"ASSESSMENT OF GROUND WATER QUALITY/POLLUTION IN KOLAR DISTRICT, KARNATAKA STATE,INDIA"

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Abstract

Kolar district falls under eastern dry agro climatic zone of Karnataka. The supply of water in the district is decreasing rapidly and its quality is deteriorating due to its over exploitation. A vast majority of ground water quality problems are caused by contamination and by overexploitation, or by combination of both. Presently over 94% of drinking water is met by ground water hence quality is important. The physico-chemical parameters of water are main criteria in determining its quality. This paper deals with the study of physico-chemical parameters of groundwater drawn from bore wells of various villages of Kolar district. 25 different sampling sources were selected for procurement of water and analyzed for different physico-chemical parameters including p^H, chloride, nitrate, fluoride and total hardness.Variations in the physico-chemical parameters in the water samples were observed. Analyzed parameters of selected water samples were compared with norms of IS 10500:2012. It was found that some of the water quality parameters were above permissible limit and some were not. This study helps different regions in understanding the potential threats to their ground water resources.

Key words: ground water, phsico- chemical parameters, Kolar district

Introduction-Water is an essential natural resource for sustaining the life and environment(Umesh Saxena and Swati Saxena,2015).In the last few decades, there has been tremendous increase in utilization of ground water for drinking, irrigation, industry and much commercial purpose. Ground water is an invisible and endangered open or common access resource(Anitha Pius *et al*.2011). Presently over 94% of drinking water is met by ground water. Use of groundwater has gradually increased due to the increase of freshwater demand and the exhaust of surface water(Sivakumar *et al.*2014).It is believed that bore well water (groundwater) is much purer than surface water and less susceptible to contamination but due to highly intervention of anthropocentric activities (agricultural explanation, deforestation, urbanization, industrialization, over utilization of agrochemicals etc) ground water quality highly varied with heavy metal contamination. The influence of solid waste dumping site, aquifer material mineralogy together with semiarid climate, other anthropogenic activities and increased human interventions have adversely affected the groundwater quality(Sarala *et al*.2012). Water is a precious commodity but in the last few decades there has been tremendous increase in the demand for freshwater due to rapid growth of population and the accelerated place of industrialization(Abhilash *et al.*2017). Presence of heavy metals in grains, vegetables, fruits and milk has shown that nothing has remained pure in this universe and this level of water pollution have reached to the alarming stage(Anil Dwivedi.2017). The purpose of the study is to ascertain the quality of groundwater collected from different sources and in different seasons (pre and post monsoon seasons) during 2014 and 2015.

Materials and Methods

Study area

Kolar district, spread over 4,012 sq Km, has population of about 16.50 lakhs.5 Taluks of Kolar District are Kolar, Bangarpet, Malur, Mulbagal and Srinivaspur. It is stretched between north latitude $12^{o}45^{l}\ 54^{ll}$ to east latitude $77^{0}50^{l}\ 29^{ll}$.

The District Kolar has 1798 villages under 156 gram Panchayats. The main occupation of the people is agriculture which is supported by only bore well water. Meteorologically the district is a dry agro climate and experiences a semiarid climate, characterized by tropical monsoon, tropical weather with hot summer and mild winter. There are no major surface water sources in the study area and main source of drinking water is by bore wells (ground water).

Water samplings

Ground water samples were collected from 25 different bore wells located at villages in Kolar district during pre and post monsoon season of 2014 and 2015. Samples were collected in pre-cleaned and rinsed bottles of 2 liter capacity with necessary pre caution and transferred to the laboratory for analysis of physico-chemical parameters.

Analysis of samples

All the samples were analyzed for different physico-chemical parameters such as p^{H}, chloride, nitrate, fluoride and total hardness. The analysis of water samples were carried out in accordance of standard analytical methods.The chemical solutions used for analysis of water samples were prepared with double distilled water and the chemicals were of SD-fine. The details of the analyzed methods are summarized in Table-1.

