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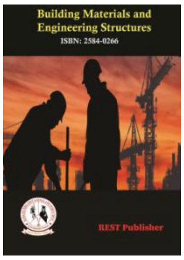

Condition of Ground Water Quality in Relation to Pollution in Krishnagiri District Taluk, TamilNadu

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Abstract. *A fundamental natural resource is water, which is essential to life. The increasing urban isation of India has an impact on the quantity and quality of groundwater. According to the Central Ground Water Board, the groundwater beneath Krishnagiri has been reduced by 60%, and additional investigation may reveal salt water intrusion. Our goal in the current work was to investigate groundwater quality assessment.This investigation's goal was to assess Krishnagiri City's groundwater's level of quality. The quality of groundwater determines whether it is suitable for use in industrial, household, agricultural, and drinking water applications. Evaluation of Groundwater Suitability in the Northern and Eastern Krishnagiri District for Irrigation and Drinking Water. Groundwater samples were taken in the research region. In Tamil Nadu's fluorosis-prone Krishnagiri area, water samples were taken from ten villages. Numerous physico-chemical indicators of water quality, including pH, TDS, TH, Ca2+, Mg2+, Na+, K+, Cl, and fluoride (F), have been measured and compared to typical values (WHO and BIS). Groundwater quality has been evaluated by looking at physicochemical elements such pH, TDS, TH, sulphate, chloride, calcium, and magnesium. A substantial linear association between several water quality metrics is revealed by the investigation. Version 16 of the SPSS statistical analysis programme was utilised for the analysis. The outcomes showed that the groundwater's pollutants were almost at the allowable levels. With a few notable exceptions, the bulk of the criteria used to evaluate the water quality showed levels within the range permitted by the Bureau of Indian Standards (BIS). None of the measurements exceeded the BIS-recommended allowed thresholds for determining the water quality, with the exception of pH at a specific point in Zone 1.*

Keywords: *Groundwater quality, Krishnagiri district quality,*

1. INTRODUCTION

Groundwater tables have been depleted, all types of soils have gotten deeper, and there is more unpredictability in water levels between rainy and dry seasons as a result of the overuse of groundwater resources across the nation. Pumping times, decreased agricultural pump set efficiency, shortened well lifespan, increased crop production variability, a reduction in the area that wells service, the emergence of groundwater markets, a decline in water quality, and the depth and construction of new bore wells. These effects have an effect on the equity, efficiency, and sustainability of groundwater use and agricultural productivity. In many areas of India, poor water quality is a major concern in addition to overexploitation and declining aquifers. Today, the quality of groundwater is seriously threatened by the disposal of home and industrial waste, which also decreases the amount of water available for agriculture and other domestic and commercial applications. Given that water has many uses, both the amount and the quality of groundwater are crucial. The physicochemical elements that determine groundwater quality variations in a region are typically impacted by geological formations and human activities. In order to determine the quality of the groundwater, physico-chemical characteristics should be researched and analyzed using GIS. One method to evaluate the quality of water is the Water Quality Index (WQI). WQI is a helpful tool for sharing knowledge about overall water quality. The WQI provides a single value that summarizes the overall water quality at a specific location based on a variety of water quality factors. In addition, it includes complex information that describes the water quality situation for the general public as well as decision- and policy-makers. It can also be used to compare the quality of diverse water sources and monitor temporal changes in water quality. It shows how different physical, chemical, and biological factors affect the water's overall state. The WQI's findings enable a preliminary classification of groundwater for use in a variety of applications and serve as a benchmark for assessing management tactics. Therefore, this study was conducted to determine the water quality index across multiple decades in various areas of Tamil Nadu's Krishnagiri district. Krishnagiri district has an elevation of 300 meters to 1400 meters above the mean sea level. It is located between 11º 12' N to 12º 49' N latitude, 77 º 27 ‘E to 78 º 38’ E longitudes. The groundwater quality is classified as excellent, good, poor, or unfit for human consumption based on the WQI values obtained. Water in its natural state is one of the most precious natural resources on Earth and is necessary for all life. Natural freshwater has become a rare resource as a result of pollution. Groundwater sources make up a sizable portion of the water supply and are frequently the only fresh source available. Numerous elements, including calcium, fluoride, and bicarbonate ion concentrations, water viscosity, pH, COD, BOD, and EC, have an impact on groundwater's composition (Hem, J.D 1991). Fluoride ions are one of the pollutants that render water unsafe for drinking, and its primary source is fluoridated rocks like fluorite. The fluoride ion exhibits special features in drinking water among water quality criteria; although its excess concentration is harmful to health, its ideal level is good (Saravanan et al. 2008). Humanity is quite concerned about water sources with high fluoride concentrations. The relationship between the qualities of calcium, sodium, and fluoride is that the higher the fluoride level, the lower the calcium. This might be the effect of calcium replacing sodium and fluoride having a stronger affinity for calcium (Diabl et al 2005). Limits for allowable fluoride concentrations in drinking water have been established by the WHO in 2008 and the BIS in 1991. (WHO 1991). Table 1 lists the fluoride levels that different authorities consider to be acceptable in drinking water. Fluoride administration at doses higher than 1 ppm has been shown to impede the production of DNA and RNA in cultured cells (Sivasankara 2000). The primary supply of drinking water, particularly in rural regions, is groundwater. This demonstrates how a shortage of clean drinking water has an influence on people's general health and life expectancy in many developing countries. India suffers from a severe lack of drinkable water of a quality that is acceptable due to depleting freshwater resources. Krishnagiri's groundwater is colourless, odourless, and primarily alkaline in composition.

