SHODHPATRA: INTERNATIONAL JOURNAL OF SCIENCE AND HUMANITIES
E-ISSN: 3048-6041 | Volume- 2, Issue- 8 | August 2025

ARSENICOSIS - A Geological problem of Bihar

Rahul Kumar Chaudhary[1], Dr. Naveen Kumar Singh[2]
[1]M. Sc, M.Phil., Ph. D Research Scholar, School of Natural and Applied Science, Vikrant University, Gwalior
[2]Prof. and Head, School of Natural and Applied Science, Vikrant University, Gwalior

Abstract

In the past few years, a large percentage of the population is suffering from Arsenic poisoning due to Arsenic contamination in ground water in the Ganga plains of Bihar. Apart from skin diseases, it is also inviting serious diseases like mental disability and cancer. According to the Bihar State Pollution Control Board (BSPC), Arsenic has been found in ground water of many districts of Bihar and the increasing incidence of gall bladder cancer in these districts is being linked to it. Among the four major agro-climatic zones in Bihar, The districts having high percentage of Arsenic are in zone- 1 and zone- 2, respectively. The risk of cancer in human organ like skin, bladder, kidney, liver and lungs has been increased in the state with the prevalence of high Arsenic (As) levels, particularly near the north of Ganga River. Moreover, effective policies and regulations are needed based on spatial variation in contamination, socio-economic condition, and demographic characteristics. In this paper we will discuss the causes, effects and diagnosis of Arsenic contamination.

Keywords - Toxicity, Environment, Ground water, Pollutant, Contamination, Disability

Introduction-

A medical condition that occurs due to elevated level of Arsenic in body, considered as Arsenic poisoning. In simple term this is Arsenic poisoning, if occurs overs a brief period of time causes vomiting, abdominal pain, encephalopathy and watery diarrhea. Arsenic poisoning causes the multisystem disorder, but the hall mark clinical manifestation are the continuous changes, this will confirmed by looking at the skin change. Arsenic (As) found in almost all environmental matrices, it is the most critical natural contaminant of global concern due to its highly toxic effect on different life forms, including humans. We can discuss its geological and hydro-geochemical background. Bihar lies in the GBM (GANGA–BRAHAMPUTRA-MEGHNA) alluvial plain. Young Holocene aquifers (15–90 m depth) with organic clay create reducing conditions that mobilize. Shallow aquifers are heavily contaminated, while deeper aquifers (100–300 m) show lower Arsenic. Arsenic research on geological, geochemical, technical, environmental, biological and social aspects and awareness of population and stakeholders are still inadequate. As above 10 µg/L reported in 22 districts and 87 blocks; more than 10 million people exposed districts of Bihar report peak levels is: BHOJPUR up to 1,805 µg/L, BUXUR ~1,929 µg/L, PATNA ~1,820 µg As of 2021–22, contamination affects 31 of 38 districts, with around 46% area under risk and 72 of 352 blocks contaminated. A global umbrella for coordinated trans-disciplinary and trans-sectorial capacity building and knowledge base is needed to address this problem holistically and sustainably. The human exposure and health impacts of Arsenic contamination in the ground water are discuss as follows. water exposure surveys show 61% of wells exceed 10 µg/L and 44% exceed 50 µg. Bio mark adults and

children exhibit elevated arsenic in hair, nails, urine; neurotoxicity in ~40–48% of symptomatic patients. Clinical effects 9.7% villagers in Patna show arsenical skin lesions; 48% neuropathy prevalence; adverse pregnancy outcomes and the carcinogenic risk documented. Infants and mothers arsenic found in breast milk; neonates excrete only ~50%, leading to accumulation and high risk of developmental harm Arsenic contamination in the food chain is significant threat to food security and human health. The food products affected are rice, wheat, seafood, livestock, potatoes etc. Studies from 11 districts show: 14% rice, 63% wheat, 3% potato samples contain arsenic above FAO limits (200, 100, 500 µg/kg respectively). Highest recorded arsenic: rice 821 µg/kg; wheat 775 µg/kg; potato 1,450 µg/kg this indicates bio magnification through irrigation with contaminated water.

