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STUDY OF ARSENIC CONTAMINATION OF GROUND WATER IN SARAN DISTRICT OF NORTH BIHAR, INDIA"

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ABSTRACT
As far as the site I of Dadibadi is concerned, its underground water shows marked variation in SEM and SU. Hence, from Dadibadi, the maximum range of arsenic concentration was observed from site I i.e. 0.02-0.10, while the minimum range of arsenic concentration was observed from site 6 i.e. 0.005-0.025 mg/l. The highest value of mean arsenic concentration was observed from site 2 i.e. 0.04578 mg/l while the lowest mean arsenic concentration was observed from site 6 and the value was 0.00979 mg/l. Similarly the minimum SD observed from the site 6 i.e. 0.00886 while the maximum SD was 0.03378 from site 3.
Now, as far as the kanauli village [i] is concerned the highest range of mean value of arsenic concentration was observed from site I with 0.5173 mg/l while the minimum value of mean arsenic concentration is 0.00986 mg/l from site 6.
Here, site 2 of kanoeli constitute maximum range of SD and its value was 0.0378, while the minimum SD of arsenic load was observed from site 6 i.e. 0.00962.

INTRODUCTION

Arsenic in groundwater, as a major contaminant and a threat to health of human beings, has been a subject of intense and in-depth research, at national and global level, in affected countries. Significant progress has been made towards understanding the pattern of arsenic distribution and processes of its mobilization in groundwater. There have been detailed studies on health impacts of chronic ingestion of arsenic. Several alternative safe water options, such as, arsenic removal filters, dug wells, rainwater harvester, pond sand filter and arsenic-safe deep tube-wells are now being deployed in affected countries as mitigation measures. In spite of such efforts, access to safe water still remains a big challenge in providing safe drinking water to all. In Bihar where drinking water supply is mainly based on groundwater sources, both in rural and urban settings, Arsenic in remains a major threat to public health.
Arsenic is a natural contaminant in groundwater at a global scale and recognized as a severe problem in many parts of the world owing to its potential risk through drinking water exposure. It is ranked as a Group 1 carcinogen, and its presence in groundwater is reported from more than 70 countries of the world affecting around 150 million people. The scenario of arsenic toxicity is alarming in different countries of Asia such as India, Bangladesh, Cambodia, China, , Nepal, Pakistan, Taiwan, Thailand and Vietnam as well as in many Latin American countries. Arsenic concentration exceeding the maximum contamination levels set by the WHO and other national and international regulatory organizations are being identified in new areas every year. The use of groundwater contaminated with arsenic for

irrigation is an additional concern due to the transfer from water to food chain and thus identified as additional pathway for arsenic ingestion by humans and livestock. This study evaluated the viability of various alternative safe drinking water options and found tube well is the most suitable due to its simplicity and technical suitability, a wide acceptance by the society and above all low cost for installation, operation and maintenance.

The concentration of Arsenic (As) in groundwater of natural origin is recognized as a severe environmental problem in many parts of the world owing to its potential risk through drinking water exposure. Arsenic has been identified as a serious public health concern (Nordstrom, 2002; Kapaj et al., 2006; Nriagu et al., 2007). Arsenic contamination in drinking water supplies reported from more than 70 countries posing a serious health hazard to an estimated 150 million people world-wide (Bhattacharya et al., 2004; Ravenscroft et al., 2009). Arsenic toxicity from prolonged exposure can lead to arsenicosis (skin alterations), cardiovascular diseases and eventually to a variety of cancers (Smith and Steinmaus, 2009) and is associated with increased mortality (Argos et al., 2010). In most cases, clinical symptoms usually develop after a long latent period of chronic poisoning from the ingestion of As. Guidelines for drinking-water quality established by the World Health Organization (WHO) include chemical and biological hazards from both natural and anthropogenic sources.

It was reported that the Ganga-Meghan-Brahmaputra (GMB) plain, which had an area of approximately 500,000 km2 and the population over 500 million, was at risk from ground water arsenic contamination. According to Public Health Engineering Department, Government of Bihar and UNICEF - Bihar, arsenic contamination of ground water was found in several districts of Bihar, viz. Patna, Saran, Vaishali, Katihar, Purnea, Araria, Supaul, Kishanganj, Madhubani, Sitamarhi, East and West Champaran, Khagaria, Begusarai and Bhagalpur. Extensive exposure to high level of arsenic in drinking water may cause serious health hazard .

