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WATER QUALITY ASSESSMENT OF KADUR TOWN'S GROUNDWATER: A PHYSICO-CHEMICAL STUDY

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ABSTRACT

Water is a vital natural resource crucial for sustaining both life and the environment. However, in recent decades, its quality has been declining primarily because of excessive use. Assessing water quality is of utmost importance when the central goal is sustainable development, with a focus on the well-being of humanity. The aim of the present study was to assess the status of the groundwater in Kadur Town. The range of physicochemical parameters like EC (583-828 µS/cm), TDS (394-596 mg/l), Total Alkalinity (324-477 mg/l), Total hardness (552-680 mg/l), Calcium (254-324 mg/l), Magnesium (297-369 mg/l) and Chloride (149-461 mg/l), were found to be higher than the acceptable limit of drinking water standards prescribed by BIS 10500:2012. The results considered that the groundwater of the study area in general cannot be considered as good quality due to excess Hardness.

Keywords: Groundwater, Physicochemical Parameters, Suitability For Drinkability.

I. INTRODUCTION

Water is an essential resource for sustaining life, and groundwater, with its suitable salt levels, serves as a valuable source of clean water for human use. However, a combination of factors including population growth, unchecked urban development, resource overexploitation, and pollution poses a significant threat to the quality of this resource. The quality of water is a matter of paramount importance to humanity as it directly impacts human well-being. Across several states in India, more than 90% of the population relies on groundwater for their drinking and various other needs. Moreover, environmental processes like climate change can influence groundwater quality by altering aquifer recharge patterns and increasing demand, thereby straining available resources in specific regions. The chemical composition of groundwater is a critical factor determining its suitability for various purposes, including human and animal consumption, irrigation, and industrial use. Among the various factors that affect groundwater quality, chemical hazards such as Calcium, Magnesium, and Nitrate are of particular concern. Ensuring that groundwater is free from physical and chemical hazards is essential for public health. The contamination of groundwater has emerged as a major environmental risk in recent years, and its suitability for drinking purposes has become a significant concern, not only in India but globally. To address these concerns, the Bureau of Indian Standards (BIS 2012) has established maximum permissible limits for various dissolved ions in water intended for human consumption. Water quality is not a one-size-fits-all concept; it varies depending on the intended use of the water. Groundwater chemistry is influenced by a variety of factors, including inputs from the atmosphere, interactions with soil, and the weathering of rocks. Consequently, water quality is assessed based on various physicochemical parameters that characterize groundwater. This study focuses on Kadur, a densely populated Taluk located in the Chikkamagaluru district of Karnataka, India. In this geographical area, the reliance on groundwater for various essential purposes surpasses the use of surface water. The specific objective of this study is to assess the physical and chemical properties of groundwater in the study area. Such research plays a pivotal role in the development of improved water quality management policies and the mitigation of issues related to drinking water contamination.

II. METHODOLOGY

Study Area

Kadur Taluk is located in the Chikkamagaluru district, in the southern state of Karnataka, India. Its coordinates are approximately 13° 33' 12.053" N latitude and 76° 0' 40.025" E longitude. The taluk covers portions of

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survey of India Toposheet Nos. 48O/14 and 15. According to the 2011 census, the population of Kadur urban in Chikmagalur district was 56,874. This area falls within the Central Dry Agro-climatic Zone of Karnataka and is situated in the Vedavati river sub-basin, which serves as a tributary to the Tungabhadra River.

