Brief Report
Volume 16:02, 2025

Hydrology: Current Research

ISSN: 2157-7587

Open Access

Arsenic Contamination in Groundwater of Bangladesh: Geochemical, Microbial and Human Impact

Rosef Asish*

Department of Water and Spatial Science, University of Western Australia, Crawley, Australia

Introduction

Arsenic contamination in groundwater is a major environmental and public health issue in Bangladesh. The country has long relied on groundwater for drinking, but over the past few decades, high levels of arsenic have been detected in millions of tube wells. Arsenic, a naturally occurring toxic element, can contaminate groundwater through geochemical processes. This contamination is not only a consequence of the natural geological environment but also exacerbated by human activities such as improper water management and the widespread use of groundwater for irrigation and other needs. The contamination of drinking water with arsenic poses serious risks to health, leading to skin lesions, internal cancers, and other health issues over long-term exposure. Addressing this issue requires an understanding of the geochemical, microbial, and anthropogenic factors contributing to arsenic contamination [1].

Description

The source of arsenic contamination in Bangladesh's groundwater is linked to the natural occurrence of arsenic in certain geological formations, particularly in the deltaic plains of the Ganges-Brahmaputra River system. Geochemical processes, such as the reduction of iron oxides, release arsenic into groundwater when there is a change in the redox conditions of the aquifers. These conditions are often influenced by the over-extraction of groundwater and the heavy pumping of tube wells, which disrupt the natural balance of the aquifers. Microbial activity in these aquifers can also affect the solubility and mobility of arsenic. Certain bacteria reduce arsenic compounds, making them more soluble and increasing their availability in the water. On top of these natural and microbial factors, anthropogenic activities such as agricultural irrigation using contaminated groundwater, poor sanitation, and urban wastewater discharge have worsened the spread of arsenic contamination in water sources. These combined factors have led to high levels of arsenic in drinking water, affecting millions of people. While arsenic contamination is widespread, not all areas are equally affected, and the concentration of arsenic in groundwater varies based on the region, depth of wells, and seasonal changes in water table levels [2].

In response to this issue, various water treatment techniques and public health programs have been implemented, but the widespread nature of the contamination makes it difficult to completely eradicate the problem. The socio-economic impact is also significant, with rural communities, in particular, bearing the brunt of this public health crisis. Solutions such as deep tubewells, arsenic filtration systems, and alternative water sources like rainwater harvesting have been proposed, but challenges remain in ensuring their sustainability and accessibility for all affected populations. Arsenic contamination in groundwater in Bangladesh has emerged as one of the most critical environmental challenges in recent decades. The presence of arsenic in the water is primarily due to natural geochemical processes, but human activities have significantly exacerbated the problem. The geochemical aspect involves the geological formations that naturally contain arsenic, particularly in the deltaic regions of the Ganges-Brahmaputra River system. The Bengal Basin, where much of Bangladesh lies, has extensive aquifers with high concentrations of arsenic due to the region's sedimentary deposits that have been enriched with arsenic over millenniapolicy strategies, nations can prevent resource-driven conflicts and create stable environments for growth and development [3].

Arsenic is often found in the form of arsenic (III) or arsenic(V) and is typically associated with iron oxides in the sediments. Under anaerobic conditions, which prevail in deep groundwater, arsenic is released into the water, becoming soluble and thus contaminating the water supply. The over-extraction of groundwater from tube wells for drinking, irrigation, and other uses has worsened this problem. When large quantities of groundwater are pumped from shallow aquifers, the redox conditions within the aquifers change, disrupting the natural processes that keep arsenic bound within sediments. As a result, arsenic is released into the water, making it unsafe for consumption. Additionally, the heavy reliance on groundwater for irrigation in Bangladesh, especially in the rice paddies of the country, has further drawn down the aquifers and exposed more of the arsenic-rich water to human populations. The overuse of shallow tube wells exacerbates the problem because these wells tap into arsenic-contaminated aquifers that were previously isolated from human contact. In addition to the natural and geochemical processes, microbial factors play a crucial role in arsenic contamination. Microbial activity in the groundwater system, such as the presence of bacteria that reduce arsenic compounds, can increase the mobility and solubility of arsenic [4].