MATERIALS AND METHODS

One hundred and thirty-two tubewell water samples were collected from different locations of **SARAN** district, Bihar, India, in the month of September to October, 2018. The samples were collected in pre-cleaned sterilized polyethylene bottles of one liter capacity following standard protocol. To avoid any contamination at the source, the samples were taken by holding the bottles at the bottom and drawn directly from the tubewell after water was allow running at least fifteen (15) minutes (Karthikeyan et al., 2010). The water samples were immediately refrigerated after collection and brought to the laboratory with extreme care and preserved for further analysis.

Chemical of analytical grade were procured from M/S, Merck India Ltd; and used through the study without further purification. To prepare all reagents and standards, double distilled water was used. All glassware was cleaned by being soaked in 15% HNO_3 and rinsed with double distilled water. Each sample was analyzed three times and the results were found reproducible within ± 3 error limit.

RESULTS

Arsenic contamination in Saran district is a huge problem affecting thousands of people every year. The range of infection is very large affecting various age groups of the inhabitants of this region. This problem is not new but the recognition of the situation is recent. As far as the contamination of underground water by arsenic in the remote areas of Saran district is the concern of the present research work. On the light of the above scenario and presence of underground pollutants, the whole areas of the research works are divided into two separate environments. Those areas which are

situated far away from the reverine systems like Gandak and Ganga. It encludes following arsenic prone areas:-

(i) Dadibadi
(ii) Kanhouli
(iii) Sahajitpur
(iv) Kolhua

So, these areas do not contain direct influence of the any rivers like Ganga and Gandak. But, the flood continuously adds water, sediment and ions of arsenic in these areas. Such kind of classification is based on the transportation of arsenic load through the mainstream water flow. However, the flood activities and its water logging in a specific area lead to the accumulation of arsenic in certain length of the underground water. Hence, the proximity of the contamination is mainly affected by the availability of polluted water with Arsenic.

So, the first block selected for this work is **Baniyapur**, situated 29 km from district head quarter i.e. Chapra.

However, the total sample collections depend upon the collection of water from tube wells and hand pumps. Hence, the underground water table can be collected and analysed regularly in the P.G. dept. of zoology, J.P. University Chapra.

As far as the site I of Dadibadi is concerned, its underground water shows marked variation in SEM and SU. Hence, from Dadibadi, the maximum range of arsenic concentration was observed from site I i.e. 0.02-0.10, while the minimum range of arsenic concentration was observed from site 6 i.e. 0.005-0.025 mg/l. The highest value of mean arsenic concentration was observed from site 2 i.e. 0.04578 mg/l while the lowest mean arsenic concentration was observed from site 6 and the value was 0.00979 mg/l. Similarly the minimum SD observed from the site 6 i.e. 0.00886 while the maximum SD was 0.03378 from site 3.

Now, as far as the kanauli village [ii] is concerned the highest range of mean value of arsenic concentration was observed from site I with 0.5173 mg/l while the minimum value of mean arsenic concentration is 0.00986 mg/l from site 6.

Here, site 2 of kanoeli constitute maximum range of SD and its value was 0.0378, while the minimum SD of arsenic load was observed from site 6 i.e. 0.00962.

At Sahajitpur area, the highest mean arsenic concentration was observed from site-I with having the value of 0.06150 mg/l and the lowest mean arsenic concentration was observed from site-6 with 0.00940 mg/l. Here, site-6 constitutes low SD value and the site-2 shows maximum SD value.

At last, from Kolhua village, the mean arsenic concentration from site-I showed maximum (0.04985 mg/l) value while the site-6 showed least mean value of arsenic concentration. Similarly site-2 of this area showed maximum SD while site-6 showed least 0.00950 SD.

As far as the villages of Chapra Sadar is concerned, the Rasalpura village area with its mean arsenic concentration showed the highest mean value from range 0.02-0.10 of site I. The observed highest mean arsenic concentration was 0.04478 mg/l. While, the lowest mean arsenic volume was observed from the range 0.005-0.025 with 0.0964 mean value. Here, site also constitute the lowest value of SD i.e. 0.008848. The highest SD 0.03654 was observed from site of the range 0.01-0.10. From Doriganj village, which is very close to the river system showed similar trends of the distribution of mean arsenic concentration value. Here, the highest mean value was observed from site I (range 0.02-0.10) with 0.050160 mg/l. while, the site-6 contributed least amount of the mean arsenic concentration

(0.006630 mg/l). Following the same trends, site-2 contributed maximum amount of SD while the site-6 had least amount of SD i.e. 0.00963.

