



IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 13 Issue: VI Month of publication: June 2025

DOI: https://doi.org/10.22214/ijraset.2025.71781

www.ijraset.com

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Comparative Study of Groundwater Quality of Pune City: Post-Monsoon and Post-Monsoon

Samiksha Bankar¹, Purva Dhoke², Shraddha Deshmukh³

Post Graduate students of the Department of Geography, Modern College of Arts, Science, and Commerce (Autonomous), Shivajinagar, Pune – 05.

Abstract: This study investigates the variations in groundwater quality in Pune city between the pre-monsoon and post-monsoon seasons. Groundwater is a vital resource for drinking, irrigation, and industrial purposes, especially in the city's periphery where treated water supply is limited. This research examines the impact of seasonal rainfall, runoff, and anthropogenic influences on groundwater quality by analysing key physicochemical parameters, major ions, heavy metals, and microbiological indicators. The findings highlight the importance of continuous monitoring and management strategies to ensure the sustainability of groundwater resources in the face of increasing contamination and environmental changes.

Keywords: Groundwater quality, Pre-monsoon, Post-monsoon, Pune city, Physicochemical parameters, Seasonal variation

I. INTRODUCTION

Groundwater is a vital resource, essential for drinking, household use, irrigation, and industrial applications, especially in areas where treated surface water is scarce or unavailable. In Pune's periphery, groundwater serves as a primary water source due to the limited reach of the city's piped water supply. Understanding the seasonal variations in groundwater quality is critical for ensuring sustainable management and protecting public health. Rainfall, runoff, and anthropogenic activities significantly influence groundwater quality, leading to fluctuations between pre- and post-monsoon periods. This study aims to assess and compare groundwater quality in Pune city during the pre-monsoon and post-monsoon seasons. By analyzing key physicochemical parameters, this research seeks to provide insights for effective water resource management and to address the challenges posed by increasing urbanization and environmental changes.

Pune District at a Glance





ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.538 Volume 13 Issue VI June 2025- Available at www.ijraset.com

II. LITERATURE REVIEW

Groundwater quality in and around Pune, Maharashtra, India, has been the subject of several investigations, highlighting various influencing factors and assessment methodologies. Studies consistently emphasize the need for comprehensive evaluation due to increasing anthropogenic pressures. Gautam et al. (2024) employed an integrated approach, combining a water quality index (WQI) with multivariate statistical techniques, to characterize groundwater quality. This methodology provides a holistic understanding of the spatial variations and the key parameters influencing groundwater quality in the studied area. The impact of waste disposal on groundwater is a significant concern, as highlighted by Nihalani et al. (2022). Their study focused on the groundwater quality in proximity to the solid waste dumpsite at Uruli Devachi, Pune, revealing potential contamination and the need for proper waste management practices to safeguard water resources. Kadam et al. (2021) took an integrated approach, combining hydrogeochemistry and human health risk assessment in the Shivganga river basin, Pune. Their work provides insights into the geochemical processes affecting groundwater quality and evaluates the potential health risks associated with its use. Several reports from the Central Ground Water Board (CGWB) provide fundamental information on the groundwater resources of the Pune district (Mishra, 2013; CGWB, n.d.). These reports offer baseline data on groundwater availability, quality, and potential issues, serving as crucial resources for further research and management strategies. Savved et al. (2013) specifically investigated the impact of urbanization on groundwater quality in the southeastern part of Pune city using hydrogeochemical facies analysis. Their findings likely demonstrate how urban development activities can alter groundwater composition and quality, emphasizing the need for sustainable urban planning. While the primary focus is on the Pune region, Mishra et al. (2011)'s study in Madhya Pradesh, though geographically different, underscores the broader issue of groundwater quality assessment and the importance of considering specific contaminants like fluoride. This highlights that similar challenges and assessment approaches might be relevant in the Pune context as well. Collectively, these studies and reports paint a picture of ongoing research and monitoring efforts aimed at understanding and managing groundwater quality in the face of urbanization, industrialization, and waste disposal in the Pune region. The methodologies employed range from statistical analyses and water quality indices to hydrogeochemical assessments and health risk evaluations, reflecting the multifaceted nature of groundwater quality management.