2. MATERIAL AND METHOD

As shown in Table 2, groundwater samples were taken in 10 different villages within the Krishnagiri district. To prevent unanticipated changes in their features, groundwater samples were collected in polyethylene bottles in accordance with APHA's regular operating protocols (Sudakar 2013, Brown et al. 1974, APHA, 1998).

Table 1 Krishnagiri district Taluk

A	Krishnagiri Taluk
B	Pochampalli Taluk
C	Uthangarai Taluk
D	Hosur Taluk
E	Denkanikottai Taluk
F	Bargur Taluk

To prevent the entry of extraneous particles, the collected groundwater samples were firmly corked before being transported to the lab. According to accepted techniques described in the literature (Sudakar 2013, Brown et al. 1974, APHA, 1998), they were examined for pH, TDS, TH, sulphate, chloride, calcium, and magnesium.

2.1. Hydrogen ion concentration (pH): The source water's pH level water's hydrogen ion concentration can be measured to determine its acidity or alkalinity. The pH of the water system has an impact on the majority of biological and chemical processes. The pH range for all groundwater samples used in this investigation was between 7.5 and 8.9. BIS for drinking water the pH scale, according to the WHO, go from 7.0 to 8.5. Samples S1 and S10 had pH values that are higher than allowed. The mucous membrane of the cells is harmed if the pH is outside the acceptable range.

2.2. Total Dissolved Solids (TDS): Did you know that water contains both inorganic and organic elements, making up the total dissolved solids (TDS)? Solids are composed of a variety of elements, including iron, manganese, magnesium, potassium, sodium, calcium, bicarbonates, chlorides, phosphates, and maybe other minerals. Human TDS values are higher. They irritate the stomach, although long-term use of water with a high TDS Kidney stones and cardiac issues may result from it. TDS values in the current investigation ranged from 627 to 2336 mg/l. TDS has a maximum allowed value of 1500 mg/l and a preferred level of 500 mg/l. The TDS value for each groundwater sample was under the allowed limit of 1500 mg/l.

