

WEST BENGAL'S HIDDEN THREAT: A COMPREHENSIVE STUDY OF ARSENIC IN MULTI-REGION GROUNDWATER

Anuradha Paul¹, Harish Saraswat², Sakshi Saxena², Dinesh Kumar Sharma²

¹Research Scholar, ² Assistant Professor Department of Chemistry,
Institute of Applied Science Mangalayatan University, Beswan

Abstract

Ground water is a dynamic, replenish-able and dependable earth resource which acts as a viable substitute to the surface water supply. Arsenic (As) contamination of groundwater affects the health of about 140 million people in India. Long-term exposure to arsenic increases mortality dramatically because it causes a variety of malignancies, lung diseases, and cardiac problems. The current study used a method that enables the measurement of the concentration of many toxic metals including arsenic in various water samples from various districts of West Bengal. Howrah, South 24 Parganas, North 24 Parganas, and Kolkata were the chosen districts. The arsenic pollution, as well as the contamination of Cd, CN, Pb, Hg, Ni, Mo, Cr, Total suspended solid, Total hardness (CaCO₃), pH, DO, BOD and COD levels, were all tested. The concentration in water containing arsenic samples varied from 0.22 to 1.92 mg/L, above the allowable level of arsenic, which is 0.01 mg/L in drinking water (according to WHO). According to our research, chronic poisoning from arsenic accounts for the majority of water pollution and poses a risk to the 3.5 million people and communities who use this untreated water directly or indirectly.

Introduction

According to the "World Health Organization" (WHO) the permissible limit for arsenic (As) in drinking water is not exceeding 10 µg/L. Despite this, the maximum contaminant level (MCL) for arsenic in drinking water in India and Bangladesh remains at 50 micro grams per litre in groundwater poses a threat to the health of almost 100 million Indians. In addition, several countries, including Bangladesh, India, China, Nepal, Cambodia, Vietnam, Myanmar, Laos, Indonesia and USA, are negatively impacted by elevated water bodies(1). Arsenic, also known as the "silent toxin," has been linked to human civilization ever since it was first developed. It is believed that Albert Magnus was the first person to isolate arsenic in the year 1250. As a systemic toxin, arsenic is known to cause problems with the kidneys, the digestive system, the nervous system, and the heart. In addition, long-term exposure to arsenic has been linked to several malignancies, including bladder. As arsenic is colourless, odourless so it is difficult to identify the contamination of arsenic in drinking water, only chemical methods can detect the presence of Arsenic. A protracted Arsenic exposure dramatically increase mortality from cardiovascular illnesses can lead to lung, skin, liver, and bladder cancer(2). As poisoning has also been linked to the death of newborns, a drop in intelligence, and problems with movement in children (1). Investigations have shown that freshwater isn't only related to As-containing guest atoms but also affected by pH, UV irradiation, and soluble guest elements. Alluvial deposits from the Holocene era are associated with that same Carboniferous Period by as-rich components. (3). Arsenic is

known to create difficulties with the kidneys, the digestive system, the neurological system, and the heart because it is a systemic poison. Arsenic has been associated with several cancers, including those of the bladder, kidney, skin, and liver, and long-term exposure to the substance has been shown to increase the risk of these diseases (4). The residents of the Bengal basin have rendered the freshwater importable by indiscriminately using the waters of the streams and rivers as conduits for coal ash and sewage. Moreover, the development of high-yielding "Boro" dry-season rice exacerbated the need for irrigation. As a result, West Bengal and Bangladesh switched their water supply strategy from groundwater to water from the surface in the early 1970s (5). In order to supply the demand for drinking, farming, and corporate water, numerous million wells (varying from low seed hand-pumped to heavy-duty motor-driven) are put into place. Arsenic (As), which may have adverse health effects at levels greater than 10 µg/L in drinking water, was found to have high amounts in a significant portion of the Around the 1990s wastewater in the Lesser Himalaya (6). In the Himalayas, particularly in the areas of Bangladesh, many hydro geological studies have been carried out to assess the groundwater recharge and comprehend the impact of groundwater movements (at the local to regional scale) on the transport of As-contaminated waters inside these drainage basins (5). However, in-depth hydro geological investigations are sparse in the southwestern Himalayan region (West Bengal), prompting district-level sustainable groundwater assessments by the Central Groundwater Regulatory Boards and Water District Investigative Commission (7). The findings of the groundwater pollution investigation using samples of water taken from four West Bengal districts are presented in this paper.