Introduction to Pune District



Pune district, located in the western part of Maharashtra, India, lies between 17°54' and 19°24' north latitude and 73°29' and 75°10' east longitude. It covers an area of 15,642 sq. km, accounting for 5.08% of Maharashtra's total area. Administratively, the district is divided into 14 talukas and includes 1866 villages.

Geomorphologically, Pune district comprises four major physiographic units: the Western Ghats, foothills, the central plateau, and eastern plains. The major drainage systems include the Bhima-Ghod, Mula-Mutha, and Nira rivers. The district experiences a tropical monsoon climate with significant variations in rainfall, ranging from 468 mm to 4659 mm annually.



International Journal for Research in Applied Science & Engineering Technology (IJRASET) ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.538 Volume 13 Issue VI June 2025- Available at www.ijraset.com

Hydrogeologically, the water-bearing formations consist of weathered, fractured, jointed, and vesicular basalts. Pre-monsoon depth to the water level in May 2011 ranged from 0.40 to 20.10 meters below ground level (mbgl), while post-monsoon levels in November 2011 ranged from 0.09 to 14.65 mbgl. Groundwater quality is generally good, suitable for drinking and irrigation, though localized nitrate contamination has been observed. About 50% of Pune district falls under the rain shadow zone, leading to drought-prone conditions in several talukas. Baramati and Purandhar talukas are categorized as "Semi-Critical" due to groundwater development reaching up to 96.13%.

IV. METHODOLOGY

- 1) Data Collection:
- Sampling Locations: Groundwater samples will be collected from a diverse range of sources, including dug wells, borewells, and community water sources, to ensure a representative assessment of groundwater quality across the study area. The selection of sampling locations will be based on factors such as accessibility, well distribution, and potential sources of contamination. GPS coordinates will be recorded for each sampling site to facilitate spatial analysis.
- Sampling Frequency: To capture seasonal variations in groundwater quality, samples will be collected during two critical periods:
- Post-Monsoon: Conducted after the monsoon season, this sampling will assess the impact of rainfall and runoff on groundwater quality.
- 2) Parameters to be Tested:

The following key groundwater quality parameters will be analyzed:

- Physicochemical Parameters:
- pH,
- Electrical Conductivity (EC),
- Turbidity
- 3) Sample Analysis:
- Detailed descriptions of the laboratory methods used for analyzing each parameter will be included.
- Quality control measures: Calibration of instruments, the use of standard solutions, and replicate analysis will be conducted.
- 4) Data Analysis:
- Statistical Analysis: Descriptive statistics (mean, median, standard deviation) will be calculated for each parameter. Correlation analysis will be performed to identify relationships between different parameters. T-tests will be used to compare pre- and post-monsoon data for significant differences.
- Spatial Analysis: Groundwater quality parameters will be mapped using GIS software to identify pollution hotspots and assess spatial variations.
- Water Quality Index (WQI) Calculation: The WQI will be calculated using standard methods to provide an overall assessment of water quality based on multiple parameters. The WQI values will be compared with drinking water standards to determine the suitability of groundwater for consumption.

