Arsenic contamination in ground water: Effect on human capital – A literature review

Arundhati Char

Introduction

Water, the epitome of life, defines all form of existence, be it for plants, animals, and social humans. However, with growing population and depleting groundwater, it is fast becoming scarce. The quality of groundwater is also questionable, with hoards of pollutants including biological, toxic, and other wastes feeding into it. Groundwater contamination is persistent across India and affects over 500 million people across 23 districts of India. (1). Bihar and West Bengal are the worst affected in India, with respect to ground water contami-nation, and specific arsenic contamination (defined as the occurrence of high arsenic (0.05 mg/l) in groundwater). It is estimated that the total vulnerable population in Bihar alone is about 10.4 million people, across four districts along the banks of river Ganga (1).

Water contaminations can be of several forms - those caused by geogenic, biogenic and anthropogenic sources. The geogenic contaminants include salinity, iron, fluoride, and arsenic which have a long-term impact on health. Specifically, arsenic contaminated drinking water causes skin pigmentation and skin cancer, and long-term use of fluoride in drinking water leads to tooth decay and crippled bones (3). To put this in perspective, there is a possibility that water could be scarce owing to extremely poor water quality. This could, in turn, limit its availability for both human uses and to the ecosystem as well. A literature review on arsenic contamination on drinking water shows its serious effect on human health. Studies show that arsenic in drinking water can cause cancer. (4, 5, 6). It is also known to have a negative health consequence on the reproductive system, birth defects and harm the central and peripheral nervous system (4). Arsenic exposure during pregnancy can adversely affect several reproductive endpoints (7, 8). The fertilizers used for the agricultural purpose also cause arsenic contamination. A study by Brammer (2008) found that arsenic-polluted water used for agriculture is a health hazard for the people eating food

from the crops irrigated in the areas of India, Bangladesh, and Nepal. (9).

The social impact of arsenic contamination

Arsenic poisoning mostly affects people from the lower socio-economic strata of society. (3). Access to the safe water supply is one of the most important determinants of health and socio-economic development (10). Besides having an impact on health per se, arsenic contamination and exposure cause social problems to humans as well. There is a lack of awareness among communities with regard to the side effects due to arsenic exposure, causing people to often mistake symptoms for leprosy or other contagious skin diseases. This has an impact on marriage prospects, employment, and even the simplest social interaction for the exposed and affected. Besides physical effect, it also has an impact on the mental health of the person, leading to depressing or even suicidal tendencies. Finally, studies have shown that arsenic contamination affects the economically poor, women more than men, young children more than adults. It also leads to social exclusion, and finally overall socio-economic impacts of the affected population (3). In short, one of the gravest impacts of arsenic poisoning is the inability of the affected persons to contribute productively in society.

The economic impact of arsenic contamination

Having understood the health consequences that arsenic contamination has, there is bound to be an economic cost due to this exposure that is important to study. Roy (2008) and Khan (2007) carried out studies based on the economic cost imposed on households due to arsenic contamination in water. The studies found that poor households incurred the largest number of sick days and suggest that children and women are more prone to diseases caused by long term exposure to arsenic. Arsenic groundwater contamination has a severe economic effect on the people residing in the areas where the menace is found. (11, 12). Economic burden of the family with at least one person affected by arsenic poisoning increases. In a state like Bihar which is mainly an agrarian society, arsenic poisoning affects agricultural outputs; due to the various health problems, it affects participation in work and eventually, the expenses related to treatment further increases the economic burden on the already impoverished families. (3). Roy, (2008), estimated the economic costs imposed by arsenic-related health problems, by using the household health production function model and household demand function for mitigating and averting activities to estimate the benefits from a decline in arsenic concentration in groundwater. Primary survey of 473 households (Midnapore and 24 Parganas districts of West Bengal) on three equation system (averting actions, medical expenditures, and a sickness function) was carried out and it was found that if arsenic concentration was reduced to the safe limit of 50 mg/l, the monthly and annual gains per household would be Rs. 297 and Rs. 3,573, respectively, and if the arsenic contamination was reduced by half of the present level, economic benefits would be Rs. 161 and Rs. 1,934 monthly and annually per household, respectively. Poor households incurred the largest number of sick days and person suffering from arsenic disease worked only 2.73 h per day compared to 8 h work per day. (11). Khan (2007) studied health impacts and costs associated with arsenic groundwater contamination using primary data from Bangladesh, where arsenic problem is considered as a major public health concern. The study follows the household production function on 900 tube-wells and 878 households and estimates that 7 to 12

