Arsenic in Irrigation Waters, Soils and Rice Grains in some Areas of Bangladesh

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INTRODUCTION

Shallow tube wells (STW), with depths of 50-70 m, constitute 80-85 % of the irrigation wells used for growing rice, the staple food crop of Bangladesh (Dey *et al.*, 1996). Hand tube wells, which draw water from very shallow depths (around 20 m), are the almost exclusive source of drinking water in the rural areas of the country where 70-80 % Bangladeshis live, have been recently found to be largely contaminated with As (BGS, 2000). About 70 million of the 130 million people of Bangladesh are at risk from high As in drinking water, 90 % of which is provided by shallow tubewells (WHO, 2001). It is suspected that the STW irrigation water may also have a high As content which may increase the As level in the soils, and thus, high amounts of As may accumulate in food grains creating an additional health hazard for the people of Bangladesh. Thus, high As drinking water coupled with As contaminated foodstuff is causing mass poisoning in Bangladesh which is probably unparallel in human history. In order to assess the real As hazard in the irrigation water-soil-rice system in Bangladesh agriculture, a survey was conducted in 5 district of Bangladesh, known to be drinking water As hot spots.

MATERIAL AND METHODS

Fifty one irrigation water from STW were collected during the period of March to April, 2001 in nine *thanas* (smallest administrative units in the districts of Bangladesh) of two central and three western districts. At each well sites, surface soils (0-15 cm) and rice samples were obtained during harvest. Air-dried soils, husked grain and straw samples (oven dried) were digested by hot digestion with HNO_3+$HClO_4$+H_2SO_4 (Standard methods for soil analysis, 1994). A Perkin-Elmer AAnalyst 100 atomic absorption spectrophotometer equipped with a FIAS-100 flow injection hydride generation system was used for all arsenic determination. All samples were pre-reduced with conc. HCl, 5 % KI and ascorbic acid mixture prior to hydride generation.

RESULTS AND DISCUSSION

Arsenic in Irrigation Water

The As content in the STW water samples varied between 0.001 and 0.277 ppm. In 20 out of 51 samples, the As content was found above 0.100 ppm (Fig. 1), whereas the safety limit for As in drinking water in Bangladesh is considered to be 0.05 ppm. Only 2 samples each from Narayanganj and Bagerhat District had a relatively high content of arsenic, >0.200 ppm.

Arsenic in Soil

Irrigation with high-As water resulted in significantly elevated As content in soil. The mean As content in the soil was found to be 11.58 mg/kg with a range of 4.15 to 26.30 mg/kg. Most of the soil samples had an As content of 5.0-15.0 mg/kg (Fig. 2). Arsenic contents in both STW water and soil were found to be higher on low land than on high land (Fig. 1 and 2).

Arsenic in Rice

The As content of rice grain ranged from 0.06 to 0.50 mg/kg. In most samples the As content was found to be less than 0.25 mg/kg. However, relatively large quantities of As, 0.265-18.614 mg/kg, were observed in rice straw. There was a highly significant correlation between grain and straw As concentration in rice. The rice varieties differed appreciably in the accumulation of As in grain (Fig. 3). This variation in As accumulation among the cultivars pointed to the possibility of development of rice genotypes to combat the problem of As toxicity. Irrigation with high–As water increased the As content in all plant parts including the grains. The implication is that, continuing high–As water irrigation over a long time could increase phyto-availability of As in the soil to such a limit where As uptake by plants and accumulation in the edible parts could become a real human health hazard.

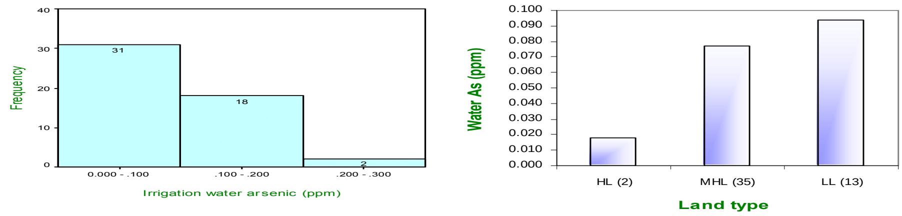

Fig. 1. Frequency distribution of As in STW waters in different *thanas* and As content in STW water on different land types.

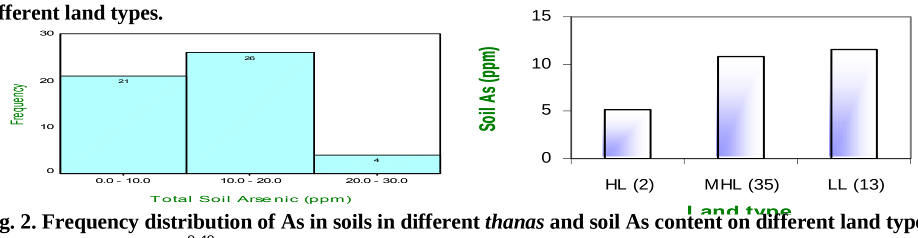

Fig. 2. Frequency distribution of As in soils in different *thanas* and soil As content on different land types.

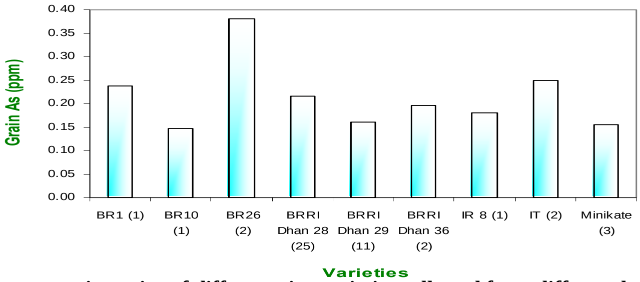

Fig. 3. Average As content in grains of different rice varieties collected from different locations of Bangladesh. Figures in the parentheses show the numbers of samples.

CONCLUSIONS

This general survey covering a small area provided a glimpse into the possibility of a real As hazard in Bangladesh agriculture. Detailed studies on the status and behavior of this highly toxic element in the water-soil-plant system across the country is in order.

ACKNOWLEDGEMENTS

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