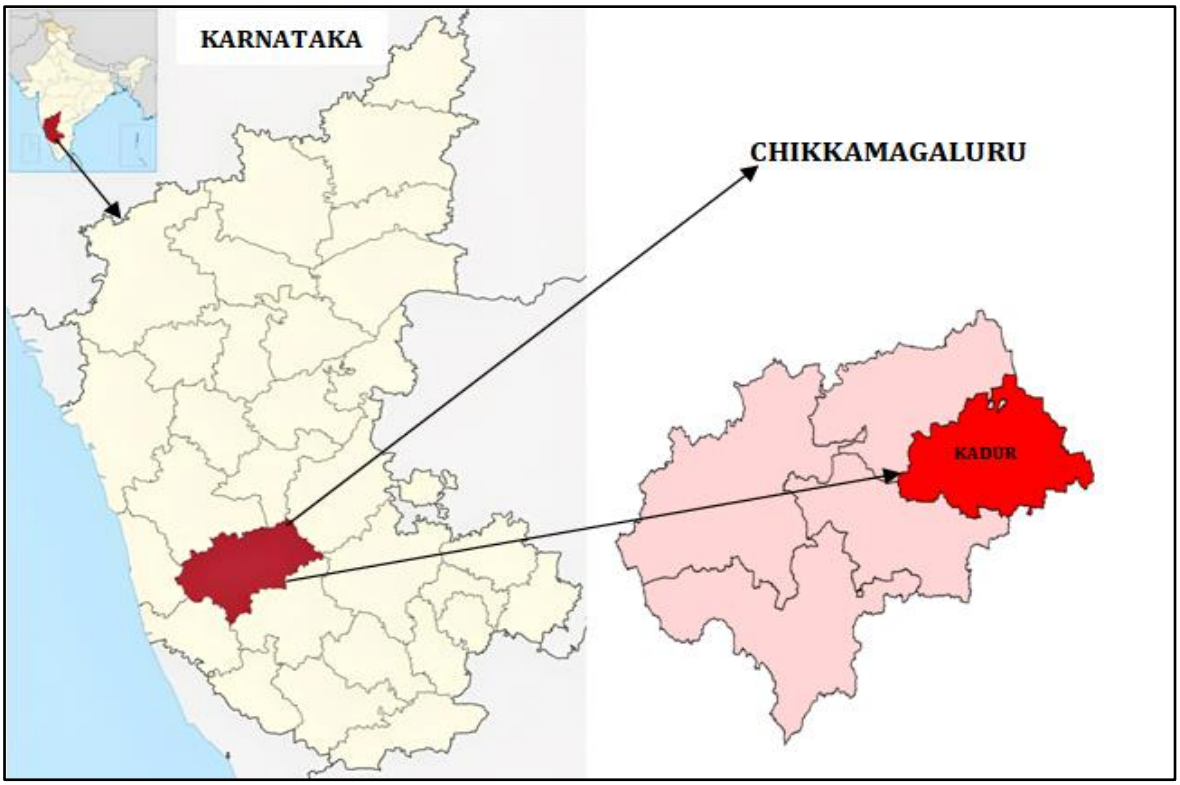

Figure 1. Location Map of Study Area

Sample collection

Water Samples from the ten selected sites namely (Dattatri Nagara (S1), Vijayalakshmi Nagara (S2), Ganapathi Pendal road (S3), Jain temple road (S4), Taluk office Road (S5), Railway Station road (S6), Bus stand road (S7), Basaveshwara hospital road (S8), Maravanji cross (S9), and Check post (S10)) were collected and taken in pre-cleaned 1 liter plastic bottles. Samples were analyzed immediately for parameters, which need to be determined instantly.

Physico-Chemical Analysis

The collected samples were analysed for major physical and chemical water quality parameter like pH, Electrical Conductivity (EC), Total Dissolved Solids (TDS), Total Alkalinity, Total Hardness, Chloride, Calcium, Magnesium, Fluoride, Nitrate and Sulphate.

III. RESULTS AND DISCUSSION

The condition of water resources relies on the effective management of water sources, which encompasses factors like overexploitation in addition to the inherent physicochemical characteristics of the area.

pH

pH serves as a significant ecological parameter and offers valuable information in various geochemical equilibrium and solubility calculations. In our study, the highest pH measurement was observed at sampling location S6, reaching a value of 7.93, while the lowest pH reading was recorded at S2, registering at 7.12. When compared to the standard values outlined in IS 10500:2012, our samples were found to be within the permissible limits as specified.

