

Arsenic in Asia: A regional overview

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Besides the well known cases of Taiwan, West Bengal (India) and Bangladesh, there are eight other countries in Asia where arsenic in groundwater has been found in excess of permissible values¹: Cambodia, China, Laos, Myanmar, Nepal, Pakistan, Thailand and Vietnam. Given the chronic health effects that result from long-term ingestion of inorganic arsenic in water, the discovery of arsenic in groundwater invariably leads to questions about further testing, patient identification, mitigation responses etc. In addition, occasional questions are raised about the need for arsenic screening in other countries (e.g. in Africa and Latin-America). To provide some context for the specialist sessions on arsenic at the WEDC Conference, and to introduce the subject to a varied international audience, this paper provides a broad overview of the arsenic situation in Asia, national responses, and areas for future attention.

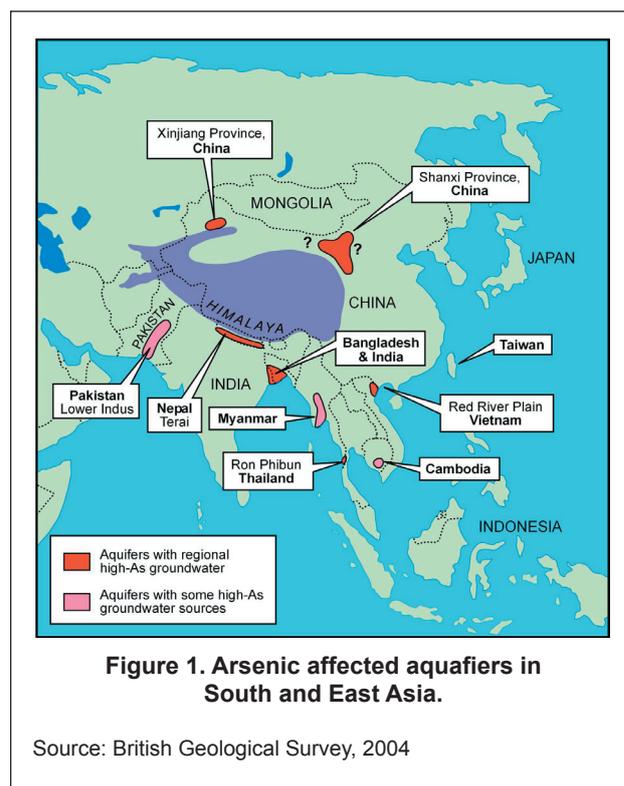
The situation in Asia: Some common features

The map (figure 1) shows the currently known arsenic affected aquifers in South and East Asia, which are used in the provision of drinking water. In the region, high groundwater arsenic concentrations typically occur under strongly reducing conditions in young (Quaternary) alluvial and deltaic aquifers (Thailand and Pakistan are exceptions though). In Thailand the occurrence of arsenic is related to mining activity, while in Pakistan more aerobic conditions predominate in the aquifers where arsenic is found). The major rivers (Red River, Mekong, Ganges, Brahmaputra, Meghna and Indus) play a role in the distribution and deposition of arsenic containing sediments (derived from Himalayan source rocks).

Other features shared between the arsenic affected areas are slow groundwater flow (which gives the arsenic time to be mobilised), high alkalinity and often high phosphorus concentrations (most likely due to decomposition of organic material in the aquifer). In many places we find high iron concentrations (> 1 mg/L) although these do not often correlate well with arsenic concentrations (except very locally).

What we know

In creating a summary of some of the available data (Table 1 overleaf), we should note two things. In the first place, the scale of the arsenic problem (and thus the costs of addressing it) is very dependent on the selected acceptable limit. In the second place, it is clear that there are still a lot of “white spots” on the overview, representing data that could not be found. This does not mean that the data do not exist. It just means that they are not easily accessible², or that the avail-



able data are too limited for general conclusions.

Some countries collect a lot of data and make it generally available (e.g. a lot of the Bangladesh data are published on the Internet), some countries collect data but do not necessarily publish it (Laos, Vietnam) while in others again few data have so far been collected (Myanmar).

In terms of population exposed and patients identified the scale of the problem varies enormously from country to

Table 1. Summary overview of selected arsenic data.

