Mrs. SWATI V BAGEWADI.et. al., International Journal of Engineering Research and Applications
www.ijera.com
ISSN: 2248-9622, Vol. 15, Issue 6, June 2025, pp 151-163

RESEARCH ARTICLE OPEN ACCESS

Ground Water Quality Assessment Using Water Quality Index in Rural Areas of Belagavi District

Mrs. SWATI V BAGEWADI
Lecturer in Civil Engineering Department
Government Polytechnic Belgaum

Prof. MAHANTESH V KANTHI
Associate professor in civil engineering
Angadi institute of technology and management
Belgaum

ABSTRACT
Groundwater plays a pivotal role in fulfilling the water requirements of urban, peri-urban, and rural communities, especially in semi-arid regions such as Belgaum and Karnataka. With the rising demand driven by rapid urbanization, agricultural intensification, and industrial expansion, the sustainability and quality of groundwater sources—openwells and borewells—have become a critical concern. This project offers a comprehensive evaluation of groundwater quality in selected localities of Belgaum, namely Hindalga, Ambewadi, and Ganeshpur, using Water Quality Index (WQI) models and an integrated analysis of physico-chemical and microbiological parameters. A total of 25 groundwater samples were collected and preserved under stringent conditions from varied hydrogeological settings. Sampling was carried out from both shallow dug wells and deep borewells, incorporating a broad range of depths (20 ft to 240 ft) and surrounding land uses (agricultural, residential, industrial). The parameters analyzed included pH, TDS, electrical conductivity, total hardness, major cations and anions (Ca^{2+}, Mg^{2+}, Na^+, K^+, Cl^-, SO_4^{2-}, NO_3^-), fluoride, and microbiological contaminants such as E. coli. The analytical results were benchmarked against BIS: 10500-2012 standards for drinking water quality.
The study employed both the Tiwari & Mishra Weighted Arithmetic Index method and the Bhargava Index method for calculating WQI values, enabling robust cross-validation. Additionally, advanced indices for irrigation water assessment such as Sodium Adsorption Ratio (SAR), Residual Sodium Carbonate (RSC), Soluble Sodium Percentage (%Na), Kelly's Ratio, and Magnesium Hazard were computed to evaluate the suitability of groundwater for agricultural use. Key findings indicate that multiple samples exceeded permissible limits for nitrates, fluoride, and total dissolved solids, particularly in areas adjacent to agricultural zones, suggesting contamination from agrochemicals and poor waste management. Ganeshpur borewells, while deeper and less exposed to surface contamination, displayed high mineral concentrations, likely due to geogenic sources and over-extraction. The WQI results classified a significant number of samples under "Poor" to "Very Poor" quality for human consumption, necessitating immediate remediation strategies.
Keywords: *Groundwater Quality, Water Quality Index (WQI), Belgaum, Tiwari Method, Bhargava Method, Borewell, Openwell, Sodium Adsorption Ratio (SAR), Physico-Chemical Parameters, Irrigation Water Assessment, Nitrate Contamination, Fluoride Toxicity, Sustainable Water Management, Hydro geochemistry, Microbial Water Contamination.*

I. INTRODUCTION

Water is one of the most essential resources for life, supporting drinking, agricultural, industrial, and recreational activities. The quality of water directly impacts human health, ecosystem sustainability, and economic development. In India, the dependency on groundwater sources like wells and borewells is immense, especially in regions where surface water is scarce or unreliable. In the city of Belgaum, situated in the state of Karnataka, groundwater is a primary source for drinking water and agricultural purposes. However, the increasing reliance on groundwater and the unregulated usage of water resources in many parts of the country have raised concerns regarding the quality and sustainability of these sources ***[9]***.

Water is a precious natural resource and one of the most essential requirements of all living beings. Groundwater is the major source of drinking water in both urban and rural areas. Groundwater is the most dependent source of water for the day-to-day requirements for various needs in the absence of alternate sources of water supply. The demand for water has increased over the years and this has led to scarcity in many parts of the world. Groundwater has made significant contributions to the growth of India's Economy and has been an important catalyst for its socio-economic development. The main occupation of people is agriculture in the study area. In the absence of surface water in the irrigation system, ground water is the main source of irrigation. The need to assess the groundwater quality is becoming increasingly important as groundwater sources become more and more contaminated by unsustainable agricultural practices. Water quality index is one of the most effective tools to communicate information on the quality of water. Water-quality indices aim at giving a single value to the water quality of a source based on one or the other system which translates the list of constituents, and their concentrations present in a sample into a single value ***[6]***. Groundwater is one of the most crucial natural resources for drinking water, irrigation, and industrial use worldwide. It plays an essential role in sustaining ecosystems, especially in regions where surface water resources are limited. Rainfall patterns including its intensity, frequency, and seasonal distribution—play a vital role in determining how much water replenishes the aquifers, which, in turn, affects groundwater availability and sustainability. At the same time, the quality of groundwater is equally important as its quantity. Groundwater quality is determined by the presence of various physical, chemical, and biological contaminants, including nitrates, heavy metals, salinity, and pathogens.

1.2: OVERVIEW OF WATER RESOURCES IN BELGAUM

Belgaum, located in the northern part of Karnataka, is a region that relies heavily on groundwater, particularly from openwells and borewells, for its daily needs. Due to its semi-arid climate, groundwater has become a critical source for drinking, irrigation, and other domestic uses. However, rapid urbanization, agricultural expansion, and pollution are contributing factors that may affect the quality of groundwater sources. Which occurs beneath the earth surface is considered free from contamination, hence usable but anthropogenic as well as natural factors are affecting the quality as well as quantity of this valuable resource due to unplanned urbanization and industrialization for the past few decades in a few parts of the country. Understanding the potential influences of human activity on ground water quality is important for protection and sustainable use of ground water resources, as well as groundwater extraction has been increasing continuously to keep pace with agricultural development in rural areas hence the hydro geochemistry study is important. Ground water in the study area is utilized for both agricultural and drinking purposes ***[7]***. Realization that ground water is a limited resource despite annual recharge and should be carefully guarded to satisfy our heads during the periods of draught and not allowed to be squandered, is yet to down in the minds of our people. Indiscriminate drilling of bore wells is not the answer to the problem of restoring sustainable yield. Enterprising individuals who are lucky enough to tap a copious supping of water in bore wells drilled within their property have claimed ownership of the water and have started supplying it in tankers to communities who are prepared to pay for it. Heavy withdrawal of water in such centers has resulted in most of the bore wells in the neighborhood going dry. Yet governments have failed to take the action to put the stop to such unregulated trading in a basic need for water.

Clean drinking water is essential to human and other life forms. Access to safe drinking water has improved steadily and substantially over the last decades in almost every part of the world. However, some observers have estimated that by 2025 more than half of the world population will be facing water-based vulnerability. Karnataka is a scarce water state which has the longest area under dry land agriculture next only to Rajasthan and has irrigation facility only to the 27% of the cultivable land. More than 55% of the irrigated area is under protective irrigation which encourages the use of micro irrigation systems to enhance the efficiency of water use and ultimately production and productivity of crops ***[10]***. Although the water is scarce, this resource is not being used by the farming community in view of several inadequacies.