Electrical Conductivity

Electrical conductivity (EC) serves as a valuable metric for assessing water purity. In our study, the EC values spanned from 583 µS/cm at S7 to 828 µS/cm at S6. Elevated EC values indicate the presence of a significant quantity of dissolved inorganic substances in ionized form.

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Total dissolved solids

Total Dissolved Solids (TDS) are typically associated with electrical conductivity. Water containing more than 500 mg/l of TDS is generally considered unsuitable for drinking water supplies, although more mineralized water may be utilized when higher-quality water is not accessible. In our study, the highest TDS value recorded during the research period was 596 mg/l at sampling location S7, while the lowest was 394 mg/l at S6. It's important to note that the TDS values for the water samples from S3, S6, S8, and S9 exceeded the limit specified by BIS standards.

Total alkalinity

The alkalinity measurement in water offers insights into the presence of natural salts in the water. The source of this alkalinity is the minerals that dissolve into the water from the surrounding soil. In our study, the highest recorded alkalinity value was 477 mg/l at sampling location S6, while the lowest was 324 mg/l at S1. Notably, these alkalinity values exceeded the limit set by BIS standards.

Total hardness

Hardness is a property of water that inhibits the formation of lather with soap and elevates the boiling point of water. The total hardness ranged from 552 mg/l at S6 to 680 mg/l at S4, exceeding the allowable limit specified by BIS standards. According to some classifications, water hardness up to 75 mg/l is categorized as soft, 76-150 mg/l is moderately soft, 151-300 mg/l is hard, and over 300 mg/l is considered very hard. Based on this classification, our results indicate that all the samples fell into the very hard water category.

Calcium and Magnesium

Calcium and magnesium in natural water originate from a variety of sources, including different types of rocks, industrial waste, and sewage. In our study, the calcium content in the water samples ranged from 254 mg/l at S6 to 324 mg/l at S10, while the magnesium content ranged from 297 mg/l at S7 to 369 mg/l at S4.

Chlorides

Chloride is typically found in natural waters in varying concentrations, often in the form of sodium chloride (NaCl), calcium chloride (CaCl2), and magnesium chloride (MgCl2). These chloride ions enter water through the dissolution of salts present in the soil. In our study, the highest chloride concentration was measured at 461 mg/l at sampling location S8, while the lowest concentration was 149 mg/l at S9.

Fluoride

Fluoride can occur naturally in groundwater as a result of the dissolution of minerals in geological formations, including fluorite, apatite, and other fluoride-containing minerals. The Fluoride values ranges from 0.49 mg/l at S2 to 0.7 mg/l at S10. All the samples found to be within the prescribed limit of BIS 10500:2012.

Nitrate

Nitrate (NO_3^-) is a chemical compound consisting of nitrogen and oxygen. It is a common form of nitrogen found in nature and is of particular significance in the context of water quality and environmental health. The Nitrate values ranges from 6.79 mg/l at S2 to 18.4 mg/l at S4. All the samples found to be within the prescribed limit of BIS 10500:2012.

Sulphate

Sulfate is a naturally occurring ion found in water, soil, and rocks, with both natural and human-related sources, and it can impact water quality and environmental health when present in excessive concentrations. The Sulphate values ranges from 19.25 mg/l at S7 to 28.4 mg/l at S1. All the samples found to be within the prescribed limit of BIS 10500:2012.

The results of the physicochemical parameters for water samples (including minimum, maximum, and mean values for each parameter) are presented in Table 1.

