Samples are collected from 13 sampling sites in southern area of Korea district during July 2023- June 2024. Samples of groundwater from Groundwater sources were obtained in polyethylene bottles that were immersed in 15 % nitric acid overnight. The soaked containers of polyethylene were cleaned with deionised water, then dried at room temperature. The containers were subsequently rinsed with water supply several times to ensure adequate flushing before processing. Samples of these samples are obtained after 10 minutes of draining the stream. To prevent unexpected variations in water content, all samples were taken to the laboratory in an icebox container and placed in a refrigerator (40C) before study. The selection, planning, and preservation procedures were similar to those recorded in previous studies and the American Public Health Association (APHA 2005) specified Basic methods were adopted.

Figure 2 study area and sampling sites

Physico-chemical analysis: All the sample were analysed for the following physico-chemical parameters; Temperature, pH, EC, Turbidity, Total Dissolved Solid (TDS), Total Hardness, Total Alkalinity, Calcium (Ca2+), Magnesium (Mg2+), Sodium (Na+), Potassium (K+) Chemical Oxygen Demand (COD), Biological Oxygen Demand (BOD), Dissolved Oxygen (DO), Chloride (Cl-), Fluoride (F-), Iron (Fe2+/Fe3+), Sulphate (SO42-), Carbonate (CO32-), and Bi-carbonate (HCO3-), Arsenic (As3+), Lead (Pb+/Pb2+), and Zinc (Zn2+) . The Physico-chemical analysis of groundwater sample was carried out in accordance to standard analytical method (APHA, 2005).

Parameters	USEPA	BIS	ICMR	WHO
pH	6.5 -8.5	6.5-8.5	8.5	6.5-8.5
EC	-	1500	300	1500
Turbidity	5	Oct-25	May-25	May-25
TDS	500	500-2000	500-2000	1000
Total Alkalinity	200	75-200	75-200	75-200
Total Hardness	300	300-600	300-600	300-600
Ca^{2+}	200	75-200	75-200	75-200
Mg^{2+}	150	30-100	50-150	50-150
COD	-	-	20	-
BOD	5	5	5	5
DO	-	-	5	-
Cl^{-}	250	250-1000	1000	250
F^{-}	4	1.0-1.5	1.5-2.0	1.5
Iron	0.3	0.3	1	0.1
SO_4^{2-}	500	150-400	200-400	400
Na^{+}	-	-	-	200
As^{3+}	0.05	0.05	0.05	0.001
Pb^{+}/Pb^{2+}	0.05	0.1	0.05-0.10	0.05-0.10
Zn^{2+}	5	5.0-15	0.1	5

Physical water quality properties include temperature, EC and turbidity. Chemical properties include quantities including pH, Total alkalinity, Total hardness, Chemical oxygen demand, Biochemical oxygen and dissolved oxygen. Monitoring of water quality can help researchers predict and benefit from the environment's natural cycles, and assess human impacts on an ecosystem. The case study focussed primarily on groundwater quality monitoring in Korea Region. They were chosen based on survey of sampling sites. The samples were analysed for physico-chemical parameters according to the protocols recommended in normal methods for water and wastewater analysis. Standards for drinking water quality describe the parameters set for drinking water quality. Despite the fact that every human being on this planet needs drinking water to live, and that water can contain many dangerous constituents, international drinking water regulations are not widely understood and approved. Any physico-chemical parameters of waste water may have multiple environmental consequences. USEPA, BIS, ICMR and Others have announced their water quality requirements.

3. RESULT AND DESCUSSIONS

'Contamination by sewage, human and animal excreta is associated with drinking water. The method of indicating organisms as invented by Percy Frankland in London in 1981 is essentially the concept of using organisms that are usually abundant in human and animal excrement, as evidence of contamination and possible presence of other potentially dangerous microorganisms (WHO, 1984). All the experiments were performed using the techniques described in APHA 2005. Related statistical analyses of the experimental data were carried out using Microsoft Excel 2010. Groundwater quality in and around the southern portion of the district of Korea. The groundwater is basic in nature and the overall hardness found in all samples falls into the range of hard to very hard. Calcium has no impact on human wellbeing in water, yet it can cause hardness issue hazard and straightforwardly identified with hardness. The total dissolved solids dropped to levels of salt under fresh water. Chloride and fluoride are very prevalent in water supplies. They are added to drinking water for various health and sanitation purposes. However, chloride and fluoride levels can be increased by Contamination with fertilisers, ground salt and factory waste including human and animal waste. The concentration of fluoride in the southern area exceeded the standard limits. The concentration of physiochemical constituents in water samples was correlated with the Bureau of Indian Standards in order to know the suitability of drinking water.

The findings derived from the study are summarised in Table 4. Standard water quality statistics of groundwater monitoring parameters are summarised in table 5.

Table 4 Seasonal Variations of the Physico-chemical Parameters Groundwater Samples during the study period