Table1: Parameters and Methods used in the analysis of ground water quality

Sl, No.	Parameters	Unit	Methods used
1	P^{H}	-	Digital P^{H} meter
2	chloride	mg/liter	Titrimetric method BY using $AgNO_3$
3	Nitrate	mg/liter	Spectrophotometric method
4	Fluoride	mg/liter	Electrode screening method by using fluoride electrode
5	Total hardness(TH)	mg/liter	Titrimetric mehod by using EDTA

Table 2 : Standards for drinking water quality

Sl No	Parameters	IS 10500:2012	ICMR:1975	BIS:1999	WHO:2006
1	PH	6.5-8.5	7.0-8.5	6.5-8.5	6.5-8.5
2	Chloride	250-1000	200	250	200
3	Nitrate	45	50	100	45
4	Fluoride	1.0-1.5	1.5	1.5	1.5
5	Total hardness(TH)	200-600	600	600	500

ISI (Indian standard institute), ICMR (Indian council of medical research), BIS {Bureau of Indian standards)

WHO (World health organization)

Results and Discussion

The physico-chemical parameters analyzed (Results) are presented in Table 1 and compared with national and world standard units. For convenient purpose, the average values of each parameter were taken in to consideration for discussion purpose. The **P^H** is a measure of acidic or basic (alkaline) nature of a solution. The acceptance P^H limit is 6.5 to 8.5(Table). In the present study P^H ranged from 6.675 (minimum) to 8.025(maximum).The PH levels is greatly affected areas are often less than 4.0 and the associated environmental impacts includes fish kills, retarded growth of crops and changes in water chemistry(Indraratna and Nethery.1995).P^H has no direct adverse effect on health. However, a lower value below 4.0 will produce some taste and higher value above 8.5 hastens the scale formation in water heating apparatus and also reduces the germicidal potential of chloride. Higher P^H induces the foundation of trinalo methana, which are toxic. Negative effect of acidification of groundwater is the corrosion of water pipes, which leads to leakage and high content of heavy metals in drinking water(Gert knutsson.1994). P^H below 6.5 starts corrosion in pipes, thereby releasing toxic metals in to surrounding. Domestic bores affected by low PH is due to water to allow peat excavation for urban development and low annual rainfall(Appleyard *et al.*2004).

Chloride is an-ion that is most commonly associated with salt such as sodium chloride(common table salt as a article of diet). Often it also associated with potassium calcium and magnesium in nature. all natural water contains chlorides in varying degree. In general chlorides shows seasonable concentration and are not harmful to mankind. A water with chloride above 250mg/L causes salty taste to water and unfit for drinking. Saline water pollution of ground water is mainly results from static fossil water and dynamics of sea water intrusion(Purnama *et al.*2012).The increase of chloride concentration in groundwater is indication of mixing of sewage water with groundwater(Sameer *et al.*2011). In the present study chloride ranged from 81 to 400 mg/ liter (Table) which was in the range below permissible limit.

Nitrate is a common nitrogenous compound, due to natural process like nitrogen cycle and highly intervention of Anthropocentric activities the concentration of nitrate in ground water greatly increased. The largest anthropocentric activity is intense farming which include excess applications of nitrogen fertilizers, manure application and growing of leguminous plants without employing of crop rotation pattren.Another potential source of nitrate to groundwater is leaching process from storage area of manure in farmland. Use of fertiliers,discharging of waste water from treatment plants and leakage of wastewater from cesspools, increased levels in nitrate concentration in groundwater(Baalougha.2008). When nitrate-nitrogen level is exceeds the permissible limit it can cause threat to human beings especially infants, pregnant and nursing women's and elderly people. Nitrate pollution is one of groundwater's mostly identified contaminants, an indicator of serious pollution as they are associated with septic waste and agricultural endeavors, leads to numerous health problems to human beings and animals(Anjaliverma *et al.*2014).The occurrence of high nitrate level in groundwater has to be recognized as a threat to humans and animals. Infant methaemoglobinaemia and nitrate poisoning of livestock occur at unexpected times and places(Sunitha.2013).Over exploitation of ground water and continuous depletion of groundwater table due to insufficient rains and no recharge of groundwater the concentration of Nitrate is on the rise(Maruthesh Reddy *et al.* 2015).In the present study nitrate ranged from 12.3775 to 183.5 mg/ liter (Table). Desirable limit for nitrate is 45 and no relaxation in permissible limit. The value observed in the present study is in the range below permissible level. It may be due to minimum usage of fertilizers and pesticides because of rain fall is lesser than minimum and lesser agricultural activities.

