



## Effect of Arsenic Contamination of Ground Water on People's Health: A Case Study of Nathnagar Block, Bhagalpur, Bihar, India

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**Abstract:** The ground water pollution is of great concern to the people of middle Gangetic belt, particularly along river Ganga from Sultanganj to Pirpainti of Bhagalpur district. The probable sources of arsenic contamination is reported to be through geological formations. The proportion of iron and H<sub>2</sub>S (Hydrogen Sulfide) is very high in this part of the land and the rural population are worst affected by stiffness of skin and skin-cancer. Keeping in view the severity of the situation, an attempt was being made to bring out the nature and extent of arsenic contamination in the underground water level of Nathnagar Block of Bhagalpur District. Wells and tube-wells have been considered as a source of ground water. The depth of the wells varies between 8-12 metres, and arsenic level ranged from 25-60 ppb (in well), that of shallow and dead tubewells between 6-80 metres and arsenic level ranged from 10-950 ppb (part per billion). Selection of villages is based on random sampling out of the villages located south of river Ganga 30 villages have been selected to carry out the research work. The paper shows that how the use of arsenic contaminated ground water is affecting people's health in the Ganga Valley and suggests the storage and use of rain water as an alternative for drinking purposes to overcome the problem.

**Keywords:** Ground water, Sediments, Arsenic contamination, Melanosis, Keratosis

### INTRODUCTION

In recent years, the presence of arsenic in ground water has been reported from several parts of the world, including USA, China, Chile, Nepal, Bangladesh and India (Chakraborty, 2004, Das *et al.*, 1994). In India, Arsenic was detected first time in West Bengal in the year 2004; and subsequently in Bihar in the same year. In 2005, while carrying out the survey work, the authors detected the presence of arsenic in the underground water sources of Nathnagar Block. This inspired them to carry out the survey work in detail; and while doing so they found at least 19 villages affected with arsenic contamination. The presence of arsenic was found even in open wells. The presence of arsenic is related with silt and clay sediments found in ground water. The arsenic affected villages are- Gosaidaspur, Serampur, Dogachhi, Dildarpur, Bindtola, Shankarpur Chawania, Mathurapur, Raghapur, Unchogaon, Makandpur, Rannuchak, Bharat Rashalpur, Gandhinikunj, Chhoti Haridaspur, Bari Haridaspur, Athgama, Rashadpur, Gauripur and Damodarapur.

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**Effect of Arsenic Contamination of Ground Water on People's Health: A Case Study of Nathnagar Block, Bhagalpur, Bihar, India**

**LOCATION OF THE STUDY AREA**

Nathnagar block is one of the administrative unit of the Bhagalpur District which extends between 25° 08' N to 25° 20' N latitude and 86°51' E to 87° E longitude covering about 128 km<sup>2</sup> or 12883.05 hectares. The area is bounded by blocks of Naugachia in the North, Jagdishpur in the South, Sultanganj and Shahkund in the West and Sabaur and Jagdishpur in the East. About 1.50 lakh people inhabit in this block and are under threat of being adversely affected by arsenic contamination. There are about 85 villages in the block (Fig. 1).

