

Arsenic groundwater contamination and its health effect in villages along main stream of river Ganga, near Digha, Patna (Bihar)

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Abstract : We investigated the extent and severity of ground water arsenic contamination in Bind Toli and Nakta Diyara village along main stream of river Ganga, near Digha, Patna, Bihar State. We conduct a survey on health status of the people inhabiting the study area. A good number of people in these villages had been found to have various type of skin problems which appear, to all probability due to presence of arsenic in their drinking water source. Ground water samples collected from seventeen different location of Bind Toli Village and 24 sample from Nakta Diyara village. All the sample were tested on an UV-Spectrophotometer by a standard silverdiethyldithio carbamate (SDDC) method and result was compared with water quality standard by Bureau of Indian standard (IS- 10500;1991).

(Keywords: arsenic, Health effect, Ground Water, Hand pump)

Introduction

Groundwater As contamination and chronic toxicity associated with it has been well documented in most of the Southeast Asian countries. More than 100 million people are affected by widespread As poisoning through drinking As-contaminated underground water in Bangladesh and West Bengal, India (Sarkar 2010)¹. Moreover, the continuous consumption of As through drinking water and food sources may lead to As poisoning known as arsenicosis. The development of visual arsenicosis symptoms has been generally assumed to follow 8–10 years of consumption of As contaminated water than

exceeds unsafe levels. However, new cases discovered in Cambodia have followed exposure times as short as 3 years due to extremely elevated As levels (3500 $\mu\text{g/L}$), socioeconomic status, and malnutrition (Phan *et al.* 2010)². The domain of As toxicity is spreading day by day and making the toxicity profile of As more dynamic.

Recently, Islam and Rahman (2007)³ has reported respiratory complications such as breathing problems, chest sounds, asthma, bronchitis, cough, and so on, in arsenicosis patients of Bangladesh exposed to As-contaminated drinking water having a mean value of 216 $\mu\text{g/L}$ for more than 7 years. In addition, several recent and previous studies have also established links between As contaminated drinking water and adverse effects on the pulmonary system (Mazumder *et al.* 2000; Mandal and Suzuki 2002)^{4,5}, cardiovascular system (Wang *et al.* 2007 and Chen *et al.* 2007)⁶ hematological system, hepatic system (Mazumdar *et al.* 1988)⁷, renal system and neurological system (Basu *et al.* 1996)⁸. Moreover, linkage of exposure to As has also been reported for spontaneous abortion, unprompted abortion, stillbirths, perinatal and neonatal mortality, reduction in birth weight, and so on (Ascengrau *et al.* 1989; Rudnai and Gulyas 1998; Ahmad *et al.* 2001; Concha *et al.* 1998; Hopenhayn Rich *et al.* 2000, 2003 and Yang *et al.* 2003)^{9,10,11,12,13,14}.

In Bihar, June 2002 the ground water As contamination was first reported in the Simaria

Ojha Patti village of Sahpur in the Bhojpur district of Bihar, India (chakraborti et al. 2003)¹⁵. The highest As concentration (1861 µg/l) was detected in the Bhojpur district itself (Ghosh et al 2007)¹⁶. The As contamination in the ground of Maner was first reported in 2007 (Singh and Ghosh 2011)¹⁷.

Therefore, the overall aim of this study was to do health affect assessment of the exposed population due to the consumption of As contaminated water use for drinking and cooking in two vil lage, Bind Toli and Nakta Diyara along main stream of river Ganga near Digha, Patna.

Experimental

Material and methods:

Ground water sample were collected from sampling site of 17 hand pump of Bind Toli village and 24 hand pump of Nakta Diyara village. Sample were collected in good quantity polythene bottle of one litre capacity and after collection it was added as a preservative. Sampling was done during pre momsoon (March – May), monsoon (June – September) and post monsoon (October – February) season. A survey on health status was conducted in both the villages during study period. All the water sample were tested on UV-Spectrophotometer by a standard Silverdiethyl-dithio Carbamate (SDDC) method as recommended by Trivedy and Goel¹⁸. The mean value of arsenic concentration with permissible limit is given in table 1 and table 2.

Results and Discussion

1. Bind Toli village:-

All the 17 water samples taken from different hand pump of Bind Toli village were tested for the presence of arsenic. Different sample showed different value of arsenic. Arsenic value ranged from minimum value of 8.33ppb (B1) to maximum value of 513ppb (B2). Only two water sample (B1) and (B7) was found to be below the permissible limit of 50ppb as recommended by Bureau of Indian Standard (BIS:10500:1991).¹⁹ In all other water sample the arsenic concentration was found

to be beyond the permissible limit of 50ppb. Nearly 95% of analysed water sample recorded as arsenic toxicity (100ppb to a maximum value of 500ppb) which was greater than the permissible limit. On the basis of survey report on health status of the people inhabiting in the Bind Toli village many people were found to be suffering from suspected cases of arsenicosis which cause ulcer, epidemiological problem, skin problem etc.

