AN OVERVIEW OF ARSENIC POLLUTION IN BARDHHAMAN DISTRICT, WEST BENGAL, ITS IMPACT ON HUMAN HEALTH AND SOME REMEDIAL MEASURES.

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Abstract
Arsenic Pollution in Groundwater is a burning issue to the present world. Major part of India is also affected by Arsenic Pollution. In India nine districts of West Bengal along the river Bhagirathi (Murshidabad, Maldah, Barddhaman, Nadia, Howrah, Hooghly, Kolkata, North 24 Parganas and South 24 Parganas) are affected by arsenic pollution. Five blocks of Barddhaman District (Purbasthali-I,II, Kalna-II and Katwa-I,II blocks) along the river Bhagirathi-Hugli also experience arsenic pollution. There are miserable effects of Arsenic on human health and environment. Poor people mainly women are badly affected by Arsenic Pollution. Govt. and NGO's should take necessary steps to remove the curse of Arsenic from our society.

Key words*: Arsenic Contamination, Groundwater, Human Health.*

Introduction

Arsenic pollution in groundwater is a world-wide issue today. Arsenic pollution has been observed in the USA, Mexico, Argentina, Chile, Ghana, Hungary, Finland, Thailand, Japan, Indonesia, Bangladesh and India (Chattopadhyay et al. 2000).

In India nine districts of West Bengal along the river Bhagirathi (Murshidabad, Maldah, Barddhaman, Nadia, Howrah, Hooghly, Kolkata, North 24 Parganas and South 24 Parganas) are affected by arsenic pollution. Five blocks of Barddhaman District (Purbasthali-I,II, Kalna-II and Katwa-I,II blocks) along the river Bhagirathi-Hugli also experience arsenic pollution.

Arsenic contamination of groundwater is often due to naturally occurring high concentrations of arsenic in deeper levels of groundwater. It is a high-profile problem due to the use of deep tubewells for water supply in the Ganges Delta, causing serious arsenic poisoning to large numbers of people. A 2007 study found that over 137 million people in more than 70 countries are probably affected by arsenic poisoning of drinking water.

Arsenic pollution was first detected in 1983 in district Barddhaman of West Bengal. At present arsenic concentration is also found in the adjacent blocks of Kalna-II and Katwa-I, II. There are as many as 45 mouzas in Purbasthali-I, II blocks, 21 mouzas in Kalna-II block and 6 mouzas and two municipalities, Katwa and Dainhat in Katwa-I, II blocks which experience arsenic concentration in groundwater.

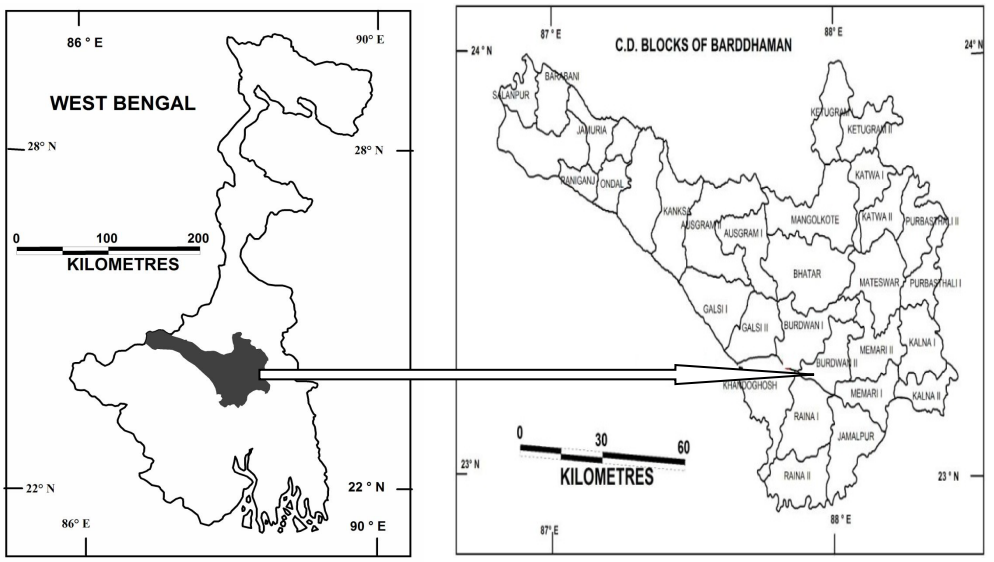
In West Bengal, during 1980s, some cases of arsenical dermatosis in the districts of North 24 Parganas, South 24 Parganas, Nadia, Murshidabad and Burdwan were reported. By the end of December 2001, this problem spreads from few villages to 2065 villages of 75 blocks in 8 districts. About 10 % of the total population of the State is exposed to the above risk.

