



Water and Sanitation Program

An international partnership to help the poor gain sustained access to improved water supply and sanitation services

Fighting Arsenic, Listening to Rural Communities

Findings from a Study on Willingness to Pay for Arsenic-free, Safe Drinking Water in Rural Bangladesh

South Asia Region

Arsenic contamination of ground water has adversely affected the access to safe drinking water sources for over 30 million people in Bangladesh. Alternative filtering technologies and development of different types of water distribution systems and sources are being proposed as possible solutions. This supply side focus has ignored the economic and institutional realities of propagating new technologies and approaches to ensure household access to safe drinking water. The Water and Sanitation Program sponsored an economic analysis of the preferences of villagers and their choices in terms of the proposed solutions. This comprehensive analysis was done by Dr. Smita Misra (SASES, World Bank) and Dr. B.N. Goldar (Institute of Economic Growth, New Delhi) in partnership with M. Jakariya of BRAC, a major NGO in Bangladesh who also conducted the household survey. The overall work was supervised by Junaid K Ahmad, WSP-South Asia.

The results of the study, presented to the government and other stakeholders, suggest that communities are not only seeking arsenic-free water sources but are also prepared to pay for alternatives that are as convenient as the traditional tubewell. 'Arsenic-free water but as convenient as the tubewell' seems to be the signal from communities. The study suggests that the preference for piped water is driven less by arsenic issues and more by convenience factors reflecting a growing structural change in the preferences of rural households for water services. This change is largely independent of the arsenic crisis but nevertheless strengthened by it.

This Field Note is based on the study and discusses key results of the survey, with the main findings and policy recommendations.



Fighting arsenic, listening to rural communities

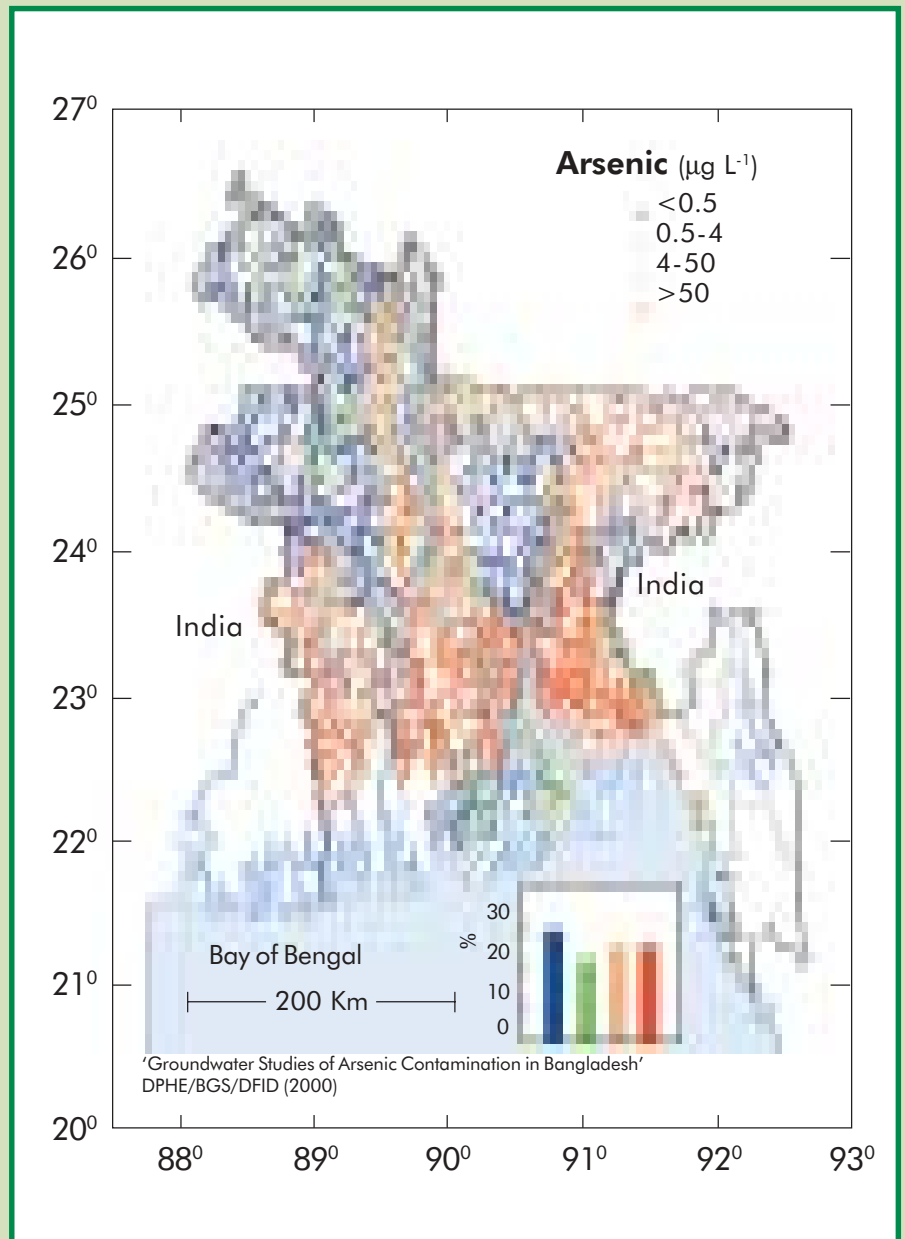
Findings from a Study on Willingness to Pay for Arsenic-free, Safe Drinking Water in Rural Bangladesh