Parameters	Ks1	Ks2	Ks3	Ks4	Ks5	Ks6	Ks7	Ks8	Ks9	Ks10	Ks11	Ks12	Ks13
Temperature	20.8	21.1	19.6	21.4	20.3	20	20.4	21.2	20.5	19.8	20.3	21	22.1
pH	8.7	7.2	7.6	7.3	7.2	7.4	7.1	8.1	7.2	8	8.3	7.3	7.4
EC	568	476	462	381	416	458	402	396	338	347	432	426	399
Turbidity	5.2	4.1	6.3	4.5	5.4	5.2	7.1	3.6	4.8	4.2	6.1	7.2	3.8
TDS	1026	978	962	784	826	958	812	792	688	720	916	852	766
Total Alkalinity	295	210	215	205	210	205	215	225	200	210	220	210	220
Total Hardness	504	448	478	434	436	470	436	496	438	442	484	424	438
Ca^{2+}	71.31	43.24	41.65	53.57	46.36	27.82	48.41	53.75	47.23	36.94	70.17	39.48	43.83
Mg^{2+}	26.7	19.23	21.26	23.46	20.18	24.06	18.76	29.5	23.68	28.82	29.64	18.73	25.94
COD	14	18	12	13	17	20	12	14	22	18	16	15	18
BOD	6.18	7.32	5.84	6.07	6.94	8.45	5.768	6.44	9.36	7.54	7.12	6.48	7.41
DO	6.56	5.14	7.88	7.6	5.43	5.08	7.72	6.49	4.72	5.26	5.86	5.92	5.32
Cl^{-}	213	193	195	187	304	205	198	186	178	193	216	194	199
F^{-}	1.23	1.76	1.37	1.58	1.48	3.187	2.76	2.87	1.92	1.66	1.57	1.5	1.36
Fe^{2+}/Fe^{3+}	0.37	0.32	0.27	0.19	0.21	0.17	0.23	0.3	0.37	0.31	0.3	0.33	0.34
SO_4^{2-}	52.67	71.69	62.24	35.6	72.65	70.41	39.49	63.88	38.12	26.86	79.46	28.98	35.65
Na^{+}	17.39	26.73	19.86	11.75	16.86	16.54	23.11	28.96	24.08	12.63	17.89	20.62	13.77
K^{+}	1.87	1.19	2.3	3.64	1.58	2.49	0.47	1.96	2.62	1.04	2.57	1.91	2.25
CO_3^{2-}	242	168	176	174	165	182	177	180	166	173	164	169	186
HCO_3^{-}	53	42	39	31	45	23	38	45	34	37	56	41	34
As^{3+}	0.017	0.023	0.014	0.036	0.048	0.024	0.045	0.008	0.021	0.012	0.02	0.031	0.027
Pb^{+}/Pb^{2+}	0.009	0.076	0.017	0.022	0.028	0.015	0.02	0.014	0.031	0.036	0.023	0.021	0.01
Zn^{2+}	1.42	1.531	1.492	2.289	1.498	2.421	1.504	2.906	1.028	2.675	1.346	0.604	0.425

Parameter	Minimum	Maximum	AM	SD	CV	Median
Temperature	19.6	22.1	20.65	0.07007	3.3921	20.8
pH	7.1	8.7	7.6	0.5082	6.6876	7.4
EC	338	568	423.15	60.02	14.184	416
Turbidity	3.6	7.2	5.19	1.1919	22.956	5.2
TDS	688	1026	852.3	106.379	12.481	826
Total Alkalinity	200	295	218.46	24.012	10.991	210
Total Hardness	424	504	456	26.745	5.865	448
Ca^{2+}	27.82	71.31	47.98	12.196	25.418	46.36
Mg^{2+}	18.73	29.5	23.84	4.0466	16.972	23.68
COD	12	22	16.07	3.0946	19.249	16
BOD	5.78	9.36	6.99	1.0502	15.017	6.94
DO	4.72	7.88	6.07	1.0846	17.853	5.86
F^{-}	1.23	3.18	1.86	31.613	15.444	1.58
Cl^{-}	178	216	197.15	0.6434	34.496	195
Fe^{2+}/Fe^{3+}	0.17	0.37	0.28	0.0664	23.72	0.32
SO_4^{2-}	26.86	79.46	52.13	18.709	35.89	52.67
Na^{+}	11.75	28.96	19.24	5.3164	27.624	17.89

K^+	0.47	3.64	1.99	0.812	40.772	1.96
CO_3^{2-}	164	242	178.61	20.23	11.326	174
HCO_3^-	23	56	39.84	8.8303	22.161	39
As^{3+}	0.008	0.048	0.025	0.0121	48.552	0.023
Pb^+/Pb^{2+}	0.009	0.076	0.024	0.0172	69.7944	0.021
Zn^{2+}	0.425	2.906	1.62	0.7546	46.409	1.498

(AM = Arithmetic mean, SD = Standard Deviation and CV = Coefficient of variation)

The present research work has been carried out in study area which is southern part of Korea district.

Temperature: Temperature is positively correlated with the growth rate of microorganisms, some of which develop bad metabolites for degree. Owing to the relationship between odour and vapour pressure, the odour of the material is often determined by temperature, thus odour calculation typically defines temperature. Temperature in groundwater samples range from19.60C to 22.10C. Statistical results recorded are AM =20.650C, SD = 0.5080C, CV = 6.6870C and Median is 20.80C.

pH: The pH of groundwater samples varies between 7.1 and 8.7 suggests that this area's groundwater is suitable for both agricultural and domestic use except Ks1. The Ks7 groundwater sample measures the lowest and the Ks1 measures the highest pH of the collected water samples. The pH range also means that, in nature, the groundwater samples are slightly alkaline. Statistical results recorded are AM =7.6, SD = 0.7007, CV = 3.399 and Median is 7.4.

EC (Electrical Conductivity): Groundwater samples have electrical conductivity varying from 338 µScm-1 to 568 µScm-1. Ks1 has the highest electrical conductivity between the water samples and Ks9 has the lowest electrical conductivity. Electrical conductivity means that the groundwater samples produce free ions. The groundwater flowing into the aquifers would dissolve the salts that are found in the soil and rocks, increasing the ion concentration. The highest electrical conductivity can be attributed to the high salt concentration contained therein. AM = 423.15 µScm-1, SD = 60.020 µScm-1, CV = 14.184 µScm-1 and Median is 416 µScm-1.

Turbidity: Turbidity in groundwater samples range from 3.6 NTU to 7.2 NTU. Ks12 has the highest turbidity between samples of water and Ks8 has the lowest turbidity. Turbidity is the proportion of relative clearness of a fluid. It is an optical quality of water and is an estimation of the measure of light that is dissipated by material in the water when a light is radiated through the water test. The higher the power of dispersed light, the higher the turbidity. AM =5.19 NTU, SD = 1.191 NTU, CV = 22.956 NTU and Median is 5.2 NTU.

