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Evaluation of Ground Water Quality in Yeliyur Grama Panchayath Villages, Kunigal Taluk

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Abstract

Life on Earth is dependent on water, which is an essential component of the atmosphere. The source of household water for millions of homes in both rural and urban areas is the tube well. Groundwater is the most alternative is facing threats. Tube well and open well samples were collected at different sites of Yeliyur grama panchayath Villages, Kunigal Taluk. The Physico-Chemical properties of all the collected 20 groundwater samples were analyzed. The quality of groundwater in and around Yeliyur grama panchayath Villages, Kunigal Taluk has been studied various parameter such as pH, Total Dissolved Solid (TDS), total hardness, total alkalinity, turbidity, Na^+, K^+, Cl^-, F^-, Ca^{2+}, Mg^{2+}, SO_4^{2-}, NO_3^{2-}, DO, Chromium and Pb. The final experimental results were compared with the WHO variable standards (2021).

Keywords: *Ground Water, Panchayath, Tube Well*

1.0 Introduction

It is well recognized that water gives the human body its necessary nutrients[1]. The main environmental resources that are at risk include rain, rivers, seas, and ground water. Uncontrolled population growth is making it easier for dangerous substances to seep into the ground water[2]. As a result, the number of water-borne illnesses has increased.

Water enjoys a kind of supreme importance due to its unique property of universal solvency. It is a property by which it dissolves most of the solutes coming in contact with it. Groundwater is an integral part of the environment. There has been a lack of adequate attention to water conservation, groundwater recharge and ecosystem sustainability[3]. Ground water which occurs as a part of hydrological cycle and one of the earth's renewable sources is an important national asset. Ground water is an important role in every nation's economy and India is no exception.

2.0 Study Area

The Yeliyur Grama Panchayath Villages are situated in Tumkur (dist.) in Karnataka, India's Kunigal (T) district. Yeliyur grama panchayath's location code, or village code, is 572126, based on data from the 2011 Census. The Yeliyur grama panchayath villages are located 50 kilometers from Tumkur district headquarters and 10 to 20 km from the sub-district headquarter, Kunigal (the Tehsildar office). The people of Yeliyur Grama Panchayath Village primarily rely on groundwater for home and agricultural uses. Their primary occupation in these villages is agriculture.

3.0 Methodology

Twenty groundwater samples were gathered from several villages inside the Yeliyur grama panchayath. Before being collected, the samples were washed three times with sample water and then placed in higher grade plastic

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Table 1. Chemical characteristics of ground water in Yeliyur grama panchayath villages

Sample No.	Place	pH	Turbidity	TH (ppm)	TDS (ppm)	Alkalinity (ppm)
1	Yeliyur 1	6.85	0.08	191	285	225
2	Yeliyur 2	7.85	0.25	652	985	285
3	Anchepalya	7.05	0.88	258	1020	770
4	Kallanayakana halli	6.25	0.52	954	1356	295
5	Hosahalli	6.97	0.29	684	754	98
6	SD palya	7.37	0.6	314	658	60
7	Bukka sagar	6.35	0.55	858	577	125
8	Bukka sagar 1	7.5	0.23	325	1258	122
9	Kurupalya	7.58	0.89	595	1658	258
10	Kuntupalya	7.65	0.32	690	1252	202
11	Vijayanagar	8.25	0.37	780	1082	365
12	Koghotta	8.35	0.02	655	1545	302
13	Koghotta 1	7.65	0.075	764	1254	309
14	Laksmipura	9.35	0.39	354	815	435
15	Edigara palya	7.05	0.06	634	952	335
16	Kempanahalli	9.1	0.32	352	805	482
17	Kalkere	8.05	0.29	375	778	362
18	Haluvagilu	6.75	0.25	311	675	462
19	Gottigere	6.85	0.89	529	1750	421
20	Bidane gere	7.95	0.15	612	1125	385

bottles with a 1.0 litter capacity. Using a water analyzer kit, parameters like pH, DO, and Total Dissolved Salt (TDS) were estimated in the field during the sampling process. (Water analyzer from Systronics, 371). The volumetric (titrimetric) method was used to estimate Total Hardness (TH), calcium, magnesium, Total Alkalinity (TA), chloride, and turbidity. Systronics-made flame photometers and UV spectrophotometers were used to estimate Na^+, K^+, fluoride, nitrate, and sulphate, and spectrophotometers were used to estimate lead. Every groundwater sample was analyzed in accordance with the APHA (1998) recommended protocols.