Water Quality Criteria for Drinking Purpose With the objective of safeguarding water from degradation and to establish a basis for improvement in water quality, standards / guidelines / regulations have been laid down by various national and international organizations such as Bureau of Indian Standards (BIS, 2012), World Health Organization (WHO, 2011), European Economic Community (EEC), Environmental Protection Agency (EPA), United States, and Inland Waters Directorate, Canada. The Bureau of Indian Standards (BIS) earlier known as Indian Standards Institutions (ISI) has laid down the standard specification for drinking water during 1983, which have been revised and updated from time to time. In order to enable the users to exercise their discretion towards water quality criteria, the maximum permissible limit has been prescribed especially where no alternative sources are available. The national water quality standards describe essential and desirable characteristics required to be evaluated to assess suitability of water for drinking purposes. The important water quality characteristics as laid down in BIS standard (IS 10500: 2012) are summarized in Table:



Table 4.1: Drinking Water Characteristics (IS 10500: 2012)

S No	Baramatara	Desirable Limits	Permissible limits
3. NU.	Farameters	(mg/l)	(mg/l)
Essential	Characteristics		
1	Colour Hazen Unit	5	15
2	Odour	Unobjectionable	-
3	Taste	Agreeable	-
4	Turbidity (NTU)	1	5
5	pH	6.5-8.5	No relaxation
6	Total Hardness, CaCO ₃	200	600
7	Iron (Fe)	1.0	No relaxation
8	Chloride (Cl)	250	1000
9	Residual Free Chlorine	0.2	1
10	Fluoride (F)	1.0	1.5
Desirable	Characteristics		
11	Dissolved Solids	500	2000
12	Calcium (Ca)	75	200
13	Magnesium (Mg)	30	100
14	Copper (Cu)	0.05	1.5
15	Manganese (Mn)	0.1	0.3
16	Sulphate (SO ₄)	200	400
17	Nitrate (NO ₃)	45	No relaxation
18	Phenolic Compounds	0.001	0.002
19	Mercury (Hg)	0.001	No relaxation
20	Cadmium (Cd)	0.003	No relaxation
21	Selenium (Se)	0.01	No relaxation
22	Arsenic (As)	0.01	No relaxation
23	Cyanide (CN)	0.05	No relaxation

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24	Lead (Pb)	0.01	No relaxation
25	Zinc (Zn)	5.0	15
26	Hexavalent Chromium	0.05	No relaxation
27	Alkalinity	200	600
28	Aluminum (Al)	0.03	0.2
29	Boron (B)	0.5	2.4
30	Pesticides	Absent	0.001
31	Uranium	0.03	No relaxation

NTU- Nephelometric Turbidity Unit.

Source: Drinking Water Characteristics (IS 10500: 2012)



International Journal for Research in Applied Science & Engineering Technology (IJRASET) ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.538 Volume 13 Issue VI June 2025- Available at www.ijraset.com

Summarized results of groundwater quality ranges of unconfined aquifer, (May 2022)

S.No	Parameters		Range
1	Electrical	Fresh	< 750
	Conductivity	Moderate	750-2250
	μs/cm at 25°C	Slightly mineralized	2251-3000
		Highly mineralized	> 3000
2	Chloride	Desirable limit	< 250
	mg/l	Permissible limit	251-1000
	_	Beyond permissible	> 1000
		limit	
3	Fluoride mg/l	Desirable limit	< 1.0
		Permissible limit	1.0 - 1.5
		Beyond permissible	>1.5
		limit	
4	Nitrate	Permissible limit	< 45
	mg/l	Beyond permissible	> 45
	_	limit	

Source: Drinking Water Characteristics (IS 10500: 2012)

Locations:

Groundwater samples will be collected from various points, including dug wells, borewells, and community water sources across the selected study area. Various locations are as follows:

North-Western: Baner,

Western: Bavdhan

South-Western: Dhayri

South-Central: Karve Nagar

Northern: Bopodi

Noth-Eastern: Viman Nagar

Eastern : Hadapsar Southern : Katraj

South-Eastern: Undri





ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.538 Volume 13 Issue VI June 2025- Available at www.ijraset.com

V. OBSERVATION OF PARAMETER TESTING

A. Groundwater Quality Parameters in Pune City - Post – Monsoon

(October-November)

1) pH

Definition: pH is a measure of how acidic or basic water is, on a scale from 0 to 14, with 7 being neutral. Values below 7 indicate acidity, while values above 7 indicate alkalinity. Expected Range in Pune:

- Typical Range: Groundwater pH levels in urban areas like Pune can vary widely but generally fall between 6.0 and 8.5.
- Ideal Range for Drinking Water: The World Health Organization (WHO) recommends a pH range of 6.5 to 8.5 for potable water.