Fluoride is the most negatively charged, light and highly active substance react with all elements of earth i.e. fluoride is anything but benign and it does not occur in the elemental state. Fluoride enrichment occurs in groundwater through the dissolution of fluoride-rich minerals(Sunil kumar srivastava *et al*.2018).Generally the concentration of fluoride in ground water is controlled by local geological setting: leaching and weathering of bed rock and climatic condition of an area(Rudra Mohan Pradhan *et al.*2018). Optimum (0.5 to 1.5 mg/L)level of fluoride concentration is very essential for animals and humans, long term exposure to 1.5 mg/L and above causes severe health effect on human beings such as dental and skeletal fluorosis, osteoporosis, hip fracture, arthritis, mental retardation, perturbations in hormone concentrations due to effect on endocrine system, effects on thyroid and pineal, impaired glucose metabolism, effects on immune cells of bone marrow, effects on fertility, reproductive hormones and developmental outcomes of reproductive system, effects gastrointestinal system, effects on the kidney functioning, causes cancer etc. Fluoride has profound effect on teeth and bones when its concentration exceeds the permissible limit. Concentration in the range of 1.0 to 1.5 mg/L strengthens the enamel and in the range of 1.5 to 4.0 mg/L results dental fluorosis where as with prolonged exposure to higher concentration(4 to 10 mg/L) results fluorosis in children's as well as adults(Suneetha *et al*.2015).Irrigated with fluoride contaminated water transfers the fluoride to different tropic levels of food chain leads to biomagnifications it is causing larger risk to the already fluoride contaminated affected population. Moreover, this new avenue of fluoride highly endangers the most susceptible infants and childrens towards dental fluorosis.(Piyal Bhattacharya et al 2018).Most of the fluoride found in ground water is geogenic in origin. Fluoride concentration in the range of 0.8 to 1.20 mg/L is considered to be beneficial, concentration above 1.5 mg/L are reported to be harmful to the teeth and bone structure of human and animals. As excess of fluoride(>1.5 mg/L) in drinking water is harmful to the human health(Roy et al 2014). In the present study fluoride ranged from 0.5mg/L to 1.9375mg/L (Table). As per **IS** 10500:2012 the desirable limit of fluoride is 1 to 1.5mg/L. The value observed in the present study some of the samples are is in the range below and above permissible limit of drinking water standard.

Hardness is defined as variable and complex mixture of cations and anions or multivalent cations in solution. Hardness of water was understood to be a measure of the capacity of the water for precipitating soap. Soap is precipitated chiefly by the calcium and magnesium ions commonly present in water but also may be precipitated by ions of other polyvalent metals such as aluminum, iron ,manganese and zinc, because only the calcium and magnesium are usually present in significant concentration in natural waters. Hard water is not suitable for bathing and washing .Hard water has high boiling point and so are not suitable for cooking. Hardness in water is naturally occurring in groundwater which weathering of limestone, sedentary rock and calcium bearing minerals(Pratap petamwa *et al*.2011).Presence of hardness ions in the municipal drinking water is the major health concern, this directly affects the rural and low community society(Yonatan Hailu *et al.*2019). In the present study total hardness ranged from 232.25mg/L to 1304.25mg/L Table. As per IS 10500:2012 desirable limit of hardness is 200 to 600 mg/L in permissible limit. The value observed in the present study some samples are in the ranged above permissible limit of drinking water standards. Drinking water containing very high values of hardness(magnesium) can cause vomiting, diarrhea, thirst, tiredness, shirred speech, confusion, muscular weakness and breathlessness(Raju *et al*.2014).

Table 3: Average results of physico-chemical parameters of groundwater in Pre and Post monsoon seasons during 2014 and 2015

Source No	P^H	Chloride	Nitrate	Fluoride	Total Hardness
I	6.965	250.75	31.125	1.0575	621.25
II	6.95	128	41.6725	1.475	515.25
III	7.4	81	19.48	1.44	432.5
IV	8.025	283.25	41.8	1.3975	519
V	7.63	292	28.0975	1.175	319
VI	7.525	229	12.3775	1.325	570.5
VII	7.325	143	97	0.5125	664
VIII	7.525	148	61.8	0.5	1304.25
IX	7.325	176.25	28.96	1.1275	387.75
X	7.65	185.25	24.1375	0.78	616.5
XI	7.68	325.5	35.8	1.2425	777
XII	7.9075	71.75	12.475	1.3575	467
XIII	7.45	147.75	38.75	1.09	418.5
XIV	7.525	215.75	24.4175	1.33	485
XV	7.47	277.25	31	1.23	345.5
XVI	7.43	148.75	45.0575	1.5025	474.75

