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RESEARCH ARTICLE

STUDY OF ARSENIC CONTAMINATION IN GROUND WATER OF GORAKHPUR DISTRICT AND ITS HEALTH EFFECT

***Priyanka Chaudhary, Jitendra kumar and Kalawati Shukla**

Department of Botany, D.D.U. Gorakhpur University, Gorakhpur, India

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ABSTRACT

Arsenic contamination in ground water has caused severe health problem around the world. The purpose of this study was to evaluate health impact of Arsenic contaminated ground water used for drinking in Gorakhpur, U.P, India. Arsenic was analyzed in ground water of study area during March to August 2015. Total 120 samples collected from different area of Gorakhpur. From the collected 120 ground water samples 31.67% of the samples were found arsenic concentration in the range of 10-50 ppb and 16.66% of the water samples were above 50 ppb. Thus total 48.33 % samples were recorded as arsenic more than the WHO standards of 0.01mg/l or 10PPb. Hydride generator Atomic Absorption Spectrophotometry (HG-AAS) is employed for the determination of Arsenic in water samples. Arsenic poising through drinking water can cause many disease like Skin cancer, gangrene, internal cancer, neurological effects, and pulmonary disease. Thus results indicate that the people drinking ground water of Gorakhpur are at risk.

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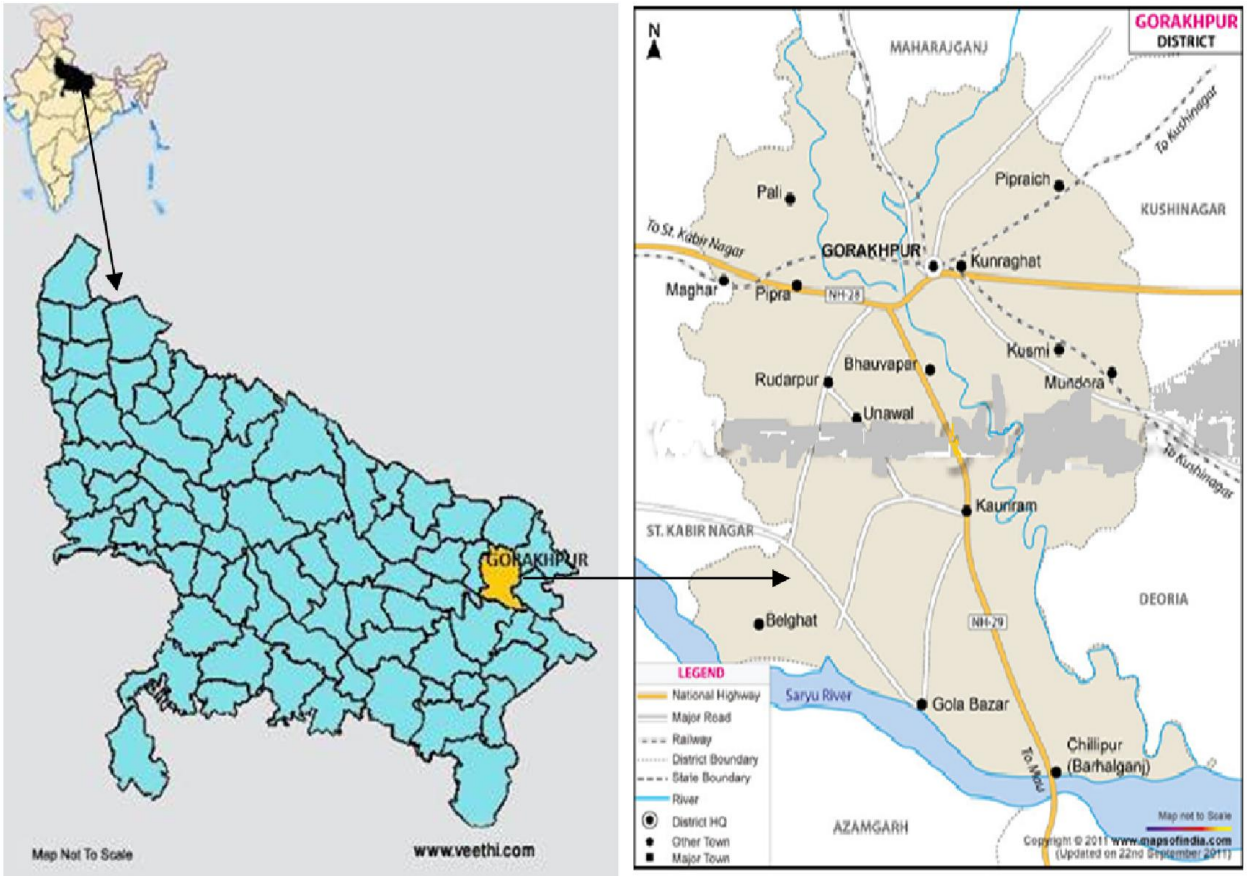
INTRODUCTION