Implications:

- Acidic Water (pH < 6): Can lead to leaching of heavy metals from pipes and soil, potentially contaminating the water supply.
- Alkaline Water (pH > 8.5): May indicate high concentrations of bicarbonates or carbonates and can affect the solubility of nutrients and metals in water.
- Effect on human health: Indicative of acidic or alkaline waters, affects taste, corrosivity and the water supply system
- pH: To assess acidity or alkalinity.

Sr. no.	Location	Desirable limits	Observed pH
		(mg/I)	
1	Katraj	6.5 - 8.5	6.10
2	Dhayari	6.5 - 8.5	5.80
3	Undri	6.5 - 8.5	6.83
4	Karvenagar	6.5 - 8.5	6.55
5	Vimannagar	6.5 - 8.5	6.06
6	Bopodi	6.5 - 8.5	5.53
7	Hadapsar	6.5 - 8.5	5.37
8	Bavdhan	6.5 - 8.5	5.75
9	Baner	6.5 - 8.5	6.49

• Result: Hadapsar have the lowest pH of 5.37 followed by Bopodi, Karvenagar, Bavdhan, Dhayari, Vimannagar, Katraj, Baner and Undri with the highest pH 6.83.





ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.538 Volume 13 Issue VI June 2025- Available at www.ijraset.com





2) Turbidity

Definition:

Turbidity measures the cloudiness or haziness of water due to suspended particles such as sediments, microorganisms, and organic matter. Expected Ranges in Pune:

- Typical Range: Turbidity levels can vary significantly based on location and season. In urban settings, turbidity might range from less than 1 NTU (nearly clear) to over 100 NTU (very turbid) during heavy rainfall or runoff events.
- WHO Guidelines: The acceptable limit for drinking water is generally less than 5 NTU.

Implications:

- High Turbidity (>5 NTU): Indicates potential contamination and can interfere with disinfection processes, making water unsafe for consumption.
- Sources of Turbidity: Urban runoff, construction activities, industrial discharges, and natural sedimentation can all contribute to increased turbidity levels.
- Effects on human health: High turbidity indicates contamination / Pollution.
- Turbidity: To measure the clarity of the water.

Sr.no.	Location	Desirable &	Observed value
		permissible limit	
1	Katraj	1-5	00
2	Dhayari	1-5	00
3	Undri	1-5	00
4	Karvenagar	1-5	00
5	Vimannagar	1-5	0.1
6	Bopodi	1-5	0.4
7	Hadapsar	1-5	0.3
8	Bavdhan	1-5	0.5
9	Baner	1-5	0.5

• Result: Katraj, Dhayari, Karve Nagar and Undri have lowest turbidity (0.0) while Bavdhan and Baner have highest turbidity (0.5) in the given samples.



ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.538

Volume 13 Issue VI June 2025- Available at www.ijraset.com





Turbidimeter

3) Electrical Conductivity (EC)

Definition:

Electrical conductivity measures the ability of water to conduct electricity, which is directly related to the concentration of dissolved ions (salts) in the water. Expected Range in Pune:

- Typical Range: EC values in groundwater can vary widely; typical values might range from 250 µS/cm to over 2,500 µS/cm depending on pollution sources and geological conditions.
- WHO Guidelines: For drinking water, EC should ideally be below $1,500 \mu$ S/cm.

Implications:

- High EC Levels (>1,500 µS/cm): May indicate salinity issues or pollution from agricultural runoff or industrial waste. High salinity can adversely affect drinking water quality and agricultural productivity.
- Sources of High EC: Industrial effluents, agricultural fertilizers, sewage discharge, and natural mineral dissolution contribute to elevated conductivity levels.



