The Arsenic Hazard in the Irrigation Water-Soil-Plant System in Bangladesh: A Preliminary Assessment

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INTRODUCTION

Bangladesh faces a serious environmental and health hazard from As contamination of groundwater, which is widely used for drinking water and for irrigation. About 80-85 % of the irrigation wells of Bangladesh are shallow tube wells (BADC, 2002), pumping water from 30-60m deep aquifers that is primarily used to irrigate *Boro* (dry season rice. Shallow tube well (STW) water has been found to contain more than 0.05 mg/l As - considered the safe As level for drinking water in Bangladesh - in 60 out of 64 districts of the country (DPHE/BGS, 2000). About 77 million of the 135 million people of Bangladesh are thought to be directly or indirectly at risk of As poisoning (Science News, 2002). However, As research in Bangladesh so far has centered on drinking water. The short- and long-term impacts of As on agriculture and food quality in Bangladesh also need immediate attention. Arsenic levels in irrigation waters, soils and rice in some intensive rice-growing areas of Bangladesh are reported here.

MATERIAL AND METHODS

The study was conducted in five *thanas* (smallest administrative units): Brahmanbaria, Senbag, Faridpur, Pabna and Tala representing diverse physiographic and hydrological situations in the eastern, central and western districts of Bangladesh. One hundred to 110 STWs (except in Senbag where the number was 42) were selected in each *thana* to cover as much of the area as possible. Water samples were filtered through 0.45 µm filters and acidified to approximately pH 2 with HCl. Composite soil (0-15 cm), rice straw and grain samples were collected from a 1 m^2 area. Water samples were analyzed for total As by an ICP. Soil samples were digested with HNO_3/H_2O_2 and analyzed for total arsenic by HG-AAS. Oven-dried straw and husked grain samples were analyzed for As by $HNO_3 – HClO_4$ digestion and HG-AAS.

RESULTS AND DISCUSSION

Arsenic concentrations in the STW waters varied widely (Fig.1). The maximum As concentration was about 0.6 mg/L and the minimum <0.01 mg/L. More than one-half of the STWs had a water As content >0.1 mg/L and 50 were >0.2 mg/L, indicating quite a high risk of soil and plant contamination from irrigation. Total soil As exceeded 10 mg/kg at about half of the sites and values up to 60 mg/kg were found (Fig.1). The correlation between irrigation water As and soil As was poor for all *thanas*. Soil factors (e.g., mineralogy, internal drainage, texture, etc.) may have played an important role in addition to irrigation water arsenic concentration in influencing As accumulation in the soil. Rice grain and straw sample analyses have been completed for two *thanas*, Senbag and Tala. Grain As content was unusually high, 0.8-1.0 mg/kg, at only a few sites, otherwise it was mostly within the range of 0.2 to 0.4 mg/kg. The As content in straw was about 10 times higher than that in grain (Fig. 1). The plant As concentrations correlated poorly with water or soil As contents, indicating that interactions within the water-soil-plant system are complex.

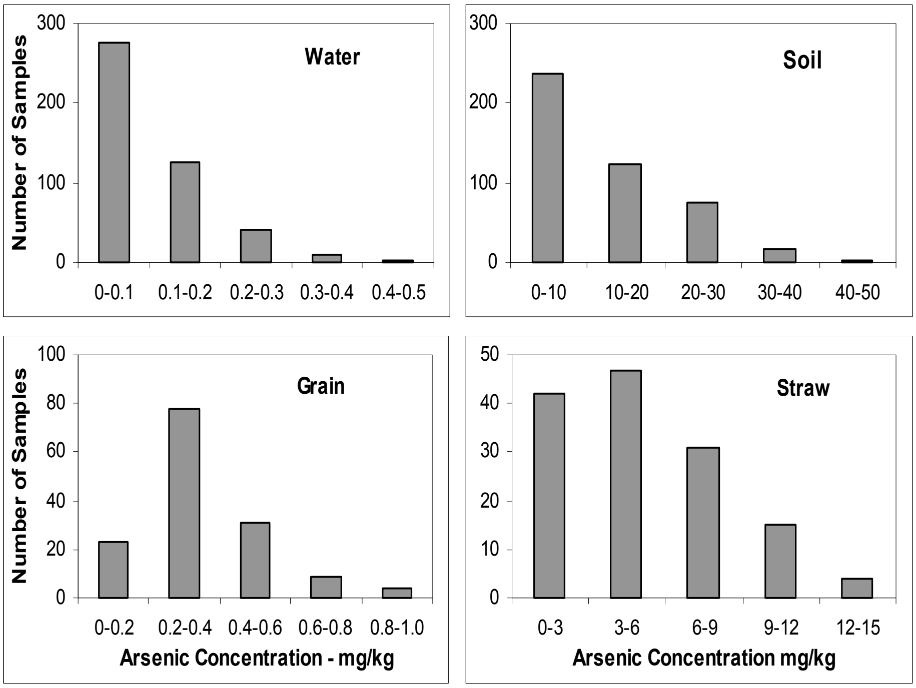

Fig.1. Distribution of Arsenic levels in shallow tube well waters, soils and rice.

CONCLUSION

A sound understanding of the chemical behavior of As in the water-soil-plant system is necessary if we are to minimize As build-up in soil and uptake by rice.

ACKNOWLEDGEMENT

The authors thankfully acknowledge financial support from US-AID.

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Science News (2002) 162, 325.