Method

The instrumental techniques used for detection of different metals were Atomic Absorption Spectroscopy (AAS). Total 58 ground water samples (mainly from tube wells) were tested from four Districts of West Bengal, India for examination of Arsenic and other toxic metal contamination (Cd, CN, Pb, Hg, Ni, Mo, Cr). Other than many physio chemical properties of water such as Total suspended solids (TSS), Total hardness as CaCO₃ and Biochemical Oxygen Demand (BOD), Chemical Oxygen Demand (COD), Dissolved oxygen (DO) and pH all are detected.

Result and discussion

Arsenic pollution casts a long, dark shadow over West Bengal, affecting diverse regions. However, its most severe impact is concentrated in the eastern and southwestern parts of the state. The contamination is primarily found in groundwater sources, including tube wells, hand pumps, and dug wells, which have become unwitting carriers of this toxic element.

Total 58 water samples, out of which 16 samples from Howrah, 12 samples from South 24 Parganas, 15 specimens from Kolkata and 15 specimens from North 24 Parganas, were tested. For to evaluate the arsenic contamination as well as heavy metal contamination (Cd, CN, Pb, Hg, Ni, Mo, Cr), Total suspended solids, Total hardness as CaCO₃, BOD, and COD. The acceptable range for As is 0.01 mg/L, Cd is 0.003 mg/L, CN is 0.05 mg/L, Pb is 0.01 mg/L, Hg is 0.001 mg/L, Mo is

0.07 mg/L, Ni is 0.02 mg/L and Cr is 0.05 mg/L. hardness as CaCO₃ is 200 mg/L, suspended solid mg/L 75 mg/L and oxygen is 4 mg/L. The As level in district Howrah for all the 16 samples number fall in the range between 0.45 mg/L to 0.92 mg/L, in community South 24 Parganas for all the 12 samples, values fall in the range between 0.72 mg/L - 1.12 mg/L, in section North 24 Parganas for all the 15 samples values fall in the range between 0.68 mg/L - 1.72 mg/L, and in community Kolkata for all the 15 samples values fall in the range between 0.22 mg/L - 0.92 mg/L, which is far away from the acceptable range (0.01 mg/L). The higher bedrock arsenic content is predicted to be associated to the higher arsenic concentration in groundwater (8).

Table 1 shows a comparison range of arsenic and other physio-chemical properties in four districts.

Serial number	Name of the District	Total Arsenic as As (mg/L)	pH	Total hardness as CaCo ₃	TOTAL SUSPENDED SOLID	BOD	COD	DO
1	Kolkata	0.22 to 0.98 mg/L	7.22-8.24	312-448 mg/L	24-58 mg/L	4-24 mg/L	16-31 mg/L	5.14-4.08 mg/L
2	South 24 Parganas	0.72 to 1.12 mg/L	7.14-8.44	250-548 mg/L	528-828 mg/L	4-12 mg/L	16-31 mg/L	4.38-5.48 mg/L
3	North 24 Parganas	0.92-1.72 mg/L	6.5-8.5	352-502 mg/L	145-2152 mg/L	12-28 mg/L	5-12 mg/L	4.44-5.24 mg/L
4	Howrah	0.58-0.98 mg/L	7.8-9.8	380- 908 mg/L	312-1044 mg/L	16-31 mg/L	6-11 mg/L	4.84-5.52 mg/L

The Arsenic and heavy metals Cd, Ni, Pb, and Hg are known to harm DNA, cause cancer and harm the central nervous system, among other detrimental effects on human health (9). Arsenic waste emissions from corporate, agriculture, and farming operations or major geological activities are to blame for the arsenic contamination (10).

