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Well Water Quality in Ernakulam District: A Snapshot of the State of Drinking Water in Kerala

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ABSTRACT: Well water quality was analysed in selected sites of Eranakulam district, Kerala. The study indicated significant variations in groundwater quality parameters across the selected areas. While most parameters were within permissible limits, the prevalence of *E. coli* contamination in a majority of the samples raised concerns about the safety of drinking water in the region. Magnesium content was also above the permissible limit in a few sites. 91% of the well water in the study area was not suitable for drinking. The distinct clustering of certain stations suggested varying sources or factors influencing the groundwater quality in those areas. Present study aimed to shed light on the water quality in the southern state of Kerala and its broader implications for India as a whole.

Keywords: Wells in Kerala, Water quality, Ernakulam, Contamination.

INTRODUCTION

Access to safe drinking water is a fundamental human right and a crucial aspect of public health. Groundwater is a crucial resource for sustaining life, agriculture, and various industrial activities in many parts of the world. In India, where water scarcity and contamination are prevalent issues, ensuring the quality of drinking water is of paramount importance. Kerala's rapid urbanization and industrial growth have led to increased pollution, threatening the quality of its drinking water sources. Unregulated disposal of industrial effluents and untreated sewage have contaminated rivers, lakes, and groundwater reserves, compromising the safety of drinking water. High levels of water pollution have contributed to the spread of waterborne diseases, adversely affecting the health of millions Ghosh *et al.* (2017). In the rural areas of Ernakulam district of Kerala, open well water is an essential source of drinking water for the local population. However, increasing concerns about water quality and potential contamination have necessitated regular monitoring and assessment of groundwater. This study aimed to assess the groundwater quality in selected regions of Ernakulam district.

MATERIALS AND METHODS

Well water samples were collected from Koovapady and Kanjoor areas of Ernakulam district, Kerala. Random sampling was adopted. All together 22 samples were collected. Samples were collected in clean plastic bottles. Different parameters such as alkalinity (ppm $CaCO_3$/l), calcium (mg/l), fluoride (mg/l), chloride (mg/l) and total hardness were analyzed using water analyzing chemical kits of Nice Chemicals. Magnesium (mg/l) content was measured by subtracting calcium content from total hardness. pH was measured using portable pH meter (Eutech-eco Tester pH). Presence/absence of Coliform bacteria was also detected using Coliform analyzing Chemical kits of Nice Chemicals. Dissolved Oxygen was measured using Digital Dissolved Oxygen analyser (Labtronics-Model LT-27) and TDS was measured using TDS/Conductivity Meter (Labtronics-Model LT-25). Temperature was measured using an ordinary thermometer.

RESULTS AND DISCUSSION

The groundwater quality parameters varied significantly across the selected villages in Ernakulam district during the pre-monsoon period (Table 1). The temperature ranged from 28.0 to 28.9°C, with an average of 28.39°C (SD=0.27). The pH values ranged from 6.6 to 8.0, with an average of 7.4 (SD=0.37). The alkalinity levels varied from 5.00 to 85 ppm CaCO3/l, with an average of 18.87 ppm $CaCO_3$/l (SD=18.77). The DO content ranged from 5.0 to 6.6 ml/l, with an average of 5.36 ml/l (SD=0.35). The TDS levels varied from 27.7 to 191.3 ppm, with an average of 81.28 ppm (SD=44.61).

Chloride concentrations ranged from 40 to 90 mg/l, with an average of 60 mg/l (SD=14.14). The total hardness ranged from 5 to 70 mg/l, with an average of 22.27 mg/l (SD=19.30). Calcium content varied from 5 to 40 mg/l, with an average of 11.59 mg/l (SD=8.36). Magnesium content ranged from 0 to 45 mg/l, with an average of 10.68 mg/l (SD=12.15). Notably, fluoride content was found to be zero at all sampling stations. Regarding bacterial contamination, out of 22 samples collected, only 2 samples were found to be free from *Escherichia coli* contamination.

To understand the spatial relationship among the sampling sites based on the physicochemical parameters, cluster analysis was performed using the PRIMER v.5 software package (Fig. 1). The analysis revealed that stations formed similarity clusters at a 90% similarity level. However, stations 12, 16, 18, 19, 21, and 22 were entirely distinct from others, indicating unique water quality characteristics in those areas.

