

Arsenic status of water, soil, rice grain and straw of individual shallow tube well command area of Brahmanbaria

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Introduction

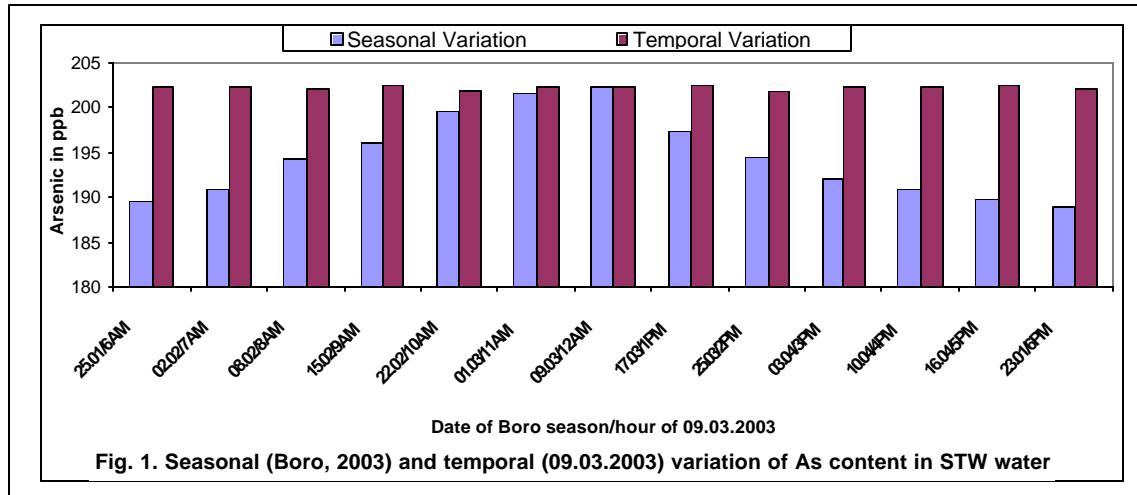
Through a general survey, it has been reported that two third of Bangladesh is affected by groundwater-arsenic (As) contamination (BGS, 1999). Use of ground water for irrigation in Bangladesh is increasing to achieve increased agricultural production. Presently, about 47 % of the net cultivated area is under irrigation, of which about 71 % utilizes groundwater (NMIDP, 1998). Most of the groundwater in irrigated areas of Bangladesh is contaminated with arsenic (Khan *et al.*, 1998). Survey work conducted by project partners (BARI, BRRI, BINA and BAU) also revealed the same results and identified many hot spots of As-contaminated areas. Brahmanbaria is one of the worse As-contaminated areas. To understand the distribution and transport of As in water and soil and its uptake by rice crops, an investigation was conducted in Brahmanbaria. The present paper reports the results of the command area study at Brahmanbaria of Bangladesh.

Methods and Materials

A few studies on the arsenic status of water, soil, rice grain and straw of a shallow tube well command area of Brahmanbaria (Old Meghna Estuarine Floodplain Soil, AEZ-19) were conducted during the boro season of 2003. Arsenic content of experimental STW water is 200 ppb, and the command area size is 2.1 hectare. Temporal and seasonal variation of As content of STW was studied (**Study 1**). Water and soil of the irrigation channel were collected at 10 m intervals from the STW, to study the distribution pattern of arsenic in the drain (**Study 2**). Four rice varieties (BR 28, BR 29, BR 36 and BINA 6) replicated four times were grown in the study field of the STW using the arsenic contaminated water to study the As contents of grain and straw (**Study 3**). Ninety-six sampling spots in a 20 m grid arrangement were selected and geo-referenced by a GPS. Soil, grain and straw samples were collected from these sampling spots. In 86 sampling spots, BRRI Dhan 29 was grown. The other varieties grown were BRRI Dhan-28, BRRI Dhan-36 and BINA-6 in 1 spot each and the local variety in 7 spots. The crop was harvested from a 1m x 1m area for determination of grain and straw yields and arsenic contents (**Study 4**). Soil, rice grain and straw samples were analyzed, following tri-acid digestion, by HG-AAS (for arsenic) and FAAS. Descriptive statistics and correlations were obtained for arsenic contents of water, soil, rice grain and straw samples.