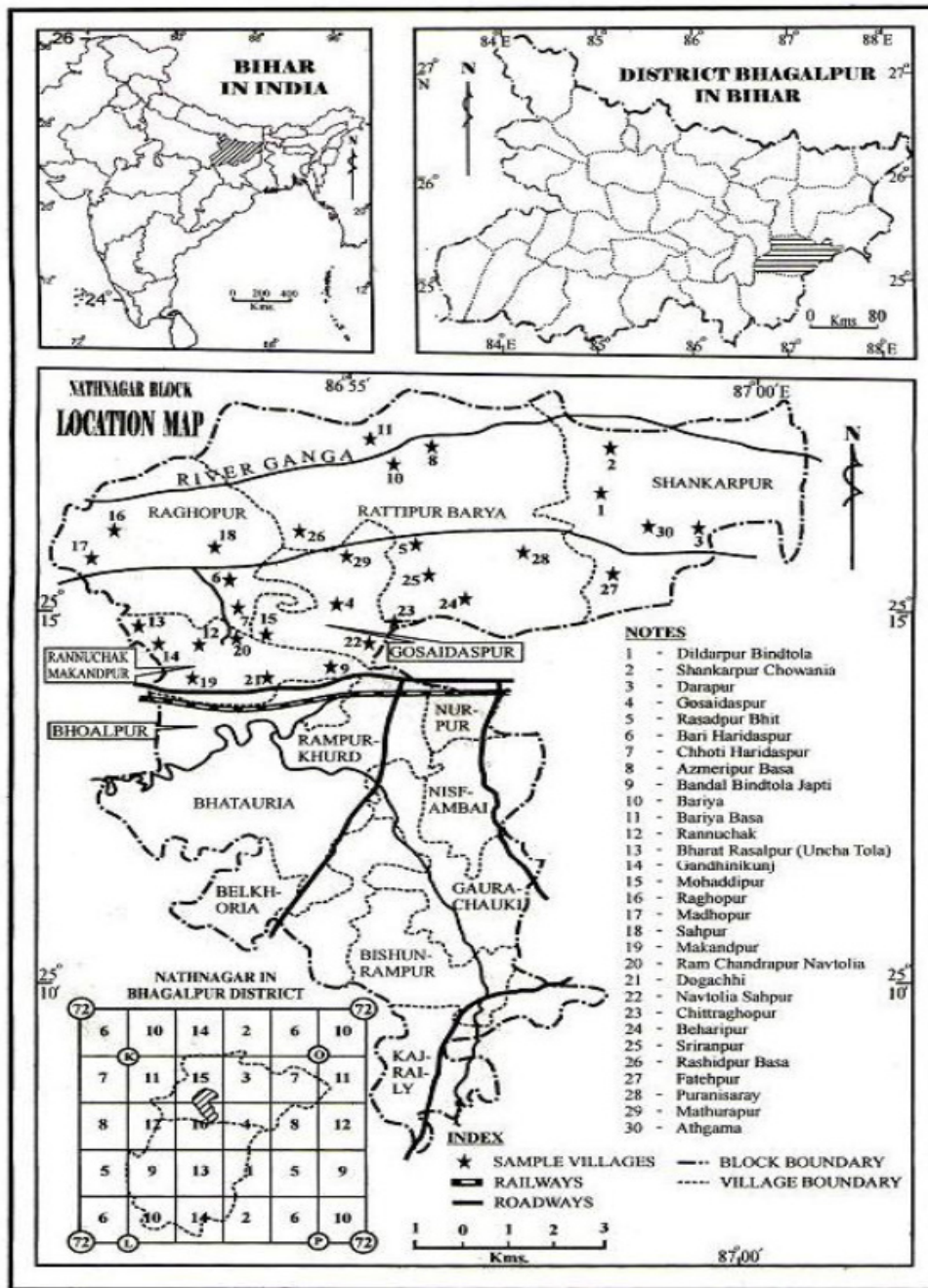


Fig 1. Location of sampled villages

## Effect of Arsenic Contamination of Ground Water on People's Health: A Case Study of Nathnagar Block, Bhagalpur, Bihar, India

The present work is confined to the villages located within 10 km extent south of River Ganga in Nathnagar block under which about 36 villages are located out of the 85 villages.

### MATERIAL AND METHODS

Arsenic detected by the help of FTK (Field test Kit) developed by National Chemical Laboratory, Pune. Further crossed checked by SDDC method (Americal Public Health Association, 1998). For exact location used 12 channel GPS (Global Positioning System) of Garmin Extrex Model 512.

