

# **Policy Dimensions of the Arsenic Pollution Problem in Bangladesh**

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## **INTRODUCTION**

The arsenic pollution of groundwater has become a major disaster for West Bengal, India and Bangladesh. The alluvial aquifer that underlies the Ganges-Brahmaputra river basin contains arsenic in mineral form and has been widely tapped for obtaining drinking and irrigation water. Over a period of about 20-25 years about four million wells have been installed to utilize the groundwater from deeper aquifer layers, typically less than 200m deep (UNICEF, 1999). Exploitation of groundwater from these wells has resulted in mobilizing the arsenic and led to mass poisoning in the region, which is defined by the generic term arsenicosis (Rahman et al., 2001). Presence of arsenic from natural sources in the groundwater is not unusual and has been documented in other parts of the world. This paper will focus primarily on Bangladesh with the implicit understanding that the recommendations may well be applicable to other developing countries.

Bangladesh is a tropical country with a total surface area of about 144,000 km<sup>2</sup> and an estimated population of 129 million as of July 2000 (UN, 2000). Of the surface area available, about 70% is arable and about 10-15% comprises forests and woodlands. World Bank estimates put the contribution of the agricultural sector to national GDP at about 25%, while a vast majority (~76%) of the population lives in rural settings (World Bank, 2000). Incidentally, this rural population is the one most impacted by the arsenic contamination, largely because of lack of access to safe drinking water. Even in the cities only about half the population has access to safe water (UN, 2000). Recent estimates

indicate that more than 35 million people are potentially at risk from drinking contaminated water (Smith et al., 2000). This indeed brings the problem to a catastrophic scale that has not been experienced by humankind before.

The Bangladesh government, with support from international agencies and local and international NGO groups, have initiated a number of programmes to determine the extent of the problem. Considering the unprecedented scale of this disaster, it has been a major challenge to come up with a cohesive strategy to tackle the problem. This is particularly difficult due to the fact that the problem is multi-dimensional and involves a number of sectors. Another confounding factor is the scientific uncertainty in a number of aspects, including the exact mechanism of arsenic mobilization, exact delineation of arsenic contamination (with concentration levels and estimated water volume) and effective medical remedies for arsenicosis. This paper overviews the various dimensions of the problem and suggests some preliminary guidelines for developing a cohesive strategy.

## **RESEARCH GAPS**

A number of gaps in the scientific knowledge exist; only a few of them are described here. Firstly, the health impact of arsenic in the presence of other pollutants and iron has not been fully studied. It is quite important to know whether presence of other pollutants worsens the arsenicosis conditions or not. Secondly, ingestion of arsenic through other routes such as contaminated food has not been adequately studied. A vast majority of the contaminated groundwater is utilized for irrigation purposes. The potential uptake of arsenic into plants and foods from the irrigation water, retention in soils and leaching back to shallower aquifers have not been investigated. Thirdly, soil retention of arsenic can lead to arsenic-laden dust particles – these have not been explicitly studied as an ingestion route. Some of these issues highlight the need for carefully conducted scientific studies that describe the fate of arsenic in the natural environment and identify all potential routes of exposure.

## **POLICY DIMENSIONS**

### **Human Health Protection**

The impacts of arsenic pollution on human health – arsenicosis, keratosis, melanosis and others – are typically gradual. Some researchers have divided them into four categories or levels ranging from mild to severe (Oshikawa et al., 2001). The transition from one level to another occurs due to continued long term exposure to arsenic contaminated water. Some of the research work done by

Oshikawa et al. (2001) clearly indicates either improvement in health or halting further degradation when use of contaminated water is discontinued in the early stages of the disease. This has important implications for formulating a health protection policy. One may argue that provision of clean and affordable supply of freshwater is absolutely essential to halting the further impacts of the problem.

Implementing such a policy, however, poses several challenges for government agencies, civil society groups and international organizations. Firstly, convincing the general public that clean freshwater will help with the common epidemic is a difficult task. This difficulty has to be viewed in the context of similar publicity campaigns carried out in the 1970's and 1980's to promote that groundwater is the safest source of water. The credibility barrier so-created can be overcome through involvement of local communities in the development of such programmes. Secondly, providing clean freshwater at low cost or free of charge would require considerable investment in developing, managing and operating a reliable water supply system. Interim measures such as supplying bottled water may not be sustainable in the long-term. Needless to say, international funding agencies as well as bilateral donors can and have stepped in to assist in the process.