The results of water quality analysis were compared with BIS standard (BIS, 2012). The assessment confirmed that temperature, alkalinity, dissolved oxygen, total dissolved solids, calcium content, chlorine content and total hardness concentration satisfies the permissible limit for drinking at all samples, whereas magnesium and faecal coliform level were not within the desirable limit in a few sites. In the present study, the water temperature showed monsoonal minimum and pre-monsoonal maximum. The bureau of Indian standard (BIS, 2012) recommends a range of 10 to 30 mg/l for magnesium in drinking water. In the study area magnesium content was above the desirable limit in 4% of the samples. Some areas in Kerala may have higher or lower levels of calcium and magnesium in the drinking water depending on the specific geological features of the region Hariharan and Mammen (1983). But it was understood that it did not have any adverse effects on the health of people who drank the water. Similar investigations have been reported from earlier studies also. People who drank water with higher levels of calcium and magnesium had a lower risk of hypertension and diabetes mellitus (Suresh *et al*., 2019). The study proved that 91% of the sampling sites were contaminated with *E. coli*. Detection of faecal indicator bacteria in drinking water provides a very sensitive method of quality assessment. Sample was contaminated with *E. coli.* Faecal coliform bacteria are known as one of the most important bacterial indicators of public health hazard due to fecal pollution. *E. coli* is commonly associated with faecal contamination and serves as an indicator of potential pathogenic contamination in water sources. Its presence in drinking water signifies a breach in sanitation and poses serious health risks, especially gastrointestinal illnesses. Earlier studies have reported instances of *E. coli* contamination in drinking water sources in both Kerala and other regions of India, pointing to the urgent need for improved water treatment and monitoring (Sharma *et al*., 2012; Shukla *et al.,* 2012). Kumar *et al*. (2017) assessed the groundwater quality in Ernakulam district and assessed that water quality is declining. Understanding and mitigating the sources of *E. coli* contamination is essential for ensuring the provision of safe drinking water to communities. The study underlined that only 9% of water was suitable for drinking at Ernakulam district.

Table 1: Distribution of different physicochemical parameters in the study area.

Station	Temperature	PH	Alkalinity	DO	TDS	Chloride	Hardness	Calcium	Magnesium	Fluoride	*E. coli*
	ºC		ppm $CaCO_3$/l	ml/l	ppm	mg/l	mg/l	(ppm $CaCO_3$/l)	mg/l	mg/l	
1	28	7.2	15	6.6	83.4	80	10	5	5	0	Present
2	28.2	7.6	20	5.2	90.4	70	20	10	10	0	Present
3	28.1	7.5	15	5.4	72	50	20	10	10	0	Present
4	28.3	7.7	10	5.2	59.3	60	10	5	5	0	Absent
5	28.6	7.6	10	5.1	84.9	60	10	10	0	0	Present
6	28.1	7.2	10	5.3	62.1	60	10	10	0	0	Present
7	28	7.7	15	5.6	112	90	25	10	15	0	Present
8	28.5	7.8	10	5.7	81.1	70	20	10	10	0	Present
9	28.7	7	15	5.9	90.2	60	25	15	10	0	Present
10	28.6	7.7	10	5.2	90.1	70	7.5	5	2.5	0	Present
11	28.4	7.2	10	5.1	36.4	60	15	10	5	0	Present
12	28.6	7.4	20	5.4	40.5	40	10	10	0	0	Present
13	28.7	7	15	5.2	30.5	60	20	10	10	0	Absent
14	28.3	6.6	10	5.1	92.6	60	10	10	0	0	Present
15	28.1	8	10	5.3	29.2	50	10	5	5	0	Present
16	28.2	7.4	35	5.4	118	60	40	20	20	0	Present
17	28.6	7.6	60	5.3	167	40	70	25	45	0	Present
18	28.7	7.6	10	5.4	27.7	40	20	5	15	0	Present
19	28.4	6.8	15	5.2	143	90	55	20	35	0	Present
20	28.9	7.9	10	5.1	34.6	50	7.5	5	2.5	0	Present
21	28.6	7.9	85	5.2	191	50	70	40	30	0	Present
22	28	7.3	5	5	52	50	5	5	0	0	Present

