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# IMPACT OF INDUSTRIAL AND AGRICULTURAL ACTIVITIES ON WATER POLLUTION IN AHIWARA DISTRICT, DURG: AN ENVIRONMENTAL ANALYSIS"

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**Abstract**
The impact of industrial and agricultural activities on water quality in Ahiwara District, Durg was evaluated through a comprehensive environmental analysis. Water samples from five different locations were analyzed for key parameters, including pH, alkalinity, electrical conductivity (EC), total dissolved solids (TDS), dissolved oxygen (DO), biochemical oxygen demand (BOD), chemical oxygen demand (COD), total hardness, temporary hardness, permanent hardness, and turbidity. Descriptive statistics was used for data analysis. The average values for these parameters were as follows: pH 7.06, alkalinity 119.6 mg/l, EC 215.8 mg/l, TDS 187.6 mg/l, DO 5.816 mg/l, BOD 4.018 mg/l, COD 7.8 mg/l, total hardness 234.88 mg/l, temporary hardness 154.6 mg/l, permanent hardness 80.28 mg/l, and turbidity 2.48 NTU. The result indicates variations in water quality parameters across different samples, reflecting the influences of both industrial and agricultural discharges. Elevated levels of total hardness and turbidity, along with varying BOD and COD values, suggest a moderate to high impact of local industrial and agricultural activities on water quality. This study provides a critical assessment of the current state of water pollution in the region and highlights the need for effective management strategies to mitigate the adverse effects of these activities on water resources.

**Keyword:**
Water Pollution, Industrial Impact, Agricultural Runoff, Water Quality Parameters

## 1. Introduction

The issue of water pollution is becoming a major environmental concern on a global scale, impacting human health, aquatic environments, and the general well-being. In India, the rapid growth of industry and intensification of agriculture have greatly added to the decline of water sources (1). The Ahiwara District in Durg, Chhattisgarh, is no exception, as it faces mounting pressure from industrialincluding steel plants, cement factories, & chemical industriesand agricultural activities, which are primary contributors to water pollution in the region.The industries discharge a variety of pollutants, such as heavy metals (i.e. lead, mercury, cadmium and arsenic), organic compounds, and suspended solids, into nearby water bodies (2,3). Industrial effluents, frequently improperly treated, flow into rivers, streams, and groundwater, causing contamination. Research has indicated that industrial effluents markedly raise the concentrations of harmful substances in water, posing a threat to aquatic life and rendering the water unsuitable for human consumption (4).In an effort to raise crop yields, chemical pesticides, herbicides, and fertilizers have been used more frequently over time. However, these chemicals finish up in neighboring water bodies due to runoff from agricultural fields, which causes eutrophication and nutrient loading. Aquatic species eventually die as a result of this process, which also causes an overabundance of algae and dissolved oxygen to be lost. Moreover, drinking water quality in rural regions is seriously threatened by these pollutants' entry into groundwater (5-7).The interaction between industrial and agricultural activities exacerbates the water pollution problem in Ahiwara. The combined effect of industrial discharges and agricultural runoff creates a complex mixture of pollutants that are difficult to treat. Moreover, the lack of effective regulatory frameworks and inadequate monitoring further complicates the situation. Even though those who depend on these

water sources for drinking, irrigation, and other daily necessities, vulnerable to the negative local community is especially health impacts of contaminated water (8).
This environmental analysis aims to assess the extent of water pollution in Ahiwara District, with a specific focus on the contributions from industrial and agricultural activities. By examining water quality parameters, pollutant sources, and the resulting ecological impacts, this study seeks to provide a comprehensive understanding of the current situation. Furthermore, it will explore potential mitigation strategies and policy recommendations to address the water pollution crisis in Ahiwara.The industrial discharged pollutants can include a wide range of toxic substances, such as heavy metals (e.g., lead, mercury, cadmium), organic chemicals (e.g., solvents, dyes, pesticides), and inorganic chemicals (e.g., acids, alkalis). The impact of these chemicals on aquatic environments can be severe, and they present significant dangers to human well-being. As an example, toxic metals discharged from industrial waste can build up in the food web, causing persistent health problems for people who eat tainted fish and seafood (9,10). Additionally, pesticides and herbicides in agricultural runoff can be toxic to aquatic life and may also contaminate drinking water supplies, posing health risks to humans (11-12).