million man-days per year are lost as a result of arsenic exposure and the sick spend between the US $3.5 to $6.25 million per year for medical help. The total cost of illness from arsenic was found to be US $9 to US $17 million per annum which was nearly 0.6 per cent annual income of the affected households. The study finds that the threat of various forms of cancers like Melanosis and Keratosis is high when there is cumulative exposure, and it is more commonly found in the poorer class rather than richer class because richer households are taking mitigation measures to reduce the risk of a health threat. This study also suggests that children and women are more likely to get affected by inflammation of the respiratory tracts which is caused by long term exposure to arsenic. Therefore, economic costs are involved in the arsenic contamination and poor suffer most from that. (12). Khan and Haque (2011) measured the private cost of arsenic exposure in Bangladesh. They found that households spend Bangladesh Taka (BDT) 1,057 per year for arsenic related ailments, which is nearly 0.73 per cent of the income of the household. This is a huge financial burden for poor households, considering that most of the population live on less than $2 a day. (13). Thakur and Gupta (2016), tried to estimate the average health costs that could be attributed to water contamination in Bihar, with inputs from specialist doctors. According to the study, total average health cost of the households for 6 months came to US$ 69.8. The monthly average cost of the households was US$ 11.6 and per person, the household cost was US$ 1.4. (14).

Arsenic contamination and agricultural productivity

While consuming water laced with arsenic poisoning is one way of exposure, arsenic contaminated groundwater used for agricultural irrigation also results in the excessive amount of available arsenic in the crops and thus enters the food chain, particularly use of contaminated rice followed by vegetables. This water contamination leads to decreased agricultural productivity, soil fertility, and also creates health problems with contaminants entering the food chain. (3,9). It has been suggested that the sooner we find a suitable and sustainable solution to resolve this problem, lesser will be its future environmental, health, socio-economic and socio-cultural hazards. (15). There is a possibility that fertilizers and pesticides used for the agricultural purpose also cause arsenic contamination. Rice and vegetables are more affected by arsenic contaminated water. Brammer (2008) in his study suggested that arsenic-polluted water used for agriculture irrigation is a health hazard for the people eating food from the crops irrigated in the areas of India, Bangladesh, and Nepal in recent times (8). This poses a serious risk to sustainable agricultural production and also the livelihoods and health of the affected population (9). There is an urgent need for possible mitigation strategy and measures. Urgent research should be undertaken to find alternative irrigation sources in the affected areas. Second, use of technology to remove contamination of water should be explored. (3).

Conclusion

It is clear that arsenic infested groundwater, as well as its presence in the food chain, is increasing the disease burden and in turn, has a significant socio-economic impact on the population where it exists. This form of water contamination affects more than 70 countries either directly or indirectly, and around 150 million people across the globe. (3). Three countries in south Asia, India, Bangladesh, and Nepal, are affected the most due to arsenic contamination in the groundwater. This, in turn, has a negative impact on the

health and socio-economic outcomes of the population that it affects. While the effects of arsenic poisoning on human health and wellbeing have been well-researched, there need to be concerted efforts to mitigate this condition on an urgent basis. While the urban communities use various means to purify drinking water before consumption, the majority of the rural communities drink water directly from wells, or hand pumps, making them most vulnerable to the ill-effects of arsenic contaminated water. Most of our rural communities (over 70 percent) still depend on groundwater sources for their drinking and cooking purposes (3). In the rural areas, alternative safe sources of both drinking water and water for irrigation need to be determined. It is believed that once groundwater is clear of all its pollutants, soil contamination will also reduce.

Attempts have been made so far to combat the menace of groundwater arsenic contamination, include identifying the causes of contamination, providing arsenic free drinking water to the affected people who depend on the groundwater resources. To reduce the socio-economic problems and to develop cost effective technology for the eradication of arsenic contamination have proven inadequate, fragmented and less responsive, as evident from the rise in a number of arsenic affected areas with every new survey. There is an urgent need to create awareness among people and educate the villagers on the dangers of arsenic toxicity and importance of using arsenic free water. This can only be achieved by active community participation among the affected stakeholders, fully supported by the government and identified stakeholders.

Disclaimer: This work is a review of a few published researches on the topic of Arsenic contamination in India and particularly Bihar state. The author thanks Dr. Barun Thakur and Dr. Vidya Gupta for their kind permission to cite their work throughout this article.

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Arundhati Char is the President and Co-Founder of U-Respect Foundation, a senior social scientist and a PhD holder in Epidemiology and Public Health. Her experience explores into research and program experience in population studies, health policy research, and health communication both in India and Africa. She is also consultant to many bi-lateral and multi-lateral agencies based in India, in strategizing programs, developing monitoring and evaluation tools, carrying out evaluation, and developing advocacy tools for various audiences.