Study Area

The study area selected for the study is Bardhhaman District, West Bengal. Burdwan (also called Bardhaman /Barddhaman) district of West Bengal is situated between the Latitude 23.53^{o} N, 22.56^{o} S and Longitude 83.25^{o} E, 86.48^{o} E. It is bound on the north by Dumka of

Jharkhand, Birbhum and Murshidabad districts, on the east by Nadia; on the south by Hoogly and Bankura, and on the west by Dhanbad district of Jharkhand. It has 32 blocks, 278 GPs and 2488 inhabited villages. There are nine municipalities in Burdwan district. Extending over an area of 7024 km^2, the district has 69,19,698 inhabitants (36,02,675 are males and 33,17,023 females).

Figure 1. Location Map of the study area



Objectives

The main objectives of the study are: To Analyse the spatial distribution of Groundwater arsenic contamination of Bardhaman district, West Bengal. To assess the impact of Arsenic pollution on Human health and To find some remedial measures for Arsenic Pollution.

Methodology

In this research work spatial occurrence of arsenic pollution in Bardhhaman District and its effect on human health have been emphasised. Spatial and temporal data on Arsenic concentration of Groundwater has been collected from SWID. Public health related data have been collected from Public health and Engineering Department, West Bengal. Socio economic survey has been conducted in Some Arsenic affected areas of Bardhhaman District.

Source of Arsenic in Ground Water

1. The source of arsenic in groundwater can be traced out by establishing the relations between the river system (drainage pattern), the area from where the rivers brought sediments i.e., parent materials. In this regard Geological Survey of India and Central Ground Water Board have done commendable job and come out with certain findings.

2.The problem of groundwater pollution by arsenic is found in the inter fluvial region of the Bhagirathi-Hugli and the Jalangi-Ichamati rivers lying mostly in the eastern part of the Bhagirathi-Hugli river of West Bengal. The arsenic contamination in ground water beyond permissible limit of 0.05mg/l has been found within the shallow aquifer (20-60m

below ground level). Apart from this area, other areas where higher incidence of Arsenic has been reported are four blocks (adjacent to the river Ganga) in Malda district, Purbasthali block of Bardhaman district and Balagarh block of Hugli district.

3. During the phases of deltaic sedimentation in the southeastern part of West Bengal, rest of the Bengal shelf was under the influence of fresh water sedimentation. The system of rivers responsible for this fresh water sedimentation could be the precursor of the Ganga, which might have been flowing into the Bengal plains through the Garo-Rajmahal gap. A number of rivers like the Damodar, the Rupnarayan etc. flowing in the Bengal plains in a south easterly direction for a considerable distance turn sharply to the south in the southern part of West Bengal. Thus the present drainage pattern responsible for sub-recent to recent sedimentation in West Bengal might have been caused due to 1) a regional south easterly slope of the basin, caused to some extent, by movements on the hinge-zone located at the edge of the shelf and 2) an increasing rate of southerly tilt of the West Bengal part of the basin due to relatively greater rate of subsidence of the southern part of the hinge through the Tertiary and recent times.

Causes of High incidence of Arsenic in Groundwater

Some of the research workers believe that leaching of arsenic in groundwater seems to have been influenced by the number of interacting factors. During the eighties there was a remarkable change in the minor irrigation sector due to rapid growth in Agro-commercialisation. Cultivation of Summer Paddy (Boro)" expanded in the seven districts of South Bengal with an unpredictable rate each year. The Boro cropping is almost dependent on the tube well irrigation. Immediate manifestation of that agro practice was lowering of ground water level at alarming rate.

The ground water occurring mainly within the shallow zone (20-60m bgl) is characterized by high arsenic(>0.5 to 1 or above mg/l) and the principal source of arsenic is the arsenic sulphides minerals deposited along with clay, peat, with iron in the reducing environment. The lowering of groundwater at rapid rate during summer season causes aeration of aquifer oxidized the arsenic sulphides, makes it water soluble. It percolates from the subsoil into water table during monsoon.

