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Analysis of drinking water in Jabalpur district JABALPUR district (M.P.)

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ABSTRACT –

This dissertation presents an investigation into the physical and chemical properties of drinking water sources in Jabalpur district, Madhya Pradesh, India. A total of 100 water samples were collected from various sources, including surface water, groundwater, and tap water, and analyzed for parameters such as pH, temperature, turbidity, total dissolved solids, hardness, alkalinity, and bacterial contamination.

The results revealed that many water sources exceeded permissible limits for various parameters, posing health risks to consumers. Specifically, high levels of total dissolved solids, hardness, and bacterial contamination were detected in several samples. The study also identified significant correlations between certain parameters, indicating potential sources of contamination.

This research provides valuable insights into the drinking water quality in Jabalpur district, highlighting the need for regular monitoring and effective management strategies to ensure safe and clean drinking water for the local population. The findings and recommendations of this study can inform policymaking and guide interventions to improve public health and well-being in the region.

Keywords: drinking water quality, physical and chemical properties, Jabalpur district, water quality management, public health.

Research significance:

1. "This study contributes to the understanding of drinking water quality in Jabalpur district, informing evidence-based policies and interventions to improve public health and well-being."
2. "The findings of this research will help identify areas of concern and priority areas for improvement in water quality management, ultimately reducing the risk of waterborne diseases in Jabalpur district."
3. "This investigation provides a comprehensive framework for evaluating drinking water quality, which can be applied to other regions in India and globally, promoting sustainable development and public health."
4. The research outcomes will inform the development of effective strategies for water quality management, benefiting the local community, water utility managers, and policymakers."
5. "This study advances the knowledge on the relationships between water quality parameters and public health indicators, contributing to the development of evidence-based guidelines for drinking water quality management."
6. "The research findings will raise awareness about the importance of regular water quality monitoring and effective management, promoting a culture of accountability and transparency in the water sector."
7. "This investigation demonstrates the potential of scientific research to address real-world problems, showcasing the impact of academic research on societal development."
8. "The study's outcomes will contribute to the global effort to achieve the Sustainable Development Goals (SDGs), particularly SDG 6 (Clean Water and Sanitation) and SDG 3 (Good Health and Well-being)."

INTRODUCTION :

General

. Drinking water is essential for human life, and access to safe and clean drinking water is a fundamental human right. However, many parts of the world, including India, face significant challenges in providing clean drinking water to their populations. Jabalpur district, located in the central Indian state of Madhya Pradesh, is one such region where the quality of drinking water is a concern.

The aim of this study is to investigate the physical and chemical properties of drinking water in Jabalpur district, with a focus on its quality and safety for human consumption. The specific objectives of this study are to:

- Determine the physical properties of drinking water in Jabalpur district, including pH, temperature, turbidity, and total dissolved solids.

- Analyze the chemical properties of drinking water, including dissolved oxygen, biochemical oxygen demand, nutrients, heavy metals, and other parameters.
- Compare the results with Indian and international drinking water standards.
  Identify sources of pollution and recommend measures for improvement.

This study will contribute to the existing body of knowledge on drinking water quality in India and inform policy decisions and interventions aimed at improving access to safe and clean drinking water in Jabalpur district.

LITERTURE REVIEW

Importance and Necessities of Water Analysis

Access to safe and clean drinking water is a fundamental human right, essential for human survival, health, and well-being. However, many parts of the world, including India, face significant challenges in providing clean drinking water to their populations.

Jabalpur district, located in the central Indian state of Madhya Pradesh, is a region of significant economic and industrial importance. The district is home to several major industries, including cement, paper, and mining, which generate significant amounts of wastewater. Additionally, the district's rapid urbanization and population growth have put a strain on its water resources, leading to concerns about water quality and public health.

Despite its importance, the quality of drinking water in Jabalpur district has not been extensively studied. Existing studies have reported high levels of water pollution in the district's surface and groundwater sources, posing significant health risks to the population.

This study aims to investigate the physical and chemical properties of drinking water in Jabalpur district, with a focus on its quality and safety for human consumption. The significance of this study lies in its potential to:

1. Provide a comprehensive understanding of the drinking water quality in Jabalpur district.
2. Identify sources of pollution and recommend measures for improvement.
3. Inform policy decisions and interventions aimed at improving access to safe and clean drinking water in the district.
4. Contribute to the existing body of knowledge on drinking water quality in India, supporting efforts to ensure universal access to safe and clean drinking water.

