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Groundwater Quality and Management: Saran (Bihar)

Ankit **Kumar**

Former Student, Dr. B.R. Ambedkar University Delhi, Karampura campus, Shivaji Marg, New Delhi, 110015

ankitdgacpr@gmail.com

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Abstract

Groundwater is a vital resource for agricultural, industrial, and domestic use, especially in regions like Saran district in Bihar, where surface water availability is often limited. This case study investigates the status of groundwater quality and the effectiveness of management practices in Saran district. Through systematic survey and analysis and use of secondary data, these findings indicate that groundwater in Saran district is affected by various factors such as over-extraction, agricultural runoff, and inadequate waste disposal practices. We found that while there are efforts to promote sustainable groundwater use, challenges such as lack of awareness, insufficient infrastructure, and regulatory enforcement hinder effective management. The case study underscores the need for comprehensive water management policies, community engagement, and the adoption of advanced monitoring and remediation technologies to ensure the long-term sustainability and safety of groundwater resources in Saran district.

Keywords: Groundwater, Surface water, sustainability, awareness, groundwater management

Introduction

Groundwater is a basis of water supply, essential for agricultural, industrial, and domestic needs, especially in areas where surface water resources are limited. In India, groundwater is a lifeline for millions, providing critical support to both urban and rural communities. The Saran district of Bihar, primarily an agrarian region, is heavily dependent on groundwater for irrigation, drinking water, and other essential uses. However, this reliance comes with significant challenges related to groundwater quality and management.

The district is grappling with the consequences of rapid population growth, intensified agricultural practices, mining, and industrial activities. These factors have led to excessive groundwater extraction, resulting in the depletion of aquifers. Furthermore, the prevalent use of fertilizers and pesticides, along with poor waste management practices, has led to the contamination of groundwater. Elevated levels of nitrates, arsenic, heavy metals, and microbial pathogens have been detected, posing serious health risks to the local population and threatening the sustainability of this vital resource. This case study aims to provide a thorough assessment of groundwater quality in the Saran district, focusing on key water quality parameters such as pH, electrical conductivity, total dissolved solids, and concentrations of major ions and contaminants. Additionally, identifying the primary sources of contamination and examining the current management framework, this study seeks to offer actionable recommendations to improve groundwater quality and ensure sustainable management. Addressing these challenges is imperative to secure the long-term availability of safe and clean groundwater, which is vital for the socio-economic development of Saran district and the health and well-being of its residents. “We never know the worth of water till the well is dry” is attributed to Thomas Fuller.

The study of groundwater quality and management has garnered significant attention globally due to its critical role in supporting human life and economic activities. Numerous research efforts have focused on assessing groundwater quality, identifying sources of contamination, and evaluating management practices.

A comprehensive review by Babiker et al. (2007) highlights the importance of understanding the hydrogeochemical processes that affect groundwater quality. Their findings emphasize the role of natural and

anthropogenic factors in altering groundwater chemistry. Similarly, studies by Ahmed et al. (2015) and Kumar et al. (2018) have documented the impacts of agricultural runoff, industrial effluents, and inadequate waste management on groundwater contamination in various regions of India.

Integrated management models combine elements of both social regulation and knowledge-intensive approaches, aiming to balance sustainability with equity. An integrated approach is argued to be more effective in addressing the complex dynamics of groundwater management at the community level (Reddy et al., 2014). However, the development and implementation of such models require significant effort, including policy reforms and institutional support. Despite these extensive studies, there remains a gap in localized research focusing specifically on the Saran district. This case study aims to fill this gap by providing a detailed assessment of groundwater quality and evaluating current management practices in the region The primary objective of this research is to evaluate the groundwater quality and management practices in the Saran district of Bihar through an analysis of existing secondary data. The specific objectives are: To identify the primary sources of groundwater quality in the Saran district based on secondary data sources, To assess the effectiveness of current groundwater management strategies and policies implemented by local authorities and community organizations, utilizing existing literature and data, To raise awareness among local stakeholders and policymakers about the critical issues related to groundwater quality and management in the region through the dissemination of research findings.