	Bangladesh	Cambodia	China	India	Myanmar	Nepal	Pakistan	Thailand	Vietnam
Wells>50ppb	27%	16%		25%	10%	7.4%	1-16%	15-39%	48%
Patients	>36,000	0	20,000		2	0	128,000	>1,000	
Exposed population (000's)	35,000	300	5,000	>5,000		500		15	>1,000
Wells tested (000's)	4,300	>10	>54	>100	95	19	39		
Rural WS coverage	72%	25%	68%	82%	74%	82%	87%	80%	67%

Laos, Taiwan and Mongolia not shown;
Pakistan patient figures based on a projection; not identified cases
Coverage figures from Unicef/WHO mid-term WSS MDG assessment 2004. Bangladesh figure adjusted for arsenic contamination, others not.

country, although we should bear in mind that to date only Bangladesh has substantially completed a mass well and population screening program. Differences in prevalence figures may partly reflect differences in available data.

A number of countries (such as Cambodia, Laos and Mongolia) have very low figures for access to improved water supplies in rural areas. For those countries especially it seems important not to get too sidetracked by the arsenic problem; their primary focus should be on satisfying demand for water, not arsenic mitigation. In other countries (Nepal, Pakistan, possibly Laos) only a small proportion of wells exceed 50 µg/L arsenic, and here too care should be taken not to over-emphasize the problem. This does not mean that the issue should be ignored altogether. The wake-up call presented by the discovery of arsenic should be heeded, and water quality issues should be tackled seriously and comprehensively. But this should happen from a risk-management perspective, and arsenic alone should not be allowed to set the agenda.

Points for Attention

The past ten years have seen a lot of activity in different countries in arsenic measurement and mitigation. Some of the lessons or suggestions that can be distilled from this work are very briefly presented below.

Establishing a Well Screening Program

Enough information is available about the general aquifer conditions under which arsenic occurs to decide whether a screening program is warranted in a particular region or country. Which approach to screening is feasible depends on the in-country situation. Field Test Kits (FTK) for arsenic are relatively cheap, and their use can contribute to awareness raising. Field work in Bangladesh has shown one of the widely used kits to have 86% sensitivity³ and 84% specificity⁴. Good enough to decide what further screening and mitigation work is needed. Laboratory tests can be more accurate, but in some countries (Cambodia, Nepal) cannot be done, while in others the quality of laboratory test results cannot be guaranteed (e.g. Bangladesh, India). Ideally, the following points need attention is establishing a screening program:

- Use FTK for initial testing in an area where arsenic may be found;
- Follow up positive results with laboratory confirmations on a sample basis, taking into account QA/QC guidelines (such as the use of duplicate samples, trip blanks, repeat analysis);
- Based on results, decide on the required extent of follow up testing. Bear in mind that given the random pattern of contamination in most places, specific advice to well owners about continued use of their water source can only be based on a test of each individual well;
- Consider early the potential for establishing or promoting private testing services at community level, and the integration of screening into any existing water quality monitoring program;
- Obtain time series data to study the influence of water level fluctuations and other seasonal differences;
- Use or establish a national database of results, tied to a national data collection form. Distribute data format and database structure to organizations engaged in well testing. To facilitate unique identification of wells and test results, use pre-numbered forms.
- Analyze and disseminate collected information.

Raising awareness

Raising awareness about water quality issues and possible actions that can be taken in mitigation is obviously important. All countries either have developed or are developing BCC materials. Bangladesh has a nationally approved campaign, and Cambodia is working on one. Nepal very quickly established a national arsenic mitigation strategy (including key messages) after the initial discovery of arsenic. Surveys in Bangladesh showed that the field testers were the most important source of information on arsenic for villagers. Also in Bangladesh, experience shows that changing behaviour is much harder than raising awareness. More than 50% of all shallow tubewells were constructed after the discovery of arsenic, and changed behaviour seems linked to the presence in the community of arsenicosis patients with visible symptoms.

Some of the campaign work in Cambodia was so success-

ful that villagers started painting their wells green (=arsenic safe) even before they had been tested ...

Important questions to answer up front are:

- How to deal with the situation that not all wells are affected. Unless all wells have been tested, the information that there may be arsenic in them can lead to confusion since no clear action is possible;
- What available options are for obtaining arsenic safe water. Is the use of wells still allowed or promoted, will the use of removal systems be allowed, etc. In a number of countries (among which was Bangladesh) there was no clear answer to this question, leading to confusion.

