

ORIGINAL RESEARCH ARTICLE

Assessment of groundwater quality in Patna district, Bihar, India, using the Water Quality Index method (Canadian Council of Ministers of the Environment method)

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Abstract: In this study, we assessed the groundwater quality in Patna district, Bihar, India, using the Water Quality Index (WQI) method, specifically the Canadian Council of Ministers of the Environment approach. Secondary data from various agencies (2004 – 2020) were analyzed to evaluate physicochemical parameters and spatial-temporal trends. Results indicated that while most samples fell within the permissible limits, samples from some locations showed elevated pH, electrical conductivity, hardness, alkalinity, chloride, and nitrate, suggesting localized contamination from natural and anthropogenic sources. Piper diagram analysis reveals $\text{Ca}^{2+}\text{-Mg}^{2+}\text{-HCO}_3^-$ dominance, pointing to carbonate rock dissolution, with some influence from agricultural and industrial activities. WQI classification categorized 76% of samples as fair to excellent, whereas 24% were marginal to poor. A heatmap analysis highlighted an improvement in water quality after 2012, though water from some stations remained persistently poor. Quantum geographic information system-based spatial mapping using the inverse distance weighting technique effectively visualized pollution hotspots and safe water zones. In conclusion, findings from the study underscore the need for regular monitoring, pollution control, advanced treatment methods, and sustainable groundwater management to ensure safe drinking water.

Keywords: Groundwater; Contamination; Water quality index; Quantum geographic information system; Spatial mapping

1. Introduction

Groundwater is one of the most widely distributed resources on Earth, accounting for approximately 0.6% of the world's total water resources.¹ It is also the largest source of freshwater, making up around 30.1%.² As a valuable economic resource, groundwater provides over 85% of public water supplies, primarily sourced from

wells.¹ Groundwater is a primary source of drinking water for billions of people worldwide.³⁻⁵ Ecologically, groundwater supports aquatic habitats, maintains river flows, and aids vegetation growth, especially in arid regions.^{1,6} Groundwater also regulates soil moisture, preventing desertification.^{1,2} In addition, groundwater serves as a buffer against droughts and climate change, ensuring water availability in times of crisis.^{1,2}



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A Spatial trend analysis of groundwater quality of Patna district, Bihar, India

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Abstract

There is a growing concern regarding groundwater quality as well as quantity status in Patna District. The present study is aimed to assess the groundwater status of Patna District using groundwater quality data collected from state and central agencies (from year 2000 to year 2016). The spatial trend analysis using GIS helped to understand the type of contamination and the affected zones. It is found that the quantity is not a critical issue but some of the parameters such as TA, TH, and Arsenic are identified as critical parameters. The western region of Patna district is affected by various water quality parameters such as TH, TA, EC, sulphate, fluoride, etc. due to high population density as compared to other regions of Patna district indicating the direct relationship between water quality and population density. Small and scattered pockets of arsenic contamination are observed along the eastern periphery of Patna District, extending longitudinally from west to east.

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