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Groundwater Quality Analysis of various Physicochemical Parameter

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Abstract—The quality of groundwater is a critical concern for sustainable water resource management.
Groundwater serves as an essential resource for a multitude of purposes, encompassing the provision of potable water and the sustenance of agricultural irrigation systems. However, it is susceptible to contamination from anthropogenic and natural sources. The objective of this research is to assess the spatial distribution and quality of groundwater parameters in Umred Taluka to provide valuable insights for effective water resource management and protection.
This study focuses on evaluating the quality of groundwater in umred taluka by analyzing various physicochemical parameters. Samples were collected from umred taluka and tested for pH, electrical conductivity (EC), turbidity, alkalinity, hardness, Calcium, and concentrations of heavy metals.

***Keywords* — Groundwater, Groundwater quality, Source, physicochemical parameter, heavy metals, Water analysis, Parameters**.

I. Introduction

Groundwater plays a crucial role in providing potable water for a considerable segment of the world's population. However, this vital resource faces increasing threats from various contaminants, including industrial discharge, agricultural runoff, and improper waste disposal. The quality of groundwater is a pivotal factor in ensuring public health, sustainable development, and the overall well-being of ecosystems that rely on this essential resource[1-5].

Assessing groundwater quality involves monitoring and analysing several key parameters, such as pH, total hardness (TH), Dissolved Oxygen, Calcium, etc. These parameters not only indicate the suitability of water for consumption but also serve as early warning signs of potential contamination[6-8].

II. Groundwater quality

2.1. *Definition of Groundwater Quality*

Groundwater quality pertains to the array of chemical, physical, and biological attributes inherent in water situated beneath the Earth's surface within aquifers. It serves as an indicator of the appropriateness of groundwater for diverse applications, encompassing drinking purposes, irrigation, industrial operations, and the sustenance of ecosystems. The quality of groundwater is determined by the presence and concentration of substances dissolved or suspended in the water.

2.2. *Purpose of groundwater quality analysis*

- Assessment of potability
- Environmental protection
- Detection of Contamination
- Public health protection
- Research and development

2.3. *Objectives of groundwater Quality*

- To protect public health

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- To protect environment
- To manage groundwater extraction rates.
- To prevent saltwater intrusion
- To ensure that groundwater used for irrigation is free from contaminants that could harm crops, soil quality, and agricultural productivity.
- To ensure industrial activity which would not be affect groundwater quality.
- To detect potential issues early, assess trends, and make informed management decisions.

III. Literature review

the methodology and findings of groundwater quality assessment in a specific area. The research focuses on Neelambur, utilizing a combination of GIS and AHP techniques to assess the spatial distribution of groundwater quality based on physico-chemical parameters.

the critical issue of groundwater quality in the context of increasing demands for drinking and irrigation water. The study is the contamination of groundwater due to untreated waste and chemical residues from industries. This pollution poses risks not only to human health but also to the flora and fauna in the region[9].

the integration of wireless sensors and machine learning techniques. The study addresses the increasing reliance on groundwater in urban areas due to unreliable surface water supplies for municipal water. To address the need for timely and accurate groundwater data, the study proposes a framework comprising three vital components: the Data Acquisition Unit (DAU), Data Transfer Unit (DTU), and Data Processing Unit (DPU). The integration of wireless sensors and machine learning is a notable aspect of the study. Wireless sensors offer real-time monitoring capabilities, allowing for continuous data collection without manual intervention[10].

a significant environmental concern, focusing on the chemical contamination of rivers and groundwater, particularly in arid and semi-arid regions where water resources are often scarce. This assessment is crucial for agricultural areas where water quality directly impacts crop productivity and soil health. By using sophisticated modelling techniques and GIS mapping, the researchers
aim to understand the distribution of various contaminants in both shallow and deep aquifers, particularly focusing on seepage from surface river water into the aquifers[11].

a critical issue related to groundwater quality in the Mangadu region. The study emphasizes the importance of water resources for regional growth and highlights the challenges posed by overexploitation, sewage discharge, and solid waste contamination[12].

the presence of pollutants that exceed acceptable limits set by organizations such as the World Health Organization (WHO), Indian Council of Medical Research (ICMR), and Bureau of Indian Standards (BIS). The research identifies that contamination of groundwater often stems from domestic, industrial, or agricultural waste[13].

