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Assessment of Ground Water Quality Parameters in Ghaziabad

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Abstract: Groundwater serves as a crucial resource for drinking, irrigation, and industrial use in rapidly growing urban centers like Ghaziabad, India. However, increasing urbanization, industrial expansion, and improper waste disposal have significantly contributed to groundwater contamination. This study evaluates the groundwater quality in Ghaziabad by analyzing several key physicochemical and biological parameters, including pH, turbidity, total dissolved solids (TDS), hardness, chloride, fluoride, nitrate, and heavy metals. The findings indicate that many of these impurities exceed the safety limits established by the Bureau of Indian Standards (BIS) and the World Health Organization (WHO), posing potential health risks to the population.

Human activities and industrial processes play a significant role in groundwater pollution, making it a critical environmental issue today. Assessing and maintaining water quality is essential for conserving and purifying the natural ecosystem. This study extends beyond Ghaziabad to also examine groundwater quality in different wards of Indore City, particularly in industrial zones.

The research focuses on determining the Water Quality Index (WQI) of Indore City by collecting groundwater samples from randomly selected locations across various wards. These samples were analyzed based on multiple physicochemical parameters, including pH, color, total dissolved solids, electrical conductivity, total alkalinity, total hardness, calcium, chromium, zinc, manganese, and nickel. The results were then compared against the Indian Standard Drinking Water Specification (IS: 10500-2012) to assess their suitability for consumption and other uses.

The study highlights the importance of continuous monitoring and effective water quality management strategies to safeguard groundwater resources. Regular evaluation of water quality parameters is essential for ensuring public health and environmental sustainability.

Keywords: Groundwater quality, water pollution, water quality standards, physicochemical analysis, environmental sustainability.

I. INTRODUCTION

Groundwater is a primary source of drinking water in many regions, including Ghaziabad, a rapidly expanding urban center in India’s National Capital Region (NCR). However, the city faces severe groundwater contamination due to industrial discharge, domestic sewage, agricultural runoff, and improper waste disposal. Assessing groundwater quality is essential to ensure safe consumption and minimize potential health risks.

Water plays a fundamental role in shaping landscapes and regulating climate, making it one of the most essential natural resources. Across the world, groundwater is extensively used for domestic needs, industrial applications, and irrigation. Over recent decades, the demand for freshwater has surged dramatically, driven by rapid population growth and accelerated industrialization. According to the World Health Organization (WHO), nearly 80% of human ailments are linked to waterborne contaminants. Once groundwater is polluted, restoring its original quality is a complex and challenging task, making proactive conservation efforts crucial.

The Water Quality Index (WQI) is an effective tool for communicating groundwater quality status to both policymakers and the public. It serves as a key parameter for assessing and managing water resources. The composition of groundwater is influenced by soluble minerals found in soil and sedimentary rock formations. Among the most common dissolved constituents are calcium, sodium, bicarbonate, and sulfate ions. Chloride ions, often associated with seawater intrusion, concentrated salts from evapotranspiration, and sewage contamination, are another frequent component. While nitrate occurs naturally, high concentrations typically indicate pollution from external sources.

Establishing water quality standards is essential for determining the suitability of groundwater for various uses. The Indian Standard Drinking Water Specification (IS: 10500-2012) provides guidelines for evaluating drinking water quality.

Many classification systems consider factors such as specific conductance, sodium levels, and boron concentration to determine groundwater suitability for consumption and other purposes.

Table: List of substances found naturally in some ground waters which can cause problems in operating wells

Substance	Types of problems
Carbon dioxide (co2)	corrosiveness
Radio nuclides	Portability
Minor constituents	Portability,
Calcium and magnesium(ca^{2+} ,mg^{2+})	Encrustation
Iron(fe^{+2},fe^{+3})	Encrustation ,staining of laundry and toilet fixtures
Manganese (Mn^{-2})	Encrustation ,staining of laundry and toilet fixtures
Silica (SiO2)	Encrustation
Chloride(Cl^{-})	Portability ,corrosiveness
Fluoride(F^{-})	Fluorosis
Nitrate($NO3^{-}$)	Methemoglobenemia
Sulphate($SO4^{-2}$)	Portability
Dissolved gases	Corrosiveness
Dissolved oxygen	Corrosiveness
Hydrogen Sulphide (H2S)	Corrosiveness

II. OBJECTIVES OF THE STUDY

1) To evaluate key physicochemical and biological parameters of groundwater.
2) To identify sources of contamination.
3) To compare groundwater quality with national and WHO standards.
4) To suggest remedial measures for groundwater protection.