Identifying patients

There is a WHO protocol for the identification of patients, taking into account visible symptoms and exposure to arsenic through a contaminated water source, and allowing for a “confirmed” diagnosis after testing of biological samples (such as hair and nail). Extensive patient screening has gone on in Bangladesh, and some has happened in Cambodia. In China, Taiwan and India varying degrees of patient identification have been completed. In some countries no patients were found at all, and in general, prevalence is low. This results in arsenicosis being considered a low priority in many national public health sectors (although the political priority of arsenic-related issues may be high). Besides low prevalence, the reason for low priority action is the continued uncertain understanding of short term and long term costs of doing “something” vs. doing nothing. Some findings of completed work include:

- Detailed surveys tend to be slow and expensive, and in Bangladesh the use of health workers (instead of doctors) resulted in up to 75% “false positive” identifications in some areas;
- Patient data needs to be linked to well data for meaningful analysis to be possible. In Bangladesh, many patients used one or more older wells before they started using their current source. This indicates the need for a “water use history” survey;
- Clear guidelines for patient confidentiality need to be set and followed. The issue is a difficult one, since on the one hand patient data should only be available to doctors, while on the other hand mitigation efforts (e.g. construction of an alternative water supply) should be focused on reaching affected families and individuals.

Providing safe water

The criticism is sometimes heard that too much time is spent measuring the arsenic problem, and not enough time solving it. The ultimate aim of a lot of the efforts in arsenic mitigation is of course making arsenic safe water available to communities. Different national situations lead to different responses. In Bangladesh, 97% of all shallow tubewells are privately owned, yet the government mandates emergency mitigation measures in all communities where more than

80% of wells exceed permissible arsenic concentrations. In India, in first instance the government tested only government wells, and it took responsibility for replacement or treatment of affected sources. In Cambodia, the majority of wells are installed by NGOs and international organizations, with ownership handed over to the community upon completion. Here responsibility for mitigation is not clear at all.

All solutions consist of either source substitution or arsenic removal. While government departments or project implementers may prefer a few options that can be widely applied, the reality is that preference and technical feasibility differ so widely that no “one size fits all” solution is possible. In Bangladesh, communities generally see the use of surface water as a step back in sophistication, arsenic removal options are tightly regulated (and expensive), deep wells are not always allowed, and rainwater harvesting cannot be subsidized using government funds because it is a individual household technology, not a community one. This constrains available choices, and mitigation has been slow. In contrast, most people in Cambodia still prefer surface water over groundwater, and there is a strong tradition of rainwater catchment. This creates possibilities for rapid mitigation where funds are available. In India a lot of work has been done on the local development and installation of arsenic removal filters (using activated alumina or granular ferric hydroxide), both of household and community size. Success has been mixed however, and progress is slow.

If there is anything mitigation experience shows us, it is that all solutions should be local, even if the problem is regional. The fastest, most lasting progress will be made when data can be analyzed and disseminated locally, and national governments can resist the tendency to prescribe (or proscribe) general solutions.

National responses to date

Table 2 shows a tabular summary of some of the approaches followed to date in the region. Empty cells mean that no response was received on the subject from the country involved, not that no activity is taking place.

Summary observations

One important realization should be that many countries have arsenic safe groundwater available. In some countries using deeper (older) aquifers offers a substantially higher chance of obtaining arsenic safe water. Its secure development will need surveys, mapping and high quality well construction, and in general we can say that sound mitigation planning needs systematic data collection, management and study.

An overall strategy for testing, awareness raising and mitigation is important, and in developing the approach the “opportunity” arsenic presents for systematically addressing wider water quality concerns should be grasped.

Finally, other problems may be more important than arsenic. Having a better picture of the health and economic impact would help, but in the absence of hard data common sense will have to guide us.

Table 2. Summary overview of national responses.

	Bangladesh	Cambodia	China	India	Myanmar	Nepal	Pakistan	Vietnam
Field testing and data management								
Field kit	X	X	X	X	X	X	X	X
Laboratory	X			X		X	X	X
National database	X	X				X		
Water options								
Sharing	X					X	X	
Dug wells	X	X		X	X	X	X	
Deep wells	X			X	X	X		
Rainwater	X	X			X			
Household treatment (arsenic)	X			X		X		X
Household treatment (SW)	X	X			X			
Community treatment (arsenic)	X			X				X
Policy development								
National policy in force	X			X		X		
National policy in development		X						

Footnotes

- ¹ The WHO provisional guideline value for arsenic in drinking water is 0.01 mg/L (10 ppb). The national or interim arsenic standard for all countries considered in this paper is 0.05 mg/L.
- ² Tables 1 and 2 were constructed using publicly available information (from published print sources and Internet), as well as responses to questionnaire surveys submitted to government departments and international support agencies in early 2004. Figures should be seen as indicative. Although care was taken in the preparation this overview does not aim to present a definitive study of available arsenic data.

- ³ Sensitivity: when the well is truly unsafe, how likely is the kit to say "Red"?
- ⁴ Specificity: when the well is truly safe, how likely is the kit to say "Green"?

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