Literature Review-

Arsenic contamination in ground water is a health and environmental concern in Bihar. Geo-genic origin, most studies Chakraborti et al. 2003 and Saha et al. 2014, attribute arsenic in the ground water of Bihar. The Arsenic is believed to be released from sedimentation layer rich in iron oxide when exposed to reducing condition in aquifer. Geo-genic source dominate over extraction in ground water for agriculture has accelerated the mobilization of Arsenic. Sharma et al. 2016, green revolution will also disturb. According Public Health Engineering Department (PHED) and Central Ground Water Board (CGWB) states that over 18 districts are severely affected, hotspots are the districts located at the Ganga plains of Bihar. Concentration of Arsenic exceeds in many districts. The government policy includes National Rural Drinking Water Program (NRDWP), JAL-JIVAN Mission and Arsenic mission centers. The research gap includes High resolution spatial mapping of arsenic prone area, need of longitudinal health studies, effectiveness and sustainability and community knowledge.

Problem Statements-

Over 10 million people in 24-38 districts are exposed to Arsenic level above to World Health Organization (WHO) safe limits. It is matter of concern that they suffer on physical and mental health. The socio-economic burden of arsenic contamination is significant and far-reaching. It include health impact (increase healthcare cost, lots of productivity) economic aspects (agriculture productivity, water treatment cost) social impacts (social stigma, community displacement) and economic burden (cost impact on GDP) A study in Ganga plain special BHOJPUR- 18.3% households had water >50 µg/L; ~5% had 300–500 µg/L. Annual per-household treatment cost ~INR 8,380 and wage loss INR 2,438; societal cost ~INR 266 million

Survey and Opinion Poll-

We selected 500 women in arsenic affected districts, out of which 300 women gave us information after their consent provided breastfeeding. Of these, 150 women were unable to breastfeed, 100 were breastfeeding but were suffering from some disease or the other and in about 130 women the amount of Arsenic in milk was more than the world health organization limit. We also took urine sample of 100 children, out of which the urine of 40 children was extremely yellow, the urine of 30 children had excessive amount of Arsenic contamination and the urine of 20 children was in normal quantity.

The survey methods used are, 1-Household survey (conducting door to door survey to collect data on water sources, arsenic level and health effect) 2-Questionnaires (Using structured question-answer method to gathered information) 3-Interviews (Conduct in-depth interviews with affected individual) and 4-Group discussion (Organizing group discussion to gather information).

Number of women who participate in the survey	500
Number of women who cooperated in the survey	380
Number of women unable to breastfeed	150
Number of women suffering from some disease	100
Number of women suffering from Arsenic contamination in breast milk	130
Number of children include in urine test	100
Total children who had trace amount of Arsenic contamination in their urine	30
Yellow urine including other infection	40
Normal urine sample	30

Survey in Cancer Institute Patna– we conducted a week-long study at cancer institute Patna, dated 12 June to 19 June 2025, selected 70 male and 122 female who comes to take treatment are suffering from arsenic contamination, where arsenic was found in the gall bladder hair even blood of the patient who were suffering from cancer. The data is given as following.

DATE	MALE	FEMALE	ARSENICOSIS IN
12 June 2025 To 19 June 2025	70	122	62 (Blood) 20 (Gall bladder) 40 (Skin)

The survey tools are 1-Arsenic test kit (using field testing kit to measure arsenic level in water samples). 2-Water sampling (collect the water samples for lab analysis). 3-Health assessment tools (using standardized health assessment tool to evaluate the health issue). 4-GIS Mapping (using geographic information system mapping to identify the Arsenic contaminated area and spread of contamination). 5-Mobile Apps and Online Survey (using mobile app to collect date and conducting online survey we can find a clear vision for Arsenic contamination).