However, the cause of arsenic contamination in ground water is still a debatable topic. Hence, it is necessary to study extensively the groundwater reservoir condition, mode of recharge-discharge relationship, groundwater movement characteristics in time and space and to determine dissolved oxygen and oxidation –reduction potential in groundwater to appreciate the cause of such arsenic concentration in groundwater.

Arsenic pollution in Barddhaman district

Arsenic pollution was first detected in 1983 in district Barddhaman of West Bengal. At present arsenic concentration is also found in the adjacent blocks of Kalna-II and Katwa-I, II. There are as many as 45 mouzas in Purbasthali-I, II blocks, 21 mouzas in Kalna-II block and 6 mouzas and two municipalities, Katwa and Dainhat in Katwa-I, II blocks which experience arsenic concentration in groundwater. Level of arsenic concentration in Barddhaman district In Barddhaman district level of arsenic concentration often (>90% samples) crosses the permissible limit prescribed by WHO (0.01ppm). In Purbasthali and Katwa police stations nearly 40%- 50% sample sites and in Kalna police station about 87% sample sites experience low arsenic concentration (<0.05ppm) in groundwater . It is found over 80%-90% sample sites of Katwa and Purbasthali police stations and 40% sample sites of Kalna police station. Both drinking water and irrigation

water are tapped from this depth. Arsenic concentration has also been found at 60m-75m depth and sometimes at 100m depth over 60% sample sites in Kalna police station and over 10%-15% sites in Katwa and Purbasthali police stations. So lithologs show that arsenic often occurs either at first aquifer layer (15m-30m) or at middle aquifer layer (30m-60m). It may occur within fine sand layer, coarse sand layer or clay layer.

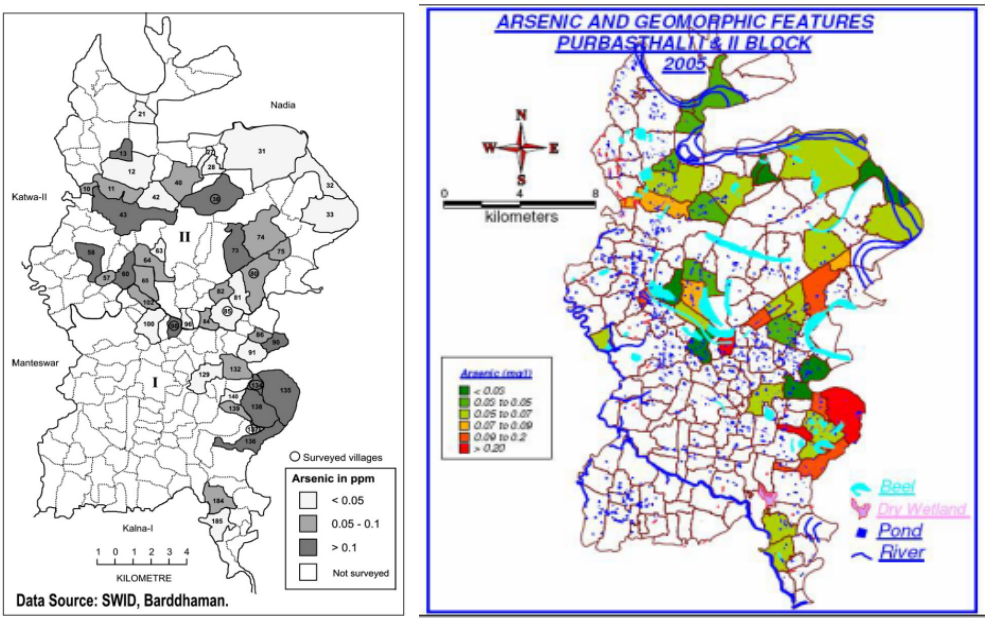


Figure 2. Arsenic Concentration in Groundwater at Purbasthali, Bardhaman District.

Figure 3. Purbasthali Block of Bardhhaman Dist.