Table 2. Chemical characteristics of ground water in Yeliyur grama panchayath villages

Sample No.	Place	DO	Calcium	Magnesium	Sodium	Potassium
1	Yeliyur 1	6.5	39	35	29	1
2	Yeliyur 2	6	143	85	110	5
3	Anchepalya	5.9	109	33	125	13
4	Kallanayakana halli	5.5	201	59	165	6
5	AHosahalli	6.3	212	85	125	7
6	SD palya	7.1	109	58	138	3
7	Bukka sagar	6.9	205	98	103	6
8	Bukka sagar 1	7.2	26	89	73	10
9	Kurupalya	7.9	131	79	66	6
10	Kuntupalya	6.9	35	34	52	4
11	Vijayanagar	5.9	141	70	95	6
12	Koghotta	6.5	128	79	164	8
13	Koghotta 1	7.25	105	23	80	5
14	Laksmipura	6.95	88	59	179	9
15	Edigara palya	7.25	103	40	110	10
16	Kempanahalli	8.5	206	106	100	4
17	Kalkere	7.25	149	46	166	8
18	Haluvagilu	8.25	195	102	144	17
19	Gottigere	6.12	215	117	306	10
20	Bidane gere	6.85	98	89	179	4

4.0 Results and Discussion

4.1 pH

pH is the determination of the acidic or alkaline nature of a solution. Concentration of hydrogen affects the taste of water[4]. In the present investigation pH values varied between 6.25 & 9.35 with an average and median value of 7.35. All groundwater samples of pH values are within the permissible limits of WHO (2021).

Table 3. Chemical characteristics of ground water in Yeliyur grama panchayath villages

Sample No.	Place	Cl-	F-	NO_3^{2-}	Cr	Pb
1	Yeliyur 1	36	0.3	14.9	0.025	0.02
2	Yeliyur 2	136	0.8	26.8	0.035	0.01
3	Anchepalya	178	0.08	27.2	0.06	0.05
4	Kallanayakana halli	287	1.3	34.5	0.037	0.06
5	AHosahalli	276	0.98	12.6	ND	ND
6	SD palya	159	0.7	128	ND	ND
7	Bukka sagar	303	0.98	33.1	0.023	0.02
8	Bukka sagar 1	136	0.9	29.5	0.035	0.03
9	Kurupalya	298	0.6	27	ND	ND
10	Kuntupalya	88	0.55	45.9	0.046	0.025
11	Vijayanagar	158	1.4	49.7	0.035	0.01
12	Koghotta	168	0.68	42.8	0.023	0.02
13	Koghotta 1	432	0.98	56.5	0.02	0.03
14	Laksmipura	306	0.78	24.1	0.034	0.02
15	Edigara palya	376	0.85	53.5	0.025	0.01
16	Kempanahalli	288	1.13	21.5	0.0312	0.03
17	Kalkere	366	1.3	11	0.012	0.01
18	Haluvagilu	336	0.15	45.8	0.03	0.021
19	Gottigere	450	0.67	25.3	0.028	0.012
20	Bidane gere	358	0.86	30.1	0.038	0.023

4.2 Turbidity

The turbidity value and the amount of suspended and biological contaminants in the water determine its quality[5]. The turbidity value in the current study ranged from 0.02 to 0.89 NTU, with an average value of 0.37 NTU, as illustrated in Figure 1 which falls comfortably within the WHO's acceptable bounds (2021).

