Arsenic Contamination at District Ballia (U.P.), India

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Abstract: Present days arsenic contamination in ground water and its affect to human life have been one of the serious problems of world. The contamination of drinking water supplies with natural occurring arsenic is major health problem. In the present paper, authors have studied the arsenic contamination at district Ballia (U.P.), India. The complete study is divided in three regions of arsenic namely Region-I (safe region of the arsenic), Region-II (low risk region of arsenic) and Region-III (high risk region of arsenic). For this, authors selected six study sites of district Ballia with two types of samples from shallow water and deep (India mark II) water. Results are presented in the tabular form and show that Dubhar, Belhari, Rewati, Maniar, Sikandarpur and Bairia are under Region-III and the ground water of Dubhar, Belhari, Rewati, Maniar, Sikandarpur and Bairia is not fit for drinking without processing.

Keywords: Arsenic; Contamination; Ballia; Wagtech Digital Arsenator

Introduction: Consumption of arsenic contaminated water causes neurological problems, skin cancer, skin eczema, sensory disorder, pulmonary insufficiency, hypertension, acute renal failure, leukemia and peripheral vascular disease. The process of the development of human body is also affected by consuming contaminated arsenic water. Acharyya [1] discussed the source and mobilization process of arsenic contamination in ground water which affecting major parts of the Southern West Bengal and Western Chattisgarh. Bates et al. [2] studied the bladder cancer due to arsenic in drinking water. Bhattacharjee et al. [3] determined the metal contents in the groundwater of Sahebgunj district, Jharkhand, India, with special reference to arsenic.

Arsenic exposure through groundwater to the rural and urban population in the Allahabad-Kanpur track in the upper Ganga plain was discussed by Chakraborti et al. [4]. Chatterjee et al. [5] discovered ground water contamination by arsenic in the residential area of Behala, Calcutta due to industrial pollution. Chatterjee et al. [6] studied the effect of arsenic in groundwater in six districts of West Bengal, India and determined that arsenic species are present in the drinking water and urine of the affected people of West Bengal. Chaudhary et al. [7] examined the ground water contamination in Ludhiana, Punjab, India.

Chaurasia et al. [8] gave a review on fingure print of arsenic contaminated water in India. Cancer potential in liver, lung, bladder and kidney due to ingested inorganic arsenic in drinking water was discussed by Chen et al. [9]. Chowdhury et al. [10] calculated ground water arsenic contamination in Bangladesh and West Bengal, India. Das et al. [11] analyzed arsenic in ground water in six districts of West Bengal, India. Das et al. [12] studied the effect of arsenic in ground water in six districts of West Bengal, India and determined that arsenic concentration was present in drinking water, hair, nail, urine, skin scale and liver tissues (biopsy) of the affected people of six districts of West Bengal, India. Dhar [13] showed that arsenic contamination of ground water is a major public problem in Bangladesh.

A review of the arsenic cycle in natural waters was given by Ferguson and Gavis [14]. Keya [15] discussed the mental health of arsenic victims in Bangladesh. Mandal and Suzuki [16] gave a review on the topic arsenic round the world. A case study of arsenic pollution of groundwater in parts of West Bengal was given by Mukopadhyay and Ghosh [17]. Nahar [18] examined some villages of Bangladesh and gave the impact of arsenic contamination in groundwater of these villages. Worldwide occurrences of arsenic in ground water were studied by Nordstorm [19]. Safiullah [20] gave an overview on the arsenic pollution in the groundwater in Bangladesh. Sarker and Mohiudin [21] discussed the impact of arsenic contamination in ground water on the socio-economic and cultural life of the people of Bangladesh. Arsenic contamination and its management were studied by Singh et al. [22].

Smedley and Kinniburgh [23] gave a review on the source, behavior and distribution of arsenic in natural waters. Smith et al. [24] determined that the people of Bangladesh are affected by many skin diseases due to contamination of drinking water by arsenic and very much needed for public health emergency. Tripathi and Dwiwedi [25] studied the effect of arsenic in groundwater of adjoining areas of Gorakhpur district (U.P.), India. Wyllie [26] gave an investigation of the source of arsenic in well water. Singh and Singh [27] discussed the problem of arsenic contamination in ground water of Ballia, Uttar Pradesh state, India. Katiyar and Singh [28] exposed the existence of arsenic in drinking water of the population of Ballia district and determined its correlation with blood arsenic level.

