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ARSENIC IN HAND PUMP WATER OF DIFFERENT BLOCKS OF SAMASTIPUR DISTRICT (BIHAR), INDIA

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ABSTRACT :

Ground water is the major source of drinking water in both rural and urban areas which may be contaminated by various means, Arsenic is one of them. 8928 hand-pump samples (250ml water sample from each) from 20 different blocks of Samastipur district, Bihar were collected in sterile containers and Arsenic was analyzed. Out of 20 blocks, 4 blocks *i.e.*, Vidyapatinagar, Patori, Mohiuddinagar, and Mohanpur hand-pumps water had arsenic contamination *i.e.*, 29.5ppb, 33.7ppb, 56.6ppb and 60.4 ppb respectively. According to SDWA (1996) the maximum permissible limits of arsenic in drinking water is 10 ppb. This research paper highlights the areas which were affected by arsenic contamination and beware the public & Bihar Government.

KEY WORDS: *Arsenic, Silver diethyl dithio carbamate (SDDC), Gutzeit generator, and Polluted water.*

INTRODUCTION:

Water is one of the prime natural resources and is called matrix of life. It is an essential part of all living systems and is the medium from which life evolved and in which life exists (Franks, 2000). About 3/4th of the earth's surface is covered with water. For development of healthy society, quality of water has great significance (Dara, 2008). Deterioration in quality of water due to pollution is a global problem. Polluted water is source of many diseases for human beings as well as animals (Nag, 2006). Groundwater is a major source for drinking water in both urban and rural areas all over the world. It is also frequently used as the alternative source for agricultural and industrial sector (Mishra, *et al.*, 2008). The ground water quality depends not only on natural factors such as the lithology of the aquifer, the quality of recharge water and the type of interaction between water and aquifer, but also on human activities, which can alter these ground water

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systems either by polluting them or by changing the hydrological cycle (Helena, *et al.,* 2000).

Samastipur district occupies an area of 2,904 square kilometres (1,121 sq mi). According to the 2011 census, the population density of the district is 1465 per sq. km.with the total population of 4.25 million. Samastipur is bounded on the north by the Bagmati River which separates it from Darbhanga district. On the west, it is bordered by Vaishali and some parts of Muzaffarpur district, on the south by the Ganges, while on its east it has Begusarai and some parts of Khagaria district. This district is traversed by a number of rivers including Budhi Gandak, Baya, Kosi, Kamla, Kareh, Jhamwari and Balan, which are the off-shoots of Burhi Gandak. The Ganges also skirts the district on the south.

Currently, Arsenic (As) is one of the most relevant single substance environmental toxicants and is ranked first in the list of 20 hazardous substances by the Agency for Toxic Substances and Disease Registry (ATSDR, 1999). The major cause of concern all over the world including India is the contamination of groundwater resource by this toxic element. Since decades, in various countries people have been and still are exposed to inorganic arsenic through geogenically contaminated drinking water. Among the 21 countries in different parts of the world affected by groundwater arsenic contamination, the largest population at risk is in Bangladesh followed by West-Bengal in India. More recently arsenic contamination of ground water has also been found in some parts of Bihar. The hazardous effect of environmental arsenic on human health can be devastating and is an important issue. Long-term exposure to arsenic in drinking-water is causally related to increased risks of cancer of the skin, lungs, bladder and kidney, as well as other skin changes such as hyperkeratosis and pigmentation changes. The ingestion of arsenic can cause a variety of diseases, including skin lesions, respiratory system problems, nervous system disorders, cancers of different organs, reproductive effects and even death in the worse cases (Thakur, *et al.*, 2011). These effects have been demonstrated in many studies using different study designs. Exposure–response relationships and high risks have been observed for each of these end-points. Increased risks of lung and bladder cancer and of arsenic-associated skin lesions have been reported.

In the present study, the extent of arsenic contamination in groundwater of 20 blocks of Samastipur district were studied. Since, groundwater is the only source of drinking water in this area, so evaluation of its quality can greatly help in the protection of drinking water resource.

MATERIALS AND METHODS:

Study areas:

Samastipur district is located at the north part of Bihar. It lies between 25º512 393 N and 85º462 563 E. 20 different blocks of Samastipur district in Bihar, were selected for identification of arsenic concentration in water samples from hand pump. A total of 8928 water samples were collected.