III. STUDY OF THE AREA

Ghaziabad, one of the fastest-growing cities in Uttar Pradesh, is a key industrial and residential hub in the National Capital Region (NCR). With rapid urbanization and a rising population, water quality has become a pressing concern due to factors such as industrial waste discharge, sewage influx, and groundwater depletion.

The city's water supply comes from multiple sources, including groundwater, municipal pipelines, and surface water from the Hindon River. However, contamination from domestic waste, untreated industrial effluents, and agricultural runoff has led to potential health hazards. Studies have highlighted concerns such as high levels of dissolved solids, heavy metals, and microbial pollutants, emphasizing the need for continuous monitoring and management.

This study aims to assess key water quality parameters—such as pH, turbidity, dissolved oxygen (DO), biochemical oxygen demand (BOD), chemical oxygen demand (COD), total dissolved solids (TDS), and heavy metal concentrations—to determine its suitability for human consumption and environmental sustainability. The findings will provide valuable insights into the current state of water quality in Ghaziabad and suggest measures to ensure safe and sustainable water resources for the city's residents.

IV. GROUND WATER QUALITY PARAMETERS

Groundwater is essential in the health of human beings and in day-to-day activities, thus its quality evaluation is necessary. Physical, chemical, and biological characteristics of water are some of the factors that determine water safety. Routine testing identifies whether groundwater is safe for drinking, irrigation, and domestic consumption. Some of the major parameters impacting groundwater quality are listed below:

1) *Physical Characteristics:*
- Turbidity: Assesses water clarity. Murky water usually suggests contamination by sediments or pollutants.
- Temperature: Affects the solubility of minerals and chemical reactions in water.
- Total Dissolved Solids (TDS): The amount of dissolved minerals, which influence water taste and use.
- Electrical Conductivity (EC): Indicates the water's capacity to conduct electricity, which shows the presence of dissolved salts.

2) *Chemical Properties:*
- pH Level: Indicates if water is acidic or alkaline. The normal range for drinking water is between 6.5 and 8.5.
- Dissolved Oxygen (DO): Critical for aquatic life and reflects the freshness and aeration of the water.
- Water Hardness (Calcium & Magnesium Levels): Excessive mineral levels lead to pipe scaling but are not toxic to health.
- Nitrate & Nitrite Levels: Excessive levels are harmful, especially to infants, as they lead to severe health problems.
- Fluoride: Strengthens teeth in small doses but is toxic in high concentrations.
- Heavy Metals (Lead, Arsenic, Mercury, etc.): In small quantities, these poisonous elements are hazardous to health.

3) *Biological Contaminants:*
- Bacterial Presence (E. coli & Coliforms): May indicate fecal contamination, which leads to serious diseases.
- Algal Blooms: High algae indicate nutrient pollution and can release toxic substances.

4) *Emerging Pollutants:*
- Microplastics: Small plastic pieces that might have long-term health impacts.
- Pharmaceutical Residues: Remnants of drugs that might interfere with human health and aquatic life.
- Pesticides & Herbicides: Agricultural runoff chemicals that have the potential to pollute water sources.

V. FACTORS INFLUENCING GROUNDWATER QUALITY

Groundwater serves as a crucial source for drinking water, irrigation, and industrial use. However, its quality is affected by various natural and human-related factors. Understanding these influences is essential for ensuring safe and sustainable water supplies. Here are some key factors that impact groundwater quality:

1) *Geological Composition:*

The mineral makeup of the rocks and soil that groundwater flows through significantly affects its quality. Certain geological formations contain high levels of elements like iron, fluoride, arsenic, or manganese, which can dissolve into the groundwater and alter its safety for consumption.

