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Review Paper

Arsenic Pollution Scenario in Eastern UP, India: A Review

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Abstract

In recent decades, arsenic pollution is being reported from the eastern region of Uttar Pradesh State after than West Bengal and Bangladesh. There has been wide spread of arsenic contaminated soil in India, of which the eastern district of Uttar Pradesh (UP) is least focused. Very recently it is reported that the 20 districts of UP are severely in toxic zone of arsenic contamination (above 0.05mg/L), where arsenic presence has been found to be more than five times of permissible limit. The districts (Ballia, Ghazipur and Varanasi) of Uttar-Pradesh were found to contain arsenic concentration exceeds from 10 mg L^{-1} *which is a WHO recommended provisional guideline value of arsenic in drinking water. Humans, plants and animals from these villages are exposed to the grave danger of Arsenic poisoning as this problem is largely unrecognized and unaware. Therefore, there is an urgent need for detailed study and mitigation endeavor from arsenic pollution. This paper intends to give an overview of the arsenic contamination in eastern U.P. and the research work carried till date.*

Keywords: Arsenic, Uttar Pradesh, soil, water.

Introduction

Access to pure water either for drinking or agricultural purpose is a first goal and a key target for every nation. But due to some natural and anthropogenic reason it's still challenge for many countries. The pollution of soil and water with Arsenic(As) is one of the most important environmental problems globally. Natural as well as anthropogenic activities are the main reason for a coverlet of arsenic contamination in ground water and soil. These contaminated ground water and soil are the major source of arsenic in food chain and other food trophic level[1]. Presence of Arsenic considered as one of the hazardous elements in the environment and exposure of it causes serious health issues arise like cardiovascular, neurological, hematological, renal, and respiratory problems. Groundwater Arsenic contamination in Eastern Gangetic River Basin reported worldwide in recent studies which causes many adverse effects not only for drinking but also for irrigation purpose. Accumulation of arsenic in soil through contaminated ground water during irrigation, which is uptake by many edible parts of plants and subsequently transferred in other food chain. Uttar Pradesh and Bihar situated in the middle and upper Gangetic belt. According to Chakraborti et al.[2] surveyed report on the in the Ganga–Meghna–Brahmaputra (GMB) region, a large population nearly 500 million people are facing arsenic problem having in area approx 500,000km^2.

The conversion of arsenic oxidation state and their presence in ground water or soil depends upon various environmental conditions. It can be recognized in three forms: Inorganic, organic, and arsine gas. Arsenic presents as in trivalent (+3) oxidation state (like arsenic trioxide, sodium arsenite, and arsenic trichloride) and in pentavalent (+5) state (like arsenates, arsenic pentoxide and arsenic acid). Interconversion of Arsenate form (+5) into arsenite form (+3) conditionally in oxidized and reduced condition, which is the most toxic form of arsenic. The conversion of more toxic inorganic form to less toxic organo-arsenic compound such as disodiummethylarsenate (DSMA) and monosodium methylarsenate (MSMA) formation via organism known as Biomethylation[3].

Hypothesis: Distribution of Arsenic in Ganga River Basin: The River Ganges is very complicated hydrology and geological point of view in the Ganges Delta region. The Ganga river basin and its tributaries spread on a very large coverage area in India and Bangladesh. It spread and bed covering four countries (China, Nepal, India and Bangladesh) and eleven states of India (West Bengal, Himanchal Pradesh, Uttarakhand, Madhya Pradesh, Chattisgarh, Uttar Pradesh, Bihar, Jharkhand, Punjab, Haryana, Rajasthan and Territory of Delhi. Combinedly the Ganges Meghna Brahmaputra (GMB) basin is a bed covering across Bangladesh, Bhutan, India, Nepal, and China. From the origin Gangotri glacier Ganga river water discharge passover into three segments. It extended as upper, middle and lower Gangetic belt. Uttar Pradesh comes under upper and Middle Ganga plain. Himalayan Mountain and Tibet plateau, consider as the biggest source of arsenic contamination in the Gangetic region and this contamination are evidently becoming life threatening in almost every year[4]. Geographically Uttar Pradesh situated in the northern region of India and border of Nepal. The river Ganga and Ghaghara are two major river flows from northeast to southeast. First time in UP arsenic introduced as a contaminant in Ballia district in 2003[5].