TDS (Total Dissolved Solids): Total Dissolved Solids in groundwater samples range from 688 mgL-1 to 1026 mgL-1. Ks1 has the highest TDS value amongst samples of water and Ks9 has the lowest TDS value. The mean of total dissolved solids in the groundwater samples of study area is 852.3 mgL-1. 500 mgL-1 and 2000 mgL-1 are the appropriate and optimum level recommended by BIS respectively. All water samples were above the acceptable level but well below BIS prescribed maximum permissible level. The higher concentration of total dissolved solids could be from the soil condition from which the water flows. From the sum of total dissolved solids calculated, it is inferred that Korea area's groundwater is suitable for agricultural and drinking purposes. AM =852.3 mgL-1, SD = 106.379 mgL-1, CV = 12.481 mgL-1 and Median is 826 mgL-1.

Total Alkalinity: The southern portion of Korea district groundwater samples have an average alkalinity of 218.46 mgL-1 that lies between the acceptable and maximum permissible standards recommended by all the organisations. The highest level of desirability as indicated by BIS is 200 mgL-1. A water study of Ks1, 295 mgL-1, has found the maximum level of alkalinity. A water study of Ks9, 200 mgL-1, showed the lowest level of alkalinity. The alkalinity of water samples was measured to provide an understanding of the salts therein. Water flows into the soils and sedimentary rocks into which it dissolves hydroxide, carbonate, which bicarbonates, which induces alkalinity. AM = 218.46 mgL-1, SD = 24.012 mgL-1, CV = 10.991 mgL-1 and Median is 210 mgL-1.

Total Hardness: The total hardness of the groundwater samples is within the WHO, USEPA, BIS and ICMR defined limits. The highest Total hardness degree, 504 mgL-1, is found in the Ks1 water sample and the lowest total hardness concentration, 424 mgL-1, is found in Ks12. The highest amount of total hardness in Ks1 can derive from the underground rocks through which the water passes. It is apparent from the measured values of total hardness of the water samples that the groundwater in the field of analysis is of good quality. AM = 456 mgL-1, SD = 26.745 mgL-1, CV = 5.865 mgL-1 and Median is 448 mgL-1.

Calcium (Ca2+): Hard water can interfere with the operation of soaps and detergents, resulting in deposits of calcium carbonate, calcium sulphate and magnesium hydroxide within pipes and boilers, resulting in lower flows of water and making heating less effective. Also, the ions in hard water can corrode metal pipes by galvanic corrosion. Hypocalcaemia is a deficiency in the electrolyte that is caused by excess calcium in the blood. & the typical adult calcium content is 8.5-10.2 mg / dL. The calcium in groundwater samples varies between 27.82 mgL-1 and 71.31 mgL-1 Suggests that this area's groundwater is suitable for both drinking and domestic use. The Ks6 groundwater sample measures the lowest and the Ks1 measures the highest calcium in the collected groundwater samples. AM = 47.98 mgL-1, SD = 12.196 mgL-1, CV = 25.418 mgL-1 and Median is 46.36 mgL-1.

Magnesium (Mg2+): Magnesium and other soluble basic earth metals are answerable for water hardness. Water containing a lot of salt earth particles is called hard water, and water containing low measures of these particles is called delicate water. An enormous number of minerals contains magnesium, for instance dolomite (calcium magnesium carbonate; CaMg(CO3)2 and magnesite (magnesium carbonate; MgCO3). Magnesium is washed from rocks and accordingly winds up in water. Magnesium has various purposes and thusly may wind up in water from numerous points of view. Magnesium is a dietary mineral for any creature yet creepy crawlies. It is a focal particle of the chlorophyll atom, and is along these lines a necessity for plant photosynthesis. Magnesium can't just be found in seawater, yet additionally in waterways and downpour water, making it normally spread all through nature. Magnesium in groundwater samples varies between 18.73 mgL-1 and 29.50 mgL-1 Suggests that this area's groundwater is suitable for agriculture, drinking and domestic use. The Ks7 groundwater sample measures the lowest and the Ks11 measures the highest calcium in the collected groundwater samples. AM =23.84 mgL-1, SD =4.046 mgL-1, CV = 16.972 mgL-1 and Median is 23.68 mgL-1.

COD (Chemical Oxygen Demand): Chemical Oxygen Demand is an estimation of the oxygen needed to oxidize solvent and particulate natural issue in water. COD can be estimated progressively with our COD analyzers to improve wastewater measure control and plant effectiveness. Compound Oxygen Demand is a significant water quality boundary in light of the fact that, like BOD, it gives a record to survey the impact released wastewater will have on the accepting condition. Higher COD levels mean a more noteworthy measure of oxidizable natural material in the example, which will diminish disintegrated oxygen levels. A decrease in DO can prompt anaerobic conditions, which is pernicious to higher amphibian living things. The COD test is frequently utilized as another to BOD because of shorter length of testing time. High concentrations suggest toxicity or degradation. The approved volume of COD in water suggested by ICMR is 20 mgL-1, while the amount of COD contained in the groundwater samples is between 12 mgL-1 and 22 mgL-1, Ks3 has the lowest concentration of COD amongst the water samples, and the highest concentration is Ks9. In all groundwater samples COD is below or met the acceptable level except Ks9 . AM =16.07 mgL-1, SD = 3.094 mgL-1, CV = 19.249 mgL-1 and Median is 16 mgL-1.

BOD (Bio-chemical Oxygen Demand): A much more precise indicator of components of water quality than COD. BOD tests the quantity of organic materials which can be biodegraded in water. Measure COD and BOD in mg of oxygen /L of vapour. COD shall always be equal to or greater than BOD. The BOD to COD ratio is the proportion of the organic materials in water that can be destroyed in the atmosphere by natural micro-organisms. The permitted volume of BOD in water recommended by WHO, USEPA, BIS and ICMR is 5 mgL-1, while the amount of BOD found in the groundwater samples is between 5.78 mgL-1 to 9.36 mgL-1. In all groundwater samples BOD is high the acceptable level. Ks7 has the lowest BOD concentration between the water samples and Ks9 has the highest concentration. AM =6.99 mgL-1, SD = 1.050 mgL-1, CV = 15.017 mgL-1 and Median is 6.94 mgL-1.