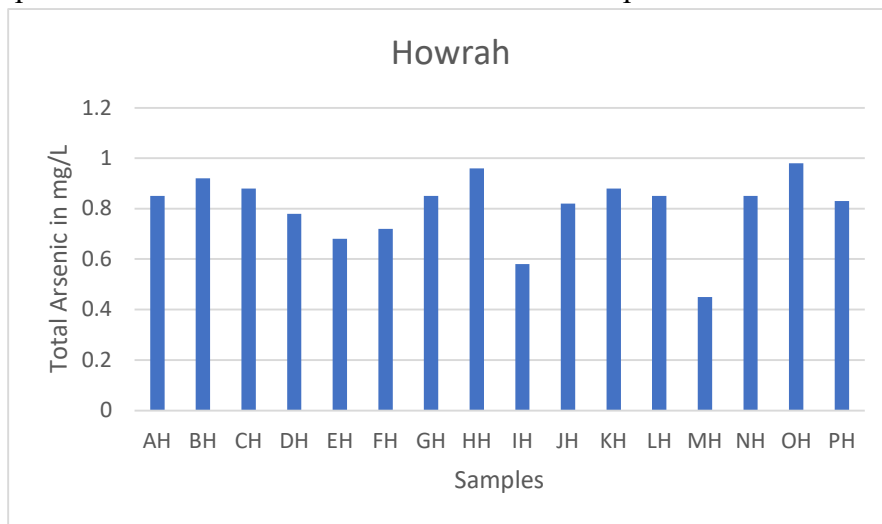
Table 2. Arsenic amount(mean) in mg/L from various district in West Bengal. (Acceptable limit of As is 0.01 mg/L)

Serial number	Arsenic as As (mean)	Name of District
1	0.805 mg/L	Howrah
2	0.9 mg/L	South 24 Parganas
3	1.33 mg/L	North 24 Parganas
4	0.673 mg/L	Kolkata

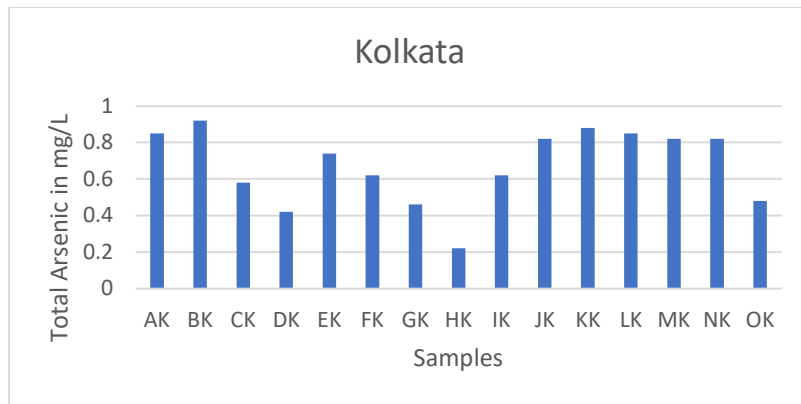
Table 2 shows the average of total arsenic present in the water samples in four districts of West Bengal . The average of arsenic in 16 water sample of Howrah district is 0.805; in 12 water sample for South 24 Parganas is 0.9 ; 15 water samples of North 24 Parganas is 1.33 and 15 water samples of Kolkata is 0.673.

All results shows that the arsenic level in ground water is much much higher than the WHO permeable range for drinking water.