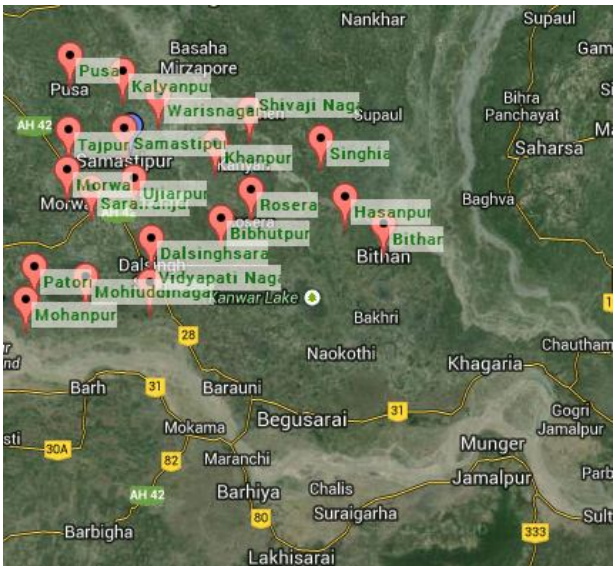

Fig. Shown geographical positions of different blocks of Samastipur Deistrict (Bihar)
Source of map : http://www.onefivenine.com/india/

Water Sampling:

One liter of water samples were collected from each hand pump in sterile clean conc. HCl added bottle so that pH of water reduced upto 1-2 (AHPA, 1995).

Determination of Arsenic :

35ml of water sample was transferred in arsenic Gutzeit generator and to it 5ml conc. HCl, 2ml of KI solution and 8 drops of $SnCl_2$ were added. After 15minutes of reduction of arsenic, 4ml Silver Diethyl Dithio Carbamate (SDDC) solution was passed through impregnated glass wool soaked with lead acetate solution. 3gm Arsenic free Zinc was added immediately into the scrubber assembly and allowed for 25 minutes for complete evaporation of Arsenic. The solution was warmed for complete release of Arsenic and the optical density of SDDC solution was measured with the help of spectrophotometer at 520nm wave length using appropriate reference blank (APHR, 1995; Gurung, *et al.*, 2005 and Seddique, *et al.*, 2008).

CALCULATION :

Standard graph for arsenic calculation was prepared against absorbance *VS* known concentration of arsenic.

$$Concentration\ of\ \ As\ mg/l = \frac{\mu g\ As(from\ colibration\ curve)}{ml\ sample\ in\ generator\ \ flask}$$

RESULTS AND DISCUSSION :

Table-1 shows the status of mean concentration of arsenic in water samples collected from hand pumps of 20 different blocks of Samastipur district. In water samples of Vidiyapatinagar, Patori, Mohiuddinagar and Mohanpur blocks, mean concentration of Arsenic was found to be higher than the permissible limit (10ppm as WHO guidelines). In Vidiyapatinagar block, out of 341 water samples, 59 samples (17.3%) were found to have 2-3 folds higher Arsenic than the permissible limit. Out of 422 water samples collected from different areas of Patori block, 59 samples (20.62%) showed 3 - 3.5 folds higher Arsenic than the permissible limit. In Mohiuddinagar block, out of 391 water samples 173 samples (44.25%) had Arsenic 5 - 6 times higher than the permissible limit. In the 227 water samples of Mohanpur block, 133 samples (58.59%) were found to have arsenic content 6 - 7 times higher than the permissible limit.

Table-1 Arsenic concentration in 20 different blocks of Samastipur district of Bihar (Analysis was made in May-June 2013)

Name of Blocks	No. of Sample Tested	Mean value of arsenic (ppb)	No. of Sample exceed from limit (NR:- upto 10ppb)	% of sample exceed from limit
Vidiyapatinagar	341	29.5	59	17.3%
Patori	422	33.7	87	20.62%
Mohiuddinagar	391	56.6	173	44.25%
Mohanpur	227	60.4	133	58.59%
Warisnagar	503	9.9	0	0
Samastipur	617	9.4	0	0
Pusa	241	9.4	0	0
Dalsinghsarai	476	9.8	0	0
Bibhutipur	619	9.8	0	0
Rosara	357	9.5	0	0
Singhia	370	8.5	0	0
Hasanpur	402	8.3	0	0
Khanpur	436	10.1	0	0
Tajpur	414	9.8	0	0
Morwa	443	10.0	0	0
Shivajinagar	382	10.5	0	0
Bithan	272	10.3	0	0
Ujiyarpur	753	10.1	0	0
Kalyanpur	690	9.7	0	0
Sarairanjan	572	9.8	0	0

In the water samples collected from Khanpur, Shivajee Nagar, Bithan and Ujiarpur blocks the amount of arsenic was slightly higher (10.1 - 10.5ppb) than the permissible limit (10ppb). The water samples from Hasanpur block was recorded to have least amount of arsenic contamination. The high concentration zone is near to the Gangetic basin while the low concentration is more distant from Gangetic basin.

CONCLUSION :

The results of the present study revealed that Samastipur district possess both high and low arsenic containing ground water which is a matter of further study. Our results confirm the presence of arsenic in groundwater in many parts of the Samastipur district. In several samples, higher amount of arsenic was found which may cause serious health problems in people while drinking such water for a long time. There is need to make public aware of health problems due to arsenic poisoning and also the immidiate need of remedial measures for providing safe drinking water in the areas where water contains arsenic above the permissible limit as set by WHO.

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