DO (Dissolved Oxygen): Dissolved oxygen levels in water are seen as an indicator of toxicity and its portability. This thus forms a key measure for the management of water pollution and waste

Treatment process control practises and regulation of waste treatment systems. For drinking water, the minimum standard value is an amount not below 8 mgL-1 (WHO, 1984). Higher levels indicate toxicity or deterioration by the microbial. The permitted volume of DO in water recommended by ICMR is 5 mgL-1, while the amount of DO found in the groundwater samples is between 4.72 mgL-1 and 7.88 mgL-1. In all groundwater samples DO is high the acceptable level except Ks9. Ks9 has the lowest DO concentration between the water samples and Ks3 has the highest concentration. According to WHO all groundwater samples DO is below the acceptable level. AM = 6.07 mgL-1, SD = 1.084 mgL-1, CV = 17.853 mgL-1 and Median is 5.86 mgL-1.

Fluoride (F-): Existing fluoride concentrations in water may not be safe. Might be detrimental to the climate. Fluoride is a neurotoxin that can be toxic, in large concentrations. Excessive exposure can cause discoloration of the dents and bone issues. There is still ample fluoride in the water, without adding any more. People have the freedom to choose whether they are taking drugs or not. Different individuals require compounds like fluoride in different quantities. Fluoride in the groundwater samples is within the WHO, BIS and ICMR defined limits are 1.5 mgL-1. The highest concentration of fluoride, 3.18 mgL-1, is found in the Ks6 water sample and the lowest concentration, 1.23 mgL-1, is found in Ks1. Some groundwater samples the fluoride concentration is above the acceptable level. Ks1 has the lowest fluoride concentration between the water samples and Ks2 has the highest fluoride concentration. AM =1.86 mgL-1, SD = 0.6434 mgL-1, CV = 34.496 mgL-1 and Median is 1.98 mgL-1.

Chloride (Cl-): The measurement of chloride concentration of water samples provides an understanding of water sample pollution from waste water, soluble chloride salts, etc. The permitted volume of chloride in water recommended by WHO, BIS and ICMR is 250 mgL-1, while the amount of chloride found in the groundwater samples is between 178 mgL-1 and 216 mgL-1. In all groundwater samples the chloride concentration is below the acceptable level recommended by all the organisations. The low chloride levels showed that the water samples were free from any waste water contamination, and the rocks or soils of the minerals do not contaminate water by chloride. As chloride concentration is below acceptable limits, it is clear that chloride contamination from industrial or domestic use does not impact the groundwater. AM = 197.15 mgL-1, SD = 31.613 mgL-1, CV = 15.444 mgL-1 and Median is 195 mgL-1.

Iron (Fe2+/Fe3+): Iron is by weight the most abundant element in the crust, it occurs in its ferric and ferrous states in water, particularly in well-aerated conditions. Drainage of rock and mineral dissolution acid mines, land fill lactates, sewage and iron-related factories are causes of high iron levels in groundwater, lakes and reservoirs, particularly where conditions are reduced (O.L. Ojo et al.). Iron in groundwater samples varies between 0.17 mgL-1 to 0.37 mgL-1. The Ks6 groundwater sample measures the lowest and the Ks1 & Ks9 measures the highest iron of the collected water samples. Ks1, Ks2, Ks9, Ks10, Ks12& Ks13 samples were above the acceptable level. AM = 0.28 mgL-1, SD = 0.664 mgL-1, CV = 23.720 mgL-1 and Median is 0.32 mgL-1.

Sulphate (SO42-): As the main anion in hard water lakes, sulphate is second to bicarbonate. Sulphates can occur naturally, or result from municipal or industrial discharges. At normal amounts sulphates are not found to be toxic to plants or animals. Concentrations of 250-500 mg / L are having transient laxative action in humans. Yet even thousand mgL-1 doses did not cause any long-term ill effects. The sulphates are poisonous to cattle at extremely high concentrations. Sulphate-induced complications are most commonly related to their tendency to produce strong acids that alter the pH. In all groundwater samples the sulphate is beloved the acceptable level. Ks10 has the lowest between the water samples and Ks11 has the highest sulphate concentration. AM =52.13 mgL-1, SD = 18.709 mgL-1, CV = 35.890 mgL-1 and Median is 52.67 mgL-1.

Sodium (Na+): Sodium in groundwater samples range from 11.75 mgL-1 to 28.96 mgL-1 . The human body requires sodium to regulate blood pressure, monitor fluid levels and proper function of the nerves and muscles. Salt in drinking water is not a health issue for normal people but can be a salt-restricted diet for those with serious health conditions. In all groundwater samples the sodium is beloved the acceptable level. Ks4 has the lowest between the water samples and Ks8 has the highest sodium concentration. AM =19.24 mgL-1, SD = 5.316 mgL-1, CV = 27.624 mgL-1 and Median is 17.89 mgL-1.

Potassium (K+): Potassium in groundwater samples range from 0.47 mgL-1 to 3.64 mgL-1 . Potassium is an integral component of life. It controls water movement in and out of cells, and is necessary for metabolism of carbohydrates, insulin secretion, and protein synthesis. While potassium amounts usually present in drinking water are typically low and may not raise health issues, potassium chloride 's high solubility and its usage in treatment devices such as water softeners may contribute to substantially increased exposure. In all groundwater samples the potassium is beloved the acceptable level. Ks7 has the lowest between the water samples and Ks4 has the highest potassium concentration.

AM =1.99 mgL-1, SD = 0.812 mgL-1, CV = 40.772 mgL-1 and Median is 1.96 mgL-1.