Another important public health issue is setting the standard for what is "clean" water. Currently, Bangladesh employs a drinking water standard of 50 ppb (or  $\mu\text{g/L}$ ) which is based on some earlier guidelines established by the World Health Organization (WHO, 1993). Many countries including Bangladesh have either kept this as the national standard or as an interim target, with the realization that significant impacts may also exist at lower concentrations in the 10-50 ppb range. It should also be noted that based on scientific information available on health impacts of arsenic contaminated water, a value lower than 10 ppb is advisable (WHO, 1999). However, such a value is still considered provisional in part due to the lack of widely acceptable analytical techniques. Existing scientific evidence should be weighed carefully and the drinking water standard for arsenic should be revised downwards. Obviously, this will have significant impacts in identifying and delineating the regions impacted by the arsenic groundwater pollution.

### **Social and Societal Aspects**

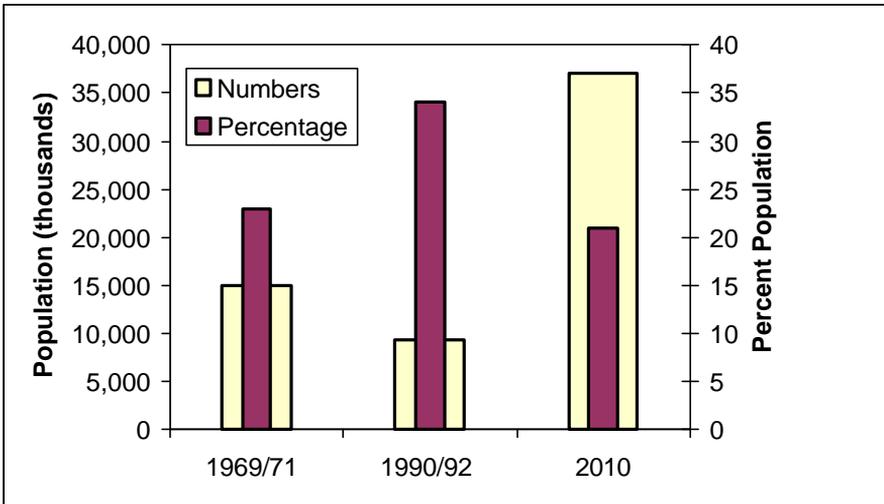
The arsenic contamination problem has triggered a number of social and societal problems that were unanticipated and are still not fully recognized. Recent studies confirm the fact that worst arsenic problems are encountered by the poorest fraction of the society (WHO, 2000) – particularly those who are already undernourished (please see Figure 1). There is also a certain social stigma associated with people affected by arsenicosis, with the disease wrongly attributed to sins in the current or past lifetimes. Yet another societal impact is that on livelihoods of families that lose head of the household or "bread-earners"

to the disease. There is a need for serious consideration of alternative livelihoods for people who may be affected by arsenicosis as well as for the orphans and widows of those who pass away.

It needs to be re-emphasized that raising public awareness on the arsenic pollution and related health problems is largely a societal problem. One has to overcome the obstacles mentioned earlier to make a public awareness campaign successful. Therefore, it is critical to fully engage the civil society in developing such campaigns and in implementing them. Numerous NGOs active in this area could be an invaluable asset in this respect.

### **Food Security**

Bangladesh currently faces a food security challenge. A recent report on State of the Environment in Asia and the Pacific (UN, 2000) projects approximately 37 million people will still be undernourished in the year 2010; please see Figure 1 for the temporal trend. The impacts of the arsenic pollution on this worsening food security have not been considered explicitly. It is also not clear whether arsenic in irrigation water is taken up by the plants or that a fraction of such uptake ends up in food. These issues of food security, both science- and policy-oriented, have to be considered in developing overall strategies to the arsenic contamination problem.



**Figure 1 : Undernourished population in Bangladesh (Source: UN, 2000)**

### Water Resource Management

Bangladesh has abundant water resources available to it – both in terms of surface water and groundwater, as shown in Table 1. The groundwater resources comprise approximately 10% of the water resources used in the country, although an estimate of the exact volume of groundwater contaminated with arsenic above WHO standards is not readily available. Figure 2 shows the sectoral distribution of freshwater and groundwater, respectively. It is obvious that a vast majority of groundwater is utilized by the agricultural sector.