## 2. Material and Methods

This section provides a comprehensive overview of the materials and methods used in analyzing the impact of industrial and agricultural activities on water pollution in AhiwarapondDistrict, Durg. The study involves the assessment of various water quality parameters, including pH, Alkalinity, Electrical Conductivity (EC), Total Dissolved Solids (TDS), Dissolved Oxygen (DO), Biochemical Oxygen Demand (BOD), Chemical Oxygen Demand (COD), Total Hardness, Temporary Hardness, Permanent Hardness, and Turbidity.

### 2.1Study Area and Sample Collection

Water samples were collected from five distinct locations in Ahiwara District, Durg. At each site, samples were gathered from a depth of 30 cm using pre-cleaned, sterilized polyethylene bottles. To avoid contamination, bottles were rinsed with the sample water before collection. Each bottle was filled to approximately 80% capacity to allow for mixing and prevent air gaps. Samples were immediately labeled with the date, time, and location of collection. They were then placed in an insulated container to maintain a consistent temperature and transported to the laboratory within 24 hours. Upon arrival, samples were stored at 4°C until analysis to preserve their chemical and physical properties. Each site was selected to represent potential impacts from nearby industrial and agricultural activities. Water samples were collected from five different locations within the district, chosen based on their proximity to industrial and agricultural activities.

### 2.2 Determination of Physico-chemical Parameters

Water quality parameters were analyzed following standard procedures. pH was measured using a calibrated pH meter. Alkalinity was determined through titration with sulfuric acid and phenolphthalein indicator. Electrical conductivity (EC) was assessed with a conductivity meter, while total dissolved solids (TDS) were calculated by evaporating water samples and measuring the residue. Dissolved oxygen (DO) was quantified using the Winkler's method. Biochemical oxygen demand (BOD) was measured by incubating samples in the dark for 5 days and recording the decrease in DO. Chemical oxygen demand (COD) was determined via the dichromate reflux method, involving digestion with potassium dichromate and titration with ferrous ammonium sulfate. Total hardness was measured using EDTA titration with Eriochrome Black T indicator, while temporary hardness was calculated by boiling the sample to precipitate calcium carbonate and measuring the remaining hardness. Permanent hardness was derived by subtracting temporary hardness from total hardness. Turbidity was assessed using a turbidity meter, with all methods performed in triplicate for accuracy.

### 2.3 Statistical analysis

Descriptive statistics was applied to calculate the average value of recorded all parameter [such as pH, alkalinity, electrical conductivity (EC), total dissolved solids (TDS), dissolved oxygen (DO), biochemical oxygen demand (BOD), chemical oxygen demand (COD), total hardness, temporary hardness, permanent hardness, and turbidity] of studied water sample. SPSS (version 20)was used for correlation analysis.

**3. Result and Discussion**

Water pollutants are diverse and have varying impacts on aquatic ecosystems, human health, and the environment. Addressing water pollution requires understanding the different types of pollutants and their sources, as well as implementing effective management and remediation strategies to protect water quality.

*3.1 pH*

The pH of water is a crucial parameter indicating its acidity or alkalinity, which directly affects the aquatic life and chemical reactions in the water body. The pH values ranged from 6.2 to 7.9 across the samples, with an average of 7.06. This average pH suggests that the water in the Ahiwara district is slightly neutral to mildly acidic. Sample 1 showed the lowest pH of 6.2, indicating slightly acidic conditions, potentially due to the influence of industrial effluents or agricultural runoff, which often contain acidic substances. Sample 3 had the highest pH of 7.9, nearing alkalinity, possibly due to the presence of alkaline materials from agricultural activities like the use of lime or other soil amendments.

*3.2. Alkalinity*

Alkalinity measures the water's ability to neutralize acids, mainly due to bicarbonates, carbonates, and hydroxides. The alkalinity values varied from 104 mg/l in Sample 1 to 164 mg/l in Sample 3, with an average value of 119.6 mg/l. higher alkalinity in Sample 3 suggests greater buffering capacity, which might be due to the dissolution of minerals from agricultural soil or industrial processes. The lower value in Sample 1 could indicate limited buffering capacity, making the water more susceptible to pH changes due to acidic inputs from industrial discharge.