Carbonate (CO32-): The most effective solution exists in carbonate-rock terrene, where soil and vegetative cover promote biogenic processing and accumulation of CO2 in the soil before part of it is drawn down into percolating water. No evidence suggests you are terrible at carbonated or sparkling water. It isn't that adverse to oral health because it doesn't appear to affect bone health. Interestingly, a carbonated drink can also increase digestion by increasing the ability to swallow and minimising constipation. The ingestion of carbonated drinks has been related to diabetes, hypertension and kidney stones, both risk factors for chronic kidney disease. Groundwater samples have carbonate varying from 164 mgL-1 to 242 mgL-1. Ks11 has the lowest between the water samples and Ks1 has the highest carbonate concentration. AM =178.61 mgL-1, SD = 20.230 mgL-1, CV = 11.325 mgL-1 and Median is 174 mgL-1.

Bicarbonate (HCO3-): The most common of anions is bicarbonate, and overall ionic bacteria, in surface water, and Hence it has a prominent position in the electrical field Leadership. It is deeply connected to several other major ions, and especially the Calcium cation. The pattern of delivery is regulated with the production of atmosphere and carbonate rocks, and Tends to explain zonal climate. Groundwater samples have bicarbonate varying from 23 mgL-1 to 56 mgL-1. Ks6 has the lowest between the water samples and Ks11 has the highest Bicarbonate concentration. AM =39.84 mgL-1, SD = 8.830 mgL-1, CV = 22.161 mgL-1 and Median is 39 mgL-1.

Arsenic (As3+): Arsenic is present in the rocks of the earth's crust, naturally. It can be found in certain sources of potable water, and wells. Drinking water containing arsenic can have significant effects on health over the short and long term. Exposure to extremely high levels of arsenic in drinking water can result in arsenic toxicity in the short to medium term. Symptoms of exposure to elevated amounts of arsenic cause stomach pain, vomiting, diarrhoea, and decreased control of the nerve, which may result in discomfort or numbness of pins and needles' and burning of hands and feet. The permitted volume of arsenic in water recommended by EPA, BIS and ICMR is 0.05 mgL-1. In all groundwater samples the arsenic is beloved the permissible limit. Groundwater samples have arsenic varying from 0.008 mgL-1 to 0.0048 mgL-1. Ks8 has the lowest between the water samples and Ks5 has the highest arsenic concentration. AM = 0.025 mgL-1, SD = 0.121 mgL-1, CV = 48.552 mgL-1 and Median is 0.023 mgL-1.

Lead (Pb+/Pb2+): At an average concentration of around 16 mg / kg, lead is a common component of the earth’s crust. Lead levels in drinking water are extremely low, since methods for treating convectional water eliminate a large amount of lead. Low pH and softness by encouraging degradation improves the water content of lead. Total lead intake from food, air , and water for adults is 3 mg / week (0.05 mg / kg of body weight) (WHO, 1984). The permitted volume of lead in water recommended by WHO, BIS and ICMR is 0.05 mgL-1, while the amount of lead found in the groundwater samples is between 0.009 mgL-1 and 0.0076 mgL-1. In all groundwater samples the lead concentration is below the acceptable level except Ks2. Ks2 has the highest lead concentration between the water samples and Ks1 has the lowest lead concentration. AM = 0.019 mgL-1, SD = 0.0087 mgL-1, CV = 44.776 mgL-1 and Median is 0.020 mgL-1.

Zinc (Zn2+): Zinc can normally be deposited into water by degradation of rock and surface particles, but because zinc ores are only partially soluble in water. Zinc is only absorbed when concentrations are extremely low. High natural water concentrations of zinc are typically associated with higher levels of other metals such as lead and cadmium. Zinc is an important mineral for body growth and development, but consuming water with high zinc levels can lead to cramps in the stomach, nausea and vomiting. Drinking water quality requirements and objectives set an aesthetic goal (AO) of 5 mgL-1. This is not a goal and is focused on fitness. The permissible concentration of zinc in water suggested by WHO, BIS and EPA is 5 mgL-1, while the quantity of zinc contained in the groundwater samples is between 0.425 mgL-1 and 2.906 mgL-1. The zinc content in all groundwater samples is below the appropriate amount. Ks8 has the largest concentration of zinc amongst the water samples, and Ks13 has the lowest concentration of zinc. AM =1.62 mgL-1, SD = 0.754 mgL-1, CV = 46.409 mgL-1 and Median is 1.498 mgL-1.

Different guideline and standards limits should be immediately applied in small scale industries for utilization of groundwater and open discharging the effluents into groundwater or land. Metals that are naturally introduced into the waterbody come primarily from such sources as rock weathering, soil erosion, or the dissolution of water- soluble salts. Natural metals pass through the marine environment independently of human activity, usually without any adverse consequences. Water used for drinking includes small quantities of heavy or trace metals that support the natural functioning of the human body but, in abundance, can be detrimental to human health.

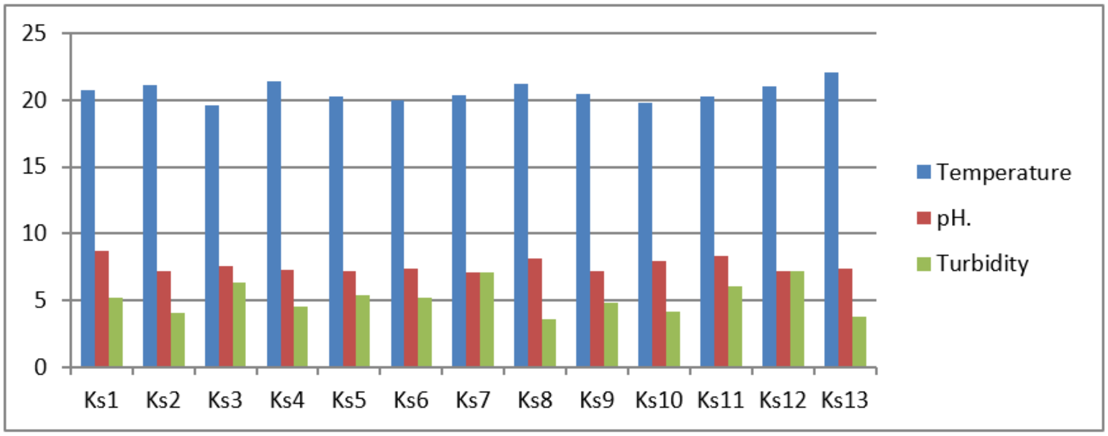

Figure 3 Temperature, pH and Turbidity

Temperature fluctuated with air temperature with positive relation. Temperature has positive relation with lead, zinc and cadmium. Groundwater may cause problem used as untreated effluent consist higher pH and temperature. pH has significant importance in all chemicals and biochemical reactions in an aquatic system. any research found that there is no relationship between turbidity pH, Temperature and microbiology, although Chalk sources appear more susceptible to E. coli than other aquifers. The phenomenon of turbidity is a location unique to a number of causes. Mitigation steps may require the use of variable speed pumps, automated waste filtering, mixing or technical solutions.