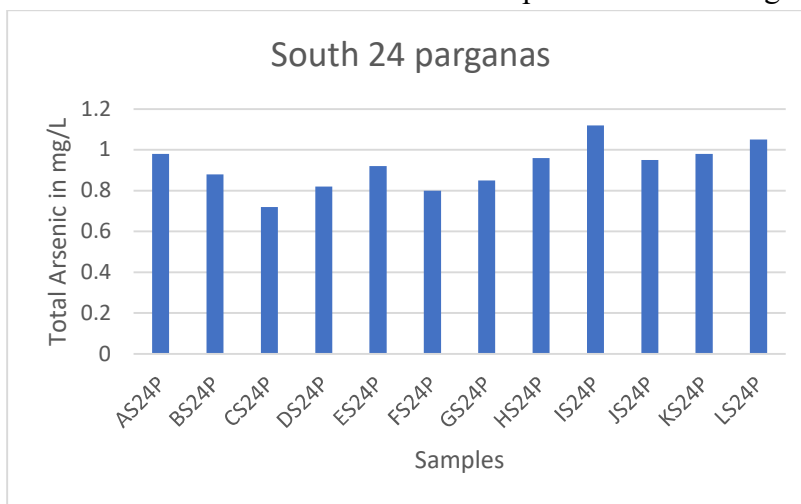
Graph1: Variation of arsenic in different water samples in Howrah Districts



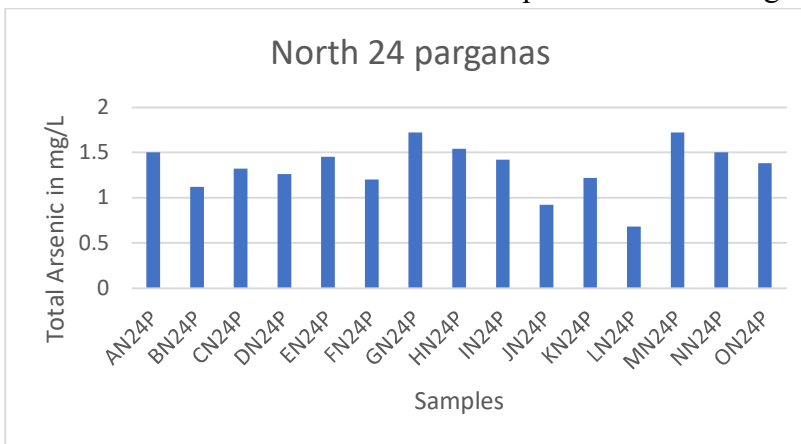
Graph 2: Variation of arsenic in different water samples in Kolkata Districts



Graph3: Variation of arsenic in different water samples in South24Parganas Districts



Graph4: Variation of arsenic in different water samples in North24Parganas Districts



Regular monitoring of arsenic levels in groundwater emerges as a linchpin in tackling the issue. It serves the dual purpose of identifying contamination hot-spots and gauging the effectiveness of mitigation measures.

Conclusion

The study emphasizes on the danger posed by arsenic in the water from four districts in West Bengal, India. The arsenic pollution, as well as the contamination of Cd, CN, Pb, Hg, Ni, Mo, and Cr, Total suspended solid, Total hardness as CaCO₃, pH and DO, BOD and COD levels, were all tested in a total of 58 water samples. According to our data, Arsenic in water samples varied from 0.22 to 1.92 mg/L, above the allowable level of arsenic, which is 0.01mg/L. The 300 million people's most outstanding health risk people who drink this water untreated is chronic arsenic poisoning. Mitigation actions are urgently required to safeguard the uninformed from such health issues. Households in high-risk areas would be informed about As and heavy metal contamination harm. However, solutions for centralizing treatment, such as good deep installation or reverse osmosis systems, can be investigated if more wells are deemed dangerous. Because of the relatively varied aquifers in the area, arsenic spatial variation is very considerable, even within a single hamlet. Certain areas could be used to lessen the population's toxicity because this prediction cannot take into account small-scale changes. Similar methods for highly accurate As prediction modelling can be used at the national level to find the areas at risk more precisely.

Geological Factors: The very presence of arsenic in groundwater is intricately tied to geological factors. Natural processes release arsenic from sediments into the aquifers, perpetuating the contamination. West Bengal's unique hydrogeological conditions play a pivotal role in exacerbating this problem.

Limitations

This study limited its survey for the metal analysis of arsenic in ground water from several regions (Kolkata, Howrah, North 24 parganas, South 24 parganas) in West Bengal. This study places additional restrictions on the acquisition of samples from the many different regions located in West Bengal.

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