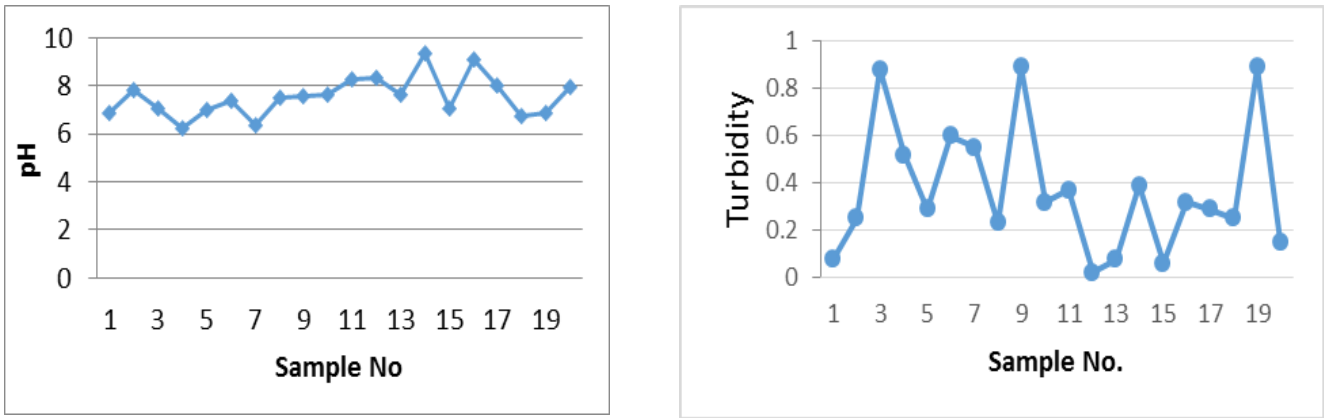

Figure 1. pH & Turbidity (NTU) values in different water samples.

4.3 Total Hardness (TH)

The groundwater classification is based on Total hardness and it is caused by presence of Ca^{2+} and Mg^{2+}, ions in the groundwater[6]. In the present study the TH values varied between 191 ppm & 954 ppm. 50% of the samples have the TH values above the permissible limits of WHO (2021).

4.4 TDS (Total Dissolved Solids)

It is the essential to classify the groundwater depends on the TDS values and indicate the nature of water quality for salinity[7]. The TDS values of ground water samples are ranged between of 285 to 1750 ppm with an average 1029 ppm as shown in Table 1 and Figure 2. It was observed that out of 20 samples 19 are above the permissible limit of WHO (2021). i.e., 500 ppm, that water samples are not fit for drinking[8].

4.5 Total Alkalinity

Table 1 and Figure 3 demonstrate that the total alkalinity values of the groundwater samples[9] varied from 60 ppm to 770 ppm, with an average value of 315 ppm, above the WHO (2011) limit of 200 ppm.

4.6 DO (Dissolved Oxygen)

It is an important pollution parameter[10]. Deficiency of DO gives bad odour to water due to decomposition of organic matters[11]. The present study showed DO values ranging from 5.5 mg/l to 8.5 mg/l as shown in Table 1 and Figure 3. All 20 ground water samples having DO values are above permissible limit of WHO (2011) i.e., 5 mg/l.

4.7 Calcium and Magnesium Ion

Ca^{2+} and Mg^{2+} are directly related to total hardness. Ca^{2+} and Mg^{2+} contents are very common in ground

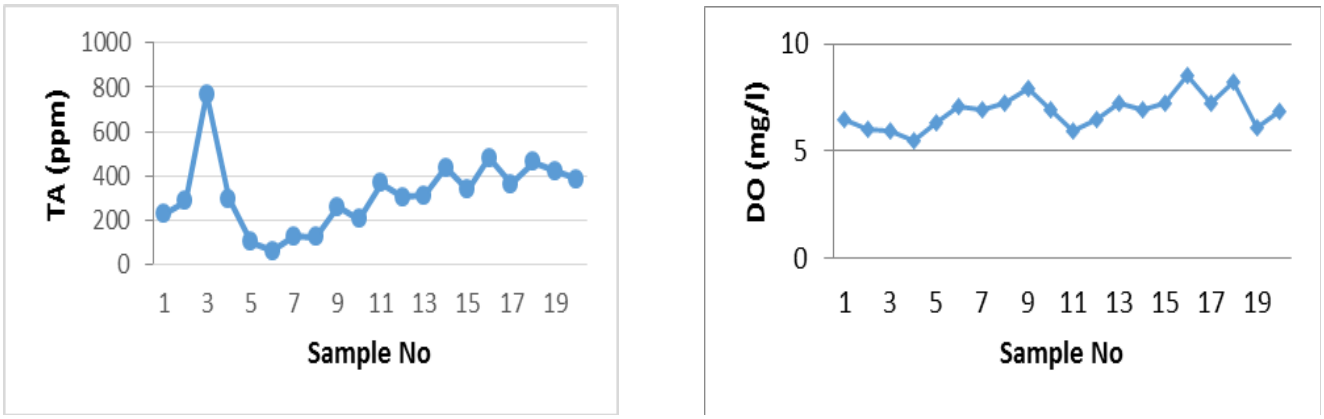

Figure 2. TH & TDS values of different water samples.