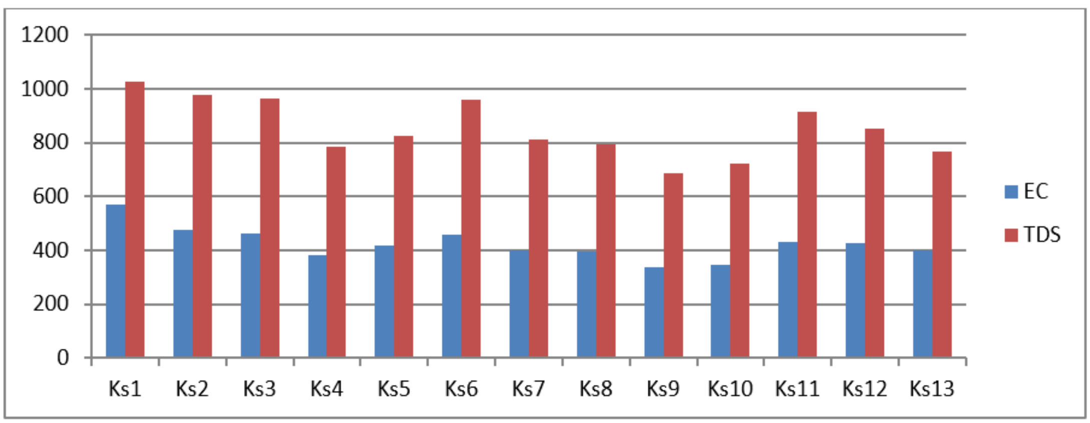

Figure 4 EC and TDS.

Electrical conductivity (EC) and total dissolved solids (TDS) are metrics of water quality used to characterise salinity levels. These two parameters are correlated and generally expressed in a simple equation: TDS = k EC (25 ° C). ... By determining the ratio value, the TDS concentration can be accurately calculated from the EC value.

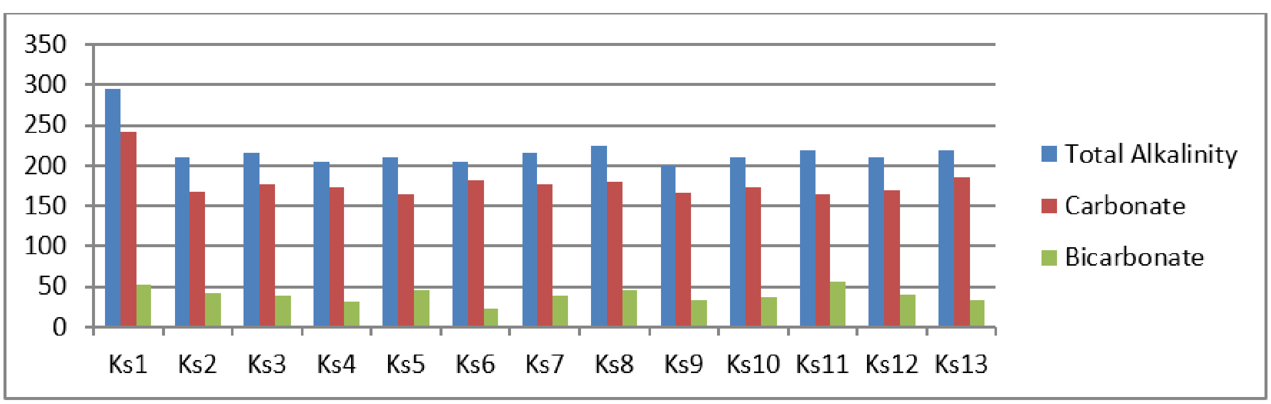

Figure 6 Total Alkalinity, Carbonate and Bicarbonate

In aquatic environments, where total hardness is almost equal to or greater than Total alkalinity, pH occasionally rises high. Carbonate and Bicarbonate are directly proportional to total alkalinity.

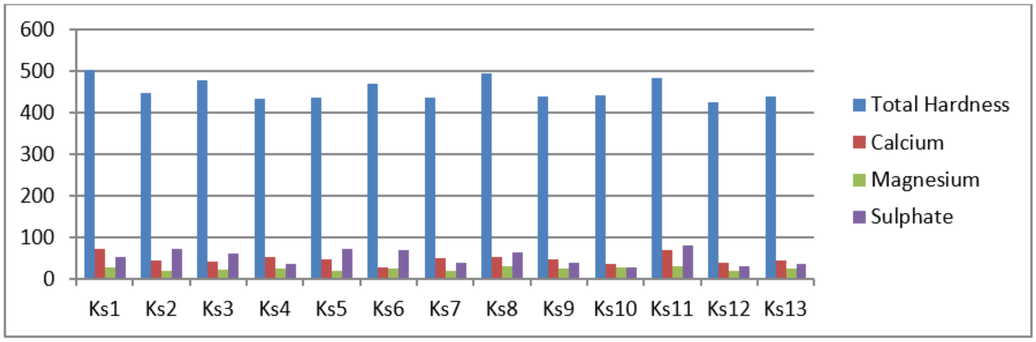

Figure 7 Total Hardness, Calcium, Magnesium and Sulphate

At the point where disintegrated, these minerals contain calcium and magnesium cations (Ca2 + and Mg2 +) and carbonate and bicarbonate anions (CO32– and HCO3–). The presence of metal cations makes the water challenging. Durable hardness (mineral substance) is generally difficult to remove by boiling. If this occurs, it is generally caused by the inclusion of calcium sulphate / calcium chloride and additionally magnesium sulphate / magnesium chloride in the water, which do not intensify as temperature rises. Particles that induce long-lasting water resistance may be dissolved using a water conditioner.