Location of arsenic pollution

It has been found that arsenic occurs in groundwater mainly in areas like-
At Nimdaho Gram Panchayat Village Ukhura, Purbasthali I, amount of Arsenic tested in different habitation is 0.118 mg/lt, 0.128,0.105, 0.090 mg/lt. Village Nakadaha (JL NO 0044) shows arsenic concentration of 0.131 -0.154 mg/ lt. In village Chupi (JL No 0079) amount of Arsenic found is 0.326 mg/lt. Village Baradamas(JL no 0122), Block Kalna II shows shows Arsenic amount of 0.017 mg/lt. Different habitations of Bundebaj Village of Kalna II block shows 0.129,0.154,0.620 mg/Lt Arsenic concentration. Bikihat village (JL No 26) of Khardihi GP of Katwa I block shows 0.067 – 0.108 mg/Lt of Arsenic. Along bil or low-lying flood-prone waterlogged areas, e.g, villages like Kubrajpur (JL 57), Dhitpur (JL 64) of Purbasthali-II block are located at low-lying waterlogged areas and Kobla (JL 138), Haripur (JL 102) of Purbasthali-I .

Effect of Arsenic on Human Health

Long-term exposure to arsenic in drinking water can cause cancer in the skin, lungs, bladder and kidney. It can also cause other skin changes such as thickening and pigmentation. The likelihood of effects is related to the level of exposure to arsenic and in areas where drinking water is heavily contaminated, these effects can be seen in many individuals in the population. Increased risks of lung and bladder cancer and skin changes have been reported in people ingesting arsenic in drinking water at concentrations of 50 µg/litre, or even lower.
Exposure to arsenic in the workplace by inhalation can also cause lung cancer. The likelihood of cancer is related to the level and duration of exposure. Increased risks of lung cancer have been observed at exposure levels that add up to more than 750 (µg/m^3).year. This figure is obtained by multiplying the average concentration in the workplace by the number of years of exposure (for example, 15 years of exposure to a workroom air concentration of 50 µg/m^3 corresponds to 750 (µg/m^3).year).
Soluble inorganic arsenic is acutely toxic, and ingestion of large doses leads to gastrointestinal symptoms, disturbances of cardiovascular and nervous system functions, and eventually death. In survivors, bone marrow depression, haemolysis, hepatomegaly, melanosis, polyneuropathy and encephalopathy may be observed.
Conclusions on the causality of the relationship between arsenic exposure and other health effects are less clear-cut. The evidence is strongest for hypertension and cardiovascular disease, suggestive for diabetes and reproductive effects and weak for cerebrovascular disease, long-term neurological effects, and cancer at sites other than lung, bladder, kidney and skin (IPCS,Environmental health criteria for Arsenic and Arsenic Compounds, EHC 224.Chapter 1)

Remedial Measures for Arsenic Pollution

Using activated alumina in water to absorb arsenic (Prabhu and Philip, 2000). Simple filtration through iron-filling. Arsenic is oxidized by iron oxides into arsenopyrites, then precipitates and is tapped in sand filter (Ahmed and Aliw, 2000). Other methods of removing arsenic from water are ion exchange, lime softening, coagulation, reverse osmosis, nanofiltration, electrolysis etc. (Chakraborty, 2000). Besides direct removal of arsenic from water, precautions can be adopted to resist further arsenic contamination in water: Aquifer zone at deepest level should be tapped rather than tapping several zones within same aquifer (Muralidharan, 1998). Cement sealing at middle layer contaminated aquifer can be practised to avoid any leakage (Muralidharan, 1998). Construction of artificial groundwater

recharge points, check dam, percolation tank etc, may raise the water level (Chappel, 2000).

Some measures should be taken by the govt. as well as the people of affected area Regular checking of nail, hair, and urine where arsenic concentration is manifested first (Chakraborty, 1998). Establishment of water analysis laboratory at block level in arsenic affected areas (Chakraborty, 1998). Boiling of water before drinking. A 25 minute boiling of water makes 64% loss of arsenic (Chatterjee, et al., 2000).

Findings and Conclusion

From the research work it is seen that mainly Kalna- I, Kalna –II, Katwa –I, II and Purbasthali I and II blocks are mainly Arsenic contaminated blocks. Victims are mainly undernourished, poor people of remote villages in Purbasthali-I,II blocks deprived of minimum transport, education, medical and marketing facilities. Among them Mandra, Kalyanpur, Phaleya villages are mention-worthy. About 20,000 inhabitants of the block suffer from prolonged weakness, conjunctival congestion, hyperpigmentation, keratosis, respiratory system disorder, hepatomegaly, portal hypertension, polyneuropathy, malignant neoplasm and edema of limbs. Suggested remedies include restricting groundwater use, abandoning affected aquifers, and microbially induced in-situ bioremediation. This paper argues that Arsenic in ground water is mainly confined to the shallow aquifers located in the abandoned channels of Bhagirathi River and poor people are mostly affected.

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