2.3. Total Hardness (TH): The three main elements that make up water hardness are sulphates, carbonates, and bicarbonates. Relates to calcium's aesthetic value and is brought on by magnesium chlorides. As a result, soap won't foam as much, and water will boil more quickly. Completely unpalatable for drinking The highest allowed level is 300 mg/l (BIS). Hardness is categorised as soft up to 75 mg/l, moderate up to 150 mg/l, severe up to 300 mg/l, and more severe over 300 mg/l. Hardness above 300 mg/l might affect the heart and lead to renal issues (Bhattacharya et al., 2012). Total hardness in groundwater samples from the study area ranges from 156 to 546 mg/l. The research area's groundwater samples, which made up 58% of the samples, were so hard that they needed to be adequately treated before use.

2.4. Chloride (Cl): Chloride can occur naturally in groundwater or be brought on by household trash. The amount of chloride in wastewater serves as a contaminant indicator. In forming chloride concentration and penetrability, soil porosity is crucial. Metal pipes and agricultural products with high chloride concentration in water bodies can be harmful. due to kidney and cardiac conditions affected individuals (Chapolikar et al. 2010). The range of chloride content is 45-660 mg/l. Most groundwater tests were within the WHO-approved limit of 250 mg/l for chloride concentration; any less chloride indicates pollution. Groundwater samples S3 and S5 have slightly greater chloride concentrations, which results in certain physical abnormalities.

2.5. Calcium (Ca): limestone, rocks, and industrial waste Calcium from abundant sources seeps into the groundwater. Calcium is crucial for healthy bone formation. The WHO says that calcium is OK. 100 mg/l is the cap value. The region has calcium concentrations between 46 and 210 mg/l. After examining the various physicochemical characteristics of the groundwater samples, the calculated parameters' descriptive statistics are provided in Table 1. The results are compared to BIS standards and the World Health Organization-recommended upper permissible levels.

2. RESULTS AND DISCUSSIONS

The chemicals utilised were all pure AR grade. All reagents and solution preparation procedures were carried out using double distilled water. For each determination, the average values of three replications were taken. The samples were collected, kept in an icebox to prevent biological activity, degradation, hydrolysis of chemical compounds and complexes, and component volatility, and then transported to the lab for the measurement of both physico-chemical parameters. Water Conservation Methods in the United States: Environmental Protection Agency Presentation (USEPA 1983). Version 16 of the SPSS statistical analysis programme was utilised for the analysis.

Table 2. data set

	PH	TDS	TH	Sulphate	Chloride	Calcium	Magnesium
Krishnagiri Taluk	8.1	1850	535	145	248	63	346
Pochampalli Taluk	6.9	735	495	93	402	147	378
Uthangarai Taluk	7.6	1050	455	134	442	154	249
Hosur Taluk	7.3	1754	376	64	384	88	432
Denkanikottai Taluk	6.1	1522	549	119	267	163	102
Bargur Taluk	6.8	1171	324	104	368	93	137

By contrasting the values of several geochemical parameters observed with the standards established by both BIS and WHO, The district of Krishnagiri's ground water's quality is assessed. According to the physico-chemical properties of the examined water sample, there are concentration variations in water quality. It ranges from 7.8 to 9.3 on the reciprocal logarithm of the hydrogen ion concentration (pH) in a water sample. With the exception of sample A, all samples were safe for ingestion. The calcium (Ca^{2+}) ion concentration in these areas varies greatly, varying from 74 mg/l at the low to 170 mg/l at the high. However, according to Indian Standards, every sample is within the upper permitted limit. Magnesium (Mg^{2+}) concentrations range from 5 mg/l to 57 mg/l. This magnesium is below the standards' allowable limit. The optimal range for chloride concentration (Cl) values is between 248 mg/l to 442 mg/l.

