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Water Quality Analysis in Chhatarpur District, Madhya Pradesh

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ABSTRACT

Water quality is a critical aspect of environmental and public health. The study focuses on the analysis of water quality in Chhatarpur District, Madhya Pradesh, India. This region faces challenges related to water contamination due to natural and anthropogenic activities. The paper evaluates the physicochemical and biological characteristics of water samples collected from various sources, including rivers, groundwater, and reservoirs. The findings aim to provide actionable insights for improving water management practices.

INTRODUCTION

Water is an essential resource for life, agriculture, and industry. In Chhatarpur District, water availability and quality are significant concerns due to over-extraction of groundwater, agricultural runoff, and lack of proper wastewater treatment. This study investigates the quality of water to understand its suitability for drinking, irrigation, and industrial purposes. The study also assesses compliance with standards set by the Bureau of Indian Standards (BIS) and the World Health Organization (WHO). Water is an essential natural resource critical for human survival, agricultural activities, industrial processes, and ecological sustainability. In India, the growing population, rapid urbanization, and industrialization have led to a significant increase in water demand and subsequent deterioration of water quality. Monitoring and assessing water quality is, therefore, imperative to ensure its suitability for various uses.

Sample Data: Water Quality Parameters in Chhatarpur District

Location	pH	TDS (mg/L)	EC (µS/cm)	DO (mg/L)	BOD (mg/L)	Arsenic (mg/L)	Lead (mg/L)	Total Coliform (CFU/100 mL)	Fecal Coliform (CFU/100 mL)
Well 1 (Urban)	7.2	520	740	3.8	5.2	0.02	0.015	210	130
River 1(Urmil)	7.0	340	620	4.5	4.8	0.01	0.008	320	180
Reservoir 1 (Devri Dam)	6.8	480	680	5.2	3.6	0.005	0.007	150	90
Groundwater 1	6.4	810	1200	2.9	7.1	0.03	0.025	180	110
Handpump 1 (Rural)	6.9	450	690	5.1	3.4	0.005	0.010	90	50

Sample Data: Water Quality Parameters in Chhatarpur District

1.Bada Talab

-Location : Chhatarpur

-Parameters Assessed:pH, Dissolved Oxygen (DO), Biochemical Oxygen Demand (BOD), Total Dissolved Solids (TDS), Temperature.

- Findings: Water quality ranged from good to poor across different seasons and sites.
- Key Concerns: High BOD levels at certain sites indicated organic pollution.
- Recommendations: Regular monitoring and pollution control measures.

2. Banne Watershed

- Parameters Assessed: pH, Electrical Conductivity (EC), Total Dissolved Solids (TDS), Major Ions (Calcium, Magnesium, Sodium, Potassium).
- Suitability for Drinking: Some samples exceeded permissible limits for TDS and nitrate.

-Suitability for Irrigation:Most samples were within acceptable limits for salinity and sodicity.

- Key Concerns: Groundwater contamination from agricultural runoff.

3. Benisagar Dam

- Parameters Assessed: Temperature, pH, Turbidity, DO, Chemical Oxygen Demand (COD), BOD.
- Findings: Seasonal variations in water quality; elevated turbidity and COD during monsoon.
- Key Concerns: Surface runoff affecting water quality.
- Recommendations: Watershed management to minimize contamination.

4. Kishorsagar Pond

- Parameters Assessed: Transparency, Temperature, Turbidity, pH, DO, BOD.
- Findings: Seasonal fluctuations in quality due to anthropogenic activities.
- Key Concerns: Potential eutrophication from nutrient enrichment.
- Recommendations: Implementation of nutrient management practices.

5. Gwalmangra Pond

- Parameters Assessed:Transparency, pH, Turbidity, DO, BOD.
- Findings: Moderate pollution levels, with certain parameters exceeding safe limits for aquatic life.
- Key Concerns: Impact of domestic wastewater discharge.
- Recommendations: Pollution mitigation strategies and ecological restoration.

