



Arsenic Contamination of Groundwater in West Bengal: Awareness for Health and Social Problems

Bidyut Kumar Santra

Department of Chemistry, Raiganj University, Raiganj, Uttar Dinajpur, West Bengal, India

Corresponding author: sntrab@gmail.com

ABSTRACT

During the last four decades arsenic contamination of groundwater in nine districts out of twenty in West Bengal has become a serious problem. About 20% population of West Bengal in nine districts (Malda, Murshidabad, Nadia, North 24 Parganas, South 24 Parganas, Kolkata, Howrah, Hoogly and Burdwan) are affected by arsenic problem. Arsenic enters into the human body by drinking of contaminated groundwater and food grains which are irrigated from contaminated water. Bio-accumulation of arsenic is occurring from the food grains as irrigated with arsenic contaminated water. Arsenic contamination of ground water in West Bengal leads to adverse effects on human health. Chronic exposure of arsenic can cause skin cancer and other health effects. Groundwater contamination with arsenic and human suffering are increasing in West Bengal. Arsenic affected people are also facing serious social problems in the affected villagers who are living in very poor economic conditions. To combat the arsenic crisis in West Bengal it is desperately need to increase awareness and educate the people about the problem. Besides, it is also necessary to use maximum of surface water resources by traditional water treatment techniques such as use water after filtration by activated alumina or use water after boiling for safe drinking water.

Keywords: Arsenic contamination, groundwater, health problems, awareness

Arsenic contamination of groundwater is a form of groundwater pollution which is due to naturally occurring high concentrations of arsenic in deeper levels of groundwater. Arsenic found all over the world in groundwater and the Ganga-Brahmaputra region is one of the major arsenic-contaminated zones in the world. It is a problem due to use of tube wells for water supply in the Ganges Delta causing serious arsenic poisoning. Arsenic contaminated water contains arsenous acid (H_3AsO_3) and arsenic acid (H_3AsO_4) or their derivatives. Arsenic contaminating ground water causes serious health problems in West Bengal from 1980's. Arsenic poisoning can cause major health complications if not properly treated. Arsenic in the water is extremely dangerous and hard to detect as arsenic has no flavour or odour.

Chronic intake of drinking water with above 50µg/L arsenic concentrations can cause the development of arsenicosis. A few articles have been published about the arsenic contamination of groundwater in West Bengal^[1-5]. This paper will highlight the serious future problem in this area due to continuous use of arsenic contaminated ground water and also for general awareness about health and social problems in West Bengal.

Arsenic as a Chemical

Arsenic is a steel-grey semi-metallic element and present in Group 15 in the periodic Table. Abundance of arsenic is 1.8 ppm in the earth's crust by weight. Arsenic does not present in its elemental state but commonly presents as sulphides (As_2S_3) and sulfosalts such as arsenopyrites, $FeAsS$. All arsenic compounds are poisonous. Arsenic is a very redox-sensitive element and its mobility is controlled by pH and redox potential in the groundwater. Arsenic is stable in four oxidation states (+5, +3, 0, -3) under the normal redox potential conditions in aquatic systems. However, predominant forms are trivalent arsenite (As^{3+}) and pentavalent arsenate (As^{5+}). The toxicity of different arsenic species varies in the order arsenite > arsenate > monomethylarsinate (MMA) > dimethylarsinate (DMA). As^{5+} exists in solution as arsenate ion and arsenic acid which forms salt such as sodium arsenate. The element arsenic is insoluble in HCl and dil. H_2SO_4 but soluble in concentrated HNO_3 . Arsenic is not an essential element for human body, although it is found in very small quantities in tissues. Elemental arsenic is not absorbed in human body but its salts are readily absorbed through the food and water.

Source of Arsenic in Ground Water

The cause of arsenic contamination in ground water is still debatable topic. The source of arsenic in ground water was traced out by geological survey of India and the Central Ground Water Board. According to them the present drainage pattern of Ganga-Brahmaputra are responsible for sedimentation in West Bengal. The affected area of West Bengal is a part of the Ganga- Brahmaputra delta having sediments of varying thickness of deposition. The source of arsenic could be from the coal fields to bring arsenic minerals from the mine working to the sediments. The source of arsenic in groundwater of lower gangetic delta is considered to be the arsenic-rich sediments which has transported from the Chotonagpur-Rajmahal highlands^[6-7]. Some research workers believe that the leaching of arsenic in ground water is due to maximum use of ground waters for irrigation. During the 80's there was a remarkable change in irrigation sector by cultivating of summer paddy expanded in the seven districts in West Bengal. The Boro cropping is depended on the use tube wells for ground water. The Boro irrigation lowers the ground water level at high rate. The ground water occurring mainly with the shallow zone (20 – 60 M) where the principle source of arsenic in the arsenic sulphites minerals deposited with the clay in the reducing environment. The lowering of ground water level at a rapid rate during summer session cause aeration and oxidised the arsenic sulphides and make it in water soluble.