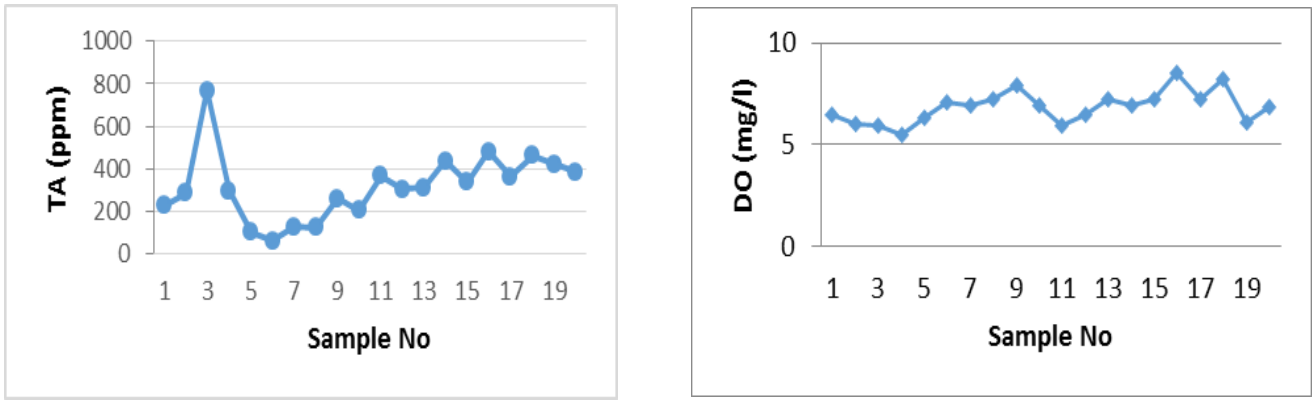

Figure 3. Total Alkalinity & DO values of different water samples.

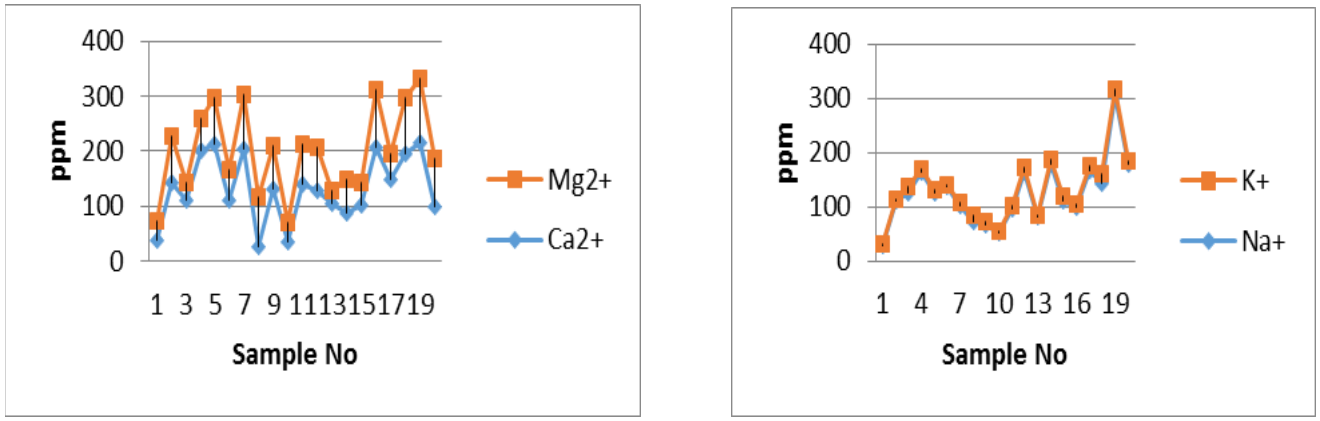

Figure 4. Ca^{2+} and Mg^{2+} ion concentration & Na^{+} and K^{+} ion in different water samples.

water[12]. Calcium and Magnesium Concentrations varied between 26 ppm and 215 ppm and 23 ppm to 117 ppm, respectively. Hence few of groundwater samples of Calcium and Magnesium ion values are above the permissible limit of WHO (2021) as shown in Table 2 and Figure 4.