At Sherpur village, the highest mean value of arsenic concentration was observed form site-I and its value was 0.04962 mg/l. While, the minimum amount of the arsenic concentration was observed from the site-6 with the mean value of 0.008635. Here, site-2 constitutes high SD value (0.03692) and the site-6 showed least SD value (0.00922) now. At Telpa, so, in present research work, the arsenic concentrations are distributed mostly in the range of 0.02-0.01. At this range the arsenic concentration is very high. Now, almost in every site the range of arsenic distribution is not similar. This heterogeneous distribution of arsenic is due to the distance from riverine sources.

Table1 Mean, SD and SEM Values of Arsenic Concentration

Name of Blocks (Baniyapur)	Range(mg/l)			**Dadhibadi** Arsenic Level(mg/l)
		Mean	SD	SEM
Site 1				
	0.02-0.10	0.04276	0.03391	0.00767
Site 2				
0.01-0.10	0.04578	0.03665	0.00818	
Site 3				
	0.01-0.10	0.03271		0.03378
0.00756				
Site 4				
0.005-0.05	0.01952	0.01795	0.00408	
Site 5				
	0.005-0.05	0.01923	0.01827	0.00406
Site 6				
0.005-0.025	0.00979	0.00886	0.00192	

Table-2 Mean, SD and SEM Values of Arsenic Concentration

Name of Blocks (Baniyapur)	Range(mg/l)			**Kanhouli** Arsenic Level(mg/l)
		Mean	SD	SEM
Site 1				
	0.02-0.10	0.05173	0.03452	0.00750
Site 2				
0.01-0.10	0.04650	0.03781	0.00810	
Site 3				
	0.01-0.10	0.03310	0.03452	0.00765
Site 4				
0.005-0.05	0.01980	0.01892	0.00405	
Site 5				
	0.005-0.05	0.01985	0.02022	0.00411
Site 6				
0.005-0.025	0.00986	0.00962	0.00185	

Table-3 Mean, SD and SEM Values of Arsenic Concentration

Name of Blocks (Baniyapur) Range(mg/l) Level(mg/l)			**Sahajitpur** Arsenic
			Mean
SD			
SEM			
Site 1			
			0.02-0.10
0.06150	0.03355	0.00721	
Site 2			
			0.01-0.10
0.04480	0.03478	0.00762	
Site 3			
			0.01-0.10
0.03456	0.03369	0.00745	
Site 4			
			0.005-0.05
0.02130	0.02015	0.00398	
Site 5			
			0.005-0.05
0.02156	0.01958	0.00458	
Site 6			
			0.005-0.025
0.00940	0.00965	0.00198	

Table-4 Mean, SD and SEM Values of Arsenic Concentration

Name of Blocks (Baniyapur) Range(mg/l) Level(mg/l)			**Kolhua** Arsenic
			Mean
SD			
SEM			
Site 1			
			0.02-0.10
0.04985	0.03341	0.00752	
Site 2			
			0.01-0.10
0.04452	0.03656	0.00712	
Site 3			
			0.01-0.10
0.03452	0.03452	0.00732	
Site 4			
			0.005-0.05
0.01863	0.01789	0.00378	
Site 5			
			0.005-0.05
0.01976	0.01852	0.00415	
Site 6			
			0.005-0.025
0.00985	0.00950	0.00175	

DISCUSSION

The study indicates that the tube well with As concentration between (10-24) for the 10 µg/L and (50-99) for the 50 µg/L cut-off levels respectively, that need to be reanalyzed and verified by laboratory analyses for cross validation. The positive cases identified by the field test kit were only 4.4 % and 3.6 % of the total tested tube well water samples for As cut-off levels at 50 µg/L and 10 µg/L, respectively. It is to be mentioned here that As concentrations in about 70% of such positive tube well at the observed level were found to be higher than that of the WHO cut-off value. Such identification of the field kit is beneficial for its users, considering that long-term exposure to As-contaminated water even at 10 µg/L increases the risk of various As-related health hazards. The study shows the potentially of using the relationship between the prevalence of As contamination as a strong indicator to achieve success in identifying them As contaminated TWs correctly. The TW test results showed high dependence on the prevalence of As concentration in TW water. The risk of false detection by the Merck field test kit is comparatively higher where the prevalence of As is low and vice versa.

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