Methodology

To achieve the outlined objectives, a comprehensive methodology was designed, primarily relying on the analysis of secondary data. This approach involves a thorough review of existing literature, government reports, academic studies, and other relevant documents. Beginning with research on groundwater quality and management across various blocks in Saran District. To gather data on groundwater quality and management practices in Saran district, a survey was conducted using a Google Form and interviews of people residing across the various blocks in the district. The survey targeted 45 participants, who were selected to provide insights into various aspects of groundwater use and management. The research was conducted from June to July 2022. The questionnaire was designed to capture information like water quality, usage patterns, management practices, and aimed to obtain both quantitative and qualitative data to inform the research.

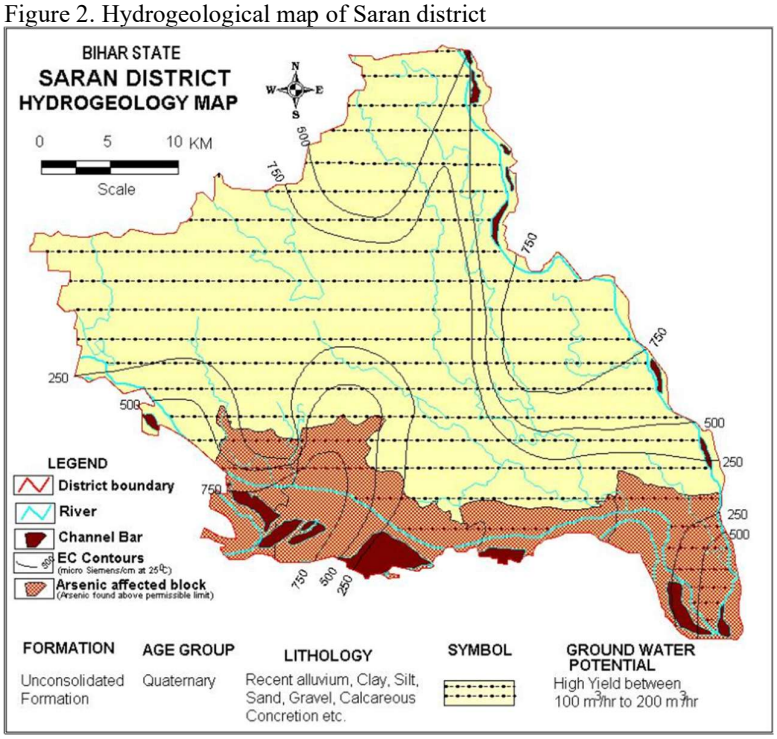
Figure 1. Administrative Map of Saran District

Source: https://www.mapsofindia.com/maps/bihar/tehsil/saran.html.

Groundwater Scenario: A Case Study of Saran District in Bihar

Chemical quality of water is important in deciding its suitability for irrigation, industrial and drinking purposes. Chemical quality of ground water of phreatic aquifer is found suitable for drinking and irrigation purposes. The ground water is mildly alkaline in nature with pH ranging from 7.36 to 8.43. Electrical conductivity (EC) varies from 580 at Sonepur to 960 micro seimens/cm at 25oC at Chapra. All major parameters are within the permissible limit. The ground water is suitable for irrigation and drinking purposes. However, Arsenic has been reported from some villages of the Sonepur, Dighwara, Chapra Sadar and Revelganj blocks. Samplings from handpumps of arsenic risk zone area has been done for arsenic concentration analysis. The arsenic contaminated water above permissible limit of 50 ppb is hazardous for human health (Ground Water Information Booklet Saran District, Bihar State, 2013).