2. Nakta Diyara village:-

All the 24 ground water samples taken from different hand pump of Nakta Diyara village were tested for the presence of arsenic. In Nakta Diyara village, the value of arsenic ranged from minimum value of 50.4ppb (B22) to maximum value of 415.8ppb (B14). The sample from all hand pump recorded toxic arsenic (From 50.4 to maximum value of 415.8ppb) beyond the permissible limit of 50ppb (IS 10500:1991). Near about 75% of the water sample having arsenic concentration greater than 100ppb. At least 29% of water sample was found to be arsenic concentration greater than 200ppb and 16% of the water sample was found to be arsenic concentration greater than 300ppb.

On the basis of survey report on health status of the people inhabiting in Nakta Diyara village a good number of people in this village have been found to have various type of skin problems which appear, to all probability, due to presence of arsenic in their drinking water source. The people have been found to be suffering from gastrointestinal epidemiological disease due to regular use of arsenic contaminated ground water drown through hand pump.

Conclusion

The ground water of Bind Toli and Nakta Diyara village along main stream of river Ganga near Digha, Patna was highly concentrated with arsenic. The residents were using similar contaminated ground water source for drinking and cooking purposes, so the cooked food with arsenic contaminated water is now other source of arsenic intake in the body of these study area. Health survey suggest that people are susceptible

Table -1
Arsenic concentration of 17 different water sample of Bind Toli village during
pre momsoon (March – May), monsoon (June – September) and post monsoon
(October – February) period of 2009 -2010

Location or site	Source of water sample	Sample code	Mean value of arsenic in ppb of pre monsoon, monsoon and post monsoon season (Per. Limit -50ppb)
At the door of private school	Hand Pump	B1	8.33
In the house of Mr. Bajnath Mahto	Hand Pump	B2	513.00
At the door of Mr. Sudarshan Mahto	Hand Pump	B3	319.00
At the door of Mr. Shivilagan Mahto	Hand Pump	B4	121.67
At the door of Mr. Sigasan Mahto	Hand Pump	B5	125.47
At the door of Mr. Pappu Mahto	Hand Pump	B6	333.33
At the door of Mr. Ravindra Mahto	Hand Pump	B7	44.17
At the door of Mr. Arjun Mahto	Hand Pump	B8	136.2
At the door of Mr. Subhash Mahto	Hand Pump	B9	339.90
At the door of Mr. Bajnath Mahto	Hand Pump	B10	217.8
At the door of Mr. Baisiph Mahto	Hand Pump	B11	238.47
At the door of Mr. Yaddu Mahto	Hand Pump	B12	267.03
At the door of Mr. Mishri Mahto	Hand Pump	B13	186.47
At the door of Mr. Bharoshan Mahto	Hand Pump	B14	139.10
At the door of Mr. Saryug Mahto	Hand Pump	B15	212.17
At the door of Mr. Ramkaran Mahto	Hand Pump	B16	319.57
At the door of Mr. Haricharan Mahto	Hand Pump	B17	86.87

Table – 2
Arsenic concentration of 24 different water sample of Nakta Diyara
village during pre momsoon (March – May), monsoon (June – September)
and post monsoon (October – February) period of 2009 -2010

Location or site	Source of water sample	Sample code	Mean value of arsenic in ppb of pre monsoon, monsoon and post monsoon season (Per. Limit - 50ppb)
At the door of Mr.Dashrath Ray	Hand Pump	B1	182.93
At the door of Mr.Dashrath Ray	Hand Pump	B2	125.43
In the campus of Middle School	Hand Pump	B3	245.60
At the door of Mr. Ravindra Ray	Hand Pump	B4	182.07
At the door of Mr. Vidya Ray	Hand Pump	B5	315.77
At the door of Mr. Ram Pani Ray	Hand Pump	B6	188.43
At the door of Mr. Chanarik Ray	Hand Pump	B7	181.77
At the door of Mr. Rudal Das	Hand Pump	B8	220.07
At the door of Mr. Vijay Ray	Hand Pump	B9	288.63
At the door of Mr. Jalandhar Ray	Hand Pump	B10	190.53
At the door of Mr. Naresh Ray	Hand Pump	B11	84.67
At the door of Mr. Heera Ray	Hand Pump	B12	88.33
At the door of Mr. Amerika Ray	Hand Pump	B13	174.07
At the door of Mr. Sobh Nath Ray	Hand Pump	B14	415.8
At the door of Mr. Hira Ray	Hand Pump	B15	370.73
At the door of Mr. Ram Jalan Ray	Hand Pump	B16	328.47
At the door of Middle School	Hand Pump	B17	89.63
At the door of Mr. Jay Shankar Ray	Hand Pump	B18	84.30
At the door of Mr. Shyam Narayan Ray	Hand Pump	B19	82.47
At the door of Mr. Rupam Ray	Hand Pump	B20	169.57
At the door of Mr. Shatnarayan Ray	Hand Pump	B21	174.5
At the door of Kashi Nath Ray	Hand Pump	B22	50.4
At the door of Mr. Indradev Sharan	Hand Pump	B23	355.2
At the dood of Yogendra Ray	Hand Pump	B24	134.33

to developing cancer and non- carcinogenic illness. Children are at the greatest health risk among all in both villages. Therefore, the issue should be delt with by providing various feasible

mitigation options and by ameliorating the nutritional status of the population. Arsenic free water pipe supply system can be adopted as one of the most important arsenic mitigation options.

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