Table 3. Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation	Variance	Skewness	Kurtosis
TDS	6	735	1850	1347.00	434.284	1.886E5	-.223	-1.499
PH	6	6.1	8.1	7.133	.6947	.483	-.128	-.010
TH	6	324	549	455.67	89.705	8.047E3	-.588	-1.291
Sulphate	6	64	145	109.83	29.404	864.567	-.506	-.283
Chloride	6	248	442	351.83	77.357	5.984E3	-.540	-1.527
Calcium	6	63	163	118.00	41.742	1.742E3	-.193	-2.367
Magnesium	6	102	432	274.00	134.121	1.799E4	-.278	-1.934

Table 1 pH, TDS, TH, Calcium, Magnesium, Sulphate ,Chloride Descriptive Statistical Analysis N, Range, Minimum, Maximum, Mean, Standard Deviation values are given.

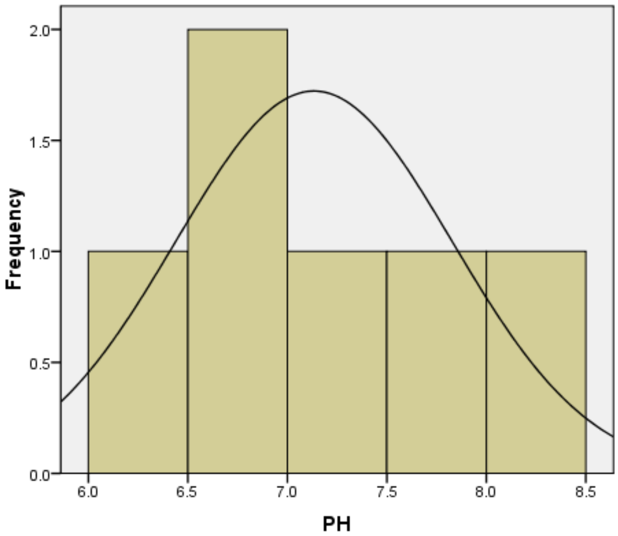

Figure 1.Frequency for pH

Figure 1 shows the histogram plot for pH. It is clear from the figure that the data is slightly skewed to the left due to attitudes towards water quality greater than 6.5-7.0; however, the fact that all other values are under the normal curve indicates that the sample substantially follows a normal distribution for all other values.

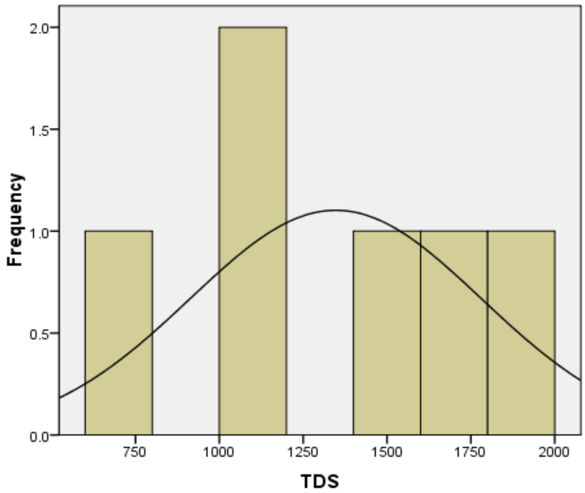

Figure 2.Frequency for TDS

Figure 2 shows the histogram plot for TDS. It is clear from the figure that the data is slightly skewed to the left due to attitudes towards water quality greater than 1000-1250; however, the fact that all other values are under the normal curve indicates that the sample substantially follows a normal distribution for all other values.

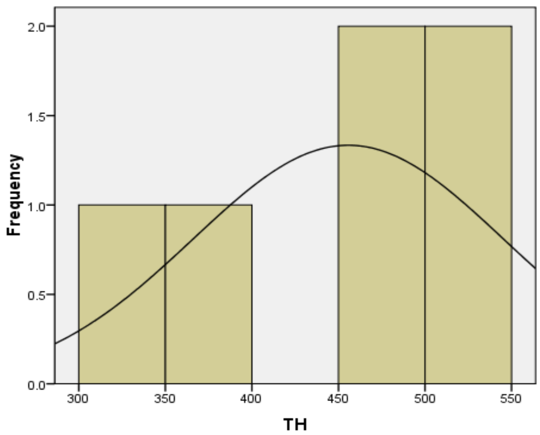

Figure 3.Frequencies for TH

Figure 3 shows the histogram plot for TH. It is clear from the figure that the data is slightly skewed to the Wrights due to attitudes towards water quality greater than 450-550; however, the fact that all other values are under the normal curve indicates that the sample substantially follows a normal distribution for all other values.