For the last decade or more, the efforts of Government, NGOs and donor organizations in

Bangladesh have succeeded in creating a 'water miracle'. Taking advantage of the shallow water aquifers, and aided by a public sector campaign encouraging people to shift from pathogen contaminated surface water to groundwater sources, the introduction of handpump technology enabled 95 percent of rural households to access clean drinking water. The tubewell technology produced by the private sector and purchased directly by households has created, perhaps, the largest private sector supported safe drinking water program in South Asia. However, arsenic contamination of the shallow aquifer is threatening to undo this success.

To give some facts and figures on the severity of the problem, tests of tubewells in Bangladesh conducted by the British Geological Survey (BGS) in 1998 (3,500 tubewells) and by the Department of Public Health Engineering (DPHE) during 1996-99 (51,000 tubewells) have indicated that a little over a quarter of the wells contain more than 50 ppb (parts per billion) arsenic, which is the maximum permissible level recommended by the Bangladesh government. In a significant proportion of cases, the level of arsenic contamination has been found to be far above 50 ppb — exceeding 300 ppb in about 8 percent of the tubewells.



Arsenic-affected areas in Bangladesh

Well-switching as a means of mitigating the current arsenic crisis in Bangladesh

Estimates suggest that about 35 million people are currently exposed to high levels of arsenic in drinking water being pumped from millions of tubewells. Cancers of the skin, liver, lungs and other internal organs, as well as diabetes and cardiovascular disease, are some of the serious health consequences of this arsenic contamination. Field tests to monitor the levels of arsenic contamination have shown that the situation is variable throughout the country; contamination is patchy and there are both safe and unsafe water sources in many districts. Careful testing, monitoring and labelling of water sources in rural areas could clearly indicate which wells were safe or unsafe. This would enable affected villages to change water supply to a safe source. Studies suggest that well-switching could be a viable option for significantly reducing arsenic exposure in many parts of the country, at least in the short-term, and is worth considering.

Even though well-switching is implicit in current efforts to paint tubewells red or green throughout Bangladesh, in accordance with results from arsenic testing, the success depends on a successful screening method and a credible on-going monitoring mechanism, neither of which are in place. There are also significant socio-economic barriers to well-switching since most wells are privately owned and neighbors may be reluctant to agree to sharing. Privacy is another issue, since many tubewells are installed near the household latrine. And women, who traditionally collect water, are not usually allowed to leave their immediate household unaccompanied. Another point to consider is that if the density of users at each well increases the aquifer may be affected and the water source may, in turn, become arsenic-contaminated.

Arsenic contamination of groundwater has been detected in 59 of the 64 districts, and 249 of the nation's 463 *upzilas* (sub-districts). In some villages, 90 percent (or more) of tubewells are unsafe and yet there are few alternatives to groundwater sources. Estimates suggest that a little over one million of the 6-8 million tubewells in Bangladesh may be yielding water containing more than 50 ppb.