Status of Arsenic Contamination in Eastern U.P.: In U.P. Jal Nigam and UNICEF combinedly reported and identified in 18 districts. Arsenic above the 50 ppb limit for drinking and Arsenic according to WHO limit was found in 31 districts[6,7].

Times of India also reported "Ground water arsenic contamination of Uttar Pradesh exceeds to the value of BIS (Bureau of Indian Standards) permissible limit of 0.01 mg/liter across 31 districts of the state.

Yano et. al., reported alarming situation and highly contaminated districts are Bahraich, Ballia and Lakhimpur Kheri among than Ambedkar Nagar, Bareli, Basti, Bijnaor, Chaudauli, Faizabad, Ghazipur, Gorakhpur, Meerut, Sant Ravidar Nagar, Shahjahanpur, Siddarth Nagar, Sitapur, Unnao and Kanpur[5]. (Table-1)

Table-1
Category of Arsenic affected districts

Category for toxic	Range of toxicity	Arsenic contaminated districts
Highly toxic	0.04 mg/l to 0.05 mg/l	Faizabad, Kanpur Nagar and Sitapur
Dangerously toxic	0.01mg/l to 0.04mg/l	Ambedkarnagar, Baghpat, Budaun, Lucknow and Pilibhit
Toxic	Around 0.01mg/l	Kaushambi, Saharanpur and Sultanpur
Worst Toxic	>0.01mg/l	Ballia, Bahraich and Lakhimpur-Kheri

Arsenic contamination in Ballia district: District Ballia is located in the eastern part of UP with shared in 17 blocks. The Ganga is main river basin and also drained with river Ghagra on the north and Chhoti Sargu in the south[9]. Agriculture is the main activity (72%) because of having high poverty (nearly 44%) and 58% low literacy rate. For irrigation purpose people depend on ground water, tubewell and number of tal and canals like surha tal, sikandarpur tal. In Ballia contamination of arsenic compared as west Bengal where arsenic exceeding 50 µg/l. District Laboratory of U.P. Jal Nigam also Confirmed Arsenic confirmatory tests by spectrophotometer.

High arsenic concentration has been found in all 16 blocks out of 17 blocks of ground water on Belthara Road, Nagra, Rasra, Chilkahar, Pandah, Navanagar, Beruarwari, Gharwar, Hanumanganj, Maniyar, Sohaon, Dubhad, Bansdeeh Revati, Beriya, Belhari and Murlichapra blocks from 14 to 820 ppb which is much higher than prescribed drinking value by WHO[10]. The Arsenic Task Force (ATF) has been reported that the presence of poisonous arsenic affected approximately 1.20 lakh people in 55 villages of three blocks (Revti, Dubahar,Belhra) in Ballia[11].

Recently Chaurasiya et al.[7] reported Arsenic concentration ranges above limit at belhri block in 50 tube well water samples and reported Arsenic above 10µg/L (94%), between 10 to 50µg/L (34%), above 50µg/L (60%) in drinking water samples[7]. The presence of arsenic in ballia found nearly in all blocks and many of their villages which are not uniformly distributed.

Arsenic contamination in Ghazipur district: Ghazipur city is a part of the middle Ganga basin in eastern U.P. This city drained parallel to the Ganga river[1]. Arsenic concentration in Ghazipur city distributed in many blocks of villages nearly ranges from 47.4 ppb to 96 ppb in ground water[12] which is high and above to prescribed drinking water level by WHO and BIS. (Table 2)

Table-2
Ground water quality of Ghazipur district[12]

Ghazipur City/Blocks	As(ppb)
Karkatpur	92.2±2.59
Sherpur Tulshipur	74.4±1.03
Bhagirathpur	91.0±2.29
Garuamakshudpur	87.8±2.96
Reotipur	74.2±1.09
Medanipur	79.8±0.67
Suhawal	47.4±0.13
Kalyanpur	89.0±0.7
Gaurahat	96.0±1.395
Sukhadeara	92.8±1.127

Arsenic contamination in Varanasi district: Shah, 2010 reported the level of arsenic contaminated of tube-wells in, Bhojpur Bahadurpur, Madhiya (>50 µg/l) Semra, Jalilpur, Ratanpur, Kateswar, Bhakhara and Kodupur (>10µg/l) villages of Varanasi[13]. These all villages situated on the eastern side of the Ganga River.