2) *Human Activities and Land Use:*

Groundwater can become contaminated due to agricultural practices, industrial activities, and urban development. Leachates from septic systems, landfills, and wastewater can introduce harmful substances such as nitrates, heavy metals, and organic chemicals into aquifers. Poor waste disposal methods in industries and landfill runoff also pose serious risks.

3) *Septic Systems and Sewage Disposal:*

Neglected septic systems and untreated sewage can lead to the infiltration of bacteria, viruses, and harmful pathogens into groundwater. This type of contamination can cause waterborne diseases and represents a significant public health risk.

4) *Climate and Hydrological Factors:*

Factors such as rainfall patterns, temperature changes, and groundwater recharge rates play a role in determining groundwater quality. Intense rainfall can lead to runoff that carries pollutants into underground sources, while drought conditions may concentrate contaminants due to reduced water levels.

5) *Over-Extraction of Groundwater:*

Pumping groundwater excessively can lower water levels, leading to issues like saltwater intrusion in coastal areas and increased concentrations of dissolved contaminants. Sustainable management practices are essential to maintain water quality.

6) *Industrial and Chemical Contaminants:*

Discharge of untreated industrial waste containing hazardous substances can severely impact groundwater quality.

VI. GROUND WATER QUALITY STANDARDS AND GUIDELINES

Ensuring the safety and purity of groundwater is crucial for human consumption, agriculture, and industrial use. Various organizations and regulatory bodies have established specific standards and guidelines for groundwater quality to protect public health and the environment. The following sections highlight key international and national groundwater quality standards.

1) *World Health Organization (WHO) Standards*

The World Health Organization (WHO) offers globally recognized guidelines for water quality to protect human health. These guidelines set permissible limits for a range of physical, chemical, and biological contaminants in groundwater. The WHO emphasizes parameters such as pH, total dissolved solids (TDS), microbial contamination, heavy metals (including lead and arsenic), and organic pollutants. The recommendations from the WHO serve as a reference for many national and regional regulatory frameworks, ensuring that drinking water remains safe for human use.

2) *Bureau of Indian Standards (BIS)*

In India, the Bureau of Indian Standards (BIS) oversees groundwater quality through IS 10500:2012, which outlines permissible and acceptable limits for drinking water. The BIS standard addresses parameters such as turbidity, color, taste, pH levels, hardness, fluoride, iron, nitrates, and microbial contamination. These standards are designed to ensure the safety of water for drinking, cooking, and other domestic purposes. Adhering to BIS regulations is essential for protecting public health and preventing waterborne diseases.

3) *Environmental Protection Agency (EPA) Guidelines*

The Environmental Protection Agency (EPA) in the United States establishes drinking water standards under the Safe Drinking Water Act (SDWA). The EPA sets Maximum Contaminant Levels (MCLs) and Health-Based Goals (MCLGs) for various pollutants, including heavy metals, volatile organic compounds (VOCs), pesticides, and microbial contaminants. The agency enforces regulations to prevent groundwater contamination from industrial discharges and agricultural practices.

VII. METHODOLOGY FOR WATER QUALITY PARAMETER ANALYSIS

A. Sampling Strategy

1) *Selection of Sampling Sites*

Choose locations based on potential pollution sources, usage patterns, and their environmental importance.
Take into account both upstream and downstream points for a thorough comparative analysis.

2) *Sampling Frequency*

Routine Monitoring: Conduct sampling on a monthly or quarterly basis.
Event-based Monitoring: Perform sampling after significant rainfall, industrial discharges, or during seasonal shifts.

3) *Sample Collection*

Utilize sterilized bottles for microbial analysis and appropriate plastic or glass containers for physicochemical tests.

Gather samples from both surface and depth (if necessary). Clearly label each sample with the date, time, location, and relevant environmental conditions.

4) Sample Preservation & Transportation

Keep samples at 4°C in an icebox during transport.