The main aim of this paper is to determine the effect of arsenic contamination at district Ballia (U.P.), India.

Material and Methods: Six study sites (Dubhar, Belhari, Rewati, Maniar, Sikandarpur and Bairia) were selected from the district Ballia (U.P.), India for this study. There are two types of samples namely Shallow and Deep (India Mark II) of water are taken from each study sites. Total twelve samples were collected. Samples were collected during the summer seasons in the months of June 2019 to August 2019 because in this time period water label remains lower. Authors have considered following important precautions in collecting the samples of water.

- Water samples were collected in neat, clean and transparence plastic bottles with tight bottles cap.
- Gloves were used by authors when collecting these samples.
- Samples were collected after ten minutes operating the pumps in order to get the fresh water.
- Samples were kept in dark places to avoid direct sunlight because some changes might

All the collected samples are tested for arsenic determination in "Pollution and Environment Assay Research Laboratory (PEARL)" of D.D.U. Gorakhpur University, Gorakhpur (U.P.), India under the supervision of Anil Kumar Dwivedi. The reading of arsenic obtained using "Wagtech Digital Arsenator" (see Fig. 1) which has 1 ppb-500 ppb (parts per billion) range and present in the "Pollution and Environment Assay Research Laboratory (PEARL)" of D.D.U. Gorakhpur University, Gorakhpur (U.P.), India.

Fig. 1 Wagtech Digital Arsenator

Results and Discussion: Results of our six study sites obtained after analyzed the twelve samples of water (Shallow and Deep) are presented in the Table: 1. For better understanding of the results, authors divided the arsenic concentration in the three regions namely Region-I, Region-II and Region-III (see Table: 2). Results

depict that Dubhar, Belhari, Rewati, Maniar, Sikandarpur and Bairia are under Region-III and the ground water of Dubhar, Belhari, Rewati, Maniar, Sikandarpur and Bairia is not fit for drinking. Results of the present study have close agreement with the available past results of the papers [27-28].

Table: 1 Arsenic Level of Water Samples of the Six Selected Study Sites

S.N.	Name of Study Site	Water Depth	Region-I	Region-II	Region-III
1	Dubhar	Shallow			24
		Deep (India Mark II)		10	
2	Belhari	Shallow			29
		Deep (India Mark II)			16
3	Rewati	Shallow			27
		Deep (India Mark II)			12
4	Maniar	Shallow			20
		Deep (India Mark II)			12
5	Sikandarpur	Shallow			21
		Deep (India Mark II)			13
6	Bairia	Shallow			18
		Deep (India Mark II)			11

Table: 2 Regions of arsenic concentration

Region Name	**Range of arsenic concentration**
Region-I (safe region of the arsenic)	$<$0 ppb to $<$5 ppb
Region-II (low risk region of arsenic)	5 ppb to $\leq$10 ppb
Region-III (high risk region of arsenic)	$>$10 ppb

Conclusion: Results of the present study indicate that

- Ground water, shallow as well as in the deep bore well of district Ballia (U.P.), India are not safe for the purpose of drinking.
- The water of shallow bore wells is very harmful for residents of district Ballia (U.P.), India.

- At all the six study sites (Dubhar, Belhari, Rewati, Maniar, Sikandarpur and Bairia) of district Ballia (U.P.), India, concentration of arsenic both in the shallow as well as in the deep bore well water samples was found in the critical range.
- The problem of arsenic contamination in the ground water at Belhari is a very serious problem for district Ballia (U.P.), India.

Recommendation: On the basis of the study, it is recommended that

- The ground water of Dubhar, Belhari, Rewati, Maniar, Sikandarpur and Bairia is not fit for drinking.
- Government should take some strict action for this issue and should also set up water purifier as many as possible at district Ballia (U.P.), India.

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