XVII	7.425	245	43.0625	1.225	282.75
XVIII	7.375	156.25	36.6375	1.1325	441.75
XIX	7.485	57.75	49.25	1.44	232.25
XX	7.275	199.75	41.525	1.395	338.75
XXI	7.2	341.75	24.8775	1.5475	386.75
XXII	5.445	400	35.925	1.4625	604.25
XXIII	7.625	323.25	21.0675	1.9375	272.75
XXIV	7.6	364.5	37.125	1.4225	535
XXV	7.55	161.75	21.0625	1.5575	580.5

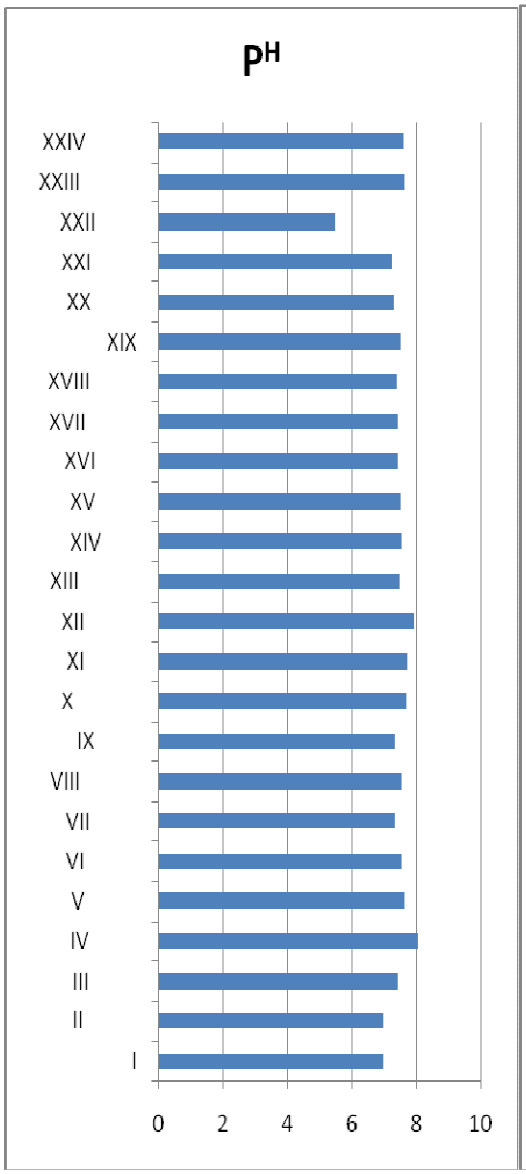

Figure 1 : Average results of pH of ground water in pre and post monsoon seasons during 2014 and 2015

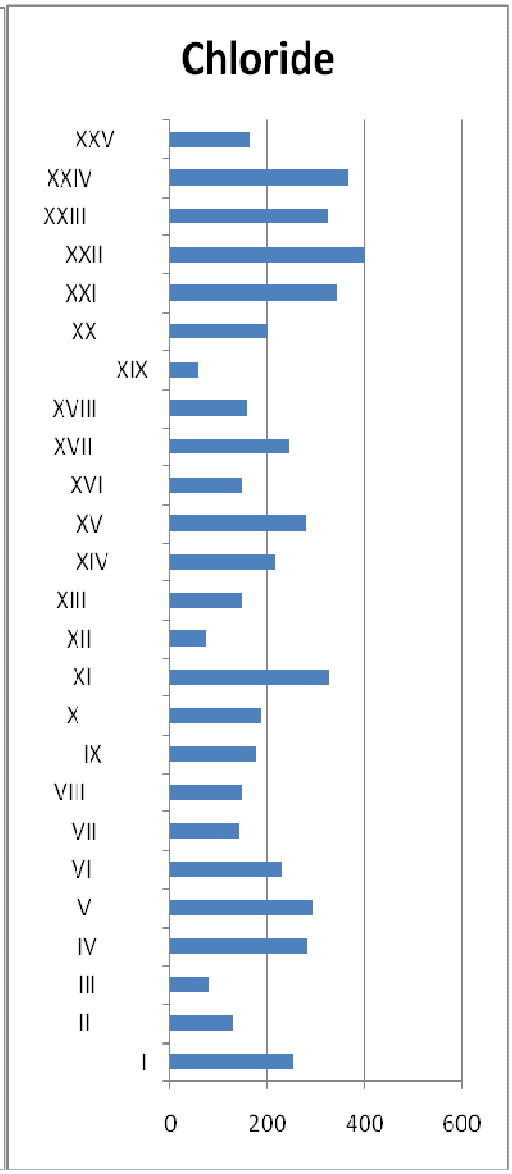

Figure 2: Average results of Chloride of ground water in pre and post monsoon seasons during 2014 and 2015