*3.3. Electrical Conductivity (EC)*

EC is a measure of water's ability to conduct electrical current, which is directly related to the concentration of dissolved salts. The EC values ranged from 198 mg/l (Sample 4) to 252 mg/l (Sample 3), with an average of 215.8 mg/l. The higher EC in Sample 3 indicates a greater concentration of dissolved ions, which could be attributed to the leaching of fertilizers or industrial salts into the water body. The relatively lower EC in Sample 4 suggests less contamination from these sources.

*3.4. Total Dissolved Solids (TDS)*

TDS represents the total concentration of dissolved substances in water, which includes both organic and inorganic materials. The TDS values varied between 158 mg/l in Sample 1 to 217 mg/l in Sample 3, with an average of 187.6 mg/l. Similar to EC, the high TDS in Sample 3 is indicative of significant pollution, potentially from agricultural runoff containing fertilizers and pesticides or from industrial wastewater. The lower TDS in Sample 1 suggests less pollution from such sources.

*3.5 Dissolved Oxygen (DO)*

DO is essential for the survival of aquatic organisms. The DO levels in the samples ranged from 5.68 mg/l (Sample 1) to 6.11 mg/l (Sample 3), with an average of 5.816 mg/l. The relatively low DO in Sample 1 could be a result of high organic pollution, which increases the biochemical oxygen demand (BOD) and reduces oxygen availability. The higher DO in Sample 3 suggests better water quality, possibly due to lower organic pollution.

*3.6 Biochemical Oxygen Demand (BOD)*

BOD measures the amount of oxygen required by aerobic microorganisms to decompose organic matter in water. The BOD values ranged from 3.89 mg/l (Sample 5) to 4.24 mg/l (Sample 3), with an average of 4.018 mg/l. Higher BOD in Sample 3 indicates a greater load of organic pollutants, likely from agricultural runoff or industrial effluents, which consume more oxygen during decomposition. The lower BOD in Sample 5 suggests less organic pollution.

*3.7 Chemical Oxygen Demand (COD)*

COD is an indicator of the total amount of oxygen required to oxidize both organic and inorganic substances in water. The COD values varied from 7.2 mg/l (Sample 1) to 8.6 mg/l (Sample 3), with an average of 7.8 mg/l. The higher COD in Sample 3 indicates significant contamination, possibly from industrial discharges that contain oxidizable chemicals. The lower COD in Sample 1 suggests less contamination.

*3.8 Total Hardness*

Total hardness is caused by the presence of calcium and magnesium salts in water. The values ranged from 208.1 mg/l in Sample 1 to 268.4 mg/l in Sample 3, with an average of 234.88 mg/l. The higher hardness in Sample 3 suggests significant leaching of calcium and magnesium from agricultural soils or industrial processes. The lower hardness in Sample 1 indicates less mineral content.

3.9 Temporary Hardness

Temporary hardness is mainly due to the presence of bicarbonate minerals that can be removed by boiling. The temporary hardness values ranged from 134 mg/l (Sample 1) to 182 mg/l (Sample 3), with an average of 154.6 mg/l. The higher values in Sample 3 indicate greater bicarbonate content, possibly from soil erosion or industrial discharges. The lower value in Sample 1 suggests less temporary hardness.

*3.10 Permanent Hardness*

Permanent hardness, which cannot be removed by boiling, is caused by sulfates and chlorides of calcium and magnesium. The values ranged from 74.1 mg/l (Sample 1) to 86.4 mg/l (Sample 3), with an average of 80.28 mg/l. The higher permanent hardness in Sample 3 suggests a significant presence of these minerals, possibly due to industrial waste or natural mineral dissolution. The lower hardness in Sample 1 indicates a lesser extent of such minerals.

*3.11 Turbidity*

Turbidity is a measure of water clarity, which can be affected by suspended solids and colloidal matter. The turbidity values ranged from 2.24 NTU (Sample 1) to 2.87 NTU (Sample 3), with an average of 2.48 NTU. Higher turbidity in Sample 3 indicates more suspended particles, likely from agricultural runoff or industrial discharge, which can reduce light penetration and affect aquatic life. The lower turbidity in Sample 1 suggests clearer water.