Table 1. Average results of the physicochemical parameters

SN.	Parameter	Minimum	Maximum	Mean	Percentage Compliance	BIS 10500:2012
1	pH	7.12	7.93	7.494	100	6.5-8.5
2	EC, µS/cm	583	828	714.5	100	-

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3	TDS, mg/l	394	596	487.9	60	500
4	Total Alkalinity, mg/l	324	477	385.1	0	200
5	Total Hardness, mg/l	552	680	620.2	0	200
6	Calcium, mg/l	254	324	288.1	0	75
7	Magnesium, mg/l	297	369	331.3	0	30
8	Chloride, mg/l	149	461	315.356	10	250
9	Fluoride, mg/l	0.49	0.7	0.559	100	1
10	Nitrate, mg/l	6.79	18.4	10.008	100	45
11	Sulphate, mg/l	19.25	28.4	23.36	100	200

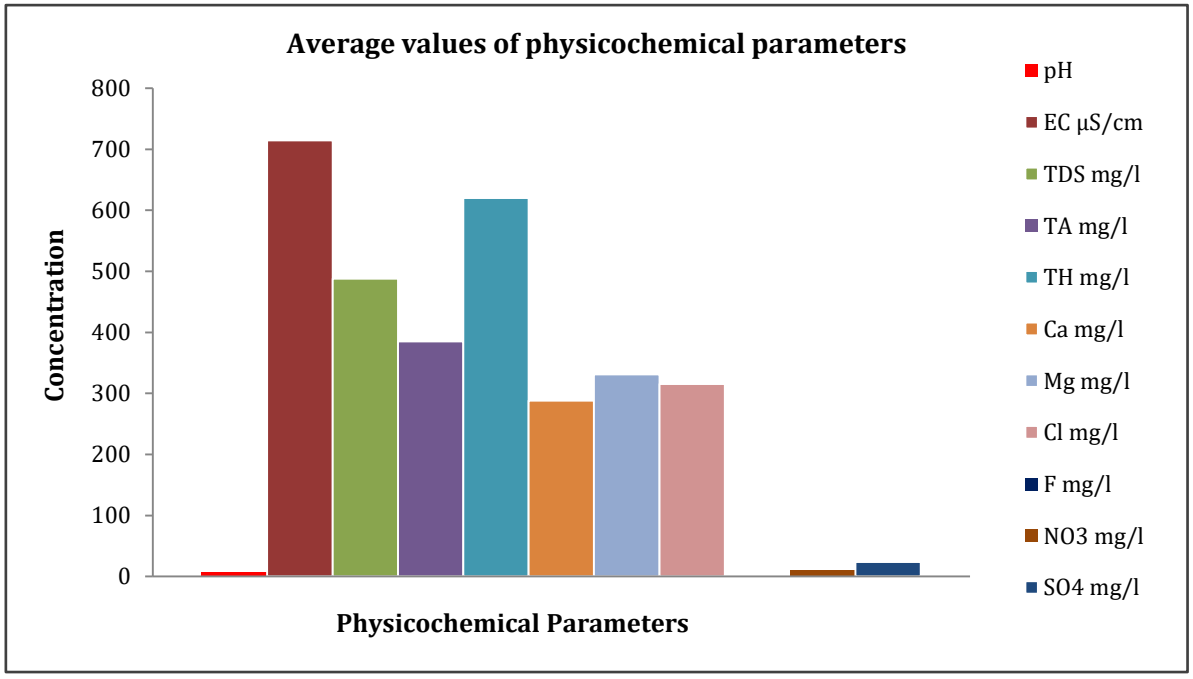

Figure 2. The average physicochemical parameter concentrations in the study area.

IV. CONCLUSION

The analysis of physicochemical parameters for the 10 well water samples in the study area shows that all of them have very high levels of hardness. Moreover, it has been observed that the hardness of all water samples does not meet the standards set by the Bureau of Indian Standards (BIS). Therefore, it is essential to take appropriate precautions before consuming groundwater in the Kadur Town region to avoid potential adverse health effects on humans. The quality of groundwater in this area might improve during the rainy season due to the influx of high-quality freshwater. This study helps to raise awareness among the local population about the significance of groundwater quality management.

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