### RESULTS AND DISCUSSION

#### Arsenic Contamination in Nathnagar

In Nathnagar block, the contamination of ground water by arsenic was first detected in 2005 when a survey was carried out by the P.G. Deptt. Of Botany team (Eco.lab) of T.M. Bhagalpur University. This has been described as the biggest calamity. More than 200 patients were found suffering from arsenical dermatosis in 52 families.

The present study identified 8 villages with high arsenic contamination in ground water and those included Gosaidaspur, Serampur, Dildarpur Bindtola, Darapur, Shankarpur Basa, Rashadpur Bhit, Mathurapur and Rannuchak. More than 60 ppb of arsenic was detected, even in open wells. Arsenic in high concentration in groundwater was detected in monsoon season and in Gosaidaspur village the maximum concentration was recorded as 1900 ppb.

The arsenic contamination of ground water has been reported in the residential area of Serampur, situated at 5km to the North West of Bhagalpur city. In Nathnagar block, according to our estimate, more than 10000 people are suffering from arsenic affected diseases. Prolonged exposure and drinking of contaminated water above the permissible limit of arsenic may cause serious illness, i.e. **Melanosis** (appearance of black spots on the upper chest, back and arms) i.e. 1<sup>st</sup> stage, followed by **Keratosiis** i.e. the second stage (skin hardening in ugly warts and nodules on hands and feet) (Fig. 2).

In the third stage, the sores turn into gangreneous and ultimately the kidneys and liver may fail to function properly (Fig. 3). Ultimately the symptoms of cancer may appear in and around 20 years. Out of the total villages investigated, only one village namely, Puranisarai, has no arsenic contamination, where 64 samples at the range of 5-36 metres depth have been examined. Remaining villages are contaminated in different contamination ranges. Village Gosaidaspur, where 263 sources have been tested in the depth range of 9-40 metres have highest concentration of arsenic in the range group of 110+ ppb whose spectro photometric result ranges between 64.73 to 949.55 which is also the highest among all the surveyed villages. No other village is near to it in respect of FTK test. The villages; Dogachi, Srirampur, Dildarpur, Bindtola and Darapur stand second, third, fourth, fifth and sixth in the range group of 110+ ppb.

**Table 1.** FTK (Field Test Kit) and Spectrophotometric result of underground water

S No.	Name of the Village & Geocordinates	Depth in feet (Ranged)	Total No. Sources Tested	No. of sources having Arsenic conc. in ppb						Spectrophoto Result		Remarks
				BDL	10	>10 - <40	40 - <50	50 - 110	110+	Min	Max	
1	Dildarpur Bindtola	30-110	41	3	0	0	1	8	29	54.91	805.35	High conc. of arsenic
2	Shankarpur Chawania	25-120	13	0	0	1	0	3	9	65.62	501.92	

**Effect of Arsenic Contamination of Ground Water on People's Health: A Case Study of Nathnagar Block, Bhagalpur, Bihar, India**