While the figures are still uncertain, estimates indicate between 30-40 million people, out of a population of 126 million, are potentially at risk of arsenic poisoning from drinking water sources. To date, several thousand patients with arsenic-related skin diseases have been identified in field surveys. Dozens of deaths due to arsenic-induced skin cancer have been reported in recent years but the actual number is likely to increase. There is at present no system to ascertain arsenic-related deaths in Bangladesh; a patient dying of cancer is categorized as 'death

by cancer' though the cause of the cancer may be arsenic poisoning. Arsenic causes damage to internal organs, but it may take years for any symptoms to appear; patients are only identified when there is visual manifestation of arsenicosis (e.g. skin lesions). Also, because the majority of the country's tubewells were only installed in the last two decades, many more people may develop symptoms of arsenic toxicity in the coming years. Paradoxically, the same wells that saved so many lives, especially of children, now pose a threat due to the unforeseen hazards of arsenic.

Bangladesh is at crossroads today, in need of effective, acceptable and sustainable solutions for addressing the arsenic crisis. Numerous bilateral and international agencies, along with Government and NGOs, are involved in arsenic research, testing and mitigation activities. Two recent studies¹, based on a specific set of criteria, have assessed people's satisfaction with

available household arsenic treatment units. Another recent evaluation, by BRAC (2000), of arsenic mitigation technologies in the context of rural Bangladesh is based on their experience in implementing an action research project in two *upzilas*.

For managing the arsenic crisis, household-based arsenic removal technologies have attracted greater attention than alternative means of supplying safe water. There is a feeling that the provision of additional community water supplies such as hand dugwells, deep tubewells, or pond sand filters to all the affected areas will require enormous funds and considerable time. On the other hand, arsenic removal technologies seem to offer a cheap and rapid form of arsenic mitigation, and to allow rural households to continue the use of their private handpumps (WSP, 2000). The question that arises is whether these technologies offer a lasting solution to the arsenic

¹ *The Rapid Assessment of Household-level Arsenic Removal Technologies*, BAMWSP, DFID and WaterAid Bangladesh, 2001. *Arsenic Mitigation in Bangladesh*, M. Feroze Ahmed, Chowdhury Mufad Ahmed, Local Government Division, 2002.

Assessment of arsenic mitigation technologies: two recent studies for Bangladesh

A rapid assessment of household-level arsenic removal technologies has recently been completed, supported by BAMWSP, DFID and WaterAid Bangladesh. The project looked at nine promising technologies, and identified three that consistently reduced arsenic below 0.05 mg/l (or 50 ppb). These are: (1) Alcan enhanced activated alumina filter, (2) BUET activated alumina filter and (3) Sono three-kolshi (pitcher) method. In addition, two technologies were identified which reduced arsenic below 0.05 mg/l in most of the time. These are the Stevens Institute Technology and Tetrahedron ion Exchange Filter.

These technologies did not appear to increase any of the significant parameters (e.g. manganese and aluminium) above Bangladesh drinking water standards and the WHO recommended levels. However, the Alcan, BUET and Sono three-kolshi technologies were found to be susceptible to bacteriological contamination.

As regards social acceptability, poverty was found to be a key factor determining the price that households were prepared to pay for the arsenic removal equipment. Although most households expressed a clear preference for the features of the most expensive technology, very few could realistically afford it on an individual basis.

Another study that has evaluated arsenic mitigation technologies in the context of rural Bangladesh is by BRAC

(2000). This came out of the implementation of an action research project in Sonargaon and Jhikargachha during June 1999 to June 2000. Installation and assessment of arsenic mitigation technologies was a major activity under the project. The main options promoted were: treatment of surface water with Pond Sand Filter (PSF) and home-based filter, rain-water harvesting, treatment of arsenic-contaminated groundwater with home-based three-pitcher filter, Safi filter, activated alumina filter, SKIDO plant and Tubewell Sand Filter, and use of shallow groundwater through dugwells. The options were assessed on several criteria: initial and running cost, ease of implementation, running and maintenance, continuity and flow for water supply, arsenic removal capacity, susceptibility to bacteriological contamination, and acceptability to the communities. The three-pitcher filters proved to be the most popular and feasible in the short-run due to their low cost, ease of operation, availability and low running cost. The other promising technologies identified by the project are activated alumina filter and tubewell sand filter (which is essentially a bigger version of the three-pitcher method). Among the community-based options, the PSF initially created high-levels of interest but, it was found later that people were more interested in using the PSF treated water for cooking than for drinking.

problem? While it cannot be denied that arsenic removal technologies provide short-term solutions, especially in severely affected areas, their effectiveness will depend on how well the local communities accept, operate and maintain the technologies.

Little effort has been made to understand people's preferences and willingness to pay for arsenic mitigation technologies. The focus has been more on technology and whether it works rather than on what people want. In particular, people's

willingness to share the costs of more robust and sustainable solutions, such as a rural piped water supply, has not been explored.