Figure 2. Hydrogeological map of Saran district

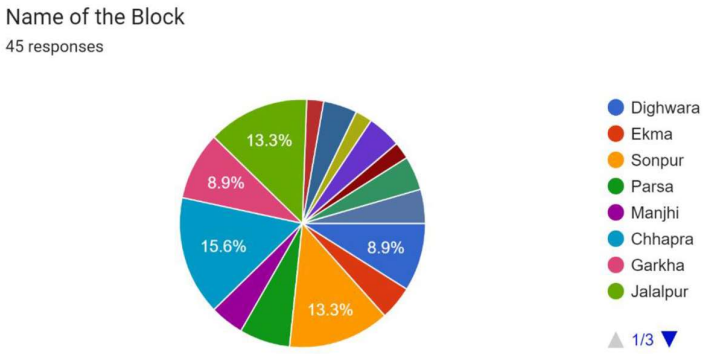


Source: (https://cgwb.gov.in/old_website/District_Profile/Bihar/Saran.pdf)

Results

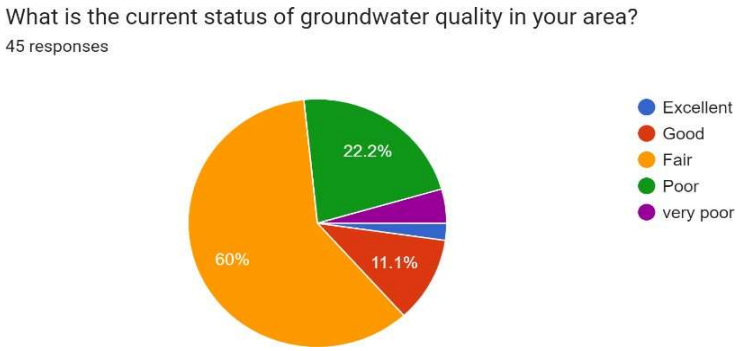
The study involved analysis of various data from different questionnaires, and this primary data collection effort seeks to obtain insights directly from household and agricultural sources. Based on the respondents' feedback, the survey results highlight a strong interest in groundwater quality among younger adults, particularly those aged 21-25, comprising 37.8% of the respondents, among this 77.8% male and 22.2% female respondents was participate in this survey, this implication shows that young adults in this age group might be more aware of or concerned about environmental issues, including groundwater quality and 25-35 years, the second largest group, representing 24.4% of the respondents.

Figure 3. Ground water uses in different blocks



This demographic may include young professionals and young families who are likely to be concerned about the quality of drinking water and its effects on health. The pie chart shows the responses to a survey about the quality of groundwater in a particular area. 60% of respondents said the quality of groundwater was good, 22.2% said it was poor, 11.1% said it was fair, and a small percentage said it was excellent or very poor.

Figure 4. Ground water quality

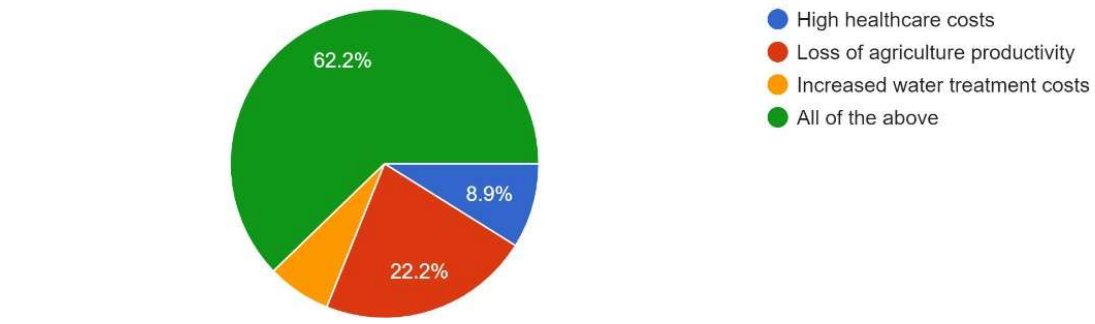


The data suggests that the overall groundwater quality is perceived to be good, though there is a significant percentage of people who believe it is poor whereas Deep Water Tables, many respondents must access groundwater from significant depths (200-300 meters), which could indicate depletion of shallow aquifers, or a general scarcity of water continuously decreased in water table of saran district.