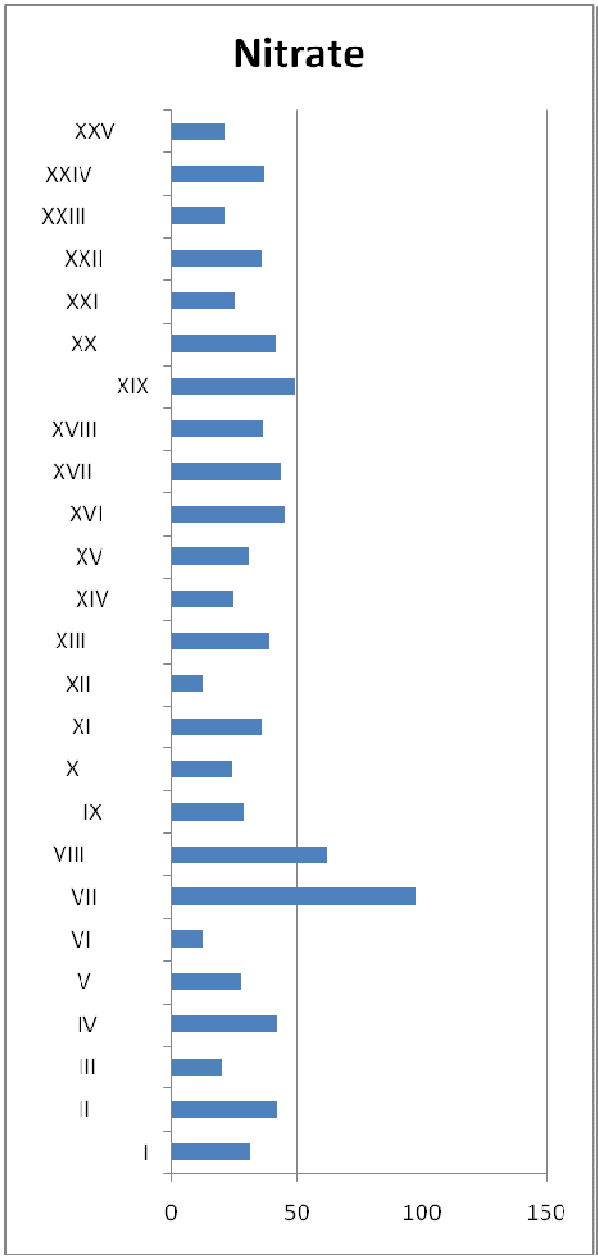

Figure 3: Average results of Nitrate of ground water in pre and post monsoon seasons during 2014 and 2015