4.8 Sodium and Potassium Ion

In the groundwater samples, monovalent cations of sodium and potassium are present. Potassium ion enters into groundwater through agricultural leaching[13]. There is no health-based standard of drinking water[14]. In the current investigation, all the samples of groundwater showed Na^{+} and K^{+} values within the permissible limits WHO (2021) as shown in Table 2 and Figure 4.

4.9 Sulphate (SO_4^{2-})

If SO_4^{2-} concentration excess of 150 mg/l present in natural water produce catharsis and dehydration upon human beings[15]. In the current study, the Sulphate concentration in groundwater samples of the study site varied between 20 mg/l to 153 mg/l and show in Figure 5. 5% of the samples groundwater showed Sulphate values above the permissible limits of WHO (2021) as shown in Table 2. Sulphate does not affect the taste of water[16].

4.10 Chloride

Another crucial metric for determining the quality of a water supply is chloride. Chloride concentrations considered to be indicator of animal origin of

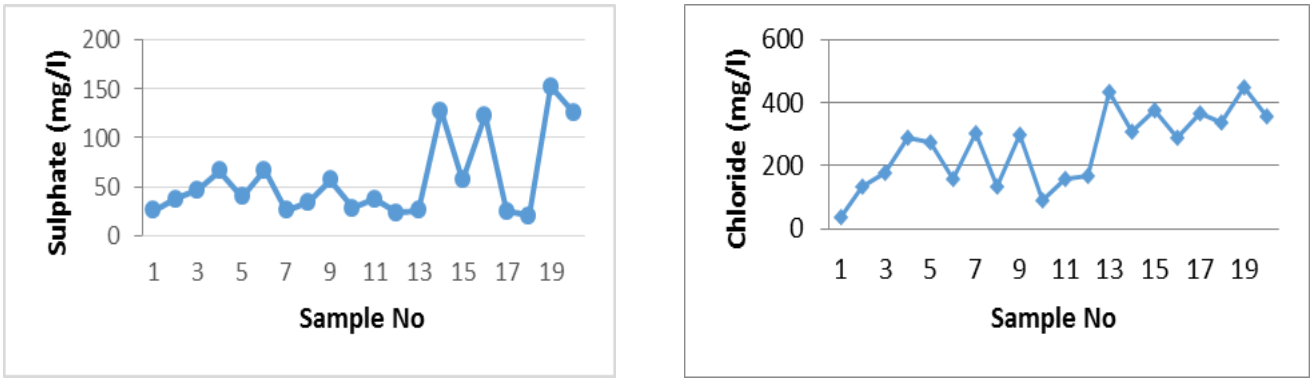

Figure 5. Sulphate & Chloride ion concentration of different water samples.

organic pollution[17]. In the current study, the Chloride concentration in water samples of the current area varied between 36 mg/l and of 450 mg/l and show in Figure 5. 60% of samples the groundwater showed Chloride values are exceeding the WHO (2011) limit i.e., 250mg/l, as shown in Table 3. Hence, the high concentration of chloride content present in groundwater samples may lead to high BP (Blood Pressure), for people who use it.

4.11 Fluoride (F^-)

Because of primary silicate weathering and related accessory mineral weathering, it is more frequently detected in groundwater than in surface waters. Dental fluorosis occurs when there is a fluoride concentration in drinking water above 1 mg/l[18]. Fluoride concentrations in groundwater samples from the research area varied from 0.08 to 1.40 mg/l in the current investigation. As indicated in Table 3 and Figure 6, four of the twenty groundwater samples had fluoride levels above the WHO's acceptable limits in 2021. Dental caries is prevented by low fluoride ion concentrations.

4.12 Nitrate (NO_3^{2-})

Water samples contain naturally occurring ions that are a part of the nitrogen cycle. One of the elements that is essential for the growth of algae and that speeds up eutrophication is nitrate. Table 3 and Figure 6 illustrate how the nitrate concentration in the local water samples for the current investigation ranged from 11 mg/l to 128 mg/l. Six (30%) of the twenty groundwater samples had nitrate levels that were higher than the WHO's 2021 acceptable limits, as seen in Table 3.

