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Arsenic Contamination of Groundwater and its Socio-Economic impacts in West Bengal

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Abstract: *Chronic exposure to Arsenic (As) can cause not only the cancerous and non-cancerous health scenario but affects the socio-economic structure of any society also. Arsenic in groundwater above the maximum permissible limit of 0.05 mg 1-1 by WHO has been found in six districts of West Bengal covering an area of 34000 km² with a population of 30 million. At present, 37 administrative blocks in West Bengal along the River Ganga and adjoining areas are seriously affected. During last two decades, As-contamination via groundwater harvesting has become a serious worldwide issue and is now a major concern in the Bengal delta. Arsenic enters human body through contaminated groundwater by directly consumption of groundwater. Recent reports reveal the fact that about 20 % of the total population in West Bengal is highly affected by arsenic which is an alarming one. Various techniques are being introduced to provide arsenic-free drinking water at an affordable cost by both the central and state govt. from time to time. Nadia district in West Bengal is suffering seriously from As- contamination and becoming vulnerable day by day. Malnutrition, poor socio-economic conditions, illiteracy, food habits and intake of As-contaminated water for many years have aggravated the arsenic toxicity in so many districts in West Bengal where major water demands are met from groundwater; the geochemical reaction and many more reasons behind this increasing rate of As-contamination and their impact on the socio-economic structure of the affected regions have been highlighted in this article. Here, the author also has tried to reduce the vulnerability of increasing As-contamination in groundwater in West Bengal by proposing some remedial measures*

Key Words: ***Arsenic****, Gangetic delta, chronic exposure, malnutrition, arsenic toxicity*

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I. Introduction

Over the past two or three decades, occurrence of high concentrations of arsenic in drinking-water has been recognized as a major public-health concern in several parts of the world. There are many clinical manifestations but the most commonly observed symptoms of chronic arsenic poisoning are conjunctivitis, melanises and hyperkeratosis. The problem of arsenic contamination in ground- water in six districts of West Bengal, India that we will describe in this paper is many times more severe than any incident previously reported. The total population drinking arsenic contaminated water, and the number of people showing arsenical clinical manifestations in these six districts, are much higher than those hitherto known from all other studies. We will describe the suffering of people drinking arsenic contaminated water, and also the arsenic concentrations in water and hair, nails, skin-scale, urine and liver tissues (biopsy sample) of affected people. We will also describe the probable source of arsenic, its mineralogy.World Health Organization (Flanagan et al, 2012) (10 µg/liter); more than 95 % of them live in West Bengal (SOES, 2010).Several studies have suggested a strong association between poor nutritional status with clinical manifestations of chronic arsenicosis, resulted less detoxification in the liver and impaired urinary elimination of arsenic (Rahman et al., 2001; Haque et al., 2003; Mitra et al.,2004).The West Bengal alluvial plain is composed of three interconnected aquifer systems: the shallowest aquifer (extending up to 12-15 meters below the surface), the intermediate aquifer (35-46 meters), and the lower aquifer (70-150 meters). However, humans are facing higher As-exposure through the tapping of groundwater sources after the introduction of domestic hand pumps and irrigation wells (Nickson et al., 2000).

SOURCE OF ARSENIC IN GROUNDWATER :

The source of arsenic is geogenic. Arsenic is present in alluvial sediment of the Delta. The mechanism and cause of arsenic leaching from source has not yet been established.According to Acharyya et al. (2000); Saha et al. (1997), the source of arsenic in grounwater of lower gangetic delta is considered to be the arsenic-rich sediments, transported from the Chotonagpur-Rajmahal highlands and deposited in sluggish streams under reducing conditions. Continued extensive pumping triggered the reduction process by inducing movement of groundwater having highly reducing degraded organic products (Acharyya, 2006).

Theories like:
Carbon reduction (Ashraf et al., 2002)
Microbial reduction (Chatterjee et al., 2004; Yoshimura et al., 2004) is suggested by different authors.

STRETCH OF ARSENIC POLLUTION IN WEST BENGAL :

From the overall study on As in West Bengal and Bangladesh, it is revealed that the magnitude of the groundwater contamination is severe (Pearce, 1998; Smith et al., 2000).

Garai et al. (1984) reported 16 patients in three families from one village of 24 Parganas District. Saha (1984) further reported 127 patients with arsenical skin lesions.

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.

Ground water having higher concentration of arsenic generally occurs within 20 – 80 M depth zone.In the combined areas of West Bengal and Bangladesh (Ganga-Padma–Bramhaputra delta), around 150 million people are at risk from arsenic-contaminated groundwater.