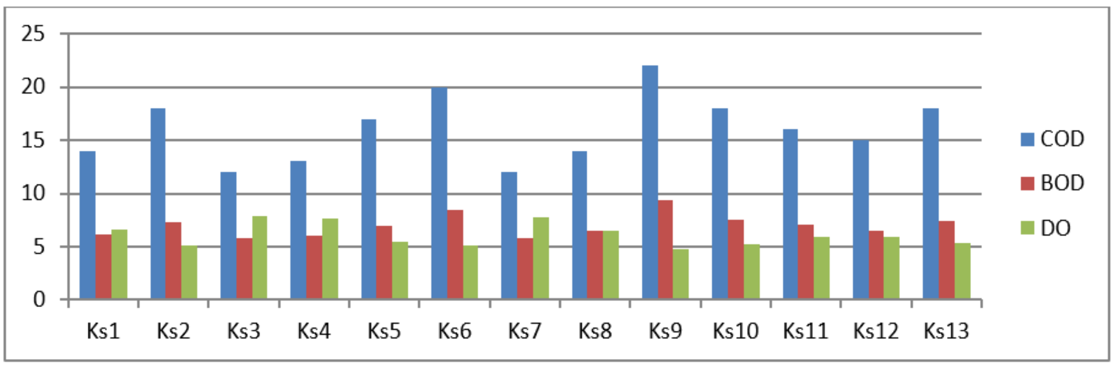

Figure 8 COD, BOD and DO.

COD-chemical oxygen demand tests the overall oxygen content, both inorganic and organic oxygen content. But BOD reflects only the amount of oxygen required to dissolve the organic matter found in the waste water by the microorganism. Higher COD amounts mean a greater volume of oxidizable organic material in the water, which reduces and can lead to anaerobic environments, which are delirious to greater aquatic life types. COD indicates a positive BOD relationship, and negative DO relationship. BOD is a representation of the oxygen used by microorganisms to decompose the waste. This results in a high degree of BOD. When the BOD level is high, the DO level reduces because the oxygen present in the water is absorbed by the bacteria.

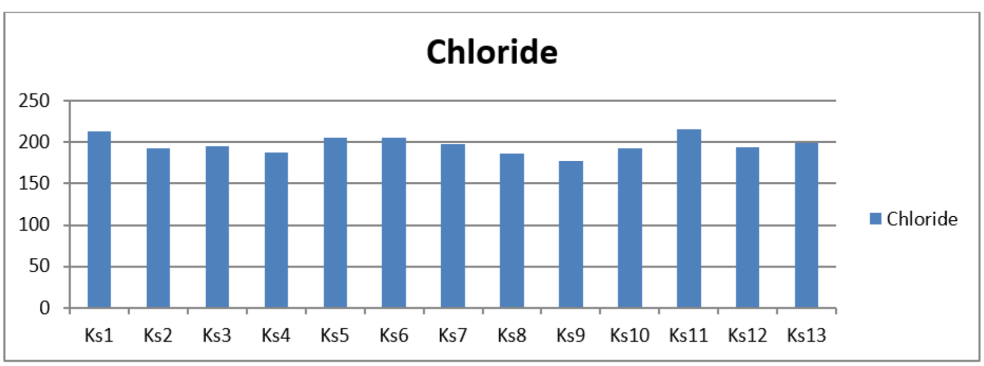

Figure 9 Chloride

Chloride concentration begins to increase at some depth due to dissolution reaction within the groundwater. Chloride in drinking water is not dangerous and most of the problems are due to the repeated correlation of high chloride levels with elevated sodium levels.

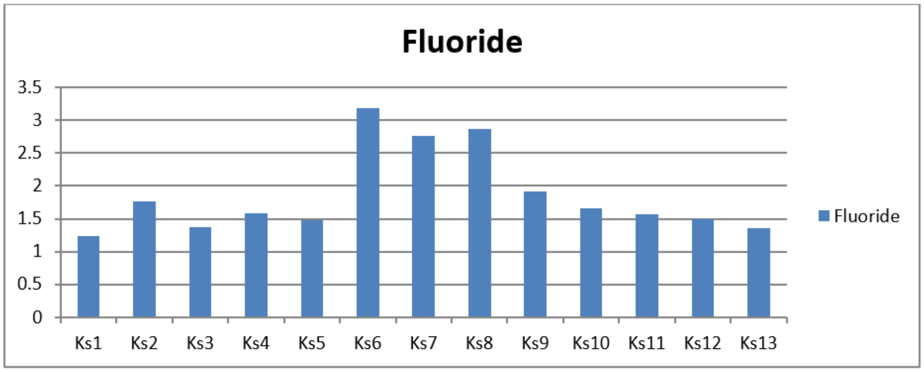

Figure 10 Fluoride

Fluoride is adsorbed on a clay layer, while fluoride is dissolved from solid phases in alkaline water; thus, alkaline pH is more favourable for the dissolution of fluoride. Fluoride pollution into water is directly related to weathering, flooding, road development, fast-growing settlements, hill-blasting. This habits should be controlled.. Siwaliks are lush green hills with a relatively low altitude, which are in near proximity to the Indo-Genetic plains where the population is high. Overgrazing, unplanned and non-scientific deforestation.

