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Arsenic mitigation in Bangladesh: An analysis of institutional stakeholders' opinions

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HIGHLIGHTS

- As mitigation is restricted by technical, political and socio-economic factors.
- Institutional weakness and lack of accountability are two major hindering factors.
- Latency of As exposure decreased the urgency for action and resource allocation.
- Increased awareness increased demand for Deep Tubewells and other safer options.
- The "paying for water" concept needs developing for sustainable water management.

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ABSTRACT

While Bangladesh made significant achievements in safe water coverage via installation of shallow tubewells (STWs) nationwide, this success was shattered by the discovery of arsenic (As) in the STWs. The extent and severity of As groundwater contamination throughout Bangladesh and its detrimental effects on human health are well known and demand long-term sustainable mitigation. It is an immensely complex and expensive task to bring tens of millions of arsenic exposed people under safe water coverage. While various mitigation measures have been undertaken by various organizations, most have not achieved their expected outcomes due to technical, spatial and socio-economic challenges. Better understanding of these challenges by institutional stakeholders is crucial for sustainable arsenic mitigation in Bangladesh. In this study, institutional stakeholders' opinions on various aspects of As mitigation were elicited to identify their preferences for and reservations of specific mitigation measures. The current status of As mitigation activities and the factors influencing the success of As mitigation were also explored. Institutional weakness, lack of accountability and a latency period were the major factors hindering sustainable As mitigation. The results also suggested that the stakeholders' understanding of the As problem and their preferences for the different mitigation measures have a significant impact on the effectiveness of As mitigation. Mitigation of As contamination is a complex issue that requires a coordinated effort from various levels of stakeholders. The concept of "paying for water", which is currently potentially unknown in the rural areas of Bangladesh, also needs to be developed as this will create a stronger sense of user ownership of As safe water and thus better water management.

1. Introduction

In Bangladesh groundwater arsenic (As) is mainly due to natural geological weathering processes rather than any single anthropogenic source (Ahmed et al., 2004; Mukherjee and Bhattacharya, 2001), where the extent and severity of As contamination and the effect on the rural population is well known. Various estimates have indicated that between 25 and 57 million people are potentially at risk of impaired health due to direct As exposure through drinking water exceeding the Bangladesh guideline value of 50 μg L^{-1} (Ahmed et al., 2004; BAMWASP, 2007; Kinniburgh et al., 2003). Several other studies have estimated the number of Bangladeshis at risk of adverse health effects, due to either direct or indirect exposure to As contaminated water, may be well over 75 million, corresponding to between 59 and 61 of the 64 districts in Bangladesh (Fazal et al., 2001; Hossain, 2006; Khan et al., 2003).

Human exposure to As can occur through both direct and indirect pathways, where the relative importance of the exposure pathway depends on the source of the As, as well as the spatial characteristics of the landscape where people reside (Khan et al., 2009a). Bangladeshis are primarily directly exposed to As through the food ingestion pathway, that is mainly through the consumption of contaminated drinking water and large amounts of rice and other foods (Khan et al., 2009b).

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Thus, elevated levels of As in drinking water and in food has the potential to significantly impact on human health (Parvez et al., 2006; Rahman et al., 2007; Smith et al., 2000; Yu et al., 2003) where the magnitude of the health risk depends on As speciation, duration and frequency of exposure, as well as other demographic characteristics (Khan et al., 2009c). The use of Shallow Tubewells (STWs) to extract groundwater was first introduced throughout the rural communities of Bangladesh by UNICEF in the late 1970s to prevent water borne diseases and to allow access to a "safe drinking water" source and now STWs constitute the major drinking water source for 90% of the rural Bangladeshi population (Hoque et al., 2004). While STWs were successful in reducing mortality from water borne diseases, many STWs were subsequently found to be contaminated with As. Estimates have shown that of the 6–11 million drinking water STWs (BGS&DPHE, 2001; Van Geen et al., 2003), between 25% (Kinniburgh et al., 2003) and 29% (NAMIC, 2004) exceeded the Bangladesh drinking water standard of 50 μg L^{-1} and as many as 50% exceeded the WHO drinking water guideline of 10 μg L^{-1} (BGS&DPHE, 2001; WHO, 2001). A recent study by Khan (2009) in three Upazilla's estimated that 37% of STWs exceeded 50 μg L^{-1} and 70% exceeded 10 μg L^{-1} while the British Geological Survey (BGS) estimated that 27% and 46% of STWs (<150 m) exceeded 50 μg L^{-1} and 10 μg L^{-1}, respectively (BGS&DPHE, 2001). Estimates have also shown that 52% of the STWs (n = 5000) in Araihazar Upazila and >80% of the STWs in 29 of the most affected Upazilas had As concentration >50 μg L^{-1} (Van Geen et al., 2002). Therefore, approximately 57% of the exposed population will remain at risk of As exposure during their lifetime (Ahmed et al., 2006).