II. LITERATURE REVIEW

The purpose of this internship was to assess the quality of groundwater in Belgaum by testing both openwell water and bore-well water. By analyzing physical, chemical, and microbiological parameters, the study aimed to:

- Evaluate the overall quality of groundwater in the region.
- Identify specific contaminants in openwells and borewells.
- Determine the impact of different sources of contamination, such as agricultural practices, waste disposal, and industrial activities.
- Provide recommendations for improving water quality and implementing sustainable water management practices in the region.

The findings from this study will help local authorities, residents, and organizations like the National Institute of Hydrology in formulating strategies to improve water quality, mitigate contamination, and ensure the sustainable use of groundwater resources in Belgaum.

III. FUTURE SCOPE

This study focuses on a specific region in Belgaum, where samples were collected from both openwell and borewell sources. While the study aims to provide a comprehensive overview of water quality, certain limitations exist:

- Limited Sample Size: The water samples collected are limited to specific locations, and results may not represent the entire region.
- Seasonal Variations: Groundwater quality may vary due to seasonal changes, rainfall, and agricultural cycles, which may not be fully captured in this study.
- Laboratory Constraints: The analysis is conducted based on available testing methods and equipment, which may limit the range of parameters tested.

Despite these limitations, the study provides valuable insights into the current state of water quality in Belgaum and highlights areas for improvement.

IV. MAJOR SOURCES OF WATER IN BELGAUM

Openwells: Shallow wells, which tap into the upper aquifers, are commonly used in rural areas. These openwells are typically less deep and may be more susceptible to contamination from surface runoff and poor sanitation practices.

Borewells: Borewells, which are drilled deeper into the ground, access water from deeper aquifers. These are typically used in urban and peri-urban areas where water demand is higher. Borewells are less susceptible to surface contamination but may face issues related to over- extraction and high mineral concentrations. Despite the heavy reliance on groundwater, there are concerns about the sustainability of these water sources. Over-extraction, pollution, and inadequate water treatment facilities are the primary factors that threaten the quality of groundwater resources.

Fig No.1: Openwell and Borewell

4
.1: *Significance of Water Quality Testing*

Water quality testing is a crucial process in assessing the suitability of water for human consumption and other uses. In the context of groundwater sources such as openwells and borewells, water quality testing becomes even more important due to the potential risks posed by contaminants. Groundwater sources can be affected by both natural factors, such as the geological composition of the region, and human activities, such as agricultural runoff, industrial effluents, and inadequate waste disposal systems.The primary goal of water quality testing is to ensure that water meets the standards for safety, health, and environmental sustainability. The key parameters tested during water quality assessments include:

Physical Parameters: These include the appearance, temperature, turbidity, and pH of the water. These parameters give an initial understanding of the water's clarity and its general suitability for consumption.

Chemical Parameters: These include dissolved minerals, salts, heavy metals, and contaminants like nitrates, which can have serious health consequences if present in high concentrations.

Microbiological Parameters: The presence of harmful microorganisms, such as bacteria, viruses, and protozoa, is a key concern in water quality. Pathogens like coliform bacteria and E. coli are indicators of water contamination from human or animal waste. In addition to ensuring the safety of water for human consumption, water quality testing helps identify potential sources of contamination and formulate strategies for improving water quality.

4.2: *Groundwater Contamination and its Sources*

Groundwater contamination is a major issue that affects the water quality of openwells and borewells.

Contaminants can originate from both natural sources and human activities. Some of the most common sources of groundwater contamination in Belgaum include:

Agricultural Runoff: Fertilizers, pesticides, and herbicides used in agricultural activities can leach into the groundwater, leading to elevated nitrate concentrations and contamination with harmful chemicals.

Improper Waste Disposal: Open dumping of solid waste, improper sewage treatment, and the lack of sanitation facilities can lead to the infiltration of organic and inorganic waste into groundwater sources, resulting in microbial contamination.

Industrial Effluents: Industrial areas may discharge untreated effluents containing heavy metals and toxic chemicals, which can seep into the groundwater, causing contamination of 4 local aquifers.

Urbanization: Urbanization often leads to increased demand for water and the creation of impervious surfaces, reducing natural filtration and causing runoff from construction sites, roads, and other urban areas that can contaminate groundwater.

Natural Factors: In certain regions, groundwater may naturally contain elevated levels of minerals such as iron, fluoride, or arsenic. While these contaminants may not always pose an immediate risk to health, long-term exposure to high concentrations can lead to various health issues.

4.3: Water Quality Index (WQI)

Water-quality indices aim at giving a single value to the water quality of a source based on one or the other system which translates the list of constituents, and their concentrations present in a sample into a single value. One can then compare different samples for quality based on the index value of each sample. What is water quality? This question is immensely more complex than the question: What is water quantity?

We can say: this reservoir contains 2 Mm3 of water or the present flow in this river is 15 m3 /s. expressing water quantity is as simple as this. But how do we express the water quality of the same stream? The quality may be good enough for drinking but not suitable for use as a coolant in an industry. It may be good for irrigating some crops but not well for irrigating some other crops. It may be suitable for livestock but not for fish culture. Whereas water quantity is determined by a single parameter the water mass water quality is a function of anything and everything the water might have picked up during its journey from the clouds to the earth to the water body: in dissolved, colloidal, or suspended form. Given the fact that water is a universal solvent, it picks up a lot.

One way to describe the quality of a given water sample is to list out the concentrations of everything that the sample contained. Such a list would be if the number of constituents analyzed and that may be anything from the 20-odd common constituents to hundreds! Moreover, such a list will make little sense to anyone except well-trained water-quality experts.

- To analyze groundwater quality for domestic and irrigation purposes.
- To assess water contamination in Hindalga, Ambewadi, and Ganeshpur areas of Belgaum city and suggest suitable remedial measures.
- To determine the Water Quality Index (WQI) using various assessment methods.
- To educate residents and local authorities on the health and environmental benefits of regular water quality monitoring.

At assessing the water quality index (WQI) and physico-chemical parameters for the ground water of Belgaum city the present work is aimed. For a physico-chemical analysis, ground water samples of selected location were collected. For calculating the present water quality status, the following quality parameters were considered: pH, electrical conductivity, TDS, total hardness, sulphate, chloride etc. After calculating the water quality status of considered parameters, results are compared with IS: 10500-2012. This ground water sample's physico - chemical characteristics suggest that the evaluation of water quality parameters should be carried out. In the present study the Weighted Arithmetic Method gives better results than Bhargava method.

V. STUDY AREA

The study area focused on Hindalga, Ambewadi, Ganeshpur Area in Belgaum, Karnataka, a region where groundwater serves as a primary source for drinking and domestic use. Sampling locations were selected to cover a range of urban, peri-urban, and rural areas to capture diverse conditions and potential sources of contamination.