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• Health Risks Associated with High EC

Increased Salinity:

High levels of dissolved salts can lead to increased salinity in drinking water, which may cause dehydration and other health issues, particularly in vulnerable populations such as children and the elderly.

The EC of groundwater is contributed by all the dissolved ionic constituents. Therefore, it is a measure of the total ionic content of the water.

Electrical Conductivity µs/cm at 25°C Range Fresh < 750 Moderate 750- 2250 Slightly mineralized 2251- 3000 Highly mineralized > 3000

Sr. no.	Location	Observed value
1	Katraj	0.9
2	Dhayari	0.8
3	Undri	3.5
4	Karve Nagar	2.5
5	Viman Nagar	0.108
6	Bopodi	0.109
7	Hadapsar	0.082
8	Bavdhan	0.100
9	Baner	0.128

• Results: Hadapsar have low conductivity (0.082) while Undri have highest conductivity (3.5). it is followed by Baner (0.128).





International Journal for Research in Applied Science & Engineering Technology (IJRASET) ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.538

Volume 13 Issue VI June 2025- Available at www.ijraset.com



Conductometer

B. Groundwater Quality Parameters in Pune City - Post - Monsoon

(March-April)

1) pH

Definition:

pH is a measure of how acidic or basic water is, on a scale from 0 to 14, with 7 being neutral. Values below 7 indicate acidity, while values above 7 indicate alkalinity. Expected Range in Pune:

- Typical Range: Groundwater pH levels in urban areas like Pune can vary widely but generally fall between 6.0 and 8.5.
- Ideal Range for Drinking Water: The World Health Organization (WHO) recommends a pH range of 6.5 to 8.5 for potable water.

Implications:

- Acidic Water (pH < 6): Can lead to leaching of heavy metals from pipes and soil, potentially contaminating the water supply.
- Alkaline Water (pH > 8.5): May indicate high concentrations of bicarbonates or carbonates and can affect the solubility of nutrients and metals in water.
- Effect on human health: Indicative of acidic or alkaline waters, affects taste, corrosivity and the water supply system
- pH: To assess acidity or alkalinity.

Sr. no.	Location	Desirable limits	Observed pH
		(mg/I)	
1	Katraj	6.5 - 8.5	7.09
2	Dhayari	6.5 - 8.5	6.86
3	Undri	6.5 - 8.5	6.21
4	Karvenagar	6.5 - 8.5	6.70
5	Vimannagar	6.5 - 8.5	6.82
6	Bopodi	6.5 - 8.5	6.81
7	Hadapsar	6.5 - 8.5	6.92
8	Bavdhan	6.5 - 8.5	6.63
9	Baner	6.5 - 8.5	6.64

• Result: Undri have least pH of 6.21 followed by Bavdhan, Baner, Karve Nagar, Bopodi, Viman Nagar, Dahyari, Hadapsar and Katraj with highest pH of 7.09.



ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.538 Volume 13 Issue VI June 2025- Available at www.ijraset.com





pH meter



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2) Turbidity

Definition:

Turbidity measures the cloudiness or haziness of water due to suspended particles such as sediments, microorganisms, and organic matter. Expected Ranges in Pune:

- Typical Range: Turbidity levels can vary significantly based on location and season. In urban settings, turbidity might range from less than 1 NTU (nearly clear) to over 100 NTU (very turbid) during heavy rainfall or runoff events.
- WHO Guidelines: The acceptable limit for drinking water is generally less than 5 NTU.

Implications:

- High Turbidity (>5 NTU): Indicates potential contamination and can interfere with disinfection processes, making water unsafe for consumption.
- Sources of Turbidity: Urban runoff, construction activities, industrial discharges, and natural sedimentation can all contribute to increased turbidity levels.
- Effects on human health: High turbidity indicates contamination / Pollution.
- Turbidity: To measure the clarity of the water.