**Table 1. Water resources in Bangladesh (Source: WRI, 2000)**

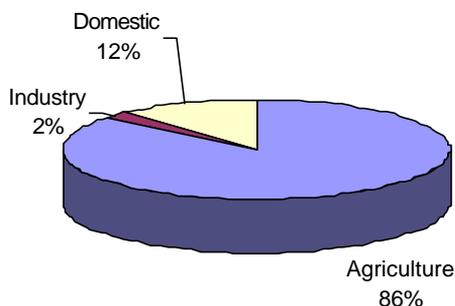
	<b>Average annual internal renewable water resources 2000</b>	<b>Annual withdrawals 1990</b>	<b>Average annual groundwater recharge 1990</b>	<b>Annual groundwater withdrawals 1990</b>
Total (km <sup>3</sup> )	105.0	14.6	21.0	10.7
Per capita (m <sup>3</sup> )	813	134	163	19.6

The abundance of available surface water, if managed appropriately, would obviate the need for utilization of groundwater in the first place. However, installing an infrastructure on a nation-wide basis for treatment and delivery of freshwater is a major undertaking. The overall approaches for remediating arsenic contamination problem, however, cannot be successful if they do not account for water availability as a broader resource management issue. In this respect, rainwater harvesting can be an important resource for drinking water – successful implementation has been undertaken in Bangladesh and Thailand (UNICEF, 2000; Oshikawa, 2001).

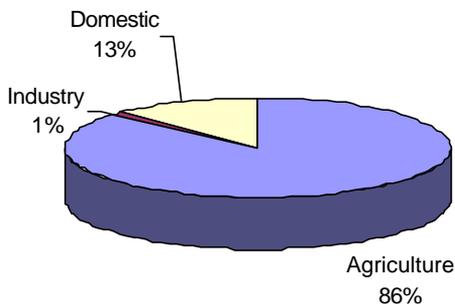
It is also important not to outright reject groundwater as a freshwater resource. It is possible that a number of “safe” non-domestic uses of this water may be found. More significantly, the potential for treating the groundwater for domestic purposes is immense. By treating the groundwater for arsenic contamination, it attains hygienically superior quality than readily-available surface water. A number of technologies are available for removing arsenic from groundwater to below the drinking water standards; these have been described in some detail in a number of other publications (e.g., WHO, 2000) and are a focus of this workshop. To be fully applicable, these technologies must be easy to operate, efficient under local climate conditions and cheap. The work done by the United Nations University in collaboration with BUET has methodically investigated a variety of options available and successfully applied them at pilot

scale in affected villages (Ali, et al., 2001). Nevertheless, scaling up the implementation of these technologies is a daunting task –both from technical and financial points of view – that can only be implemented if the international agencies, NGO groups and relevant government institutions join their resources.

### **Total Water Usage**



### **Groundwater Usage**



**Figure 2. Water usage in Bangladesh (Source: WRI, 2000)**

### **Information Management**

One major aspect of strategies to tackle the arsenic pollution problem is management and dissemination of information to various stakeholders, including researchers, policymakers, politicians, international donor agencies and the general public. The information can come in various forms including – but not limited to – data from groundwater monitoring, geographical distribution of arsenic contamination, medical facts about diseases triggered by drinking

arsenic-contaminated water, resources available for remediation activities and number of people impacted. Use of newer dissemination technologies, including the Internet, should be fully utilized.

Transparency in information management is also critical for fully understanding the problems and for developing a cohesive strategy. Openness and transparency can increase trust among government agencies, scientists and the public. At a minimum, it can create awareness as well as educate, alert, and prepare people about the risks they may face. Transparency between the government agencies and donors is also necessary, so that the needs and expectations about financial assistance of both are well understood.

## CONCLUSIONS

The arsenic pollution crisis in the region is indeed severe and is pushing the limits of our knowledge and the capacity to respond to it. Considering the various dimensions of the problem discussed earlier, it is essential to develop a cohesive strategy on a region- or nation-wide basis. Based on the discussion in this paper, the key elements of such a strategy can be summarized.

- *Raising Public Awareness* should be the starting point for any approach to deal with the arsenic problem;
- *Information Dissemination and Transparency* play a key role in effectiveness of remedial strategies while building the confidence of stakeholders, particularly general public;
- *Participation of the Civil Society* has to be a key element of designing, planning and implementing remediation strategies;
- *Improving Nutrition* and fighting undernourishment has to be a central element to fight arsenicosis;
- *Alternative Livelihoods* should be provided for those who are directly impacted by arsenic contamination as well as their immediate families;
- *Scientific Research* has to be emphasized to reduce uncertainty, with due consideration to local conditions;
- *Drinking Water Standards* have to be modified in view of the scientific research;
- *Water Resource Management* on a regional or national scale is essential to fully exploit the abundant surface water resources available – this has to include treated groundwater as a critical component;
- *Treatment Technologies* that are cheap, efficient and easy to use should be applied at a large scale as an interim or mid-term solution; and
- *Intra-governmental Coordination* is a must for effective implementation of the elements described here.

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