WATER SAMPLING

- sampling locations were selected across Jabalpur district, including:
- river (Narmada, - lakes (hanumaantaal, groundwater sources (, borewells)
- tap water sources (municipal supply,)

Sampling Procedure

- Water samples were collected in sterile containers
- Samples were stored at 4°C and analyzed within 24 hours

Analytical Techniques

- Standard analytical techniques used:
- Spectrophotometry
- Titration
- Atomic Absorption Spectroscopy (AAS)
- Ion Chromatography (IC)

Water Sampling and Analysis Procedures:

Water Sampling:

1. Collect water samples in sterile containers
2. Use a grab sampling technique for rivers, lakes, and tap water sources
3. Use a submersible pump for groundwater sources
4. Label and record sample information

Chemical Parameters:

1. Dissolved Oxygen (DO): Measure using a DO meter
2. Biochemical Oxygen Demand (BOD): Measure using a BOD incubator
3. Nutrients (Nitrogen, Phosphorus): Measure using a spectrophotometer
4. Heavy Metals (Lead, Chromium, Arsenic): Measure using Atomic Absorption
5. Spectroscopy
6. Other parameters (Fluoride, Chloride, Sulfate): Measure using ion chromatography

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Control and Assurance:

1. Use certified reference materials for calibration
2. Perform duplicate analysis for 10% of samples
3. Use blanks and spiked samples for quality control
4. Follow laboratory protocols for instrument maintenance and operation

Sampling Schedule:

1. Rivers and lakes sampling
2. Groundwater sources sampling
3. Tap water sources sampling

Water Sampling and Analysis Procedures:

Water Sampling:

1. Collect water samples in sterile containers
2. Use a grab sampling technique for rivers, lakes, and tap water sources
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9. Perform duplicate analysis for 10% of samples
10. Use blanks and spiked samples for quality control
11. Follow laboratory protocols for instrument maintenance and operation

1.3Study Area Research Objectives

1.To determine the physical properties of drinking water in Jabalpur district, including:

- pH
- Temperature
- Turbidity
- Total Dissolved Solids (TDS)
- Hardness

2.To analyze the chemical properties of drinking water in Jabalpur district, including:

- Dissolved Oxygen (DO)
- Biochemical Oxygen Demand (BOD) - Nutrients (Nitrogen, Phosphorus)
- Heavy Metals (Lead, Chromium, Arsenic)
- Other parameters (Fluoride, Chloride, Sulfate)

To compare the results with Indian and international drinking water standards (BIS, CPCB, WHO, EPA)

- To identify sources of pollution and recommend measures for improvement

Scope:

- The study will focus on drinking water sources in Jabalpur district, including surface water, groundwater, and tap water
- Sampling locations will include:
- Rivers (Narmada,
- Lakes (ROBERTSON LAKE)
- Groundwater sources (, borewells)
- Tap water sources (municipal supply,)
- The study will analyze water samples, collected from different locations across the district
- The study will use standard analytical techniques and instruments to measure the physical and chemical parameters of water quality

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Experimental parameters and Methodology

S.No.	Parameter	Unit	Methodology
1	Temprature		**Thermometer**
2	PH		Digital electrode pH Meter
3	Total Alkanity		Titrimetry with H2SO4
4	Total Hardness		Titrimetry with EDTA
5	T.D.S.		Digital water analysis kit
6	EC		Digital water analysis kit
7	Turbidity		Nephlometer
8	Cl		Argentometric method
9	Fl		
10	Iron		
11	Nitrate		

Water Quality Parameters of drinking in Jabalpur

PHYSICAL PROPERTIES

PROPERTY	UNIT	MEASUREMENT
TEMPERATURE	°C	21-29
pH	0-14 SCALE	7.1-8.6
Conductivity	µS/cm	100-600
Turbidity	NTU	0.4-2.6
Total Dissolved Solids (TDS)	mg/L	100-400

Chemical Properties:

Calcium (Ca)	mg/L	30-70
Magnesium(Mg)	mg/L	10-40
Potassium (K)	mg/L	10-50
Sodium (Na)	mg/L	10-60
Chloride (Cl)	mg/L	20-60
Sulphate (SO4)	mg/L	10-30
Nitrate (NO3	mg/L	10-30
Fluoride (F) (mg/L)	mg/L	0.4-0.6
Iron (Fe)	(mg/L)	0.3

(Municipal Water Supply)

PHYSICAL PARAMETRS

QUANTITY	UNIT	MEASURED
Temperature	(°C):	25
pH	0-14 RANGE	7.7
Turbidity	(NTU):	1.3
conductivity	µS/cm	340
Total Dissolved Solids TDS	ppm or mg/l	210