Certain bacteria, particularly those that thrive in anaerobic conditions in deep aquifers, have been shown to catalyze the transformation of arsenic from less soluble to more soluble forms, thus intensifying contamination. This microbial transformation can make it even more difficult to mitigate arsenic exposure, as conventional water treatment systems may not effectively address the release of soluble arsenic. On top of these natural and microbial causes, human activities also significantly contribute to the spread of arsenic contamination. One of the key anthropogenic factors is the lack of proper sanitation and wastewater treatment. In rural areas, the widespread practice of open defecation and inadequate sewage systems leads to the contamination of groundwater with fecal matter and other pollutants. Furthermore, the use of arsenic-based pesticides in agriculture, though less widespread, has added another source of arsenic to the environment, particularly near agricultural zones. The agricultural sector, which heavily depends on groundwater for irrigation, exacerbates the problem by pumping arsenic-contaminated water into fields, which ultimately returns to the groundwater system and spreads arsenic contamination further [5].

***Address for Correspondence:** Rosef Asish, Department of Water and Spatial Science, University of Western Australia, Crawley, Australia, E-mail: rosef@asish.au*

Received: 01 March, 2025, Manuscript No. hycr-25-165426; **Editor Assigned:** 03 March, 2025, PreQC No. P-165426; **Reviewed:** 17 March, 2025, QC No. Q-165426; **Revised:** 22 March, 2025, Manuscript No. R-165426; **Published:** 31 March, 2025, DOI: 10.37421/2157-7587.2025.16.566

Conclusion

In conclusion, arsenic contamination in Bangladesh's groundwater is a serious and complex problem with geochemical, microbial, and anthropogenic components. The widespread nature of the contamination has resulted in significant public health risks, particularly for those relying on contaminated groundwater for drinking and daily use. While efforts to address arsenic contamination through improved water management and treatment techniques have made some progress, the issue remains pervasive, particularly in rural areas. On-going research, policy intervention, and better infrastructure are essential to provide long-term solutions to ensure safe and clean drinking water for the people of Bangladesh. A combination of geological understanding, microbial control, and socio-economic development is crucial to mitigating the risks associated with arsenic exposure and improving public health in the affected regions.

Acknowledgment

None.

Conflict of Interest

None.

References

1. Anawar, H. M., J. Akai, K. M. G. Mostofa and S. Safiullah, et al. "Arsenic poisoning in groundwater: Health risk and geochemical sources in Bangladesh." *Environ Int* 27 (2002): 597-604.
2. Chakraborty, A. K. and Khitish Chandra Saha. "Arsenical dermatosis from tubewell water in West Bengal." *Indian J Med Res* 137 (2013).
3. Chowdhury, Uttam K., Bhajan K. Biswas, T. Roy Chowdhury and Gautam Samanta, et al. "Groundwater arsenic contamination in Bangladesh and West Bengal, India." *Environ Health Perspec* 108 (2000): 393-397.
4. Harvey, Charles F., Christopher H. Swartz, A. B. M. Badruzzaman and Nicole Keon-Blute, et al. "Arsenic mobility and groundwater extraction in Bangladesh." *Science* 298 (2002): 1602-1606.
5. Nickson, Ross, John McArthur, William Burgess and Kazi Matin Ahmed, et al "Arsenic poisoning of Bangladesh groundwater." *Nature* 395 (1998): 338-338.

How to cite this article: Asish, Rosef. "Arsenic Contamination in Groundwater of Bangladesh: Geochemical, Microbial and Human Impact." *Hydrol Current Res* 16 (2025): 566.