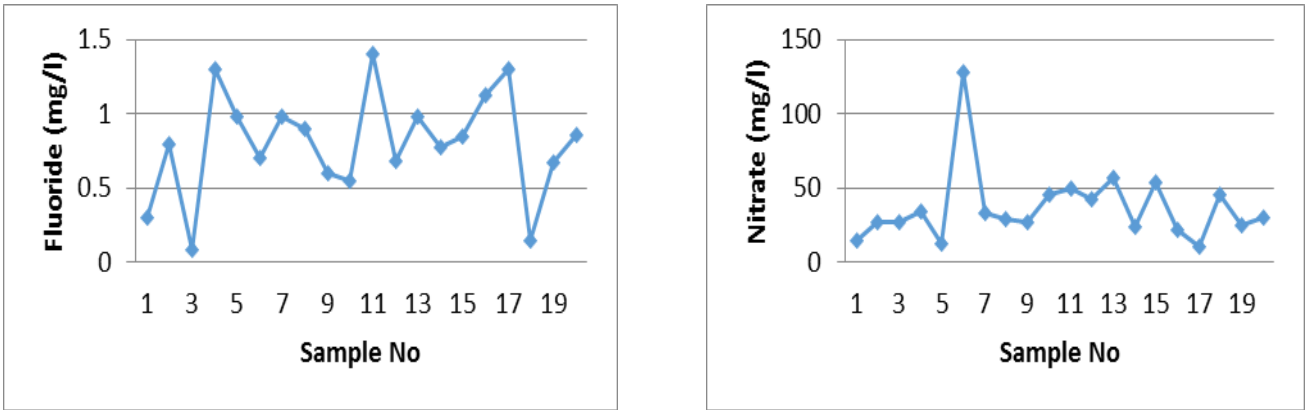

Figure 6. Fluoride & Nitrate ion concentration (mg/l) of different samples.

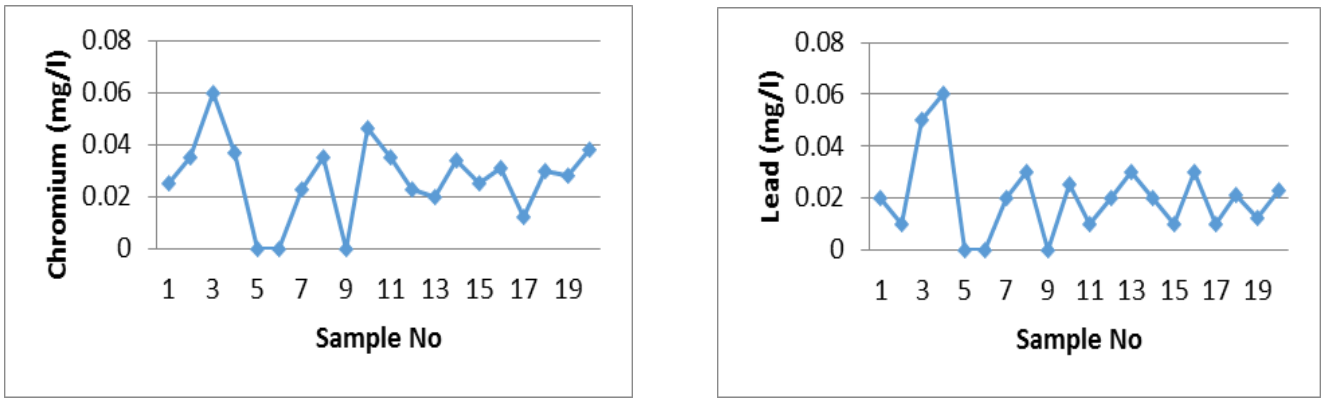

Figure 7. Chromium and Lead ion concentration of different samples.

4.13 Chromium

It is present in nature at in small quantities and it is more important in basic type of rocks. Chromium is known to be as carcinogenic substance for lung cancer. The nitrate concentration in water samples of the area varied between 0.01 mg/l and 0.06 mg/l as shown in Table 3 and Figure 7. The groundwater samples showed chromium values below the permissible limits of WHO (2021) as shown in Table 3.

4.14 Lead

An unwanted trace metal that is less common in the earth's crust is lead. It is significant in universal lead compounds, which include paints, plumbing fixtures, and solder for water distribution systems. The WHO (2021) states that the maximum amount of lead that can be present in water is 0.01 mg/l. Table 3 and Figure 7 illustrate the range of lead concentrations in the groundwater samples, which was 0.01 mg/l to 0.06 mg/l. Table 3 indicates that, of the twenty groundwater samples, thirteen (65%) had lead values over WHO (2021) permitted limits. Groundwater samples contain significant levels of lead, which is a cumulative toxicant that affects the kidneys and nervous system[19].