	Location	Desirable &	observed value
Sr.no.		permissible limit	
1	Katraj	1-5	1.1
2	Dhayari	1-5	0.1
3	Undri	1-5	0.6
4	Karvenagar	1-5	1.1
5	Vimannagar	1-5	1.0
6	Bopodi	1-5	1.0
7	Hadapsar	1-5	1.9
8	Bavdhan	1-5	0.3
9	Baner	1-5	0.6

• Result : Dhayari have least turbidity of 0.1 followed by Bavdhan, Baner, Undri, Viman Nagar, Bopodi, Katraj, Karve Nagar and Hadapsar with highest turbidity of 1.9.



Table 5 - Pie Chart



ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.538 Volume 13 Issue VI June 2025- Available at www.ijraset.com



Turbidimeter

3) Electrical Conductivity (EC)

Definition:

Electrical conductivity measures the ability of water to conduct electricity, which is directly related to the concentration of dissolved ions (salts) in the water. Expected Range in Pune:

- Typical Range: EC values in groundwater can vary widely; typical values might range from 250 μ S/cm to over 2,500 μ S/cm depending on pollution sources and geological conditions.
- WHO Guidelines: For drinking water, EC should ideally be below $1,500 \mu$ S/cm.

Implications:

- High EC Levels (>1,500 µS/cm): May indicate salinity issues or pollution from agricultural runoff or industrial waste. High salinity can adversely affect drinking water quality and agricultural productivity.
- Sources of High EC: Industrial effluents, agricultural fertilizers, sewage discharge, and natural mineral dissolution contribute to elevated conductivity levels.
- Health Risks Associated with High EC
 - Increased Salinity:

High levels of dissolved salts can lead to increased salinity in drinking water, which may cause dehydration and other health issues, particularly in vulnerable populations such as children and the elderly.

The EC of groundwater is contributed by all the dissolved ionic constituents. Therefore, it is a measure of the total ionic content of the water.

Electrical Conductivity µs/cm at 25°C Range Fresh < 750 Moderate 750- 2250 Slightly mineralized 2251- 3000 Highly mineralized > 3000



Sr. no.	Location	Observed value
1	Katraj	0.064
2	Dhayari	0.006
3	Undri	0.016
4	Karve Nagar	0.076
5	Viman Nagar	0.060
6	Bopodi	0.081
7	Hadapsar	0.077
8	Bavdhan	0.078
9	Baner	0.006

• Results: Dhayrai and Baner have least conductivity (0.006) followed by Undri, Viman Nagar, Kartraj, Karve Nagar, Hadapsar, Bavdhan and Bopodi having highest conductivity of 0.081.





Conductometer



ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.538 Volume 13 Issue VI June 2025- Available at www.ijraset.com

OBSERVATION

VI.

Here are detailed observations from the survey and study:

1) pH Levels:

- Post-Monsoon: The pH ranged from 5.37 (Hadapsar) to 6.83 (Undri), showing acidic trends in several regions. This lower pH can lead to leaching of harmful metals from pipes and soil into water supplies.
- Pre-Monsoon: The pH was more stable, ranging from 6.21 (Undri) to 6.92 (Hadapsar), closer to the recommended range for potable water.
- 2) Turbidity:
 - Post-Monsoon: Certain areas, such as Bavdhan and Baner, exhibited increased turbidity levels (0.5 NTU), indicating potential contamination from urban runoff.
 - Pre-Monsoon: Overall turbidity was lower compared to post-monsoon conditions, with Hadapsar showing the highest turbidity at 1.9 NTU. This reflects greater clarity but increased susceptibility to concentrated contaminants.
- *3)* Electrical Conductivity (EC):
 - \circ Post-Monsoon: Undri recorded the highest EC values (3.5 μ S/cm), signaling salinity concerns likely due to dissolved salts introduced during the rainy season. Locations such as Hadapsar had the lowest EC (0.082 μ S/cm), indicating comparatively fresh water.
 - Pre-Monsoon: Conductivity levels were significantly reduced across most locations, showing minimal salinity and dissolved ion content.