Hindalga Village

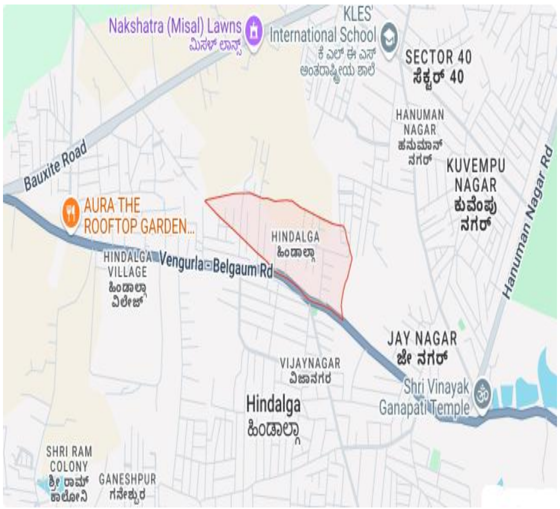


Fig No. 2 - ***Hindalaga Map, Belagavi***

Hindalga Village spans approximately 0.64 square kilometers, which is equivalent to 640,000 square meters/ 160 acres. Hindalga falls under the jurisdiction of Gram Panchayat, which is responsible for civic administration, including water supply, sanitation, and infrastructure development. Residents of Hindalga Village also rely on local borewells and open wells for their drinking water needs, especially during periods of water scarcity. It's divided in 30 words with a population of 25000. Significance of source selection: There were continuous complaints received about water contamination to NIH.

Ambewadi Village

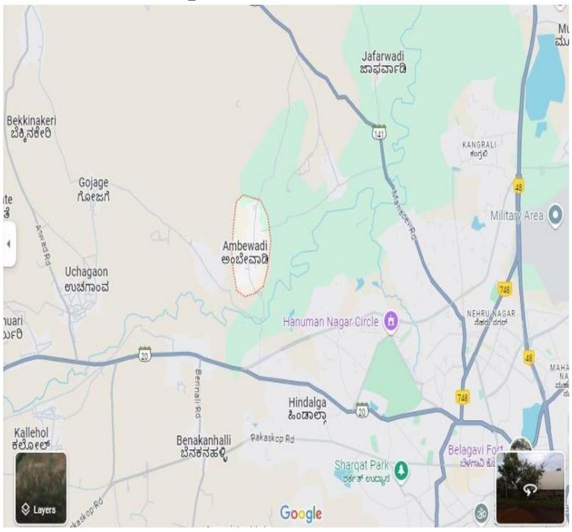


Fig No. 3 - Ambewadi Map, Belagavi

Ambewadi is a village located in Belgaum district, Karnataka, India. The village covers a total geographical area of approximately 863.56 hectares (8.63 square kilometers/ 2000 acres), population of 20000. Ambewadi falls under the jurisdiction of the local Gram Panchayath system, which oversees the village's civic and infrastructural needs. Ambewadi is a rural settlement characterized by its agricultural activities, cultural heritage, and proximity to the urban center of Belgaum, contributing to its socio-economic development.

Significance of source selection: Ambewadi village in Belgaum district primarily relies on uncovered wells, hand pumps, and boreholes for its drinking water needs. However, the village lacks a comprehensive drainage system, which can pose challenges to maintaining water quality.

Ganeshpur Area

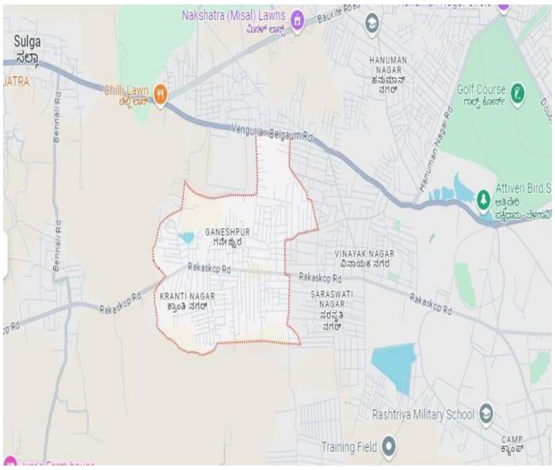


Fig No. 4 - Ganeshpur Map, Belagavi

Ganeshpur is a locality in Belagavi (formerly Belgaum), Karnataka, covering an area of approximately 1.55 square kilometers, which equates to 1,550,000 square meters/ 383.15 acres, population of 15000. Ganeshpur falls under the jurisdiction of the Belagavi Urban Development Authority (BUDA), responsible for urban planning and development in the region. The Belagavi City Corporation manages the provision of drinking water in Ganeshpur. In Ganeshpur, Belagavi, borewells are a primary source of drinking water. However, concerns have been raised about the quality of this groundwater.

Significance of source selection: A study assessing groundwater quality in NIH Belagavi found that a significant portion of the water samples exceeded permissible limits for various contaminants, rendering them unsafe for consumption

VI. METHODOLOGY

Preparation: Cleaning the Sampling Containers: clean, sterilized bottles were used for collecting samples. Labeling: Each bottle was labeled with details such as date, time, location, and any other relevant information (e.g., openwell or borewell identification, depth, etc.).

Sampling Process for Openwells: Purge the Well: Before collecting the sample, the well was purged by running the water for at least 10–15 minutes to clear any stagnant water or debris. Sampling Point: Collecting water from a location that is as close to the water source as possible, ideally from the center of the openwell to avoid surface contamination.

Sampling Process & Sample Location: Purge the Borewell: Like wells, the borewell was purged for 10-15 minutes to remove stagnant water and ensure the sample reflects the fresh, available ground water. The purpose of the sampling was to ensure diverse and representative data collection for assessing the quality of well water in the study area by including shallow dug wells in residential and agricultural areas, borewells in urban and semi-urban zones, and wells located near potential contamination sources such as agricultural fields, industrial areas, and waste disposal sites.

A total of 25 water samples were collected from three distinct locations as part of the internship project to assess water quality, including 11 open well samples from Hindalga to analyze traditional groundwater sources, 5 borewell samples from Ganeshpur representing deeper aquifers accessed through modern drilling, and 9 well water samples from Ambewadi village to evaluate rural water quality, with the sampling strategy designed to capture spatial variability for a comprehensive assessment. To prevent microbial activity and chemical reactions, appropriate preservatives were added based on the type of analysis, and the samples were stored at 4°C in refrigerated conditions and analyzed within the recommended holding time of 24 hours to ensure accuracy and reliability of the results.