Figure 5. Rainwater Reservoir to Collect and Discharge into Groundwater.

Agricultural runoff (40%) is the most common source of groundwater contamination that people are aware of. This is likely because agricultural runoff is a widespread problem, and people are often more familiar with the sources of pollution in their own communities. The least common response (8.9%) was that they were aware of mining, regarding groundwater contamination, most respondents (42.2%) are concerned about decreased water availability, followed by health risks (28.9%), environmental damage (24.4%), and no concerns (4.5%). Nearly a quarter of the respondents feel that agricultural practices negatively affect groundwater quality. This could be due to the use of harmful chemicals, over-irrigation, or poor waste management practices that lead to contamination. Regular Water Quality Testing (46.7%) this is the most common measure.

Figure 6. Economic impacts of poor groundwater quality



The overwhelming majority of respondents (62.2%) identified high healthcare costs as the most pressing economic impact. This suggests a widespread recognition of the direct link between contaminated groundwater and increased incidence of waterborne diseases, such as cholera, and other gastrointestinal issues, The financial strain on households and public health systems is considerable. Nearly a quarter of respondents (22.2%) pointed to the negative effects on agriculture. Contaminated groundwater can lead to soil degradation, affecting crop yields and, consequently, farmers' livelihoods and this leads to Reduced agricultural productivity has a cascading effect on the local economy. Farmers may face lower incomes, and there may be a reduction in food supply, leading to increased prices and potential food insecurity. A smaller but significant percentage (8.9%) highlighted the increased costs associated with treating contaminated groundwater. This reflects the economic burden on both public utilities and private households that must invest in filtration systems or purchase bottled water to ensure safe drinking water. Most respondents (68.9%) report that chemical analysis is the primary method used to assess groundwater quality. This type of testing is crucial as it detects harmful contaminants such as heavy metals, nitrates, and other chemicals that can pose serious health risks if present in drinking water. A smaller percentage (13.3%) of respondents conduct physical tests. Physical analysis focuses on attributes like turbidity (clarity), colour, and temperature. A significant portion of the population either does not test their groundwater or lacks awareness about the types of tests available. This emphasizes the need for greater education and broader implementation of groundwater quality assessments to safeguard public health. The fact that most respondents (82.2%) are aware of the Bihar government's '***Nal Jal Yojana'*** (a scheme for urban slum-dwellers) scheme demonstrates that the outreach and communication strategies employed have been largely effective. This high level of awareness suggests that the government's efforts to inform the public about the scheme have reached a significant portion of the population. The data clearly suggests a strong preference for a multi-faceted approach to managing groundwater resources. Respondents recognize that leveraging various modern technologies together—rather than relying on any single method is key to effective groundwater management. This comprehensive strategy is crucial in addressing the diverse challenges associated with groundwater resources.

The survey results underscore the economic implications of poor groundwater quality, with high healthcare costs emerging as the most significant concern among respondents. This highlights the need for urgent interventions to improve groundwater quality, not only to safeguard public health but also to protect agricultural productivity and manage water treatment costs effectively. Addressing these issues holistically is crucial for sustainable economic development, particularly in areas heavily reliant on groundwater resources. It is important to note that this chart only shows the results of a single survey and may not be representative of the overall population. Further research is needed to determine the true extent of groundwater quality, the sources of pollution and management.

Discussion

From my research on the drinking water quality in five blocks of Saran district, the findings indicate that the water from tube wells, hand pumps, shallow wells, and low-depth sources is of very poor physicochemical quality. The study clearly demonstrates that water from hand pumps (***chapakal***), shallow wells, running water, and low-depth sources, without filtration, is unfit for human consumption. The location and construction of these water sources significantly impact contamination levels. The government has made efforts to mitigate this issue by digging ponds and raising awareness about rainwater collection. Over the past years, the government of Bihar has constructed wells and hand pumps and introduced schemes like ***HAR GHAR NAL JAL YOJANA***. My survey reveals that most people utilize these schemes for their water needs. I recommend that the administration of Saran district urgently develop local treatment plants to purify all shallow water sources for the residents, particularly in municipalities and similar areas across all blocks. It is essential to regularly test drinking water in laboratories to ensure it is safe for consumption. If not addressed, the gradual contamination of groundwater will have a significant impact on the lives of the district's residents. According to WHO, a minimum of 15 Liters per person per day is required, but in these blocks, excessive groundwater wastage has led to a yearly decline in water levels.