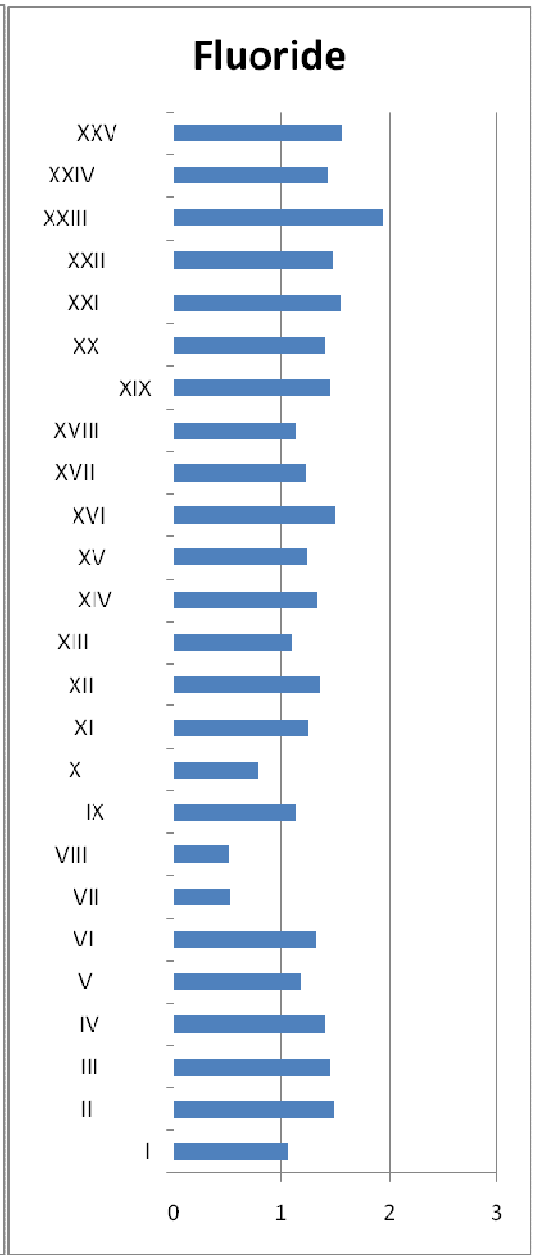

Figure 4: Average results of Fluoride of ground water in pre and post monsoon seasons during 2014 and 2015

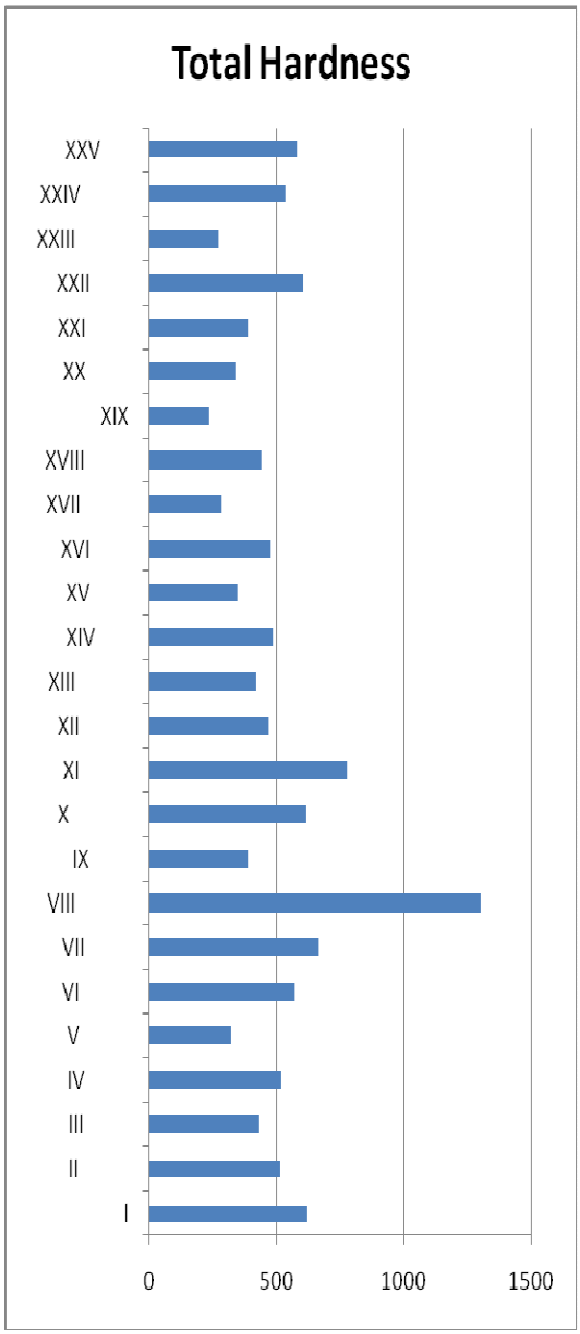

Figure 3: Average results of Total hardness of ground water in pre and post monsoon seasons during 2014 and 2015

Conclusion

In the present study, the values of different physico-chemical parameters observed for some parameters were below and above the permissible limits. The acceptance PH limit is 6.5 to 8.5,in present study PH ranged from 6.675 to 8.025. Fluoride and total hardness were beyond the permissible limit. Similarly chloride and nitrate were below the permissible limit. The results of study reveals that, quality of groundwater is not fit for drinking purposes due to contamination, especially

the fluoride and total hardness. Hence, it is suggested that the water should be properly treated before consumption.

Note: in figures 'X' axis Showing Sources and 'Y' axis showing concentration of parameter in mg/liter

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