Additional survey findings revealed:

- A majority of households struggled with inconsistent water availability.
- Common health issues included skin conditions and digestion-related diseases due to water quality.
- Average water supply duration varied widely, with several households receiving less than six hours of water per day.

VII. KEY INSIGHTS

- 1) Seasonal Dynamics: Seasonal rainfall plays a dual role—while it naturally dilutes existing pollutants, it introduces new contaminants such as fertilizers and pesticides through agricultural runoff, particularly in urban settings.
- 2) Regional Disparities: Locations such as Hadapsar faced the lowest water quality parameters in terms of pH and turbidity, reflecting increased risk factors for public health and usability.
- 3) Health Implications: Communities heavily dependent on groundwater face risks from contaminants, including nitrates, heavy metals, and pathogens. The lack of stable, clean drinking water contributes to gastrointestinal disorders, kidney-related issues, and skin diseases.
- 4) Environmental Impact: Contaminant influx during the monsoon disrupts local ecosystems, reduces agricultural yields, and exacerbates water stress in affected regions.
- 5) Economic Considerations: The financial strain from healthcare, water treatment, and reduced agricultural productivity highlights the need for investment in advanced water management technologies and policies.

These observations and insights call for enhanced strategies like regular monitoring, improved runoff management, and innovative water purification techniques.

VIII. CONCLUSION

Monitoring pH, turbidity, and electrical conductivity is crucial for assessing groundwater quality in Pune City. These parameters provide insights into potential health risks associated with contaminated water supplies and inform necessary interventions for improving water quality. Regular testing against established standards ensures that groundwater remains safe for consumption and use within the community.

Here are detailed observations from the survey and study:

1) pH Levels:

Post-Monsoon: The pH ranged from 5.37 (Hadapsar) to 6.83 (Undri), showing acidic trends in several regions. This lower pH can lead to leaching of harmful metals from pipes and soil into water supplies.

Pre-Monsoon: The pH was more stable, ranging from 6.21 (Undri) to 6.92 (Hadapsar), closer to the recommended range for potable water.



International Journal for Research in Applied Science & Engineering Technology (IJRASET) ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.538

Volume 13 Issue VI June 2025- Available at www.ijraset.com

2) Turbidity

Post-Monsoon: Certain areas, such as Bavdhan and Baner, exhibited increased turbidity levels (0.5 NTU), indicating potential contamination from urban runoff.

Pre-Monsoon: Overall turbidity was lower compared to post-monsoon conditions, with Hadapsar showing the highest turbidity at 1.9 NTU. This reflects greater clarity but increased susceptibility to concentrated contaminants.

3) Electrical Conductivity (EC):

Post-Monsoon: Undri recorded the highest EC values (3.5 μ S/cm), signaling salinity concerns likely due to dissolved salts introduced during the rainy season. Locations such as Hadapsar had the lowest EC (0.082 μ S/cm), indicating comparatively fresh water.

Pre-Monsoon: Conductivity levels were significantly reduced across most locations, showing minimal salinity and dissolved ion content.

Additional survey findings revealed:

- A majority of households struggled with inconsistent water availability.
- Common health issues included skin conditions and digestion-related diseases due to water quality.
- Average water supply duration varied widely, with several households receiving less than six hours of water per day.

IX. RECOMMENDATIONS

- 1) Almost entire Pune district is underlain by Deccan Trap Basalt, where dug wells are most feasible ground water abstraction structures for ground water development.
- 2) Borewells are another alternative structure but their construction requires special technical and scientific attention. Borewells generally tap deeper fracture in hard area for which selection of sites is suggested at favourable hydrogeological locations.
- *3)* The Overall Stage of Ground Water Development in the district has reached about 71.51%. Therefore, future development of ground water resources should be taken up with proper care and planning.

