Water Pollution In Three Barrages Across The Ajay River Due To Coal Mining Activities: A Seasonal Study

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Abstract
The impact of coal mining on water quality in the Ajay River is a growing concern, particularly in barrages located downstream of mining areas. This study investigates water pollution in three different barrages across the Ajay River by analyzing water samples collected during the rainy, winter, and summer seasons. The study focuses on evaluating the physicochemical characteristics of water and the concentration of heavy metals, including arsenic, iron, zinc, chromium, and others. The seasonal variations in parameters such as pH, turbidity, conductivity, hardness, and Biological Oxygen Demand (BOD) indicate that water quality deteriorates, particularly during the rainy and summer seasons, due to coal mining activities. This research highlights the urgent need for monitoring and management strategies to mitigate the impact of coal mining on water quality in the Ajay River.

Keywords: Water pollution, Coal mining, Ajay River, Seasonal variation, Water quality, Heavy metals

1. Introduction

Water pollution caused by industrial activities, particularly coal mining, has become a significant environmental challenge, especially in riverine ecosystems. Coal mining leads to the release of various pollutants, including heavy metals and suspended solids, which can severely impact aquatic ecosystems and pose risks to human health (Choudhary et al., 2020). Rivers located near coal mining regions, such as the Ajay River in West Bengal and Jharkhand, India, are highly susceptible to contamination from mining runoff and waste discharge (Singh et al., 2019).
The Ajay River serves as a vital water source for domestic, agricultural, and industrial uses. Three major barrages constructed along the river are crucial for regulating water flow and providing irrigation, but they are also prone to contamination from mining activities. This study aims to assess the seasonal variation in water quality across three barrages during the rainy, winter, and summer seasons, with a focus on key physicochemical parameters and heavy metal concentrations.

2. Materials and Methods

Water samples were collected from three barrages along the Ajay River during the rainy, winter, and summer seasons. The samples were analyzed for various physicochemical parameters, including pH, temperature, turbidity, electrical conductance, hardness, alkalinity, total solids, and concentrations of heavy metals such as arsenic, iron, fluoride, zinc, chromium, lead, cadmium, copper, and mercury (Das & Ghosh, 2021). Biological parameters such as Chemical Oxygen Demand (COD), Biological Oxygen Demand (BOD), Dissolved Oxygen (DO), and total coliform counts were also measured to assess microbial contamination.

3. Results and Discussion

3.1. Rainy Season

During the rainy season, the water quality parameters showed significant variability due to surface runoff and increased mining effluent discharge. The pH values ranged from 7.08 to 7.35, indicating a slightly neutral to basic environment. Water temperatures remained consistent, between 32.2°C and 32.5°C. Turbidity values were higher during this period (17.0–20.0 NTU), reflecting the influx of suspended particles due to heavy rainfall. Electrical conductance ranged from 158 to 165 µS/cm, while hardness values varied between 42.9 and 48.6 mg/L, which could be attributed to the increased presence of dissolved solids from mining runoff (Choudhary et al., 2020).

Alkalinity ranged from 72.5 to 85.7 mg/L, and total solids were between 94.9 and 98.5 mg/L. Heavy metals such as arsenic (<0.01 mg/L), iron (0.01–0.06 mg/L), and fluoride (<0.1 mg/L) remained within permissible limits, although fluctuations were noted for iron due to mining activities. The COD values (6.0–8.0 mg/L) and BOD (2 mg/L) indicated moderate organic pollution. Dissolved oxygen (DO) levels ranged from 5.7 to 5.9 mg/L, and total coliform counts were relatively high, ranging from 2.0×10^2 to 2.1×10^2 CFU/100 mL,

3.2. Winter Season

The winter season showed improved water quality compared to the rainy season, as reduced rainfall minimized surface runoff. pH values were higher, ranging from 8.02 to 8.14, indicating a more basic environment. Water temperatures dropped to between 26.6°C and 27.3°C. Turbidity values were negligible (0 NTU) during this season, reflecting clearer water conditions. Conductance values ranged from 181 to 219 µS/cm, while hardness increased to 42.7–52.1 mg/L, possibly due to the concentration of dissolved solids as water levels decreased (Singh et al., 2019).

Alkalinity values (58.9–64.3 mg/L) and total solids (115.2–122.9 mg/L) were higher in winter compared to the rainy season. Heavy metal concentrations, including arsenic, iron, fluoride, and zinc, remained within permissible limits. COD (7.0–8.0 mg/L) and BOD (2–3 mg/L) values indicated moderate pollution levels, while DO levels ranged from 5.5 to 5.7 mg/L. Coliform counts were slightly lower compared to the rainy season, ranging from 1.8×10^2 to 2.1×10^2 CFU/100 mL (Das & Ghosh, 2021).

3.3. Summer Season

During the summer season, water quality parameters showed distinct changes due to increased evaporation and lower water levels. The pH ranged from 7.11 to 7.68, remaining neutral to slightly basic. Water temperatures were higher, ranging from 29.6°C to 33.5°C. Turbidity values peaked during this season (22.0–35.0 NTU), likely due to lower water levels and increased sediment disturbance. Conductance values ranged from 154 to 183 µS/cm, while hardness increased further (48.2–56.5 mg/L), reflecting the concentration of dissolved minerals in the water (Choudhary et al., 2020).

Alkalinity ranged from 92.9 to 112.7 mg/L, and total solids were between 109.2 and 113.4 mg/L. Arsenic, fluoride, and zinc levels remained below detection limits, while iron concentrations (0.01–0.06 mg/L) fluctuated. COD values were highest in the summer (8.0–13.0 mg/L), indicating increased organic pollution, while BOD ranged from 3 to 4 mg/L. DO levels remained stable at 5.4–5.6 mg/L, and total coliform counts were highest during this season, ranging from 2.3×10^2 to 2.7×10^2 CFU/100 mL, reflecting elevated microbial contamination during warmer conditions (Singh et al., 2019).

4. Conclusion

This study demonstrates that water quality in the Ajay River varies significantly with the seasons, particularly in response to coal mining activities and associated runoff. The rainy season exhibited the highest levels of turbidity and microbial contamination, while the summer season showed increased concentrations of dissolved solids and higher COD and BOD values. Although heavy metal concentrations remained within permissible limits, the seasonal fluctuations in iron levels suggest the potential for long-term accumulation in the river system. These findings underscore the need for continuous monitoring of water quality in the Ajay River, particularly near mining sites, to safeguard both aquatic ecosystems and public health.

References

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