the impact of urbanization on groundwater quality. The research findings are particularly significant as they shed light on the impact of urbanization on groundwater quality in Perundurai taluk. Urbanization often leads to increased pollution from various sources such as industrial discharges, domestic sewage, and runoff from urban areas[14].

a valuable contribution to groundwater management by introducing a GIS-based groundwater quality index. The approach offers a

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systematic and objective method to assess and monitor groundwater quality, taking into account spatial and temporal variations. The findings from the Nasuno basin study demonstrate the practical application of the GQI, showcasing its utility in identifying areas of concern for sustainable groundwater use and highlighting the need for targeted management interventions[15].

the overview of salient groundwater quality indices developed over the years and utilized for assessing groundwater quality globally. These indices provide a standardized way to assess and compare groundwater quality across different regions and contexts[16].

a Geographical Information System (GIS) tool to develop thematic maps depicting groundwater quality in the Gaza Strip. By integrating environmental data, the study aimed to provide a comprehensive view of the spatial variation in

below with figure1-8

4.1. *pH:*

pH serves as a metric indicating the acidity or alkalinity of a solution, determined by assessing the concentration of hydrogen ions (H+) within the solution. Regardless of the method used, it is important to ensure that the solution being measured is well mixed and free of contaminants that could affect the pH reading.

Fig. 1. *pH*

4.2 *Electrical Conductivity (EC):*

Electrical conductivity (EC) can be measured in water using a conductivity meter, also known as a conductivity probe or sensor. This device measures the ability of water to conduct an electric current, which is influenced by the presence of dissolved salts and other charged particles in the water.

Fig. 2 *Electrical Conductivity*

4.3. *Turbidity:*

Turbidity quantifies the extent to which water loses its clarity as a result of suspended particles being present. The most common method to determine turbidity in water is by using a turbidimeter or nephelometer. Here are the steps to determine turbidity in water using a turbidimeter:

1. Fill a sample cell with the water you want to test.

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2. Insert the sample cell into the turbidimeter and close the lid.
3. Allow the turbidimeter to stabilize for a few seconds.
4. Read the turbidity value displayed on the turbidimeter.

Fig. 3 *Turbidity*

4.4. *Chloride:*

This test is based on precipitation of an insoluble chloride salt. The chloride test is a widely employed chemical analysis utilized to ascertain the quantity of chloride ions contained within water samples. The test is simple and can be performed in a laboratory or in the field.

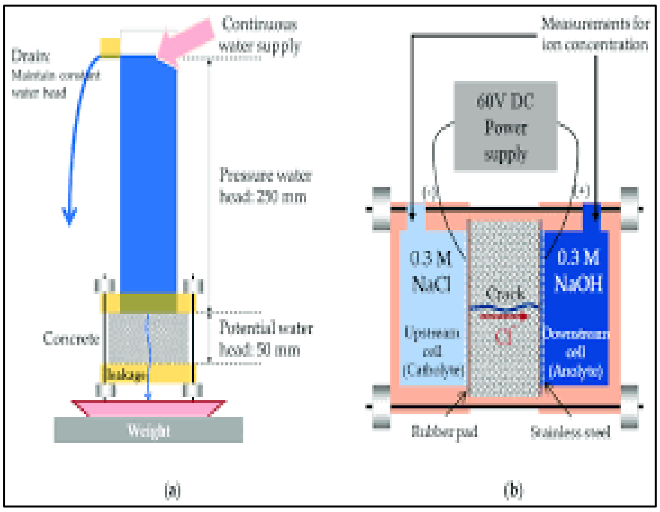

Fig.4 *Chloride*

4.5. *Alkalinity:*

Alkalinity is a measure of the water's capacity to neutralize acid. It's due to the presence of those types of substances in water which have tendency to increase the concentration of OH- ions either by hydrolysis or by dissociation of water.