Arsenic contamination in Bahraich district: In Bahraich arsenic contamination have been found 10 blocks of villages (Balaha, Mahasi, Jarwal, Chitaura, Kaiserganj, Phakharpur, Mihinpurwa, Shivpur, Huzoorpur, Tejwapur) out of 14 blocks.[5,8]

Arsenic contamination in Kanpur, Unnao and Allahabad, district: Chakraborti et al. revealed ground water contaminated with in the district of Kanpur (Gangaghat, Sikandarpur Sarosi Sikandarpur, Achalagan blocks), Unnao (Kanpur urban comes in unnao distric) and Allahabad (Kunda, Nababganj and Kariahara block) district where the level of arsenic exceed from the value of 50 mg/l. Tripathi et al. found the presence of arsenic in drinking water supplies ,hair and nails at Kanpur in five divisions (Vajidpur, Panki block C, J.K. colony, Dadanagar and Motinagar) and reported the level of contamination in water, hair and nail were 2.4331, 0.5332 and 0.40604 ppm respectively[3] (table-3).

Table-3
Arsenic contamination in Kanpur, Unnao and Allahabad, district

District	Affected Block	Nature of sample	As level	References
Ballia	Chain chapara	water	Up to 110 ppb	6
Ballia	Belhara road	water	14-820 ppb	7,10
Ballia	Rasara,Chilkahar Pandah	water	23-180 ppb	10
Ballia	Navanagar Hanumanganz	water	181-360 ppb	10
Ballia	Maniyar and Sohaon	water	361-540 ppb	10
Ballia	Dubhad	water	541-720 ppb	10
Ballia	Bairiya	water	721-820 ppb	10
Ballia	Sohaon	water	36.94 ppb	1
Ballia	Sohaon	Soil	14.08 ppm	1
Ballia	Haldi	water	310.15 ppb	1
Ballia	Haldi	soil	9.82 ppm	1
Ghazipur	Karkatpur	Water	257.21 ppb	1
Ghazipur	Karkatpur	Soil	9.24 ppm	1
Ghazipur	Dharmarpur	Water	401.75 ppb	1
Ghazipur	Dharmarpur	Soil	11.32 ppm	1
Varanasi	Bahadurpur Maldhiya bhojpur	water	>50ppb	13
Varanasi	Jalipur, Kateswar Bhakhara kodupur	water	>10ppb	13
Behraich	Balaha, Mahasi, Jarwal. Chitaura, Kaiserganj, Phakharpur, Mihinpurwa, Shivpur, Huzoorpur, Tejwapur	water	10-100ppb	5,8
Allahabad	Kunda, Nababganj Kariahara	water	>50ppm	4
Kanpur	Gangaghat, Sikandarpur Sarosi Sikandarpur, Achalagan blocks	water	>50ppm	4
Unnao	Kanpur urban	water	>50ppm	4

Conclusion

Either report of arsenic contamination in 20 and 31 districts, there is not more study and researches going on in Uttar Pradesh as West Bengal and Bangladesh. Evaluation according to WHO guideline, it is clear that maximum districts of UP has been strongly affected out of range to arsenic contamination. After acceptance of arsenic trouble in West Bengal and Bangladesh the other states have been distinguished out of which Uttar Pradesh and Bihar to be a major concern. After being spread of arsenic contamination in soil and ground water in the eastern district of Uttar Pradesh is least focused. Arsenic contamination has been proven by a lot of researches and awareness program in West Bengal and Bangladesh but in Uttar Pradesh villagers are still facing problem of Arsenic contamination in soil, water and crops because the problem is not so much focused as research point of view.

Recommendation: As per the above survey many states especially eastern Uttar Pradesh districts are yet unexplored on the basis of arsenic contamination survey. The More severe survey on large scale is needed to determine the extent to which regions are affected to arsenic contamination.

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