VII. FINAL RESULT

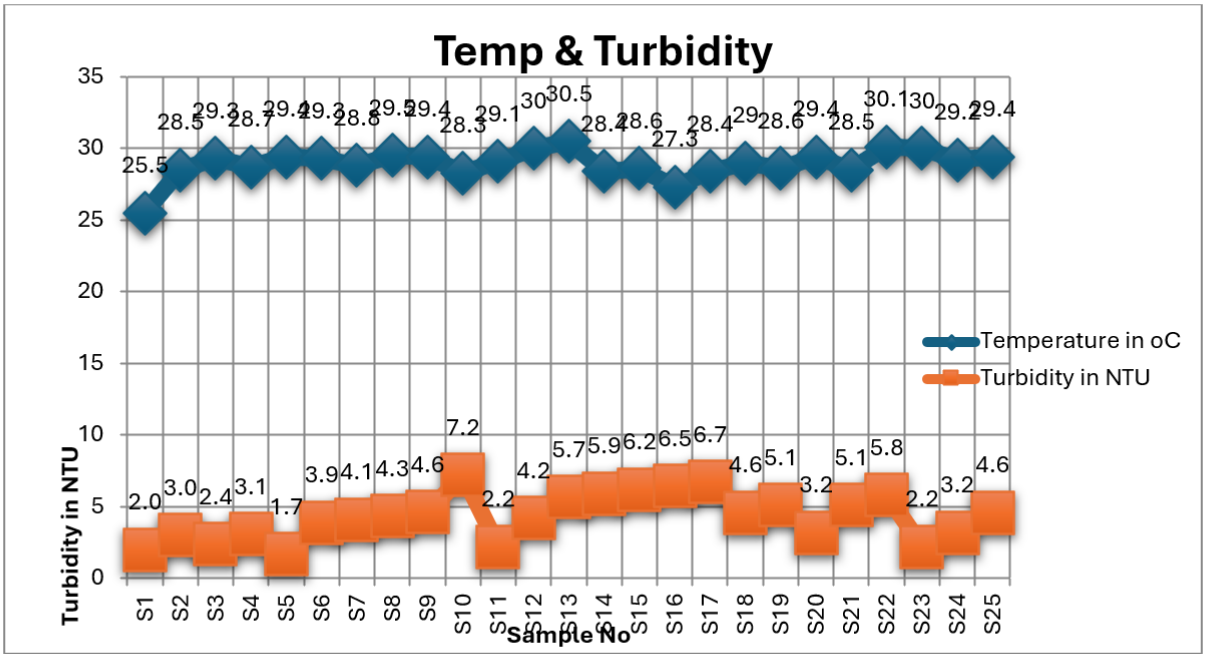
7.1 Physical Parameters

% of Deviation above BIS 10500-2012 standards

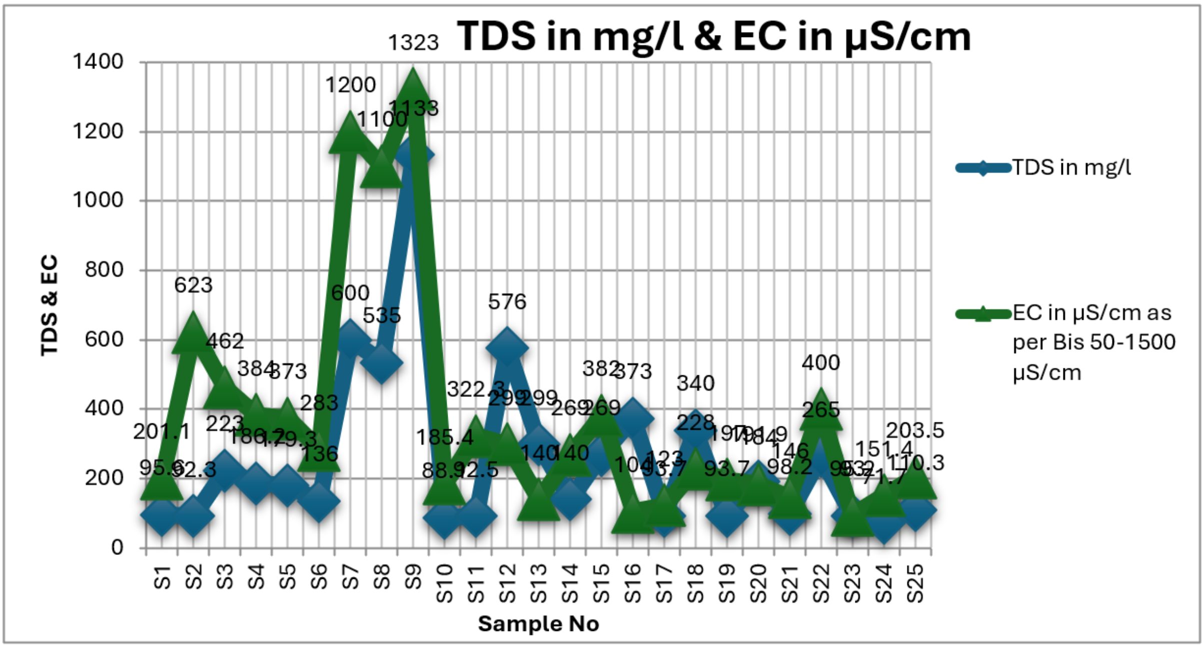
Table No: 3.1

BIS Limits	5 NTU		500 mg/l		750 µS/cm		
Sample No	**Turbidity in NTU**	**% of deviation Turbidity in 5 NTU**	**TDS in mg/l**	**% of deviation TDS in mg/l**	**EC in µS/cm as per BIS 750 µS/cm**	**% of deviation of EC as per BIS µS/cm**	**Area**
S1	2	-60	95.6	-81	201.1	-73	Hindalga
S2	3	-40	92.3	-82	623	-17	Hindalga
S3	2.4	-52	223	-55	462	-38	Hindalga
S4	3.1	-38	186.2	-63	384	-49	Hindalga
S5	1.7	-66	179.3	-64	373	-50	Hindalga
S6	3.9	-22	136	-73	283	-62	Hindalga
S7	4.1	-18	600	20	1200	60	Hindalga
S8	4.3	-14	535	7	1100	47	Hindalga
S9	4.6	-8	1133	127	1323	76	Hindalga
S10	7.2	44	88.1	-82	185.4	-75	Hindalga
S11	2.2	-56	92.5	-82	322.3	-57	Hindalga
S12	4.2	-16	576	15	299	-60	Ganeshpur
S13	5.7	14	299	-40	140	-81	Ganeshpur
S14	5.9	18	140	-72	269	-64	Ganeshpur
S15	6.2	24	269	-46	382	-49	Ganeshpur
S16	6.5	30	373	-25	104	-86	Ganeshpur
S17	6.7	34	93.7	-81	123	-84	Ambewadi
S18	4.6	-8	340	-32	228	-70	Ambewadi
S19	5.1	2	93.7	-81	197	-74	Ambewadi

S20	3.2	-36	191.9	-62	184	-75	Ambewadi
S21	5.1	2	98.2	-80	146	-81	Ambewadi
S22	5.8	16	265	-47	400	-47	Ambewadi
S23	2.2	-56	93	-81	95.2	-87	Ambewadi
S24	3.2	-36	71.7	-86	151.4	-80	Ambewadi
S25	4.6	-8	110.3	-78	203.5	-73	Ambewadi



Graph no: 7.1: Variation in Turbidity in NTU



Graph no: 7.2: Variation in TDS in mg/l

Discussion on Physical Parameters

- Turbidity levels varied from 2 to 7.2 NTU (Nephelometric Turbidity Units) & TDS levels ranged from 78.1 to 1133 mg/L.
- Most samples met the BIS standard of ≤5 NTU for drinking water, except for a few openwell water samples near agricultural fields which showed higher turbidity due to surface runoff.
- About 9 samples (36%) showed slightly higher turbidity than BIS values ...
- TDS in all borewell samples were within the permissible limit of 500 mg/L, some well water samples exceeded this threshold. Higher TDS levels in well water were due to percolation of domestic sewage into the wells. About 3 samples, i.e 12 % of deviation above standard values, were seen in TDS & EC values.