Cause of Arsenic problem-We can broadly divide the action of Arsenic spread into two parts; Natural and Human origin.

Natural causes- Natural causes of Arsenic pollution includes burning of trees, plants, volcanic eruption, Arsenic found in minerals and nuclear reaction at higher temperature. Man-made causes -India ranks 120th in the list of 122 countries in the world water quality index. Use of toxic chemicals helps in this pollution. Mining and industrialization have also increases

the arsenic pollution. The waste chemicals released from factories also contain Arsenic, which contaminates the soil and ground water.

Means of Propagation are-

(1)-It spread through the air. -

(2)-Comes into the ground through runoff and leaching.

(3)-It spread through volcanic eruption

Effect of Arsenic Contamination -Bihar, a state in eastern India, located Ganga- Meghna-Brahmaputra (GMB) basin faces a problem of Arsenic contamination in groundwater. The effect of arsenic contamination can be served and far reaching. Here are some potential effects of arsenic pollution. Main effects are-

a. Environmental Effect -Arsenic pollution affects the photosynthesis process of trees and plants, it provide toxicity. It creates imbalance in the environment by affecting the rates of birth and death .Arsenic contamination effect on bio-diversity. Arsenic poisoning in the ground water of Bihar causes, soil contamination, water pollution and bio diversity.

b. Mental effect of Arsenic pollution- Arsenic pollution affects the nervous system of newborns and children under 5 years of age. This Arsenic affects young people and old people by causing mental depression, headache and mental weakness.

c. Economic effect- In the economic effect it shows the healthcare cost (arsenic affected people feels very costly health treatment), lost productivity (it lead lost productivity, affecting economic growth) and agriculture losses (arsenic contamination can affect crop yield and quality).

d. Physical effect of Arsenic pollution-Arsenic reaches our body through drinking water and various other means and affect bladder, kidney, liver etc. Rashes on skin sand temporary disability have also been seen in peoples bodies is Arsenic affected district of Bihar. Long term exposure to arsenic can gives cancer, including skin lung, bladder, kidney and liver cancer. It shows skin lesions and cardiovascular disease.

e. Social effect- The social effect of arsenic contamination is Social stigma (Arsenic contamination shows social stigma that lead the affecting an individual social and economic well-being.

Identification of Arsenic- Arsenic problem can be identified through various method first is clinical evaluation it includes medical history that can identified the potential exposure of Arsenic and physical examination it can be by skin lesions, hyperpigmentation and keratosis. Second method is laboratory test method it includes the blood test that identify the Arsenic level in blood, urine test it shows the level of Arsenic in urine and hair and nail analysis. However in general test, metallic taste in drinking water, turbidity, yellowness, these all indicates the presence of Arsenic. In the diagnosis of Arsenic here two type of symptoms first

nonspecific and second is delayed onset. Main importance of early detection is prompt treatment and prevention. The diagnosis tools are Atomic Absorption Spectroscopy (AAS) and Inductive coupled Plasma Spectroscopy (ICPS).Also there is an arsenic kit available in the market which taste the amount of arsenic we can use it.

Government approach against Arsenic pollution in Bihar-Plan has been made by Bihar pollution control board and NGO water aid to install semaric filters. It has pores in the soil and also contains a chemical which enlarge the arsenic particles and it passes through the pores. This is quite economical and will help in providing clean water to the people. The Policy Recommendations in India, National Aquifer Mapping Program(NAMP). Aims to reduce or mitigate toxic substance in ground water, it lead by the central ground water board (CGWB), Arsenic treatment units also work to provide the safe and pure drinking water. Coloring of affected hand pumps and Ground water based pipe water supply schemes. Scale-up safe water access: Expand piped water, deep- bore wells, community filters. Routine testing & monitoring: Revive local labs; integrate arsenic testing in public health. Community mobilization: Awareness campaigns, training in filter maintenance, participatory planning .Agricultural safeguards: Promote safe irrigation water sources; food monitoring. Health surveillance: Victim screening, bio monitoring, and targeted medical interventions. It is obvious that high-arsenic drinking water may be a factor in arsenic toxic in human beings. It seems to be important in the control of the disease to consider how to prevent arsenic intake from drinking water. The symptoms and signs of Arsenic poisoning may be reduce if the quality of drinking water improved. In some cases, the symptoms and signs of Arsenic poisoning were reduced three years after the quality of drinking water improved. The morbidity rate also declined. Numerous studies suggested that improvement of water quality, the rate of improvement in the symptoms and signs of arsenic poisoning in human beings may increase with a decrease in arsenic level in the drinking water source.