Problem in West Bengal

During 1980's some cases of skin disorder in the districts of North 24 Parganas, South 24 Parganas, Nadia, Murshidabad and Burdwan were report from where it is known that the disease is due to use of arsenic contaminated groundwater. Out of the twenty districts in West Bengal, 9 districts Malda, Murshidabad, Nadia, North-24-Parganas, South-24-Parganas, Bardhaman, Howrah, Hoogly and Kolkata are affected

by arsenic contaminated groundwater (Fig. 1). Ground water having higher concentration of arsenic generally occurs within 20 – 80 M depth zone^[8]. In West Bengal more than 26 millions of people are potentially at risk for drinking arsenic contaminated water. The other six districts in the northern part of West Bengal and 5 districts in western part of West Bengal are arsenic safe-zone.

Health Problem

Although the arsenic contamination in ground water problem is about four decades old but still it is deeply concerned with arsenic contamination of drinking water^[9-10]. The irrigated water containing arsenic can enter to the bodies of human through vegetables and food grains. The complex nature of arsenic increases the severity of the health problems in West Bengal. Chronic poisoning by arsenic compounds leads to diarrhoea, gastrointestinal problems, anemia, renal defects, neurological defects, skin cancer etc. It also blocks the thiol function of the enzymes. Arsenic (+3) exerts its toxic action by attacking –SH groups of an enzyme and thereby inhibits enzyme action. It inhibits the function of thioredoxin reductase and pyruvate dehydrogenase enzymes. Arsenic inhibits ATP synthesis by replacing the phosphate group. Due to the chemical similarity between arsenic and phosphorous, arsenic interferes some biochemical process of ATP (Adenosine Triphosphate). Arsenic can induce oxidative damage of DNA, altered DNA methylation and altered regulation of DNA-repair.

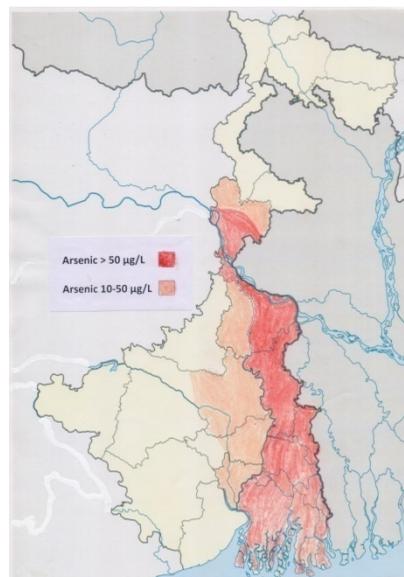


Fig. 1: Area of arsenic contaminated groundwater in West Bengal

Social Problem and Awareness

Arsenic affected people are also facing serious social problems. The affected villagers are living in very poor conditions^[11-12]. A few people are aware of arsenic pollution and its impacts on the human health. A large number of people are ignorant of arsenic pollution. They suffer from arsenic diseases and become the victim of arsenic contamination of water but they do not think of it. When the impact of arsenic becomes serious and people suffer from black foot disease then only they can realize that they are suffering from arsenic poison. When people suffer from different skin diseases, the body looks very rough, black spots are found on the hand and foot. Therefore, awareness is needed among the rural people and make them free from arsenic diseases. It is essential to develop management plans involving adequate medical and infrastructural support for them. A change in tapping of newer water resources is essential. The general antidotes for arsenic poisoning are chemicals having –SH groups e.g. 2, 3-dimercapto propanol.

Conclusion

Arsenic contamination of ground water is an alarming problem in West Bengal. Millions of peoples in nine districts are drinking ground water with the arsenic contamination. The affected people do not have alternative sources of safe drinking water. The only way is to stop consumption of arsenic contaminated

drinking water. Therefore, it is necessary to organise awareness camps regularly in the affected area. It is also needed desperately to increase awareness and educate the people about the serious problem. Besides, the maximum surface water resources such as rain water should be used. So rain water harvesting followed by proper purification can be used as low cost effective arsenic free water. Still there is not enough technology to encounter to the arsenic exposed people. The general awareness by Government, Semi-Government agencies, NGOs and other individual are needed and collective efforts is the only solution of this problem.

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