7.2 Chemical Parameters

% of Deviation above BIS 10500-2012 standards

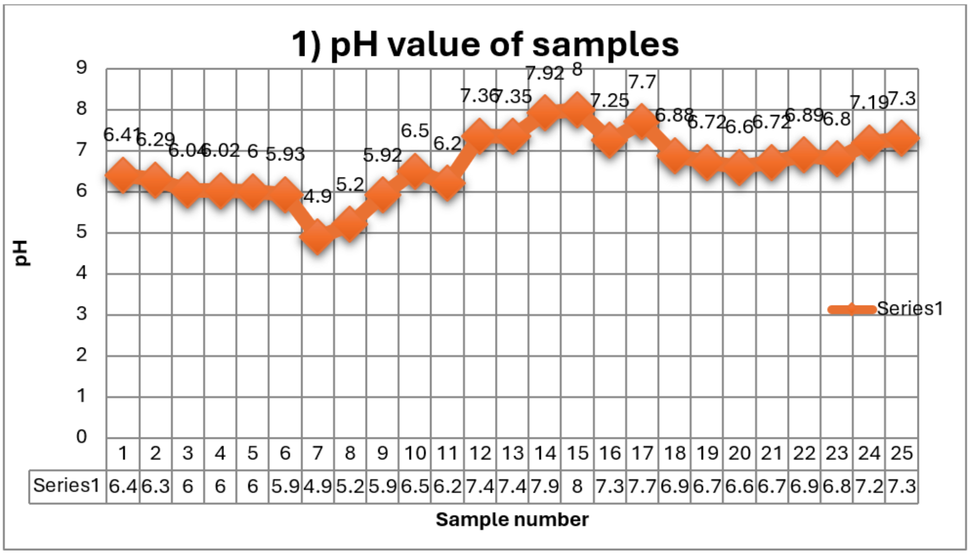
Table No:7.2 (a)

BIS Limits	6.5-8.5		200 mg/l		300 mg/l		
Sample No	**pH Hindalga village**	**% of deviation <6.5 pH**	**Total Alkalinity in mg/ l Hindalga village**	**% of deviation Total Alkalinity in mg/l**	**Total Hardness in mg/ l of Hindalga village**	**% of deviation Total Hardness in mg/l**	**Area**
S1	6.41	1.4	60	-70	115	-62	Hindalga
S2	6.29	3.2	90	-55	95	-68	Hindalga
S3	6.04	7.1	90	-55	97	-68	Hindalga
S4	6.02	7.4	75	-62.5	135	-55	Hindalga
S5	6	7.7	55	-72.5	140	-53	Hindalga
S6	5.93	8.8	85	-57.5	132	-56	Hindalga
S7	4.9	24.6	80	-60	89	-70	Hindalga
S8	5.2	20.0	90	-55	100	-67	Hindalga
S9	5.92	8.9	79	-60.5	102	-66	Hindalga
S10	6.5	0.0	75	-62.5	116	-61	Hindalga
S11	6.2	4.6	100	-50	86	-71	Hindalga
S12	7.36	-13.2	245	22.5	25	-92	Ganeshpur
S13	7.35	-13.1	245	22.5	110	-63	Ganeshpur
S14	7.92	-21.8	85	-57.5	30	-90	Ganeshpur
S15	8	-23.1	260	30	65	-78	Ganeshpur
S16	7.25	-11.5	270	35	75	-75	Ganeshpur
S17	7.7	-18.5	220	10	185	-38	Ambewadi
S18	6.88	-5.8	85	-57.5	100	-67	Ambewadi
S19	6.72	-3.4	150	-25	50	-83	Ambewadi
S20	6.6	-1.5	60	-70	70	-77	Ambewadi
S21	6.72	-3.4	70	-65	65	-78	Ambewadi
S22	6.89	-6.0	95	-52.5	20	-93	Ambewadi
S23	6.8	-4.6	65	-67.5	25	-92	Ambewadi
S24	7.19	-10.6	55	-72.5	20	-93	Ambewadi
S25	7.3	-12.3	35	-82.5	22	-93	Ambewadi

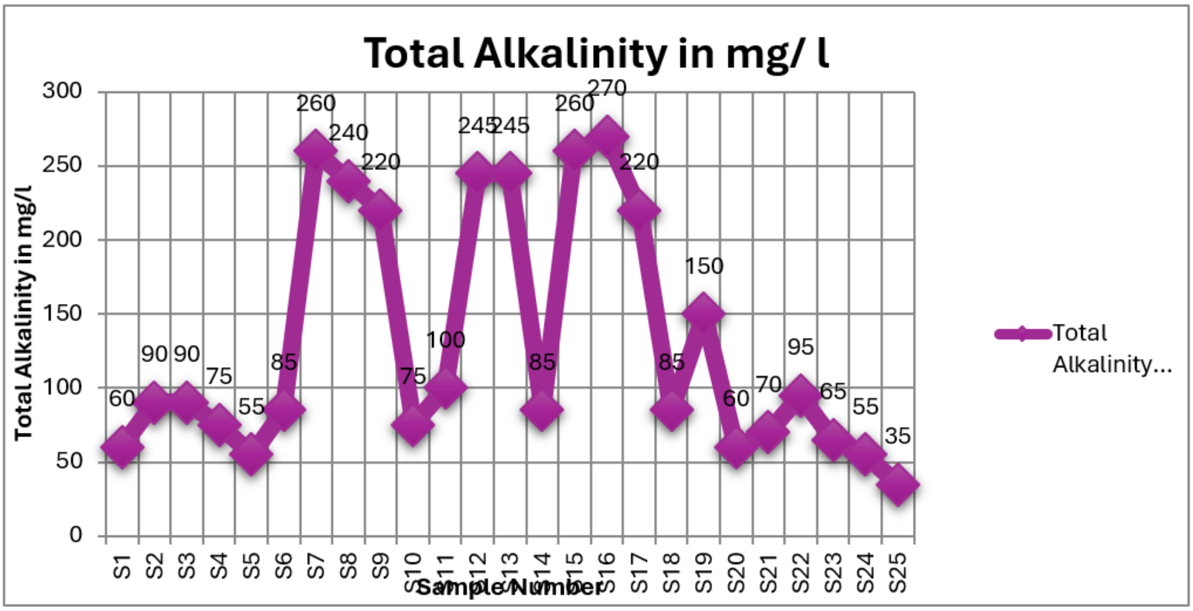
Chemical Parameters (cont)
% of Deviation above BIS 10500-201standards