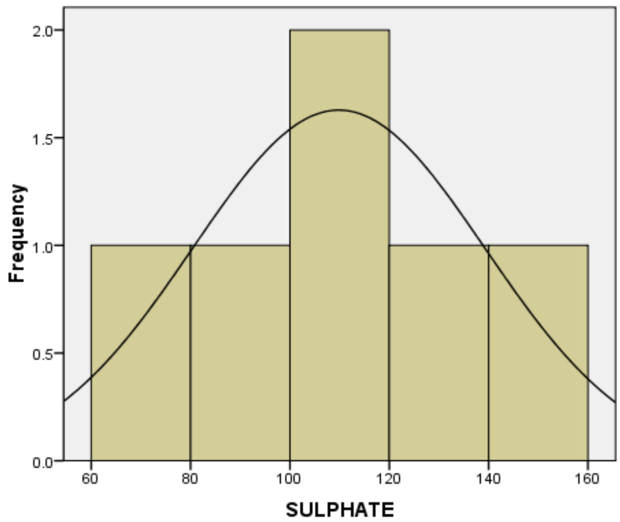

Figure 4.Frequency for Sulphate

Figure 4 shows the histogram plot for Sulphate. It is clear from the figure that the data is slightly skewed to the center due to attitudes towards water quality greater than 100-120; however, the fact that all other values are under the normal curve indicates that the sample substantially follows a normal distribution for all other values.

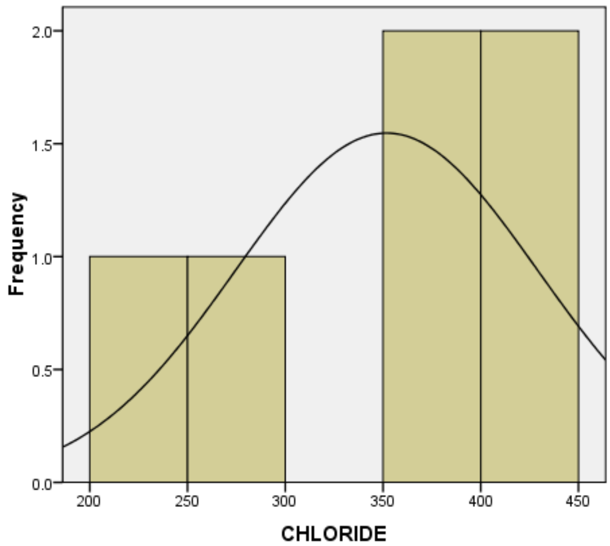

Figure 5.Frequencies for Chloride

Figure 3 shows the histogram plot for Chloride. It is clear from the figure that the data is slightly skewed to the Wrights due to attitudes towards water quality greater than 350-450; however, the fact that all other values are under the Wrights curve indicates that the sample substantially follows a normal distribution for all other values.

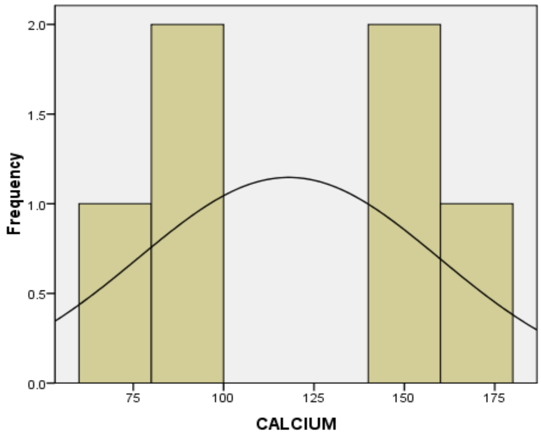

Figure 6. Frequency for Calcium

Figure 3 shows the histogram plot for TH. It is clear from the figure that the data is slightly skewed to the Wrights due to attitudes towards water quality greater than 100, 150; however, the fact that all other values are not under the normal curve indicates that the sample does not substantially follow a normal distribution for all other values.