X. ACKNOWLEDGEMENT

I sincerely thank the Department of Geography, Dr. Amit E. Sonawane (Head, Dept. of Geography, MCASC, Pune-05).

I sincerely appreciate the guidance & support given by Prof. Aniket S. Adsul (Course In-charge), Prof. Priyanka Kumari and Prof. Shikha Yadav and the non-teaching staff, for their support and resources. Special appreciation goes to Prof. (Dr.) Vilas Kamble (former Vice- Principal and former head, Department of Geography) and Mr. Chirag Sir from IIT Bombay for their invaluable guidance. I am also grateful to the Department of Chemistry and its staff for their assistance. Their collective encouragement and contributions were essential to the successful completion of this project.

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International Journal for Research in Applied Science & Engineering Technology (IJRASET) ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.538 Volume 13 Issue VI June 2025- Available at www.ijraset.com

PHOTOGRAPHS

Samples





Questionare

/			
		7. Employment status of Head of hausehold	
	WITTE OUALITY SURVEY &	Unarrighteen	
	WALER CONCILIENT	Surgery ownatory small informal business	
		Covernment employee	
		V Den haveness	
		Privais terployee	
	1. Name of the Respondent	Other	1
	mangha patih		
		8. Average monthly Household income	
	2. Age of the Respondent	< As 5000	
	68	Ry 10,001-23000	
T. BANKEL		Jar 2000	
	Fhat NO GOI, Bela ava Jushlife	Rt M.207 100,200	
	Near Ganga Glitz. Undri pune-411060	+ % YIGE	
	4. Total members of the household	9 Hisusing details:	
	5	1 Jane	
		2.3014	
	5. Highest education among the minibers of hisiskhold	1844	
	O Ninely	184	
	() Midak	Slovy Squatters	
) High school	Criter .	
	Same water Area Survey		
	Screenion (BA/BSC-BCOT: (BE)		
	O MAYNEY	10. Nature of Job	
	C Above	Lookatka	
and y	O Blando	I Bularinan	
	6. Total number of lauscheids who are employed		
	1		
1 Part Part In			



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	so is water always available from your main water source
11. Type of Family	er "/ ver water is always available
Noclear	
han	No, water is available most of the time
Lunded	No water is available some of the time
	No. water is rardy analable
12. What is the main source of strinking water for members of your household?	C Deritiros .
themen (tanker,)	
Drawel	Lucia and day is writer supplied as werses
	23. How many nous per day of water supplied on areage
	24 hours per day
Rainvater collection	12-17 hours per day
municipad water Bottled water	6-11 hours per day
Surface water (river, stream, dam, take, pond, casal engation channel)	1 / Inst than kinours
13. What is the main source of water used by members of your household for	Don't know
other purposes, such as cooking and hand washing?	
Sursuan	24. Is the water supplied from your main source usually acceptable? If
Dogwell	unacceptable, select the main reasons
Water from upring	() We accessive
E-www.color.com	Na unacceptable tade
	No. uniconytable colour
Pursaged water Komod water	No. unaccostible smel
Surface water (river, steerin dam, lake provid canal inspation (hannel)	No consues viaresals
	Dentinew
14. Where is that water collected from?	
Bore well.	
	25. What do you usually do to the water to make it safer to down
	V Kol
15 values was the hore well excavated?	Add Urach I chimow
	Use water for scruamic sand, composite, reverse ovmosik et (1
	Solar disministron
10/15 years	Let # stand and scale
> 15 years	Oner
Other	

26 What are the total number of sportiments
18
27. what are the number of apartments that are occupied by people
7
36 What are the DHF punch age and ferri many is some of a
ce tribe are the rine supply take and inequency in series of hours per day
bround water (tanker).
29. whether there is an odor in the water and if so, then why
yes, highly teorbid.
Ť
30. What is the current health and environment awareness status in the locality
🔿 Very good
C Good
/ hurage
Minimum
C IN
81. Suggestions to improve the condition of stater supply
- Need watter Suppry of The
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