

Assessment of Water Quality and Ecological Risk in the Phalgu River, Gaya (Bihar, India)

Gaurav Kumar

B.I.T. Mesra, Ranchi, Jharkhand-835215

doi.org/10.64643/JATIRV2I3-140163-001

Abstract- The Phalgu River in Gaya, Bihar is an important seasonal river system that supports domestic, cultural, and agricultural activities. In recent years, anthropogenic pressures such as sand mining, urban discharge, and agricultural runoff have significantly influenced river water quality. This study evaluates the physicochemical characteristics of the Phalgu River and assesses ecological risk using indices such as Water Quality Index (WQI), Heavy Metal Pollution Index (HPI), and Ecological Risk Index (ERI). Water samples were collected from multiple sampling stations during pre-monsoon and post-monsoon seasons. Parameters including pH, dissolved oxygen, turbidity, total dissolved solids, electrical conductivity, and selected heavy metals were analyzed using standard laboratory procedures. Results indicate noticeable spatial and seasonal variations in water quality. Mining-affected zones exhibited higher turbidity, conductivity, and metal concentration compared with relatively undisturbed sites. The findings highlight the growing influence of anthropogenic activities on river health and emphasize the need for sustainable river management strategies.

Index-Terms- Phalgu River; Water Quality Index; Heavy Metals; Ecological Risk Index; Sand Mining; Bihar

1. INTRODUCTION

River ecosystems play a crucial role in maintaining environmental balance and supporting human livelihoods. However, increasing population pressure and uncontrolled exploitation of natural resources have led to a gradual deterioration of river water quality in many parts of the world. Activities such as sand mining, urban wastewater discharge, and agricultural runoff introduce pollutants that alter the natural physicochemical characteristics of river systems.

In India, several rivers flowing through urban and semi-urban areas experience significant environmental stress due to unregulated resource extraction and waste disposal. The Phalgu River

in Gaya district of Bihar represents one such system where seasonal flow and intense human activity contribute to fluctuating water quality conditions.

Assessment of river water quality often involves the analysis of physicochemical parameters combined with environmental indices such as the Water Quality Index (WQI), Heavy Metal Pollution Index (HPI), and Ecological Risk Index (ERI). These indices provide a simplified yet comprehensive understanding of environmental conditions by integrating multiple parameters into a single value.

The present study aims to evaluate the water quality status of the Phalgu River and to identify the potential ecological risks associated with anthropogenic disturbances, particularly sand mining and urban influences.

II. STUDY AREA

The Phalgu River flows through the Gaya district of Bihar and holds both hydrological and cultural importance. The river originates from the confluence of the Lilajan and Mohana rivers near Bodh Gaya and flows northward through the plains before joining the Punpun River.

The basin experiences a subtropical monsoon climate characterized by hot summers, moderate winters, and a concentrated rainfall period during the southwest monsoon. Seasonal variability strongly influences river discharge and sediment transport.

Several stretches of the river are subjected to intensive sand extraction to meet construction demands. In addition, domestic wastewater discharge and agricultural activities along the riverbanks contribute to changes in water quality. These factors make the Phalgu River an important site for evaluating the environmental impact of human activities on river ecosystems.

III. MATERIALS AND METHODS

Water samples were collected from selected sampling stations along the upstream, middle, and downstream reaches of the Phalgu River. Sampling was conducted during both pre-monsoon and post-monsoon seasons to capture seasonal variability.

Clean polyethylene bottles were used for sample collection following standard procedures. Prior to sampling, bottles were washed thoroughly with distilled water and rinsed with dilute nitric acid. Samples were preserved at low temperature and transported to the laboratory for analysis.

Physicochemical parameters including pH, turbidity, dissolved oxygen (DO), total dissolved solids (TDS), electrical conductivity (EC), and biological oxygen demand (BOD) were measured using standard analytical techniques. Heavy metal concentrations were determined using atomic absorption spectrophotometry.

Water Quality Index (WQI) was calculated to evaluate overall water quality. The Heavy Metal Pollution Index (HPI) was used to assess the impact of metal contamination, while the Ecological Risk Index (ERI) helped estimate the ecological threat posed by these pollutants.

IV. RESULTS AND DISCUSSION

The analysis of physicochemical parameters revealed significant spatial variations in water quality across the sampling locations. Upstream sites generally exhibited relatively better water quality compared with middle and downstream locations where human activities are more intense.

Elevated turbidity and total dissolved solids were observed near sand mining zones, indicating increased sediment disturbance and suspended particles. Electrical conductivity also showed higher values in areas receiving urban runoff and domestic wastewater.

Seasonal comparison showed that post-monsoon samples typically had slightly improved dissolved oxygen levels due to increased water flow and dilution effects. However, certain heavy metals exhibited higher concentrations in some sites, suggesting localized contamination sources. The Water Quality Index values indicated that several stretches of the river fall within the moderate to poor water quality category. Similarly, the Heavy Metal Pollution Index suggested moderate pollution levels in mining-affected regions. Ecological Risk Index results pointed to potential ecological stress in areas where metal accumulation and sediment disturbance were high.

These findings demonstrate that anthropogenic activities, particularly sand extraction and urban discharge, are influencing the ecological condition of the Phalgu River. Effective management practices are therefore essential to prevent further degradation.

V. CONCLUSION

The present study highlights the influence of human activities on the water quality and ecological condition of the Phalgu River in Gaya, Bihar. Physicochemical analysis combined with environmental indices revealed moderate levels of water quality deterioration in several sections of the river.

Sand mining, domestic waste discharge, and agricultural runoff were identified as key factors contributing to water quality variation. Seasonal differences also play a role in determining the distribution and concentration of pollutants.

Continuous monitoring and implementation of sustainable river management policies are necessary to maintain ecological balance and ensure safe water resources for local communities. Strengthening environmental regulations related to sand mining and waste disposal could significantly improve the health of the river ecosystem.