Table No:3.2 (b)

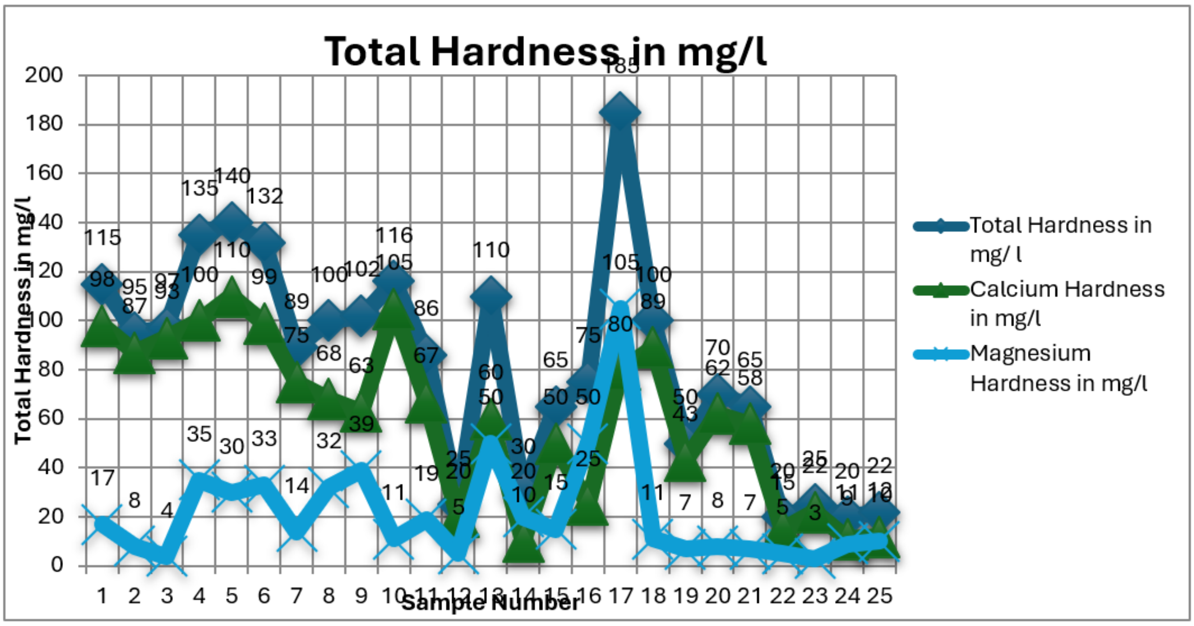
BIS Limits	250 mg/l		45 mg/l		150mg/l		
Sample No	Chlorides as Cl mg/ l in Hindalga village	% of deviation of Chlorides Cl in mg/l	Nitrates as NO_3 mg/ l	% of deviation Total Alkalinity in mg/l	Sulphates as SO_4 mg/ l	% of deviation Total Hardness in mg/l	Area
S1	124	-50	5	-89	5	-97	Hindalga
S2	149	-40	8	-82	8	-95	Hindalga
S3	298	19	12	-73	12	-92	Hindalga
S4	223	-11	15	-67	15	-90	Hindalga
S5	248	-1	7	-84	7	-95	Hindalga
S6	174	-30	2	-96	10	-93	Hindalga
S7	670	168	47	4	120	-20	Hindalga
S8	756	202	51	13	130	-13	Hindalga
S9	942	277	60	33	199	33	Hindalga
S10	198	-21	10	-78	18	-88	Hindalga
S11	100	-60	9	-80	30	-80	Hindalga
S12	595	138	12	-73	22	-85	Ganeshpur
S13	397	59	10	-78	35	-77	Ganeshpur
S14	124	-50	12	-73	28	-81	Ganeshpur
S15	372	49	17	-62	40	-73	Ganeshpur
S16	372	49	6	-87	33	-78	Ganeshpur
S17	496	98	8	-82	85	-43	Ambewadi
S18	446	78	22	-51	60	-60	Ambewadi
S19	198	-21	15	-67	35	-77	Ambewadi
S20	372	49	10	-78	52	-65	Ambewadi
S21	99	-60	12	-73	59	-61	Ambewadi
S22	173	-31	10	-78	62	-59	Ambewadi
S23	198	-21	13	-71	75	-50	Ambewadi
S24	148	-41	8	-82	45	-70	Ambewadi
S25	100	-60	16	-64	79	-47	Ambewadi