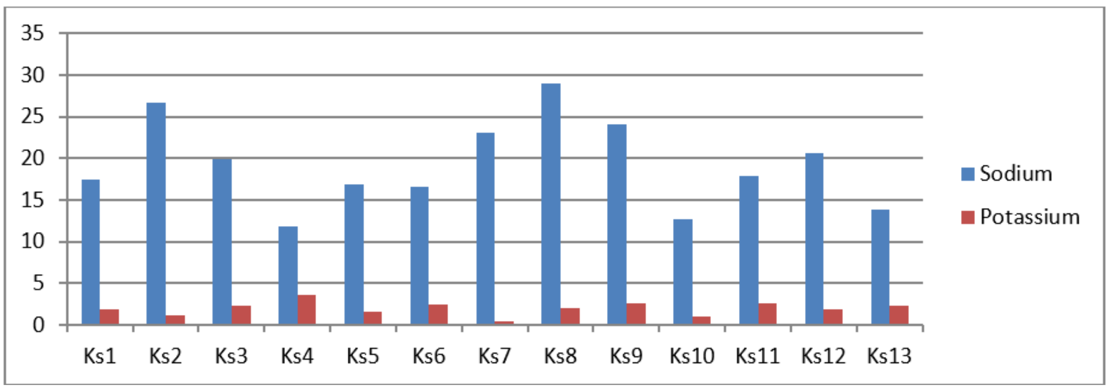

Figure 11 Sodium and Potassium

Sodium is more flexible in soil than potassium and is often used as an measure of human impacts on shallow ground water. Sodium is also a natural mineral chemical. Like potassium, sodium is eventually extracted from the block. Concentrations thus rise with time.

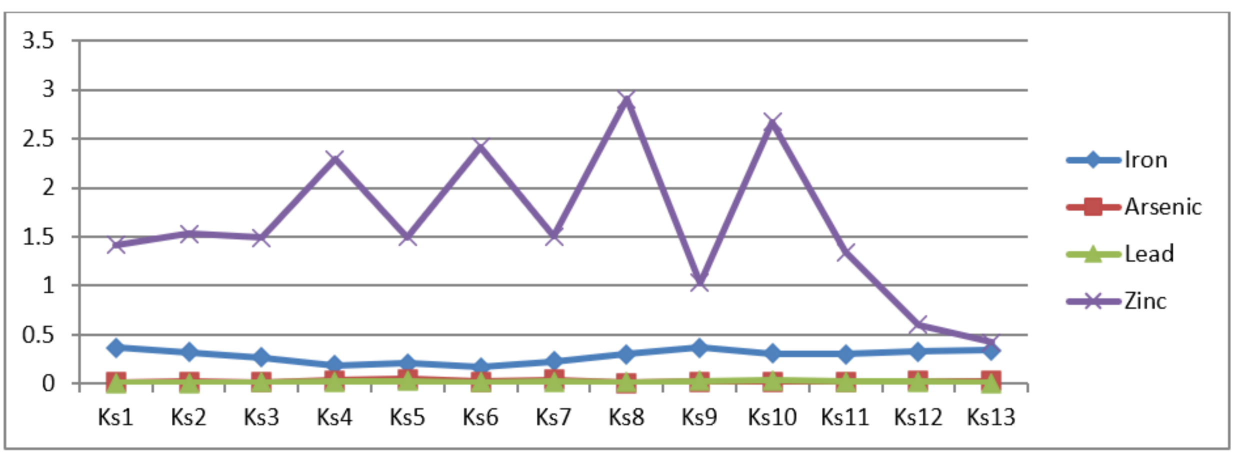

Figure 12 Iron, Arsenic, Lead and Zinc

Iron occurs as a cation (metal) in the atmosphere and can take one of two typical forms: insoluble ferric iron (Fe3 +) or soluble ferrous iron (Fe2 +). Iron is very prevalent in rocks found around NC and is considered a dangerous contaminant due to cosmetic concerns (taste, scent, and staining) rather than health effects...Arsenic is a metalloid that exists as an oxyanion (negatively charged) in the atmosphere. It is present naturally in some volcanic minerals, sedimentary rocks, and sulphide-bearing rocks and ores, and is also an anthropogenic contaminant in lead arsenate chemicals, wood preservatives, coal ash, among others. Arsenic is known to be one of the most harmful and carcinogenic of controlled pollutants. Lead is a thick soft metal that is very resistant to corrosion. The primary source of lead is PbS. The molecular form of lead determines its solubility in water and biological fluids, the degree of soil fixation and the type of chemical reaction occurring in the marine, marine and soil environments. Zinc is easily absorbed by clay minerals, carbonates and hydroxides (especially Fe and Mn oxides). As with other cations, the adsorption of Zn increases with pH; Zn hydrolyzes with pH > 7.7 and firmly adsorbs soil surfaces under these conditions. The values of alkalinity in the effluents were found very high. Alkalinity has found helps regulate the pH of a water body, but also the metal content. Alkalinity has found with positive correlations with Cd, Cu, Fe, Mn, Ni, Pb and Zn. Bicarbonate and carbonate ions in water can remove toxic metals out of solution.

4. CONCLUSION

Water is the most Essential commodity for all living creatures. Man need it for his physiological existence water is the elixir of life it is a source of energy and govern the evolution and function of the universe on the earth 97.3% of the world's water. Groundwater pollution is the existence in groundwater of some contaminants which exceed the limits prescribed for drinking water. This investigation has been done to find the quality of groundwater of urban and rural area in the southern portion of Koria district. As a result, some parameters in the water here do not meet the standard value; in nine groundwater samples the fluoride concentration was found to be higher than the acceptable limit. The pH of groundwater samples ranges between 7.1 and 8.7 all samples is alkaline. In all groundwater samples BOD is high the permissible level, in all groundwater samples recommended by ICMR, the high appropriate amount of DO except Ks9 is high. Ks9 has the lowest concentration of DO amongst the water samples and Ks3 has the largest concentration. According to WHO, all groundwater tests of DO are below the permissible level. Iron exceeded acceptable level in six groundwater sample. Analyzed the heavy metal and found Pb = 0.76 mgL-1 in one groundwater sample (Ks2), which was found to be higher than standard level. According to the result obtained from this study, the groundwater in the study area is contaminated; hence its treatment is very much needed.

CONFLICT OF INTERESTS

None.

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