4.6. *Total*
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Fig. 6: *Total Hardness*

4.7. *Dissolved Oxygen (DO):*

Dissolved oxygen (DO) is typically measured in water to assess its quality and the

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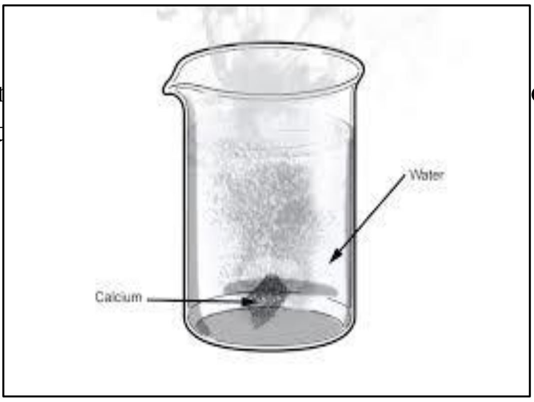


Fig. 7: *Dissolved Oxygen*

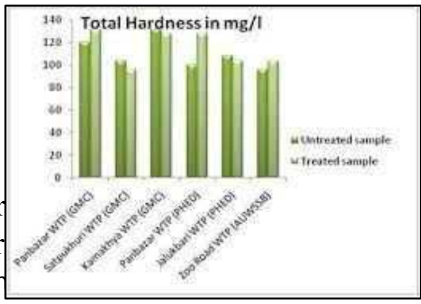
4.8. *Calcium:*

The most common method for determining calcium in water is through a technique called complexometric titration, which involves the use of a chelating agent called ethylenediaminetetraacetic acid (EDTA) to form a complex with the calcium ions present in the water sample.

Fig. 8 *Calcium*

V. Study area

Area Details:
Area: Umred Taluka, Nagpur District



Umr... District of Mahar... ed within the Vidarbh... n. Positioned 48 kilometers south of Nagpur's district headquarters, it serves as a Taluka headquarters. Umred is bordered by Bhivapur Taluka to the east, Kuhi Taluka to the north, Chimur Taluka to the south, and Pauni Taluka to the east. Covering an area of 989.21 square kilometers, the Taluka boasts a population density of 156 individuals per square kilometer. The total population of Umred stands at 154,180, with 79,054 males and 75,126 females. According to the 2011 Census, 64.99% of the population resides in urban areas, while 35.01% resides in rural areas. The percentage of the population living in rural areas within Umred Taluka is notably high, reflecting a broader trend in Ma... banized states... than 60 perce... reas by 2011

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Table No. 1: turbidity details

Stations	Water Sample	pH	Turbidity (NTU)
S1	Agricultural	7.75	5
S2	Residential	7.64	4
S3	Agricultural	7.09	3
S4	Agricultural	6.7	4
S5	Agricultural	1.98	8
S6	Agricultural	2.01	8
S7	Agricultural	2.45	5
S8	Residential	6.3	4
S9	Agricultural	7.28	3
S10	Agricultural	6.65	3

Table No. 2: chloride details

Stations	Water Sample	E.C. (ms)	Chloride (mg/l)
S1	Agricultural	0.77	99.4
S2	Residential	2.08	234.3
S3	Agricultural	0.68	170.4
S4	Agricultural	0.68	149.1
S5	Agricultural	0.95	156.2
S6	Agricultural	0.87	113.6
S7	Agricultural	0.90	163.3
S8	Residential	1.72	227.2
S9	Agricultural	0.94	184.6
S10	Agricultural	0.98	355.7

Table No. 3 : alkalinity and TH

Stations	Water Sample	Alkalinity (mg/l)	T.H. (mg/l)
S1	Agricultural	221	46
S2	Residential	210	72
S3	Agricultural	270	63
S4	Agricultural	201	96
S5	Agricultural	123	87
S6	Agricultural	112	76
S7	Agricultural	198	91
S8	Residential	213	77
S9	Agricultural	208	57
S10	Agricultural	201	67

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Table No. 4 DO AND CALCIUM DETAILS

Stations	Water Sample	D.O. (mg/l)	Calcium (mg/l)
S1	Agricultural	5.9	127
S2	Residential	6	104
S3	Agricultural	6.1	101
S4	Agricultural	4.9	169
S5	Agricultural	7.3	164.1
S6	Agricultural	6.6	179.4
S7	Agricultural	7.6	228
S8	Residential	5.7	221
S9	Agricultural	4.3	176
S10	Agricultural	5.7	140