Arsenic contamination in groundwater is widely studied in India and its neighboring countries. Jakhrani *et al.,* 2009 reported that high Arsenic level in groundwater of Khairpur, Pakistan, while Safiuddin and Karim 2001 have reported that the serious arsenic contamination of groundwater in Bangladesh has come out recently as the biggest natural calamity in the world. Groundwater arsenic contamination was also reported in the Terai area of Nepalin 2001. In 2003, a report on arsenic ground water contamination in the Middle Ganga Plain of the state of Bihar in India was published. 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. It is now recognized that millions of people from India have been endangered by the prospect of consuming water contaminated with arsenic at levels greater than the guideline value of acceptable level set by the World Health Organization (Flanagan *et al*, 2012). Based on 20 years of surveys of groundwater arsenic contamination and its health effects on the Ganga–Meghna–Brahmaputra (GMB) Plains, with a population of over 500 million, we have found that significant portions of all the states on the Ganga Plain (Uttar Pradesh, Bihar, Jharkhand, West Bengal), some parts of the Brahmaputra plain (Assam), and most of the plains of Bangladesh are arsenic affected (Chakraborti *et al.,* 2004).

****Corresponding author: Priyanka Chaudhary,***
Department of Botany, D.D.U. Gorakhpur University, Gorakhpur, India.

Health effect of arsenic

Arsenic is well-known for its toxicity and carcinogenicity. Clinical effects of arsenic mainly include Keratosis and Melanosis. Other clinical manifestations include body related disturbances, cerebral inffection, cangrene, muscular atrophy, depressive state, auditory problem and various neurological symptoms. The acceptable source of arsenic is the geological route, as it was transported by rivers from the sedimentary rocks in the Himalayas during tens of thousands of years. On the other hand, the anthropogenic sources are other unwanted sources of arsenic. In average, 27% of the shallow tube wells in Bangladesh are producing water with arsenic in excess in comparison to the Bangladesh standard of 0.05mg/l for drinking water (Ahsan *et al*., 2008). Non-cancer effects of arsenic can include thickening and discoloration of the skin, stomach pain, nausea, vomiting, diarrhoea, blindness, partial paralysis and numbness in hands and feet. Arsenic has been linked to cancer of the bladder, lungs, skin, kidney, nasal passages, liver and prostate (Ahsan *et al*., 2008).



Map of Gorakhpur District

The United States Environment Protection Agency (USEPA) and International Agency for Research on Cancer (IARC) have specified arsenic as known human carcinogen. According to EPA weight of evidence classification for carcinogens, arsenic is categorized as Group A Carcinogen. Its classification indicates that there is sufficient evidence from epidemiological studies to support a case effects relationship between the substance and cancer. As is virulent poison on acute ingestion, 76 mg As (3+) is considered to be lethal to adults and extremely toxic on long-term exposure to a very low concentration (Azcue and Narjagu, 1994 in Sharma 1999). Extremely toxic arsenic oxide former use as a poison for vermin has been vastly reduced on Account of concerns over its accumulation in the food chain. Arsenic enters the human body through ingestion, inhalation, or skin absorption. Significant route of As ingestion is drinking water. In addition, ingestion of As through drinking water has been implicated in several noncancer diseases, for example, peripheral vascular disease; hypertension; respiratory, neurologic, and liver disorders; and diabetes mellitus [IARC 2004; National Research Council (NRC) 2001; WHO/IPCS (International Programme on Chemical Safety) 2001]. Early effects of exposure to Arsenic in drinking water include pigmentation changes and hyperkeratosis (IARC 2004; Smith *et al.,* 2000), which reportedly appear after 5–10 years of exposure (Guha Mazumder *et al.,* 1998).Most ingested and inhaled arsenic is well absorbed through the gastrointestinal tract and lungs into bloodstream. It is distributed in large number of organs including the liver, lung, kidney and skin. About 70 % of the arsenic is excreted mainly through the urine.

Most arsenic absorbed into the body is converted by liver to less toxic methylated arsenic then efficiently excreted in the urine (Saha, 1999, in Nagarnaik 2002).

METERIALS AND METHODS

Study area

The present district of Gorakhpur lies between Lattitude 26º 13' N and 27º 29' N and Longittude83º05' E and 83º 56' E. According to the Central Statistical Organization the district had an area 6,316 sq. Km. in Tarai belt of river Rapti and Rohni. It is situated in the eastern part of the state of Uttar Pradesh in India, near the border with Nepal. The principal town in the transghagar plain. The name of the city has been assigned after the name of Saint Guru Gorakhpur of 12th century. The location of the city is very important strategic being located quite near to Indo-Nepal Border and very well connected by Railway.