Ensure microbiological samples are analyzed within 6 hours and chemical samples within 24 to 48 hours.

2. Analysis of Water Quality Parameters

2.1 Physical Parameters

Parameter	Method	Instrument Used
Temperature	In-situ measurement	Thermometer
Turbidity	Nephelometric Method	Turbidity Meter
Total Dissolved Solids (TDS)	Gravimetric/Conductivity	TDS Meter
pH	Electrometric Method	pH Meter
Electrical Conductivity (EC)	Conductivity Method	Conductivity Meter

2.2 Chemical Parameters

Parameter	Method	Instrument Used
Dissolved Oxygen (DO)	Winkler's Method	DO Meter
Biochemical Oxygen Demand (BOD)	5-day Incubation	BOD Incubator
Chemical Oxygen Demand (COD)	Dichromate Reflux	Spectrophotometer
Nitrate (NO_3^-)	UV Spectrophotometry	Spectrophotometer
Phosphate (PO_4^{3-})	Colorimetric	Spectrophotometer
Chloride (Cl^-)	Argentometric Method	Titration
Heavy Metals (Pb, Hg, Cd, As)	Atomic Absorption Spectroscopy (AAS)	AAS/ICP-MS

2.3 Microbiological Parameters

Parameter	Method	Instrument Used
Total Coliform	Membrane Filtration	Incubator
E. coli	Most Probable Number (MPN)	Water Bath Incubator
Fecal Coliform	Membrane Filtration	Incubator

S.No.	Water Quality Parameters	Method/Instrument Used
1	Turbidity	Nephelometer
2.	Alkalinity	Titration
3.	P^H Value	P^H meter
4.	Hardness	Titration
5.	Chloride Content	Simple Titration
6.	Free Ammonia	Simple Boiling
7.	Organic Ammonia	Boiled Water + $KMNO_4$
8.	Nitrate	Color Matching Technique

S.No.	Parameters	Acceptable Units (Irrigation Purpose)	Analyzed Readings (2020)
1	Turbidity (NTU)	15	18.23
2.	Alkalinity(mg/l)	500	62.30
3.	P^H Value	6.5-8.5	7.1
4.	Hardness(mg/l)	500	32.18
5.	Chloride Content	500	69
6.	Ammonia	<1.2PPM	1.1 PPM
7.	Nitrate(mg/l)	<10	9
8.	TSS (mg/l)	100	25.84

Table-2: Analyzed and permissible limits of parameters

VIII. CASE STUDIES

Here are references to four research studies that analyze water quality parameters in Ghaziabad:

1) Physio-Chemical and Biological Analysis of Sewage Water along Hindon River Ghaziabad City (U.P) India

Dr. Mamta Bhardwaj conducted a study in 2013 to assess the pollution profile of the Hindon River. This involved analyzing various physico-chemical and biological parameters over a six-month period, including water temperature, pH, turbidity, alkalinity, acidity, total solids, BOD, COD, and plankton composition.

2) Drinking Water Assessment of Four Locations from Ghaziabad, Uttar Pradesh

Researchers Shikha Bisht, B.A. Patra, and Monika Malik collected drinking water samples from four different locations in Ghaziabad. They analyzed these samples for various physico-chemical and elemental parameters, such as pH, nitrate, fluoride, chloride, sulfate, total dissolved solids, hardness, alkalinity, calcium, magnesium, and several metals.

3) Assessment of Water Quality of Hindon River in Ghaziabad and Noida, India by Using Multivariate Statistical Methods

Nida Rizvi, Deeksha Katyal, and Varun Joshi evaluated the water quality of the Hindon River using multivariate statistical methods. They analyzed data from eight sampling stations and employed techniques like Pearson correlation, principal component analysis, and cluster analysis to identify the main factors affecting water quality variations.

4) GroundwaterQuality in Ghaziabad District, Uttar Pradesh,India: Multivariate and Health Risk Assessment

This study focused on assessing groundwater quality and the potential health risks associated with heavy metal ingestion in peri-urban and urban-industrial areas of Ghaziabad. The researchers utilized multivariate analysis and fuzzy comprehensive assessment to evaluate sources of heavy metals and pollution levels.