I agree with this observation, as most people are aware of the scheme and are making efforts to reduce water contamination and store water for daily use.

Conclusion

Groundwater in Saran district, Bihar, is a crucial resource for agricultural, industrial, and domestic use, but it faces significant challenges from over-extraction, agricultural runoff, and inadequate waste disposal practices. Despite efforts to promote sustainable groundwater use through schemes like ***NAL JAL YOJANA***. Our findings highlight the urgent need for comprehensive water management policies, robust data collection and sharing systems, and best practices in agriculture and waste management to protect and enhance groundwater quality. Implementing Integrated Water Resource Management approaches and developing local treatment plants to purify shallow water sources, particularly in urban areas, are key recommendations. Encouraging greater community participation in water management practices and regularly testing drinking water in laboratories will ensure its safety for consumption. Addressing these issues will make groundwater in Saran district a reliable and safe resource for residents, significantly improving their quality of life and health. This research underscores that with proper testing and management, the groundwater in Saran district can be suitable for drinking and other uses, ensuring the long-term sustainability and safety of this essential resource.

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References

- Ballabh, Vishwa et al. (2003): "Groundwater and Agriculture Production: A Comparative Study of Eastern UP, Bihar and West Bengal", IWMITATA Water Policy Programme, Anand.
- CGWB (2006), "Dynamic Groundwater Resources of India" (as of March 2004), Central Groundwater Board, New Delhi.
- Drinking water standards of BIS 10500: 2012.
- Ghosh A. K., Singh S. K., Nupur Bose, Chaudhary S., Arsenic contaminated aquifers: a study of the Ganga levee zones in Bihar, India., Annual Conference, Royal Geographical Society, London (2007)
- GoI (2007), Report of the Steering Committee on Water Resources for Eleventh Five Year Plan (2007-2012), Planning Commission, May.
- Moench, Marcus (2000), "India's Groundwater Challenge", downloaded from http://www.india-seminar.com/2000/486/486%/20moench.htm on 16th June 2006.
- Narasimhan (2008), "Groundwater Management and Ownership", Economic and Political Weekly, February 16, pp. 21-27.

- Reddy V Ratna (2012): Hydrological Externalities and Livelihoods Impacts: Informed Communities for Better Resource Management. *Journal of Hydrology*, (412-413): 279-290.
- Reddy V Ratna (2005): Costs of Resource Depletion Externalities: A Study of Groundwater Overexploitation in Andhra Pradesh, India. *Environment and Development Economics*, 10(4): 533-556.
- Reddy M.S., Reddy V.R. and Rout S.K. (2016): *Groundwater Governance: Development, Degradation and Management (A Study of Andhra Pradesh)*. Jaipur: Rawat Publications.
- Reddy, M. S., & Reddy, V. R. (2010). Groundwater: Development, Degradation, and Management emphasizes the urgent need for bridging the gap between scientific hydrological knowledge and community practices.
- Thakur B. K. and Gupta V., Arsenic concentration in drinking water of Bihar: health issues and socio-economic problems, *Journal of Water, Sanitation and Hygiene for Development*, 6 (2), 331-341 (2016).
- The United Nations World Water Development Report 2015.
- Sarthi PP and Singh AK (2013): A Simple approach about the Characteristics of Available Surface Water in the Bihar State of India, Geosciences, 3(2): 68-76.
- WHO, 2021, Guidelines for Drinking-water Quality, 4th Edition, IWA Publishing, London 564
- https:// www.who.int/water_sanitation_health/2021/dwq guidelines/