5.0 Conclusion

Analysis has been done on the groundwater quality in and around Yeliyur Grama Panchayath Villages. A small number of the groundwater samples were found to have significant levels of lead, total hardness, TDS, and chloride, making them completely unfit for human consumption. In certain areas, the groundwater quality in the Yeliyur grama panchayath villages poses a health risk to humans. Recommended that the Yeliyur grama panchayath authorities install large-scale "chloride removal units" or reverse osmosis units in addition to water softeners to reduce excessive hardness from the groundwater. Yeliyur Grama Panchayath Villages to make drinking water and clear the groundwater of an excessive amount of TDS and chloride. Additionally, we can recommend that the Yeliyur grama panchayath authorities (Government) implement certain water treatment technologies and should be installed in a safety place.

6.0 References

1. Tank SK, Chippa J. Analysis of water quality of Halena block in Bharatpur area. Int J Sci Res Pub. 2013.
2. Manohar M, Harishraju M. Geochemical analysis of groundwater along the Vrishahavathi river basin. Br J Appl Sci Technol. 2017; 4(20):1-17.
3. Manohar M, Harishraju M. Hydrochemical appraisal of groundwater in Chintamani taluk - a study. Int J Innov Res Sci Eng Technol. 2014; 3(4):11685-11693.
4. Krishne Gowda YH, Harishraju M, Manohar. A situational study of Groundwater in Kunigal Taluk. J Eng Sci Technol. 2019; 2(8):01-04.
5. Udom TK, Raihan Mohd. Groundwater and soil vulnerability in the cross river state. Euro J Sci. 2002; 4:628-635.
6. Bansal J, Dwivedi AK. Assessment of ground water quality by using water quality index and physico chemical parameters: review paper. Int J Eng Sci Res Tech. 2018; 7:170-174.

7. Ojo OI, Otieno FAO, George M. Groundwater: characteristics, qualities, pollutions and treatments: An overview. Int J Water Resour Environ Eng. 2012; 4(6):162-170.
8. Lalitha V, Sai Tejaswini. A study on assessment of groundwater quality and its suitability for drinking in Vuyyuru, Krishna(dist.), Andhra Pradesh. IJEDR. 2017; 5(2):1662-1668.
9. Adhikary P, Chandrasekaran H, Kamble K. Assessment of groundwater pollution in west Delhi, India using geostatistical approach. Environ Monit Assess. 2010; 167:599-615.
10. Shanmugam D, Premkumar R. Physicochemical analysis of groundwater samples near Industrial Area, Cuddalore District, Tamilnadu, India. Int J ChemTech Res. 2012; 4(1).
11. Manohar M, Harish Raju M, Krishne Gowda YH. Spatial distribution of fluoride in groundwater. Int J Eng Technol Sci Res. 2017; 4(11).
12. Ramesh K, Soorya Vennila. Hydrochemical analysis and evaluation of groundwater quality in and around Hosur, Krishnagiri District, Tamil Nadu, India. Int J Res Chem Environ. 2012; 2(3):113-122.
13. Mithra J, Bhaskaran R, Kumar S. International Journal of Engineering Research and Applications. 2012; 2(6):1237-1243.
14. Kandasamy K, Mayildurai R, Mahalakshmi R. Physicochemical analysis of groundwater quality of Velliangadu area in Coimbatore District, Tamilnadu, India. Rasayan J Chem. 2019; 12(2):409-414.
15. Anwar K, Vanita A. Analysis of groundwater quality using statistical techniques: a case study of Aligarh city (India). Int J Tech Res Appl. 2014; 2(5):100-106.
16. Khan A, Rehman Y. Groundwater quality assessment using water quality index (WQI) in Liaquatabad Town, Karachi, Pakistan. Acad J Environ Sci. 2017; 5(6):95-101.
17. Krishne Gowda YH, Harish Raju M, Manohar M. Physico-chemical analysis of the groundwater – a case study. Int J Eng Technol Sci Res. 2017; 4(11).
18. Gopalkrushna Haribhau M. Trace metals contamination of surface water samples in and around Akot city in Maharashtra, India. Res J Recent Sci. 2012; 1(7):5-9.
19. Ibrahim AK, Ahmed SH, Radeef AY, Hazzaa MM. Statistical analysis of groundwater quality parameters in selected sites at Kirkuk governorate/Iraq. IOP Conf Ser Mater Sci Eng. 2021; 1058:012028.