Geology of Gorakhpur

The geology of the district exposes mineral products are few and unimportant. The minerals of commercial value are the nodular limestone conglomerate known as kankar, brick and saltpetre.. Brick clay is abundant everywhere and bricks are made all over the district. The soil in the district is light sandy or dense clay of yellowish brown colour. The sand found in the rivers is medium to coarse grained, grayish white to brownish in colour and is suitable for construction purposes.

Table 1. Arsenic concentration in ground water samples of Gorakhpur

Sampling area	Total no. of samples	Arsenic concentration			Max. observed Arsenic concentration (PPb)
		<1to <10 PPb	10 to 50 PPb	>50 PPb	
Badhalganj	6	1	4	1	70
Pipiganj	6	1	3	2	53
Bhathut	6	2	1	3	45
Pipraich	6	4	2	0	35
Sahjanva	6	5	1	0	15
Sikriganj	6	4	1	1	40
Belghat	6	3	2	1	28
Kauriram	6	4	1	1	46
Jungal kauriya	6	2	3	1	35
Sardar nagar	6	5	1	0	54
Vikas nagar	6	3	2	1	58
Medical collage	6	2	4	0	36
Bichchia colony	6	3	1	2	29
Divya nagar	6	4	2	0	19
M.M.M. engineering collage	6	3	2	1	59
Mirjapur	6	3	1	2	69
Rajghat	6	3	2	1	52
Gorakhnath	6	3	1	2	42
Mohhadipur	6	2	2	0	23
GIDA	6	3	2	1	57
Total	120	62	38	20	
Percentage	100	51.67	31.67	16.66	

Table 2. Arsenic level in ground water samples of Gorakhpur district

Sampling area	Total no. of samples	Arsenic concentration (PPM)		
		Range	Mean	S.D.
Badhalganj	6	0.040-0.100	0.071	0.022
Pipiganj	6	0.022-0.034	0.029	0.004
Bhathat	6	0.030-0.046	0.039	0.005
Piprauli	6	0.032-0.049	0.04	0.005
Sahjanva	6	0.016-0.028	0.022	0.004
Sikariganj	6	0.040-0.050	0.046	0.003
Belghat	6	0.038-0.062	0.05	0.008
Kauriram	6	0.026-0.052	0.039	0.009
Jungal kauriya	6	0.030-0.065	0.048	0.013
Sardar nagar	6	0.022-0.056	0.039	0.011
Vikas nagar	6	0.017-0.065	0.041	0.016
Medical collage	6	0.042-0.055	0.048	0.004
Bichhiya colony	6	0.015-0.042	0.032	0.009
Divya nagar	6	0.025-0.038	0.031	0.004
M.M.M engineering collage	6	0.036-0.042	0.039	0.001
Maniram	6	0.012-0.050	0.034	0.013
Rajghat	6	0.026-0.048	0.038	0.007
Gorakhnath	6	0.036-0.052	0.044	0.005
Mohhadipur	6	0.026-0.046	0.035	0.007
GIDA	6	0.028-0.039	0.034	0.003
Total	120			

Sampling

The water sample were collected in plastic container of 2 liter capacity from hand pump of different area of Gorakhpur district. All bottles used were washed with nitric acid. After filling the water samples few drops of concentrated nitric acid were added to the water sample for preservation till analysis. Total 120 sample were collected from hand pump in month (March–August) from 20 different sampling sites of Gorakhpur district.

RESULTS AND DISCUSSION

The collected ground water samples were tested for Arsenic concentrated level with the help of AAS. The samples of ground water collected from Gorakhpur district showing acceptable (<1to<10ppb), moderate (between 10-50 ppb) and high (>50 ppb) concentration of Arsenic is summarized in Table1 and Arsenic concentration level, collected 120 ground water samples from different sampling sites of Gorakhpur district is shown in Table 2. The evaluation of Arsenic concentration in 120 ground water samples from 20 sampling areas of 6 month duration of Gorakhpur district, Uttar Pradesh, India has provided useful insight into the extent of Arsenic toxicity in the study area. It was found that 90 samples taken from different hand pumps was higher than the permissible limit of 10 PPb and 31.67% of the ground water samples were arsenic concentration in the range of 10-50 PPb and 16.66 % of the samples were above 50PPb. Thus total 48.33% samples were found arsenic more than the permissible limit during the study. The 120 ground water sample collected from the selected sampling sites. Arsenic level detected was in the range of 0.012 ppb to 0.065 ppb. The minimum value of Arsenic was found in Sahjanava, ranges from 0.016 ppb to 0.028 ppb and

the maximum value was present in Badhalganj area ranges from 0.040 ppb to 0.100 ppb of Gorakhpur district. From the above results we find out that over exploitation of Ground water leads to fast depletion of groundwater table which may be the reason of release from deep layer that leads to spread of arsenic problem in groundwater in Gorakhpur districton periods of past years. There are 2 main reasons of arsenic contamination problem in ground water i.e. naturally and industrial.

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