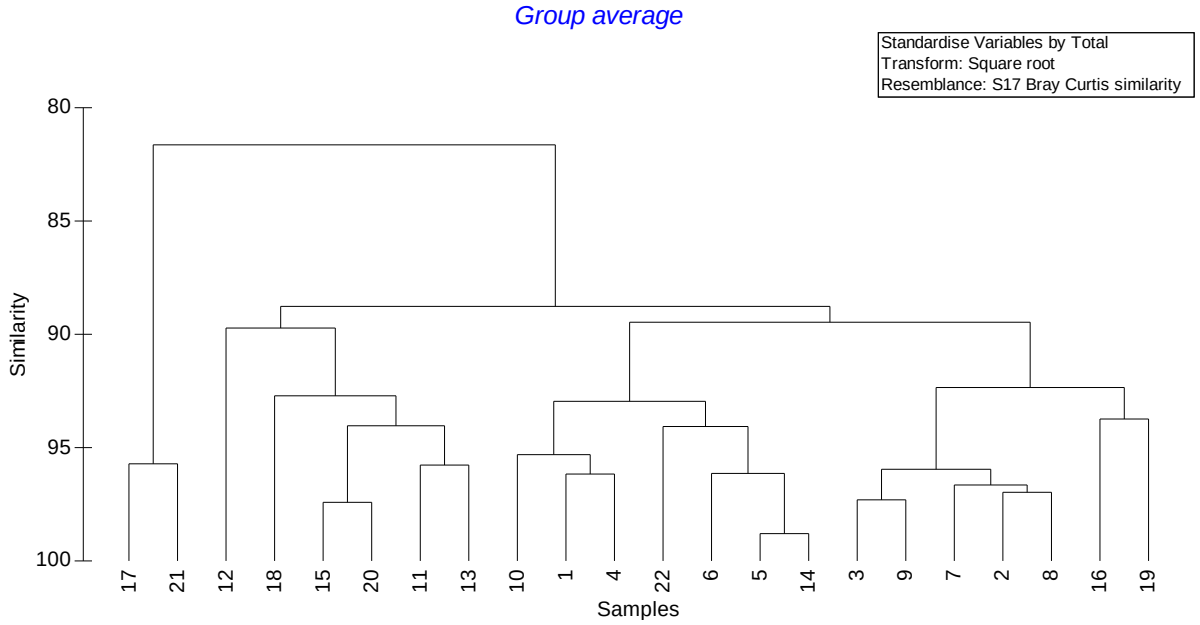

Fig. 1. Cluster analysis of sampling sites

The findings of this study are in line with the results of similar previous studies in Kerala and India. In Alappuzha district, the groundwater quality was generally good, but that there were some areas with high levels of bacterial contamination (Kumar *et al*., 2011). It is also found that the groundwater quality was declining over time in Alappuza district (Suresh and Kumar 2013). Similar observation was given by Radhakrishnan and Kumar (2014) at Thrissur district. Singh *et al*. (2016) assessed the groundwater quality in Pathanamthitta district, Kerala, India. The results showed that the groundwater quality was generally good, but that there were some areas with high levels of contamination from industrial pollutants and agricultural runoff. In Gujarat, it was found that the groundwater quality in the state was generally poor, with high levels of contamination from industrial pollutants and agricultural runoff (Shah *et al*., 2012).

CONCLUSIONS

The assessment of groundwater quality in selected villages of Ernakulam district during the pre-monsoon period reveals both positive and concerning results. While most physicochemical parameters were within acceptable limits, the widespread bacterial contamination necessitates immediate action to ensure access to safe drinking water. The cluster analysis provides valuable insights into the spatial distribution of groundwater quality and can aid in targeted interventions to address water quality issues in specific regions. The present study highlights the need for regular monitoring of groundwater quality in Ernakulam district and other parts of Kerala. Further research and monitoring efforts are essential to safeguard groundwater resources and protect public health in the studied area. Overall, the findings of the present study provide valuable insights into the groundwater quality in Ernakulam district. These insights can be used to improve the management of groundwater resources and protect public health in the region.

FUTURE SCOPE

Future research has the potential to contribute valuable insights and recommendations to address the identified issues. Conducting a comprehensive, long-term monitoring program to track the changes in well water quality over time will help to understand seasonal variations, identify trends, and ascertain the impact of various factors on water quality. Investigating the specific sources of contamination, especially *E. coli*, in the well water is also recommended. Researching and developing cost-effective and scalable water treatment technologies suitable for removing contaminants like E. coli and excess magnesium from well water is an another aspect of research. By delving into these areas of research, future studies can contribute to a better understanding of well water quality in the Eranakulam district and provide valuable insights that may have broader implications for water resource management and public health in the state of Kerala and other regions of India facing similar challenges.

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Conflict of interest. None

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