Mitigation: Efforts & Gaps

Arsenic poisoning mitigation involves various steps to reduce exposure of contaminated water, includes water treatment process like Adsorption, Coagulation, Ion Exchange and membrane filtration. We can use alternative water source like Rain Water, Deep Wells Dug Wells etc. In the Programs & Technologies the Govt. initiatives: Deep hand pumps, piped supply schemes, rainwater harvesting, labeling and sealing of contaminated wells, arsenic filtration units and Field trials: Gravity-based filters and bioremediation by using local microbes show promise. The limitations are in the field of Arsenic pollution are Insufficient coverage relative to affected population; poor maintenance of infrastructure; inadequate monitoring and community Arsenic has been used as a medicine and as a poison since humans first became interested in chemistry. The untoward effect of "medicinal" arsenic, primarily inorganic arsenic, have only recently been appreciated because their ill effects are of a chronic nature and large epidemiologic databases are needed to define deleterious outcomes. Engagement and Lack of accountability and awareness; absence of testing labs; obsolete filters; no tube well decommissioning

Conclusion-

water is life, if water is their then there is tomorrow. This is absolutely true in the plain banks of Ganga in Bihar, as the amount of Arsenic in increasing, people are becoming sick are on the verge of death. Arsenic poisoning is a significant public health concern globally, particularly in region with contaminated water sources. The effect of Arsenic exposure can be devastating, ranging from skin lesion and cardiovascular diseases in various form of cancer. Effective mitigation strategies, including providing safe drinking water, implementing water treatment technology and promoting public awareness are crucial to reducing the impact of arsenic poisoning. Continued research, policy implementation and community engagement are essential to addressing this critical issue and protecting the health and well-being affected population.

References-

1. Andersen L. C. D., Bruland K. W. Biogeochemistry of arsenic in natural waters: the importance of methylated species. Environmental Science and Technology. 1991;25(3):420–427. doi: 10.1021/es00015a007. [DOI] [Google Scholar]
2. Bhattacharya P., Jacks G., Ahmed K. M., Routh J., Khan A. A. Arsenic in groundwater of the Bengal Delta Plain aquifers in Bangladesh. Bulletin of Environmental Contamination and Toxicology. 2002;69(4):538–545. doi: 10.1007/s00128-002-0095-5. [DOI] [PubMed] [Google Scholar]
3. Bhattacharya P., Chatterjee D., Jacks G. Occurrence of arsenic-contaminated groundwater in alluvial aquifers from delta plains, eastern India: options for safe drinking water supply. International Journal of Water Resources Development. 1997;13(1):79–92. doi: 10.1080/07900629749944. [DOI] [Google Scholar]
4. Bhattacharya P., Welch A. H., Stollenwerk K. G., McLaughlin M. J., Bundschuh J., Panaullah G. Arsenic in the environment: biology and chemistry. Science of the Total Environment. 2007;379(2-3):109–120. doi: 10.1016/j.scitotenv.2007.02.037. [DOI] [PubMed] [Google Scholar]
5. Chakraborti D., Rahman M. M., Das B., Murrill M., Dey S., Chandra Mukherjee S., Dhar R. K., Biswas B. K., Chowdhury U. K., Roy S., Sorif S., Selim M., Quamruzzaman Q. Status of groundwater arsenic contamination in Bangladesh: a 14-year study report. Water Research. 2010;44(19):5789–5802. doi: 10.1016/j.watres.2010.06.051. [DOI] [PubMed] [Google Scholar]
6. Devesa V., Del Razo L. M., Adair B., Drobná Z., Waters S. B., Hughes M. F., Stýblo M., Thomas D. J. Comprehensive analysis of arsenic metabolites by pH-specific hydride generation atomic absorption spectrometry. Journal of Analytical Atomic Spectrometry. 2004;19(11):1460–1467. doi: 10.1039/b407388f. [DOI] [Google Scholar]
7. Fendorf S., Michael H. A., van Geen A. Spatial and temporal variations of groundwater arsenic in South and Southeast Asia. Science. 2010;328(5982):1123–1127. doi: 10.1126/science.1172974. [DOI] [PubMed] [Google Scholar]