IX. LITERATURE REVIEW

Gupta, R., Sharma, P., & Kumar, S. (2022).Physicochemical parameter and water quality index assessment of groundwater in Ghaziabad, India. Environmental Monitoring and Assessment.

Kumar, A., Singh, R., & Verma, P. (2021). Seasonal variation of surface water quality and its influence on public health in Ghaziabad. Journal of Water Resource Management.

Sharma, D., Yadav, M., & Mishra, R. (2020). Heavy metal contamination and water quality assessment in the Hindon River, Ghaziabad. International Journal of Environmental Studies.

Verma, P., Tiwari, K., & Singh, S. (2019). Groundwater pollution and risk assessment in Ghaziabad's urban and industrial zones. Water Science and Technology.

Chaudhary, N., Sharma, V., & Gupta, S. (2018). A comparative study of drinking water quality in different zones of Ghaziabad city. Hydrology Research.

Sharma et al. (2018) investigated industrial discharge effects on river water and recorded alarming concentrations of lead (Pb) and cadmium (Cd), which are harmful to human health.

Kumar and Gupta (2020) assessed groundwater quality and found excessive levels of nitrates and fluoride, which are largely due to agricultural runoff and industrial effluent.

Mishra et al. (2019) examined physicochemical properties of surface water and reported that high levels of biological oxygen demand (BOD) revealed organic pollution.

Singh et al. (2021) focused on microbial pollution and detected Escherichia coli (E. coli) in groundwater, which is an indicator of sewage intrusion.

Das et al. (2020) discussed different water purification technologies and suggested techniques such as reverse osmosis and activated carbon filtration to improve the quality of water.

Patel & Verma (2022) analyzed the health impacts of heavy metal pollution, attributing exposure to neurological diseases and kidney injury. Choudhary et al. (2021) presented community-based water conservation practices, emphasizing the need for integrated water resource management (IWRM) to manage pollution.

Rana & Singh (2019) presented the use of GIS and remote sensing in detecting pollution hotspots.

Yadav et al. (2021) analyzed industrial zones in Ghaziabad, indicating that untreated effluents significantly impair water quality.

Mehta & Roy (2023) analyzed policy interventions, recommending more stringent environmental regulations and increased wastewater treatment plants.

X. CONCLUSION

The analysis of water quality parameters in Ghaziabad raises significant concerns about contamination levels and their potential effects on public health. The study shows variations in important indicators like pH, dissolved oxygen, turbidity, and heavy metal concentrations, highlighting the necessity for ongoing monitoring and stricter regulatory actions. While some parameters are within acceptable limits, others surpass recommended standards, pointing to possible pollution sources from industrial, agricultural, and domestic activities.

To ensure access to clean and safe water, a collaborative effort is essential, involving local authorities, environmental agencies, and community engagement. Enhancing wastewater treatment facilities, encouraging sustainable water management practices, and increasing public awareness can help reduce the risks linked to water pollution. Future research should concentrate on long-term monitoring and advanced treatment technologies to enhance water quality and protect both human and ecological health in the area.