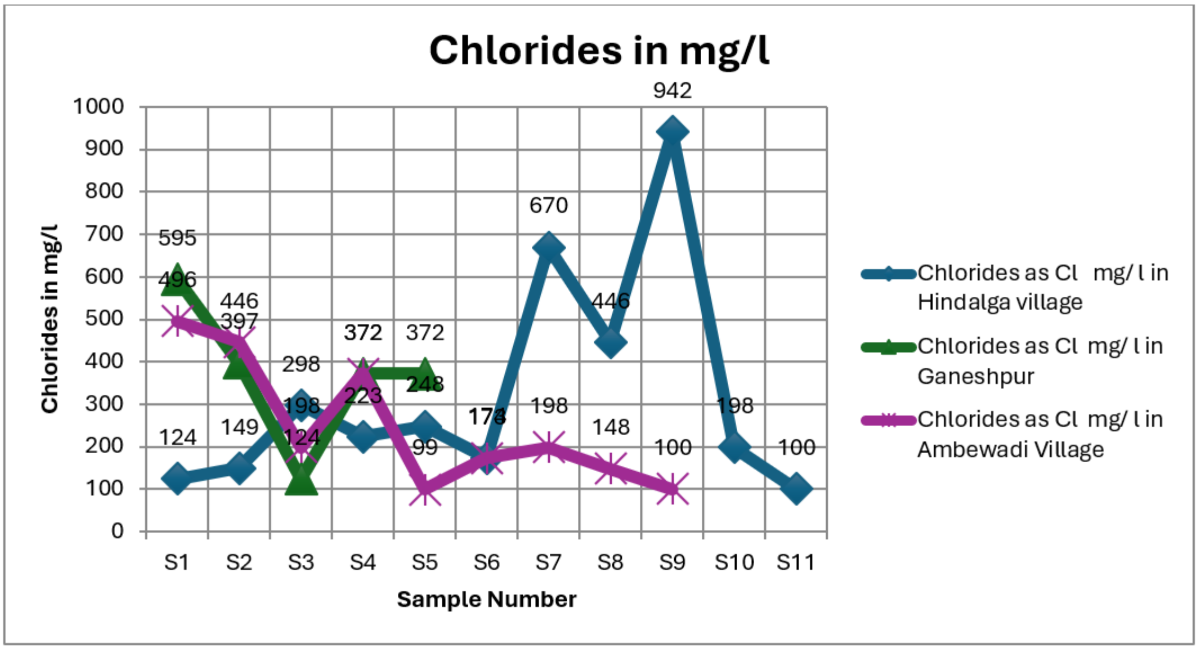
Graph no: 7.3: Variation in pH



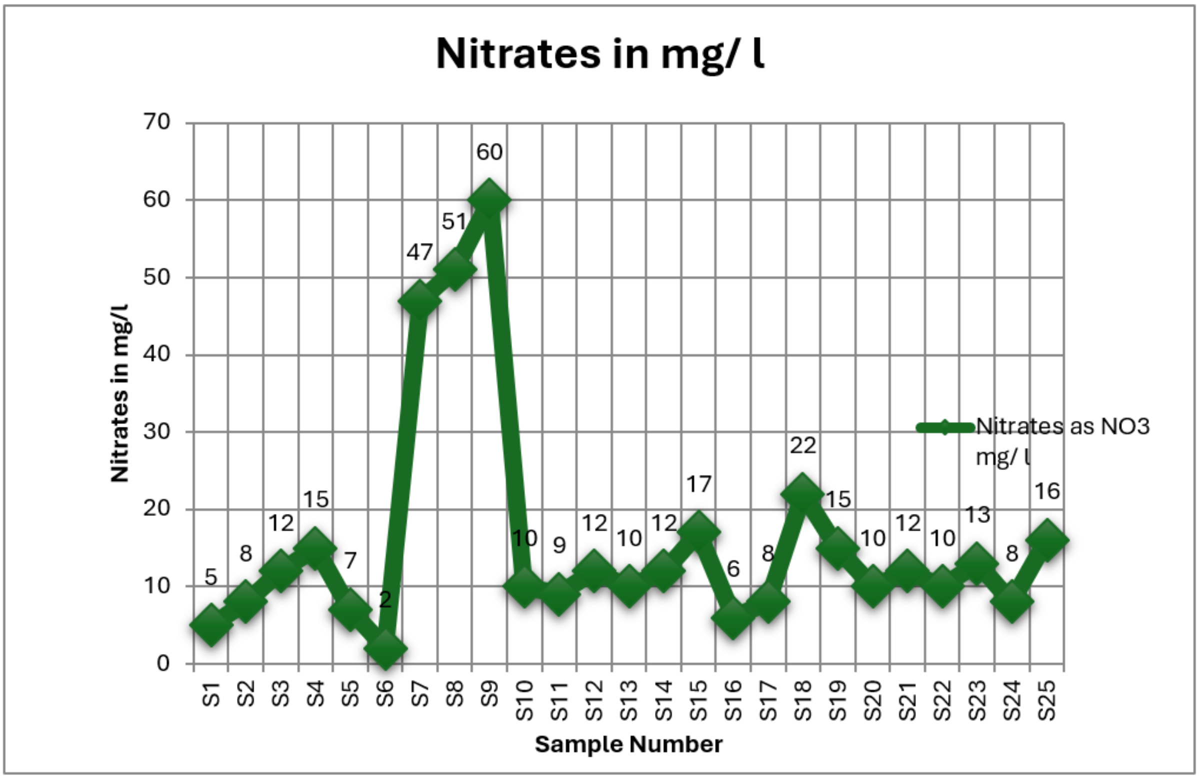
Graph no: 7.4: Variation in Total Alkalinity in mg/l



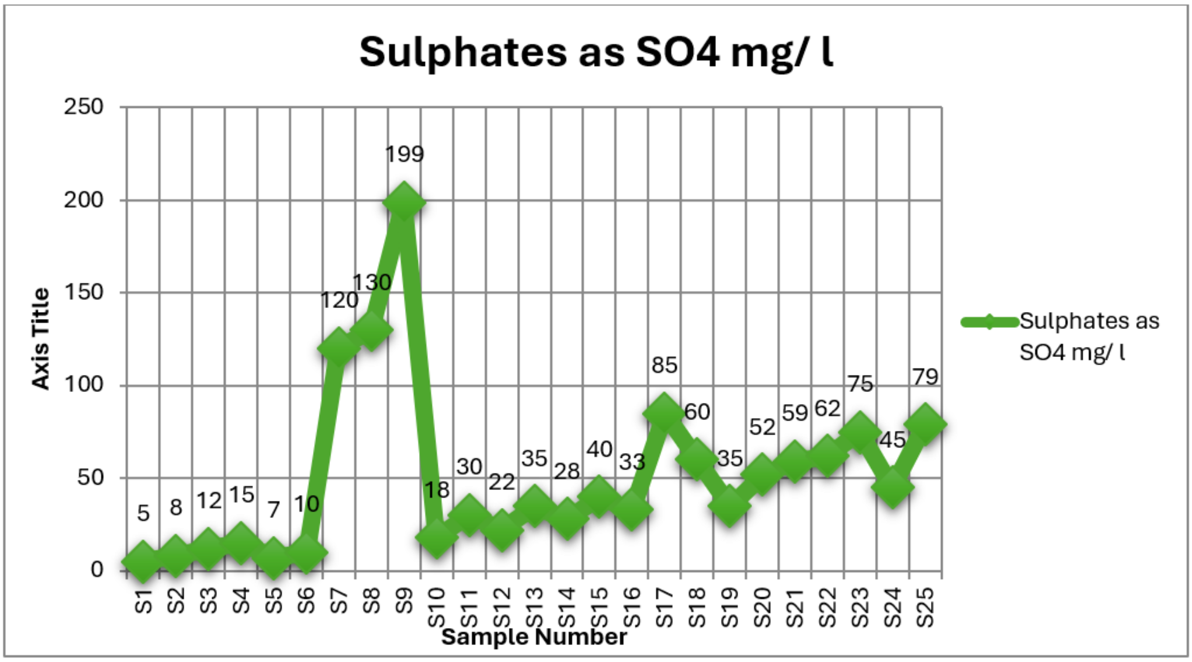
Graph no: 7.5: Variation in Total Hardness in mg/l