3	Darapur	30-115	18	1	0	0	0	2	15	59.82	825.89	
4	Gosaidaspur	30-130	263	54	1	2	1	36	169	64.73	949.55	
5	Rasadpur Bhit	20-110	44	14	0	6	2	13	9	41.51	176.07	
6	Bari Haridaspur	40-112	203	176	5	11	4	7	0	50.05	109.19	
7	Chhoti Haridaspur	35-110	48	18	6	9	1	11	3	42.85	355.8	
8	Azmeripur Basa	30-120	152	129	0	3	1	11	8	46.6	338.83	
9	Bandal Bindtola Japti	25-135	18	16	2	0	0	0	0	10.19	15.23	
10	Bariya	30-105	175	164	2	4	0	3	2	69.19	271.87	
11	Bariya Basa	25-90	31	25	1	3	0	1	1	35.69	190.32	
12	Rannuchak	22-110	362	260	14	22	22	40	4	44.46	440.2	
13	Bharat Rasalpur (Uncha Tola)	30-120	66	44	4	8	3	2	5	55.67	306.25	
14	Gandhinikunj	35-105	62	44	2	4	0	9	3	49.37	384.82	
15	Mohaddipur	30-110	58	55	0	2	0	1	0	30.41	55.8	
16	Raghopur	25-105	153	148	1	1	0	2	1	51.33	147.76	
17	Madhopur	20-110	108	102	1	4	1	0	0	40.36	43.23	
18	Sahpur	25-120	133	130	0	2	0	1	0	25.61	80.69	
19	Makandpur	35-120	365	294	0	33	12	15	11	43.12	317.85	
20	Ramchandrapur Navtolia	30-115	91	63	7	11	2	5	3	42.31	326.78	
21	Dogachhi	22-120	90	9	2	11	5	22	41	50.16	367.85	
22	Navtolia Sahpur	25-105	68	68	0	0	0	0	0	—	—	
23	Chittraghapur	35-120	57	40	1	2	1	10	3	56.71	535.45	
24	Beharipur	25-105	36	7	1	18	6	4	0	43.68	56.78	
25	Srirampur	30-112	147	12	1	11	9	83	31	44.64	281.69	
26	Rashidpur Basa	15-105	49	33	2	5	2	4	3	37.94	184.37	
27	Fatehpur	30-110	40	26	5	9	0	0	0	35.16	45.72	
28	Puranisaray	18-120	64	64	0	0	0	0	0	40.69	53.57	
29	Mathurapur	30-105	81	55	1	2	3	17	3	44.91	110.71	
30	Athgama	35-115	40	20	0	11	3	5	1	45.71	213.18	
		Total	3076	2074	59	195	79	315	354			

## Effect of Arsenic Contamination of Ground Water on People's Health: A Case Study of Nathnagar Block, Bhagalpur, Bihar, India

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### Note:

1. Spectrophotometric test was done after 3 months of collection of sample by Silver diethyldithiocarbamate (SDDC) Method APHA 1998 Vol. 1)
2. BDL - Below Detection Limit
3. 110+ ppb is maximum indication of FTK limit

The present research work has been undertaken keeping in view the importance of arsenic problem in ground water and associated health hazards. The concentration of arsenic in water sample collected from selected villages of Nathnagar Block of Bhagalpur district, Bihar shows high concentration. The ground water of the region is characterized by high iron content and H<sub>2</sub>S (Hydrogen sulfide) also. Out of total wells under consideration only 5 wells were showing the proportion of arsenic as FTK (Field Test Kit) 60, 40, 35, 30 and 40\* (all in part per billion). Arsenic occurs in the silt, clay as well as in the sandy layers as coatings on mineral grains. We know, Nathnagar Block lies in flood prone area and the symptoms of arsenic effects are found in the flood plains and new sediments area as reported by the various research workers concerning with arsenic studies. The drinking of contaminated water above the permissible limit of arsenic for a longer period may cause serious illness.

The arsenic calamity is biggest in Bhagalpur, because of the fact that the water of some villages are showing high arsenic contamination. The following table is showing the comparison of FTK (Field Test Kit) and Spectrophotometric results of some selected villages of Nathnagar block along with their location, geo-coordinates and depth of underground water sources in metres.

### CONCLUSION

Arsenic contamination in ground water and consequent ill-health of people from arsenic poisoning have been widely reported. The most commonly observed symptoms of chronic arsenic poisoning are skin cancer, conjunctivitis, melonosis and hyper keratosis. Consumption of arsenic contaminated water for a longer period causes other damages to human health also.

Now, there is the need to combat with the situation by providing an alternative source of water for drinking and other domestic purposes. Bhagalpur district, on an average, receives about 1310.4 mm of annual rainfall and has about 200 km<sup>2</sup> of wetland along with vast river basins which become flooded almost every year and are free from arsenic contamination. These water sources can be utilized as an alternative source for the people of the area.



**Fig2.** Keratosis 2nd stage developed in both feet of a child



**Fig3.** Arsenicosis 3rd stage- symbolizes parts of body start developing gangrene and cancer

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