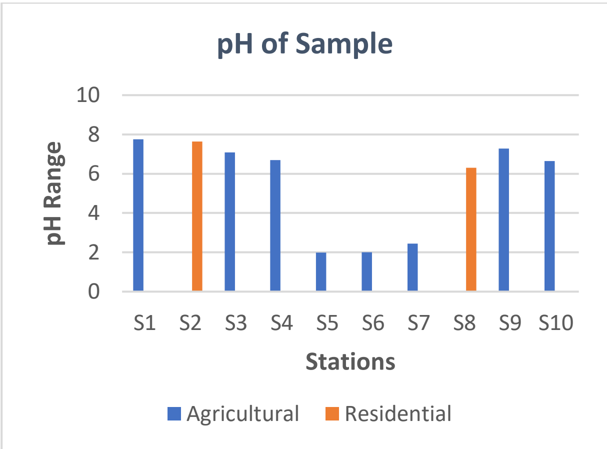

Fig 10: pH of Sample

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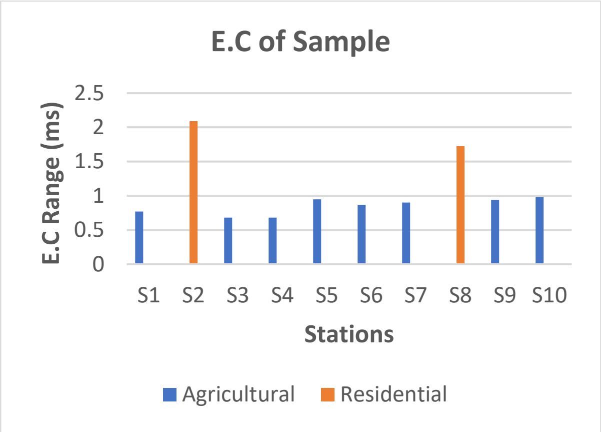