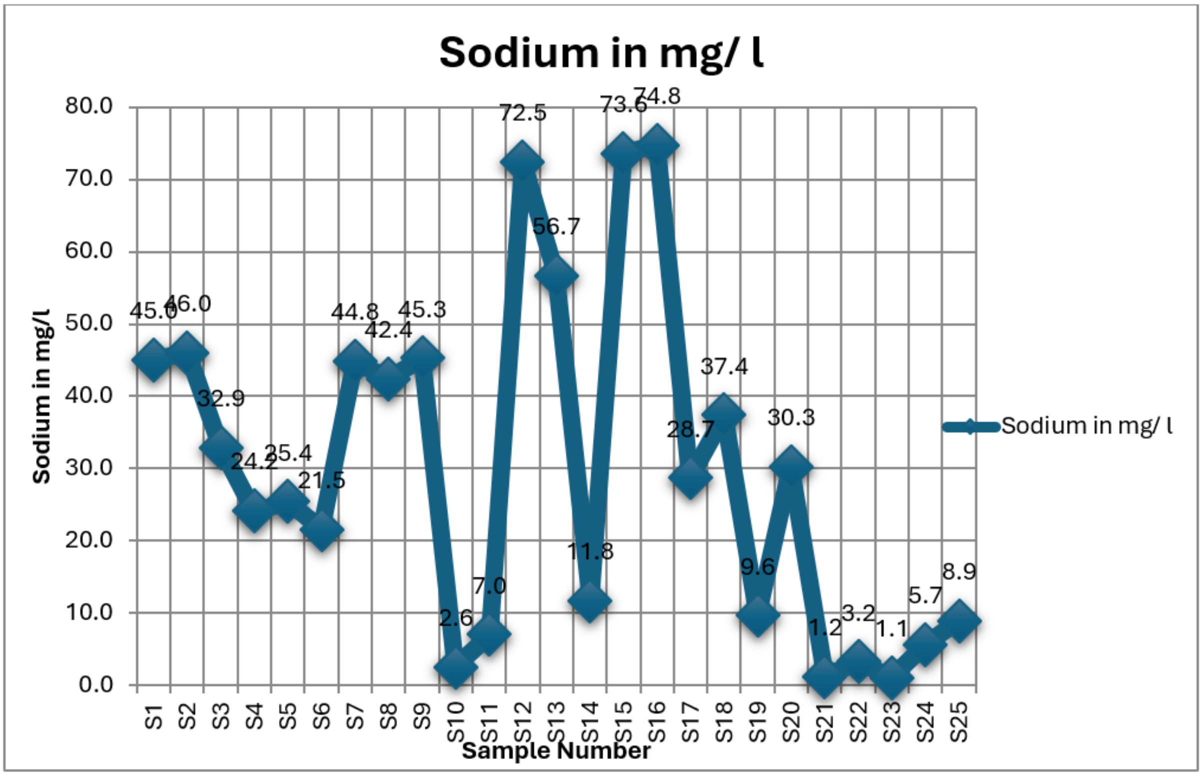
Graph no: 7.6: Variation in Chlorides in mg/l



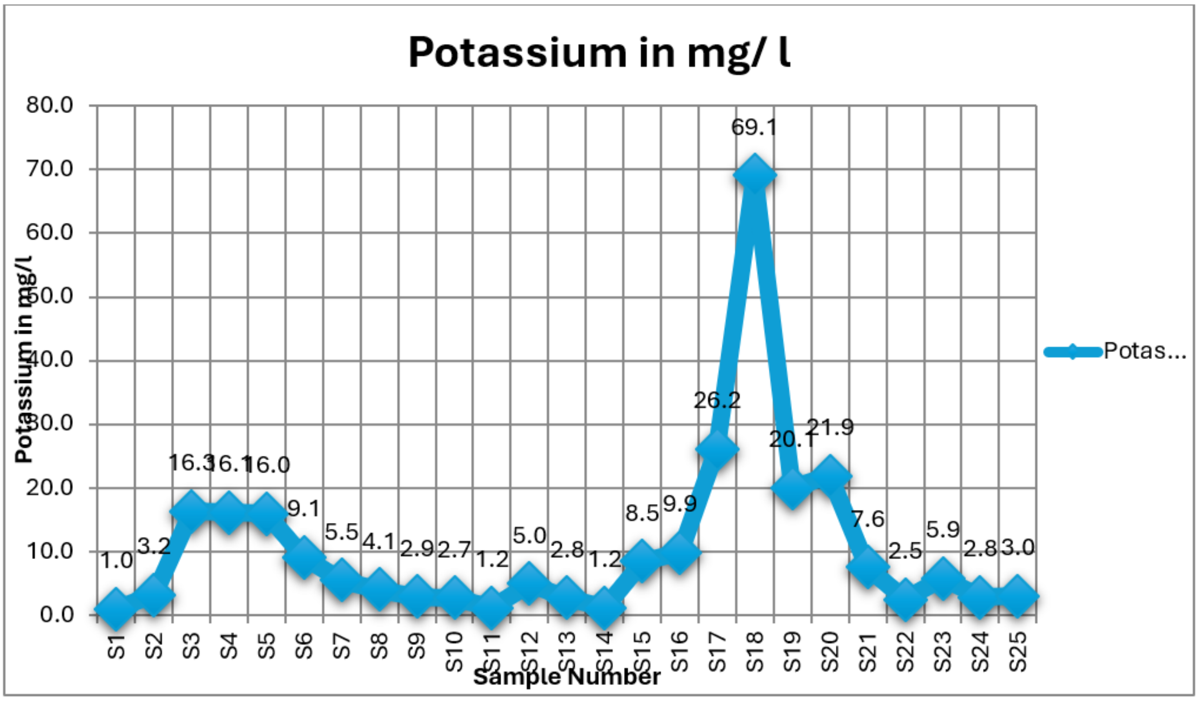
Graph no: 7.7: Variation in Nitrates in mg/l



Graph no: 7.8: Variation in Sulphates in mg/l



Graph no: 7.9: Variation in Sodium in mg/l



Graph no: 7.10: Variation in Potassium in mg/l

VIII. CONCLUSION

Most borewell samples met the standards set by the Bureau of Indian Standards (BIS) and World Health Organization (WHO) for drinking water. Openwell water showed more instances of contamination, especially in areas near agricultural fields, urban settlements, and improper waste disposal sites. Water quality assessment of openwell water and borewell water is crucial for understanding its suitability for drinking, domestic, and industrial purposes. Based on the physical, chemical, and biological parameters analyzed.

This study emphasizes the importance of preserving groundwater quality as a vital natural resource. While borewell water in Belgaum was found to be largely safe, the vulnerability of well water highlights the urgent need for preventive measures and sustainable practices. Through collaborative efforts among local authorities, researchers, and communities, it is possible to ensure the availability of clean and safe groundwater for all. By addressing contamination risks, adopting innovative solutions, and promoting awareness, Belgaum can serve as a model for effective groundwater management in similar regions.

REFERENCES

[1]. CGWB – Ground Water Yearbook India 2021–22- Analyzes groundwater quality in shallow aquifers across various regions.
[2]. Ground Water Directorate, Karnataka – Water Quality Report (2018–19).
[3]. Indian Institute of Science (IISc) – Water Situation in Bengaluru: Assesses groundwater quality and availability in Bengaluru's buffer zones.
[4]. IIT Bombay – Groundwater Data Analysis in Thane District: Analyzes long-term groundwater data to develop seasonal models.
[5]. Jal Jeevan Mission – Water Quality Monitoring & Surveillance Framework: Outlines protocols for water quality monitoring in rural areas.
[6]. Evaluation Study on Impact Assessment of Rural Drinking Water Supply Scheme in Karnataka-Evaluates the impact of rural water supply schemes across five districts in Karnataka.