8. Mirlean N., Baisch P., Diniz D. Arsenic in groundwater of the Paraiba do Sul delta, Brazil: an atmospheric source? Science of the Total Environment. 2014;482-483:148–156. doi: 10.1016/j.scitotenv.2014.02.138. [DOI] [PubMed] [Google Scholar]
9. M. Shahid, M. Imran, S. Khalid, B. Murtaza, N. K. Niazi, Y. Zhang, I. Hussain, Arsenic environmental contamination status in South Asia, Arsenic in Drinking Water and Food, 2020, pp. 13–39 Search PubMed
10. Mukherjee A., Sengupta M. K., Hossain M. A., Ahamed S., Das B., Nayak B., Lodh D., Rahman M. M., Chakraborti D. Arsenic contamination in groundwater: a global perspective with emphasis on the Asian scenario. Journal of Health, Population and Nutrition. 2006;24(2):142–163. [PubMed] [Google Scholar]Nriagu J., Bhattacharya P., Mukherjee A., Bundschuh J., Zevenhoven R., Loeppert R. Arsenic in soil and groundwater: an overview. In: Bhattacharya P., Mukherjee A., Bundschuh J., Zevenhoven R., Loeppert R., editors. Arsenic in Soil and Groundwater Environment. Amsterdam, The Netherlands: Elsevier; 2007. pp. 3–60. [Google Scholar]
11. Polizzotto M. L., Harvey C. F., Li G., Badruzzman B., Ali A., Newville M., Sutton S., Fendorf S. Solid-phases and desorption processes of arsenic within Bangladesh sediments. Chemical Geology. 2006;228(1—3):97–111. doi: 10.1016/j.chemgeo.2005.11.026. [DOI] [Google Scholar]
12. P. Bhattacharyya and M. M. Alam, Arsenic-contaminated soil toxicity and its mitigation through monocot crops, in Contaminants in Agriculture, ed. M. Naeem, A. Ansari and S. Gill, Springer, 2020 Search PubMed
13. R. N. Ratnaike, Postgrad. Med. J., 2003, **79**, 391–396 CrossRef CAS PubMed , https://pmj.bmj.com/content/postgradmedj/79/933/391.full.pdf.
14. Suzuki K. T., Kurasaki K., Suzuki N. Selenocysteine β-lyase and methylselenol demethylase in the metabolism of Se-methylated selenocompounds into selenide. Biochimica et Biophysica Acta—General Subjects. 2007;1770(7):1053–1061. doi: 10.1016/j.bbagen.2007.03.007. [DOI] [PubMed] [Google Scholar]
15. Welch A. H., Lico M. S., Hughes J. L. Arsenic in ground water of the Western United States. Ground Water. 1988;26(3):333–347. doi: 10.1111/j.1745-6584.1988.tb00397.x. [DOI] [Google Scholar]
16. Welch A. H., Westjohn D. B., Helsel D. R., Wanty R. B. Arsenic in ground water of the United States: occurrence and geochemistry. Ground Water. 2000;38(4):589–604. doi: 10.1111/j.1745-6584.2000.tb00251.x. [DOI] [Google Scholar]