REFERENCES

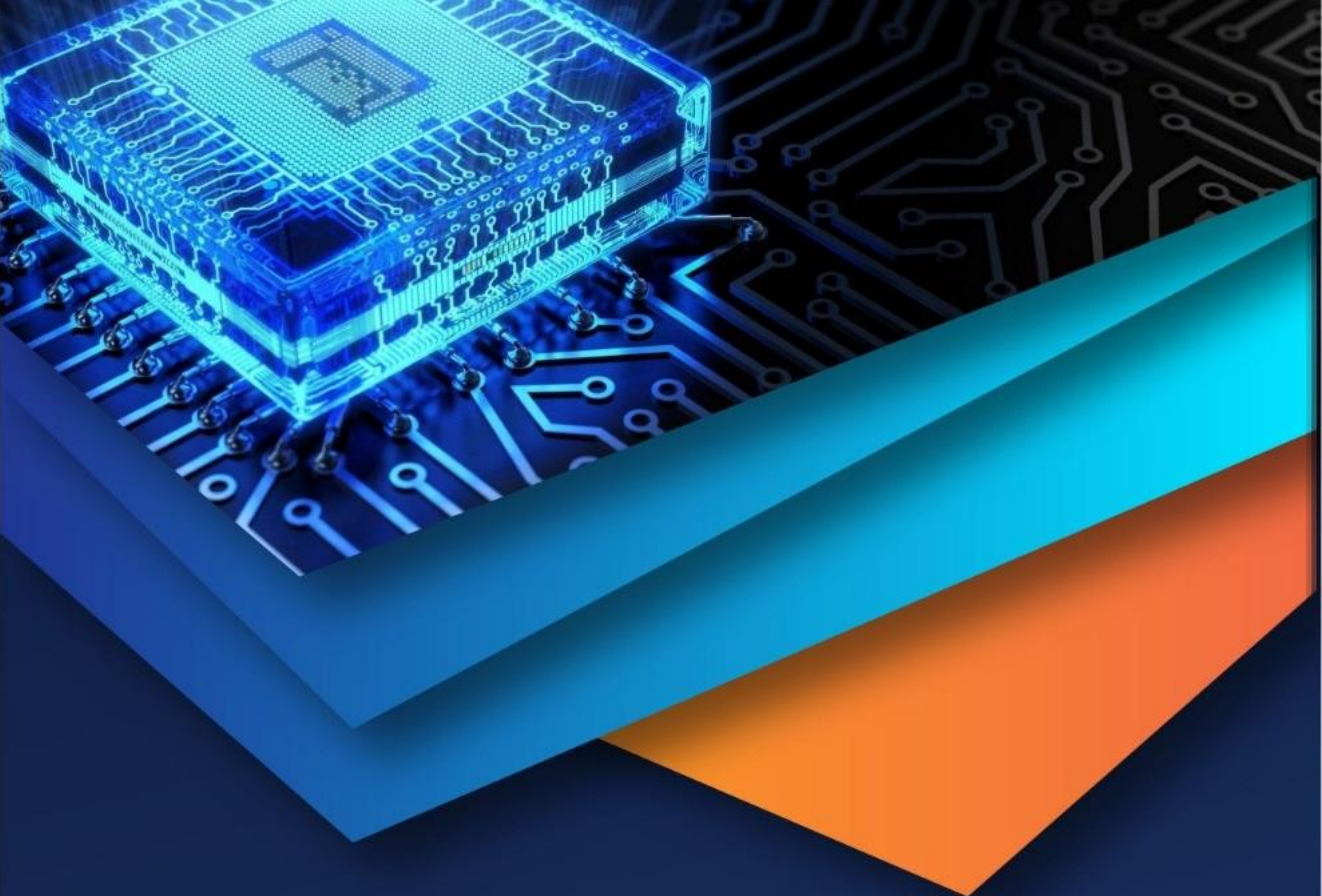
[1] Gupta, R., Sharma, P., & Kumar, S. (2022).Assessment of Physicochemical Parameters and Water Quality Index of Groundwater in Ghaziabad, India. Environmental Monitoring and Assessment.

[2] Kumar, A., Singh, R., & Verma, P. (2021). Seasonal Variation in Surface Water Quality and Its Impact on Public Health in Ghaziabad. Journal of Water Resource Management.

[3] Sharma, D., Yadav, M., & Mishra, R. (2020). Evaluation of Heavy Metal Contamination and Water Quality in the Hindon River, Ghaziabad. International Journal of Environmental Studies.

[4] Verma, P., Tiwari, K., & Singh, S. (2019). Groundwater Pollution and Its Risk Assessment in Urban and Industrial Areas of Ghaziabad. Water Science and Technology.

[5] Chaudhary, N., Sharma, V., & Gupta, S. (2018). A Comparative Study of Drinking Water Quality in Different Zones of Ghaziabad City. Hydrology Research.



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