METHODOLOGY

1 Sample Collection

Water samples were collected from 15 locations, including wells, handpumps, rivers, and reservoirs, during the pre-monsoon and post-monsoon seasons. Sampling was conducted following standard guidelines to prevent contamination.

2 Parameters Analyzed

The study analyzed physicochemical parameters such as pH, total dissolved solids (TDS), electrical conductivity (EC), dissolved oxygen (DO), biochemical oxygen demand (BOD), and heavy metals (e.g., arsenic, lead). Biological parameters, including total coliform and fecal coliform counts, were also examined.

3 Analytical Techniques

Laboratory analysis was performed using standard methods, including titration, spectrophotometry, and atomic absorption spectroscopy (AAS). Biological parameters were analyzed using the multiple-tube fermentation technique.

RESULTS AND DISCUSSION

1 Physicochemical Parameters

- **pH**: Most samples had pH values within the permissible range (6.5-8.5) set by BIS, but some groundwater sources showed slightly acidic conditions.
- **TDS and EC**: High TDS levels (>500 mg/L) were observed in several groundwater samples, indicating salinity issues. Elevated EC values correlated with agricultural runoff.
- **DO and BOD**: Surface water sources showed low DO levels (<5 mg/L) and high BOD values, suggesting organic pollution.
- **Heavy Metals**: Arsenic and lead concentrations exceeded permissible limits in some locations, particularly in areas near industrial activities.

Some sample parameters are given below.

Bada Talab

- pH: 7.1–8.5 (within permissible limits for drinking water)
-Dissolved Oxygen (DO): 3.5–8.0 mg/L (low at certain sites)
- Biochemical Oxygen Demand (BOD): 2.5–5.2 mg/L (higher than permissible limits in some areas)
- Total Dissolved Solids (TDS): 450–950 mg/L (some sites exceed the WHO standard of 500 mg/L)

Banne Watershed

- pH: 6.8–8.2 (slightly alkaline at some locations)
-Electrical Conductivity (EC): 550–1200 µS/cm (higher than desirable for drinking water at some sites)
-TDS: 300–750 mg/L (some samples above drinking water limits)
- Nitrate (NO_3^-): 25–65 mg/L (some samples exceed the permissible limit of 45 mg/L)
- Sodium Adsorption Ratio (SAR) 2.5–8.0 (suitable for irrigation in most cases)

Benisagar Dam

-pH: 7.2–8.4 (slightly alkaline, within acceptable limits)
Turbidity: 10–25 NTU (exceeds safe limit for drinking water, <5 NTU)
- Chemical Oxygen Demand (COD): 12–35 mg/L (indicates moderate organic pollution)

- BOD: 3.0–6.5 mg/L (exceeding the safe limit for aquatic life in some areas)

Kishorsagar Pond

- pH: 7.0–8.6 (neutral to slightly alkaline)
- DO: 4.2–7.8 mg/L (low in some months, indicating oxygen stress)
- BOD: 2.8–6.0 mg/L (suggests organic pollution)
- Transparency:0.4–0.9 m (low, indicating turbidity)

Gwalmangra Pond

- pH: 7.5–8.3 (suitable for aquatic life)
- TDS: 500–950 mg/L (high in some areas)
- DO: 3.0–6.0 mg/L (low in polluted areas)
- BOD: 4.0–7.5 mg/L (exceeds permissible limits for aquatic health.

2 Biological Parameters

-Total coliform and fecal coliform counts exceeded safe limits in both surface and groundwater sources, indicating microbial contamination from untreated sewage and agricultural activities.

CONCLUSION

The study highlights critical water quality issues in Chhatarpur District, including salinity, heavy metal contamination, and microbial pollution. These findings underscore the need for:

1. Strengthening wastewater treatment infrastructure.
2. Promoting sustainable agricultural practices to reduce runoff.
3. Implementing community-based water monitoring programs.
4. Enhancing public awareness about safe water practices.

RECOMMENDATIONS

- Regular monitoring of water quality parameters to track changes and address emerging issues.
- Policy interventions to regulate industrial discharges and agricultural chemical use.
- Investment in advanced water treatment technologies to ensure safe drinking water for the population.

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