Fig 11: E.C of Sample

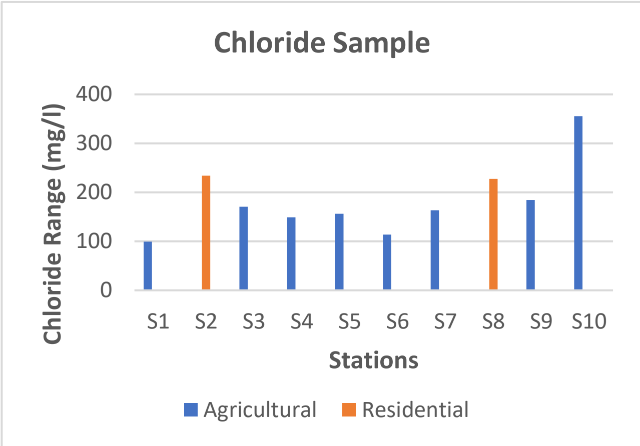

Figure 13: Chloride Sample

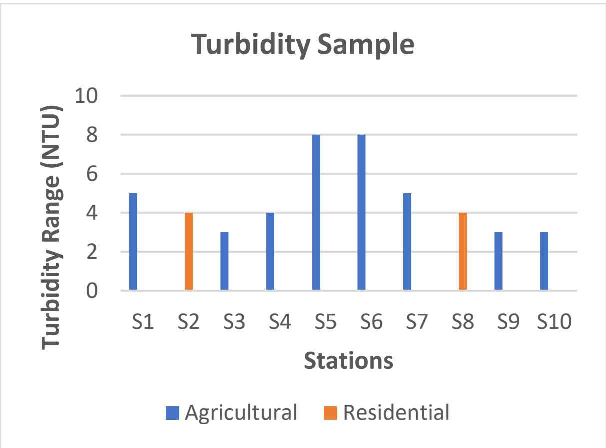

Figure 12: Turbidity Sample

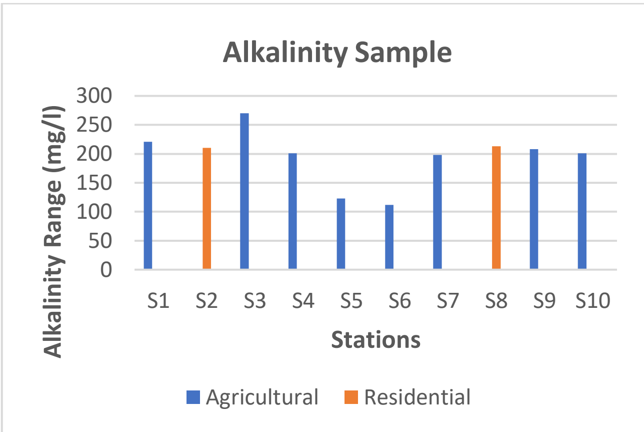

Figure 14: Alkalinity Sample

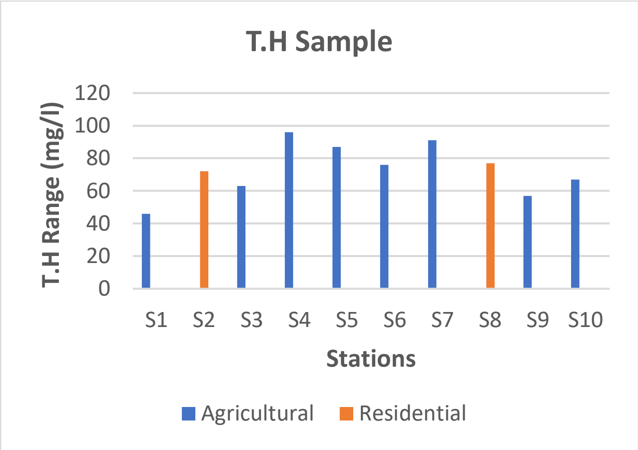

Figure 15: T.H Sample

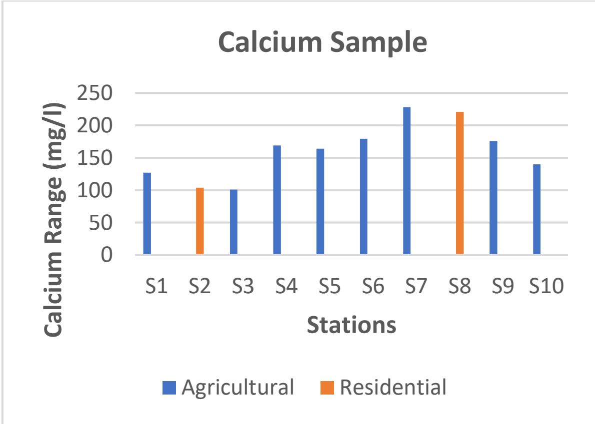

Fig 17: Calcium Sample

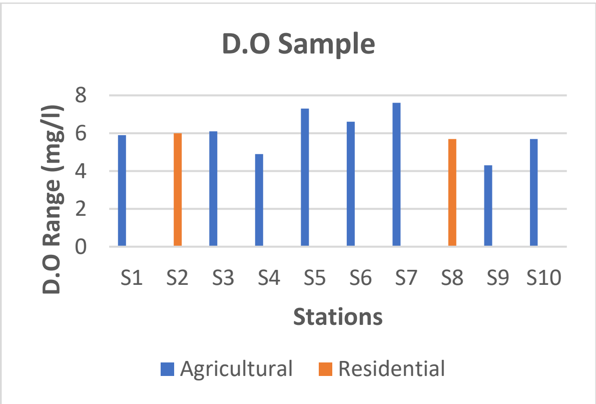

Fig 16: D.O Sample

VII. Conclusion

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- The groundwater samples from the study areas underwent collection and analysis to assess various physicochemical parameters. The findings indicate that the majority of these parameters fall within permissible limits.
- However, turbidity levels exceeded the established threshold at all sampling stations. Conversely, chloride content remained below the prescribed limit across all stations.
- According to BIS, water has an Alkalinity of 200mg/l. S1, S2, S3, S4, S8, S9, S10 are having high Alkalinity value.
- Ph content of the stations was observed to be under the range of (6.5-8-5) expect S5, S6, S7, S8.
- As per standard Total Hardness should not exceed 600mg/l.
- The government must add chloride and fluoride into public water supply for maintaining their content in drinking water.

• The turbidity levels of the samples are within acceptable limits.

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• Groundwater samples from the study areas underwent collection and analysis to evaluate various physicochemical parameters.

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