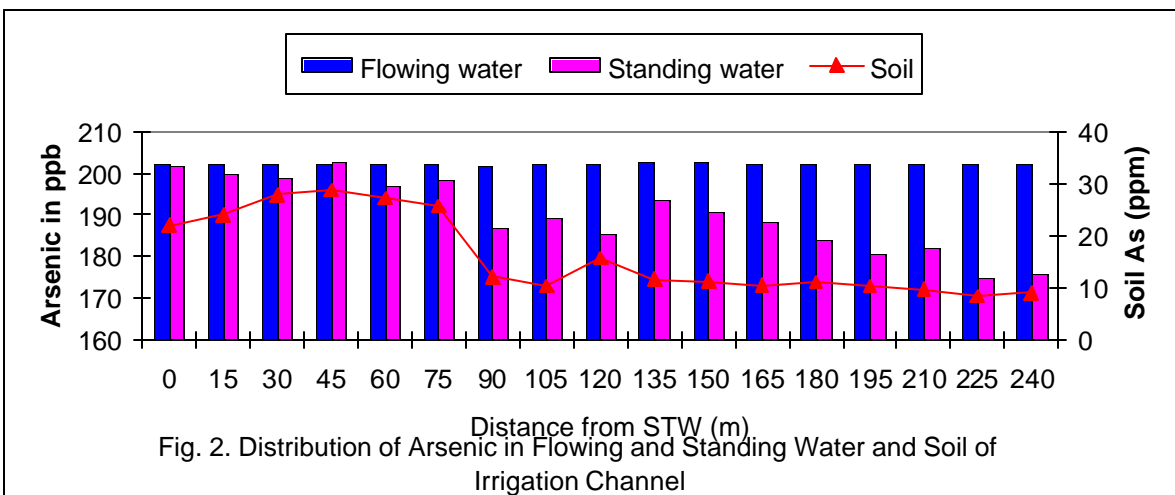
Results and Discussion

Study 1 : Seasonal and temporal variation of arsenic content in irrigation water from the shallow tube well (STW).



There was no variation of As content of the STW within a day, but arsenic content slightly was higher in early march and declined thereafter (Fig. 1).

Study 2 : Study of Arsenic content in irrigation water and corresponding soil samples from the irrigation channel.



It was found that As contents of irrigation water (standing water) were slightly higher and those of drainage-canal soil were considerably higher at the starting point than at the far point of the irrigation channel, while that of the flowing water of the irrigation channel remained the same at all points (Fig. 2).

Study 3: Study on the influence of arsenic-contaminated irrigation water on yield and uptake of four Boro rice varieties.

Table 1: Yield, yield attribute and As content of Boro varieties grown with As contaminated irrigation water.

Treatment	Life duration	Plant height (cm)	No. of filled grains/panicle	1000 grain weight (gm)	Grain yield (t/ha)	Straw yield (t/ha)	Arsenic content in ppm	
							Grain	Straw
BR 28	137	85.3c	89.3b	21.82	4.00b	4.82c	0.550 ab	3.79ab
BR 29	154	93.8b	103.2a	21.33	4.92a	6.19b	0.576 ab	3.81ab
BR 36	140	87.9bc	86.5b	21.48	3.84b	4.65c	0.507 b	3.57b
BINA6	159	115.8a	106.5a	21.51	5.02a	6.56a	0.612 a	4.06a
SE (±)	-	3.2	5.6	NS	0.12	0.14	0.03	0.17
CV (%)	-	4.8	8.3	2.5	3.9	3.5	7.6	9.3

It was found that As content was higher in long duration varieties and lower in short duration varieties (Table 1).

Study 4 : Study of macro level variation of arsenic content in boro rice grain, straw and soil from the STW command area.

Arsenic contents of soil, rice grain and straw of the Brahmanbaria STW command area are described in Table 4 (a).

Table 4 (a). Arsenic contents of soil, rice grain and straw of Brahmanbaria command area.

Parameter	Arsenic concentration		
	Min.	Max.	Mean
Soil (ppm)	3.21	24.4	9.42
Rice grain (ppm)	0.16	1.20	0.43
Rice straw (ppm)	0.33	4.02	2.00

Table 4 (b). Correlation between arsenic content of soil, grain and straw of Brahmanbaria command area.

Arsenic content	Soil-As	Grain –As
Grain-As	0.62**	
Straw-As	0.84**	0.61**

Significant correlations between arsenic contents of soil, grain and straw were observed in samples of Brahmanbaria (Table 4b). Arsenic content was higher in near and depressed points of the command area while it was lower in far and elevated points of the command area.

Conclusion

- Study 1 :**
1. There is no variation of Arsenic content in irrigation water of a specific Shallow Tube Well within a day.
 2. Arsenic content of irrigation water was higher in early march and declined there after.
- Study 2:**
1. There is no variation of Arsenic content of irrigation water (flowing water) in a irrigation channel.
 2. Arsenic content of irrigation water (standing water) was higher at starting point and lower at end point of an irrigation channel
 3. Arsenic content of adjacent soil sample was higher at starting point and lower at end point of a irrigation channel
- Study 3:**
1. Arsenic content in rice grain and straw is higher in long duration BINA-6 and BR 29 and lower in short duration BR 28 and BR 36.
- Study 4:**
1. Arsenic content of rice grain, straw and soil sample is comparatively higher at nearest point of STW and lower at far point of STW

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