The estimated population drinking Arsenic-contaminated water above 10 and 50µg/L were ~9.5 and ~4.6 million respectively. In West Bengal alone, 26 million people are potentially at risk from drinking Arsenic-contaminated water above 10 µg/L (Chakraborti, 2003).

Based on Arsenic concentrations, West Bengal was classified into three zones: highly affected 9 districts (Malda, Murshidabad, Nadia, North-24-Parganas, South-24-Parganas, Bardhaman, Howrah, Hoogly and Kolkata, mainly in eastern side of Bhagirathi River) where average arsenic load is > 50 µg/L (upto 300 µg/L) can be found in tube-wells; mildly affected 5 districts (in northern part) where average Arsenic load in tube-wells was below 50 µg/L (a few above 50 µg/L but all < 100 µg/L) and Arsenic-safe 5 districts (mostly <3 µg/L) in western part.

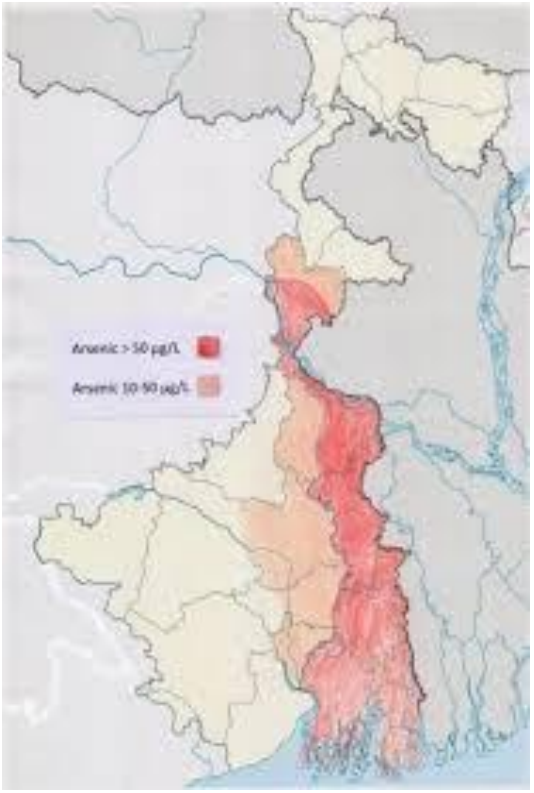

Fig. 1: Arsenic contaminated groundwater of West Bengal

Fig 2:Effect of arsenic exposure on humans

ARSENIC POISONING

1. Bioaccumulation in plant :

In general plants takes up As(V) by phosphate transporter channels in plants grown on aerobic soils and metabolize it through phosphate transport channels (Tripathi et al., 2005).At higher concentrations, Arsenic has inhibiting effects towards plant metabolic processes growth (Marques and Anderson, 1986). At high concentrations, Arsenate in plants inhibits photosynthesis through interference of the pentose–phosphate pathway (Tu and Ma, 2002; Adriano, 2001).

Some common plants of Bengal like Indian mustard (Brassica juncea), kachusak (Colocasiaantiquoram) and Kalmisak (Ipomeareptans) have moderate arsenic accumulation capacity (Nickson et al., 1998). Food parts (e.g. potato skin, leafy vegetables, rice, wheat, cumin, turmeric powder and cereals) collected from the arsenic affected sites of the Murshidabad district of West Bengal, contained upto 373µgKg-1 (Goessler and Kuehnelt, 2002).

2. Arsenic in human body :

Several studies in humans indicate that both Soluble Arsenic compounds [also the organoarsenicals] are well absorbed across the gastrointestinal tract (Hindmarsh and McCurdy, 1986; Bettley and O'Shea, 1975). Urinary excretion account for 55-80 % of daily intakes of inorganic Arsenic in humans (Buchet et al., 1981; Crecelius, 1977; Mappes, 1977).Arsenic concentration in the hair, nail and urine is established as biomarkers for arsenic contamination (Chakraborti, 2003).

3. 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. 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. 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.

4.Social Problem and Awareness :

Arsenic affected people are also facing serious social problems. The affected villagers are living in very poor conditions.A few people are aware of arsenic pollution and its impacts on the human health. 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. 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.

II. Discussion And Conclusions

Arsenic contamination has been spreading to newer areas and at the present situation, approximately 450 million people living in the Ganga-Meghna-Brahmaputra delta, is at risk (Maeda, 1994).

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 contaminateddrinking water.It is also needed desperately to increase awareness and educate the people about the serious problem.Rainwater harvesting is a common technology used for collection and storage of rainwater. In many states of India mostly in the eastern parts, the average annual rainfall in eastern part of India is about 2,000 mm/year (Tripathi et al., 2005). So rain-water harvesting followed by proper purification can be used as a very cost-effective measure of gettingArsenic free drinking 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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