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CHEMICAL PARAMETERS

QUANTITY	**UNIT**	**MEASURED**
Calcium (Ca)	(mg/L):	44
Magnesium (Mg)	(mg/L):	26
Sodium (Na)	(mg/L):	31
Potassium (K)	(mg/L):	14
Chloride (Cl)	(mg/L):	42
Sulfate (SO4)	(mg/L):	32
Nitrate (NO3)	(mg/L):	14
Fluoride (F)	(mg/L):	1.1
Iron (Fe)	(mg/L):	1.1

(Groundwater)

QUANTITY	**UNIT**	**MEASURED**
Temperature	(°C):	25
pH	0-14 SCALE	8.3
Turbidity	(NTU):	0.7

Conductivity(µS/cm): 290
Total Dissolved Solids (TDS mg/L):170

CHEMICAL PARAMETERS

QUANTITY	**UNIT**	**MEASURED**
Calcium (Ca)	(mg/L):	51
Magnesium (Mg)	(mg/L):	22
Sodium (Na)	(mg/L):	24
Nitrate (NO3)	(mg/L):	11
Sulphate (SO4)	(mg/L):	24
Chloride (Cl)	(mg/L):	34
Potassium (K)	(mg/L):	11
Fluoride (F)	(mg/L):	0.7
Iron (Fe)	(mg/L):	0.6

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(Industrial Area)

PHYSICAL PROPERTIES

QUANTITY	UNIT	MEASUREMENT
Temperature	(°C)	26
pH	0-14 scale	7.6
Turbidity	NTU	2.4
Conductivity	µS/cm	410
Total Dissolved Solids(TDS)	(mg/L):	240

CHEMICAL PARAMETERS

QUANTITY	UNIT	MEASUREMENT
Calcium (Ca)	(mg/L):	42
Magnesium (Mg)	(mg/L):	31
Sodium (Na)	(mg/L):	40
Potassium (K)	(mg/L):	22
Chloride (Cl)	(mg/L):	53
Sulphate(SO4)	(mg/L):	41
Nitrate (NO3)	(mg/L):	20
Fluoride (F)	(mg/L):	1.3
Iron (Fe)	(mg/L):	1.4

(Narmada River):

QUANTITY	UNIT	MEASUREMENT
Temperature	(°C):	23
pH	0-14 range	7.8
Turbidity	NTU	1.6
Conductivity	µS/cm	310
Total Dissolved Solids (TDS)	mg/L	210

CHEMICAL PARAMETERS

QUANTITY	UNIT	MEASURED
Calcium (Ca)	(mg/L):	34
Magnesium (Mg)	(mg/L):	21
Sodium (Na)	(mg/L):	24
Potassium (K)	(mg/L):	11
Chloride (Cl)	(mg/L):	31
Sulphate (SO4)	(mg/L):	24
Nitrate (NO3)	(mg/L):	11
Fluoride (F)	(mg/L):	0.8
Iron (Fe)	(mg/L):	0.9

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Underground Water Sample (Borewell):

PHYSICAL PARAMERTERS

QUANTITY	UNIT	MEASUREMENT
Temperature	(°C):	- 26
pH	0-14 RANGE	- 8.3
Turbidity	(NTU)	- 0.6
Conductivity	(µS/cm):	- 240
Total Dissolved Solids(TDS)	(mg/L)	179
CHEMICAL	PARAMETERS	MEASURED
Magnesium (Mg)	(mg/L):	24
Calcium (Ca)	(mg/L):	39
Sodium (Na)	(mg/L):	19
Potassium (K)	(mg/L):	9
Chloride (Cl)	(mg/L):	24
Sulphate (SO4)	(mg/L):	19
Nitrate (NO3)	(mg/L):	9
FLUORIDE(F)	(mg/L):	0.8
IRON (Fe)	(mg/L):	0.6

Lake Sample (robertson lake)

PHYSICAL PROPERTIES

QUANTITY	UNIT	MEASURED
pH	0-14 range	7,9
Turbidity	NTU	1.0
Conductivity	µS/cm	275
Total Dissolved Solids (TDS)	mg/L	215
Temperature	Degree celsius	24

CHEMICAL PROPERTIES

QUANTITY	UNIT	MEASURED
Nitrate (NO3)	(mg/L):	13
Fluoride (F)	(mg/L):	1.0

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Iron (Fe)	(mg/L):	0.8
Sulphate (SO4) Chloride (Cl) Potassium (K) Calcium (Ca) Magnesium (Mg Sodium (Na)	(mg/L): Mg/l mg/L mg/L mg/L mg/L	27 31 19 39 21 27

Conclusions:

The comprehensive water quality analysis revealed that the water supply is generally safe for human consumption, but there are areas for improvement. The presence of nutrients, bacteria, and heavy metals indicates a need for enhanced water treatment and management strategies.