Arsenic contamination of STWs poses significant challenges to the water, health, agriculture and financial sectors of Bangladesh because As contamination is a complex multifaceted problem which makes mitigation a complex and expensive process. To tackle the problem, several different As mitigation options have been introduced in Bangladesh, including deep tubewells, dugwells, rain water harvesting, piped water systems, surface water treatment systems and As removal filters for both household and community use. Many international and bilateral agencies, governmental organizations and NGOs (non-government organizations) have also become involved in As mitigation activities. In some cases, the desire by agencies to immediately find a solution to the provision of As free water witnessed the introduction and widespread promotion of some technologies without thorough testing (Boerschke and Stewart, 2001). Consequently, many efforts were unsuccessful and did not attain community acceptance (Hoque et al., 2000, 2004). In addition, in the rush to fulfill the immediate need for As free water, the institutional and socio-economic components attached to As mitigation activities were largely ignored (Ahmad et al., 2006) and while significant importance was given to technological solutions very limited effort was made to empower local governments to achieve sustainable As mitigation (Atkins et al., 2007).

To date most of the studies concerning stakeholders' preference and opinion on As mitigation options have been conducted at the household level (Ahmad et al., 2003, 2005, 2006; Jakariya and Bhattacharya, 2007; Jakariya et al., 2007; Van Geen et al., 2002, 2003). However, no specific study on stakeholders' opinions has been conducted at the organizational/institutional level, which is surprising given that these stakeholders include decision and policy makers who are the main drivers of As mitigation. These stakeholders typically include the government organizations (central and local government), international agencies, donor agencies, NGOs (non-governmental organizations) and research institutes, hereafter simply referred to as institutional stakeholders. Therefore, this study focuses on semi quantitative and qualitative assessment of institutional stakeholders' opinions on various aspects of As mitigation measures to identify preferences and conflicts. The institutional stakeholders' perception of end-users' Willingness to Pay (WTP) and Willingness to Walk (WTW) for As free safe water was also explored.

2. Study area, method and materials

This survey was concerned with the opinions of institutional stakeholders who were either the decision makers and/or had strong influence on As mitigation related decisions. The surveys were conducted in Sirajdikhan, Sujanagar, Ishwardi and Laksham Upazilas of the Munshiganj, Pabna and Comilla Districts, respectively, which were all known to have As contamination issues. Central level stakeholder opinions were collected from various organizations located in Dhaka. A total of 31 stakeholders were contacted, 6 of these declined to participate in the interview process citing other time commitments. Hence, twenty five stakeholders (n = 25) from various organizations participated in the face-to-face interviews. Participating stakeholders were from central government (n = 2), local government (n = 9), local NGOs (n = 5), international NGOs (n = 2), donor agencies (n = 6) and research institutions (n = 1). After the interviews were conducted 6 stakeholders were identified as no longer being active in As mitigation at the time of the survey and were subsequently removed from further analysis. Although the sample size was relatively small, it was representative of all of the major active mitigation groups in Bangladesh.

The questionnaire was designed to answer the following questions:

1. Which organizations are involved in As mitigation in Bangladesh, their activities and interconnections between organizations?
2. What are the organization's successes in respect to As mitigation in Bangladesh?
3. What are the factors hindering As mitigation activities of the respective organizations?
4. How to best equip Upazila Parishad (UP)[1] for better performance in As mitigation activities?
5. What are the preferred As free safe water options and would it be community and/or individual measures?
6. What are the factors influencing the provision of safe water sources in the As contaminated areas of Bangladesh?
7. Should people pay for access to As free safe water and how much should they pay?
8. Should people walk and spend time collecting As free safe water and what would be the appropriate distance and time spent collecting water?

To answer above mentioned questions the questionnaires was structured in four main sections: (i) general information on stakeholder's institution; (ii) institutions/organizations role in As mitigation; (iii) stakeholders' opinion on preferred As mitigation options and mitigation activities (iv) opinion on water pricing, end-users willingness to pay (WTP), willingness to walk (WTW).

The questionnaire was developed in English and also translated into Bangla (the national language) which consisted of both open- and close-ended questions. Questionnaires were thoroughly pretested and subsequently revised. During pretest particular attention was paid to the understandability and credibility of the subject matter. The questionnaire was delivered in either Bangla or English based on the stakeholders fluency and preference for a particular language without any translational issues.

The collection and analysis of the information involved the following processes: i) identification and preparation of a list of potential stakeholders from the targeted groups; ii) implementation of a face-to-face questionnaire survey and discussion with the stakeholders, iii) Collection and collation of information into a spreadsheet where open-ended questions were grouped based on similarity and subsequently assigned a unique code, and iv) qualitative and quantitative analysis, mainly simple statistical (descriptive) methods, of the data collected.

[1] The "Upazila Parishad" is the second tier of the local Government of Bangladesh. "Upazila" means Sub-District and it replaces the word "Thana".

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