Result of correlation analysis showed positive correlation among all the studied parameters of water samples (Table 2).

**Table 1: Concentrations of water quality parameters of Ahiwara Pond**

| S.No. | Parameters | Sample-1 | Sample-2 | Sample-3 | Sample-4 | Sample-5 | Average value |
|---|---|---|---|---|---|---|---|
| 1 | pH | 6.2 | 7.1 | 7.9 | 7.2 | 6.9 | 7.06 |
| 2 | Alkalinity (mg/l) | 104 | 110 | 164 | 114 | 106 | 119.6 |
| 3 | EC (mg/l) | 203 | 217 | 252 | 198 | 209 | 215.8 |
| 4 | TDS (mg/l) | 158 | 188 | 217 | 198 | 177 | 187.6 |
| 5 | DO (mg/l) | 5.68 | 5.77 | 6.11 | 5.81 | 5.71 | 5.816 |
| 6 | BOD (mg/l) | 3.96 | 3.99 | 4.24 | 4.01 | 3.89 | 4.018 |
| 7 | COD (mg/l) | 7.2 | 7.8 | 8.6 | 8.1 | 7.3 | 7.8 |
| 8 | Total Hardness | 208.1 | 248.2 | 268.4 | 224.2 | 225.5 | 234.88 |
| 9 | Temporary Hardness | 134 | 168 | 182 | 143 | 146 | 154.6 |
| 10 | Permanent Hardness | 74.1 | 80.2 | 86.4 | 81.2 | 79.5 | 80.28 |
| 11 | Turbidity (NTU) | 2.24 | 2.54 | 2.87 | 2.36 | 2.39 | 2.48 |

**Table 2: Correlation among all the studied parameters of Ahiwara Pond**

| | *pH* | *Alkalinity* | *EC* | *TDS* | *DO* | *BOD* | *COD* | *Total Hardness* | *Temporary Hardness* | *Permanent Hardness* | *Turbidity* |
|---|---|---|---|---|---|---|---|---|---|---|---|
| pH | 1 | | | | | | | | | | |
| Alkalinity | 0.84 | 1 | | | | | | | | | |
| EC | 0.76 | 0.92 | 1 | | | | | | | | |
| TDS | 0.99 | 0.83 | 0.70 | 1 | | | | | | | |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| DO | 0.90 | 0.99 | 0.89 | 0.90 | 1 | | | | | | |
| BOD | 0.79 | 0.97 | 0.86 | 0.81 | 0.97 | 1 | | | | | |
| COD | 0.93 | 0.86 | 0.70 | 0.97 | 0.92 | 0.90 | 1 | | | | |
| Total Hardness | 0.90 | 0.83 | 0.90 | 0.85 | 0.86 | 0.80 | 0.81 | 1 | | | |
| Temporary Hardness | 0.85 | 0.80 | 0.91 | 0.79 | 0.83 | 0.77 | 0.77 | 0.99 | 1 | | |
| Permanent Hardness | 1.00 | 0.85 | 0.77 | 0.98 | 0.90 | 0.78 | 0.91 | 0.89 | 0.84 | 1 | |
| Turbidity | 0.90 | 0.92 | 0.96 | 0.85 | 0.93 | 0.87 | 0.83 | 0.98 | 0.97 | 0.90 | 1 |

**Conclusion**

The data indicates that Sample 3 consistently shows higher levels of contaminants across various parameters, suggesting significant pollution from industrial and agricultural activities in that area. In contrast, Sample 1 generally exhibits lower contamination, indicating lesser impact from these activities. The findings highlight the need for stringent monitoring and management of industrial and agricultural practices in the Ahiwara district to protect water quality.

The data shows some variability in chemical and physical parameters across the samples.pH and DO are relatively stable, suggesting consistent water quality in terms of acidity and oxygenation.Alkalinity, EC, TDS, and Hardness show more variation, indicating differences in mineral content and dissolved substances.BOD and COD suggest low to moderate levels of organic and chemical pollutants. Turbidity is low, indicating clear water.These variations could be attributed to differences in the water source, treatment processes, or environmental factors affecting each sample.

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