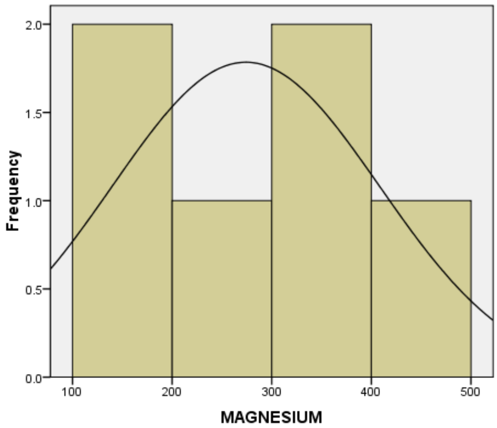

Figure 7.Frequencies for Magnesium

Figure 3 shows the histogram plot for TH. It is clear from the figure that the data is slightly skewed to the left due to attitudes towards water quality greater than 100-400; however, the fact that all other values are under the normal curve indicates that the sample substantially follows a normal distribution for all other values.

Table 4.Correlations

	PH	TDS	TH	Sulphate	Chloride	Calcium	Magnesium
PH	1	.289	.004	.333	.066	-.595	.608
TDS	.289	1	.119	.075	-.681	-.618	.132
TH	.004	.119	1	.560	-.546	.354	-.013
Sulphate	.333	.075	.560	1	-.410	.062	-.398
Chloride	.066	-.681	-.546	-.410	1	.324	.250
Calcium	-.595	-.618	.354	.062	.324	1	-.389
Magnesium	.608	.132	-.013	-.398	.250	-.389	1

Table 6 A shows the correlation between water quality parameters for pH. For tax planning is having highest correlation with Magnesium and having lowest correlation with Calcium. Next the correlation between motivation water quality for TDS. For tax planning is having highest correlation with pH and having lowest correlation with Chloride. Next the correlation between water quality parameters for TH. For tax planning is having highest correlation with Sulphate and having lowest correlation with Chloride. Next the correlation between water quality parameters for Sulphate. For tax planning is having highest correlation with TH and having lowest correlation with Chloride. Next the correlation between water quality parameters for Chloride. For tax planning is having highest correlation with Calcium and having lowest correlation with TDS. Next the correlation between water quality

parameters for Calcium. For tax planning is having highest correlation with TH and having lowest correlation with TDS. Next the correlation between water quality parameters for Magnesium. For tax planning is having highest correlation with pH and having lowest correlation with Sulphate.

CONCLUSION

Except in a few places, the groundwater's caveat chemistry indicates an excess of Na. Na+, Mg2+, Ca2+, and K+ are the most abundant elements. Except for a few samples, the groundwater's ion composition indicates an overabundance of chloride. Except for a few places, the cation chemistry of groundwater indicates an excess of Na. With the exception of a few samples, the ion chemistry of groundwater reveals an overabundance of chloride. Cl and Na levels in the research region have increased due to rock dissolution and household, agricultural, and industrial effluents. When compared to WHO allowed limits and BIS requirements, the analytical results revealed that 40% of the sample did not contain potable water. Parental control of litho logy and human influences, such as discharges from neighboring tanneries, which impact the hydro geochemistry of groundwater and render it unsafe for drinking, are the main causes of all hydro geochemical processes in the studied region. The results indicated that the contaminants in the groundwater were close to the permissible limits. However, in some cases it exceeds the permissible level for drinking water. Version 16 of the SPSS statistical analysis programme was utilised for the analysis.

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