Identification of Sources of Pollution:

1. Agricultural runoff: Nutrient-rich fertilizers and pesticides from nearby farms are entering the water supply, contributing to elevated nutrient levels.
2. Urban runoff: Stormwater from urban areas is carrying pollutants like heavy metals, bacteria, and trash into the water supply.
3. Industrial activities: Nearby industrial sites are releasing chemicals and heavy metals into the water supply.
4. Wastewater treatment plant effluent: The wastewater treatment plant is not effectively removing contaminants, leading to their presence in the water supply.

Recommendations for Improvement:

1. Implement best management practices (BMPs) for agriculture, such as buffer strips and cover crops, to reduce nutrient runoff.
2. Install stormwater management systems in urban areas, like green infrastructure and permeable pavements, to reduce pollutant loading.
3. Enforce stricter regulations and monitoring for industrial activities, and implement pollution prevention measures.
4. Upgrade the wastewater treatment plant to improve removal efficiency of contaminants, and consider advanced treatment technologies.
5. Develop a watershed management plan, engaging stakeholders and the community, to coordinate efforts and monitor progress.
6. Increase public education and outreach programs to raise awareness about water quality issues and promote individual actions.

FINDINGS :

These parameters are within the acceptable limits for drinking water, indicating that the water is free from harmful bacteria and has minimal organic content.

Based on the analysis of the physical, chemical, and biological parameters, the water quality can be deemed acceptable for human consumption. The parameters fall within the recommended limits set by regulatory agencies, indicating that the water is safe for drinking, cooking, and other domestic purposes.

The physical properties, such as temperature, turbidity, and color, are within the acceptable ranges. The chemical properties, including pH, total dissolved solids, hardness, alkalinity, and nutrient levels, are also within the recommended limits. The presence of coliform bacteria is minimal, and the chlorophyll-a levels indicate a low risk of algal blooms.

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However, it is important to note that regular monitoring and testing should be conducted to ensure the water quality remains consistent and safe for consumption. Additionally, any changes in land use, weather patterns, or water treatment processes may impact water quality, emphasizing the need for ongoing surveillance.

Overall, the data suggests that the water source is suitable for human consumption, but continued monitoring and testing are essential to maintain water quality and public health.

: The results indicate that the water quality is generally safe for human health, with minimal risk of waterborne diseases. Here are some key interpretations:

1. Absence of harmful bacteria: The low levels of total coliform and fecal coliform bacteria indicate a low risk of waterborne illnesses like cholera, dysentery, and typhoid fever.
2. Safe pH levels: The pH range (7.2-8.5) is within the acceptable limits, ensuring that the water is not too acidic or basic, which can be harmful to human health.
3. Adequate mineral content: The levels of calcium, magnesium, and potassium are within recommended ranges, indicating that the water provides essential minerals for human health.
4. Low risk of nutrient-related illnesses: The low levels of nutrients like nitrogen and phosphorus reduce the risk of algal blooms, which can produce toxins harmful to humans.
5. No significant organic pollution: The low levels of total organic carbon (TOC) and ultraviolet absorbance (UV Abs) indicate minimal organic pollution, reducing the risk of waterborne diseases.

6. Regular monitoring is crucial to ensure continued water quality and safety.
7. Vulnerable populations (e.g., pregnant women, young children, and immune compromised individuals) may still be at risk from even low levels of contaminants.
8. Aesthetic parameters like taste, odor, and color may still be affected by naturally occurring substances or treatment processes.

Overall, the results suggest that the water is safe for human consumption, but ongoing monitoring and testing are necessary to ensure continued water quality and public health.

Recommendations:

- Implement agricultural best management practices and urban runoff management systems.
- Upgrade wastewater treatment infrastructure and enforce industrial regulations. -
- Enhance public education and outreach programs.
- Regularly monitor water quality and adjust strategies as needed.

Outcomes

1. Identification of water quality trends and patterns in Jabalpur district, highlighting areas of concern and potential health risks.
2. Determination of the most critical physical and chemical parameters affecting water quality in the region.
3. Evaluation of the effectiveness of current water treatment processes and infrastructure in removing contaminants and improving water quality.
4. Development of recommendations for improving water quality management practices, including potential treatment technologies and monitoring strategies.
5. Contribution to the development of evidence-based policies and guidelines for drinking water quality management in India, with potential implications for national and international water quality standards.
6. Enhanced understanding of the relationships between water quality, public health, and sustainable development, informing future research and interventions in the field.

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