The fact that household preferences among arsenic mitigation technologies have not received due attention provided the motivation for a major study of this aspect in the context of rural Bangladesh. The study focused on people's evaluation of the proposed solutions to the arsenic problem, expressed in terms of their ranking of the effectiveness of mitigation technologies and their willingness to

pay for them. Other aspects covered in the study are people's perception of the arsenic problem and the steps they are taking after discovering contamination in their water source. By its very nature, the study had to be based on primary data collected from household surveys.

The field survey, covering about 2,900 households, was carried out between October-December 2001 in rural areas of three hydrogeologically representative districts; Chandpur (high water table area), Chapai Nawabganj (low water table area)

and Barisal (coastal area). The three areas are also representative of the available water sources, current levels of water consumption and related convenience aspects. BRAC conducted the survey work, using trained supervisors for the job. Care was taken to ensure that the sample was representative and the quality of data collected high.

2,430 households were covered in the survey of arsenic-affected areas (about 800 per district). 300 households were covered in the arsenic-free control areas — 150 from Bolarhat *thana* in Chapai Nawabganj district and 150 from Commilla Sadar *thana* in Commilla district. In addition, 150 households were included from Banaripara *thana* in Barisal district, an arsenic-affected area which is marked by large scale shift to public tubewells.

The survey data have been used to assess and analyze people's willingness to pay for arsenic-free, safe, drinking water options in rural areas of Bangladesh. The factors that influence the demand for these options have been investigated and the preferences of various household/community-based arsenic mitigation

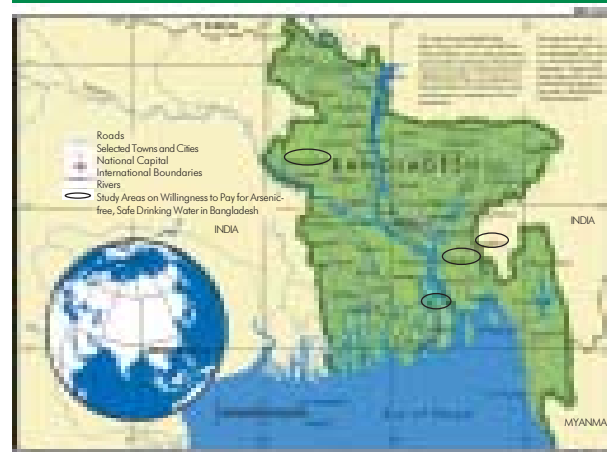
technologies examined. A major focus of the study has been on piped water supply systems, in particular whether such a supply from alternative water sources are preferred to the arsenic mitigation technologies used for treating tubewell water.

Household perceptions regarding arsenic-related health impacts



Survey data reveal that the majority of people have heard about the arsenic problem. 87 percent of respondents in the sample area (arsenic-affected) and 53 percent of the respondents in the control area

(arsenic-free) reported that they knew about the arsenic problem. Their information sources vary from development agencies working in the rural areas (NGOs/government/other agencies), other residents in the village, and public networks such as



The areas covered in the survey





radio/TV. However, most respondents were not aware of the serious health implications posed by arsenic-contaminated water. In the arsenic-affected sample area, about half the respondents had at least some idea of the symptoms of arsenicosis but only 35 percent knew that in the advanced stages, arsenicosis can lead to gangrene, cancer or even death. For the control area the corresponding figure was only 4 percent. So while the majority are aware of the arsenic problem in general, awareness levels of the likely effects on their health was found to be extremely poor.

While it is difficult to assess directly from the study, this low awareness of serious health risks from drinking arsenic-contaminated water may indicate that there is a low risk perception of either arsenicosis or the general dangers of arsenic in the water supply.

Arsenic contamination of tubewells and households' coping strategies



In the sample (arsenic-affected) area, 58 percent of the households report that the tubewell nearest to their house has been tested for arsenic. In the control (arsenic-free) area, less than 1 percent of the households report such a test. This indicates that while a majority of tubewells in the arsenic-affected areas have been tested, a sizeable portion still remain to be investigated.

The results suggest a marked inter-district variation. Of the tested tubewells in Chandpur, over 90 percent are contaminated. The proportion is much lower in the arsenic-affected areas of Chapai Nawabganj (23 percent) and Barisal (41 percent). For the sample area as a whole, 61 percent of the tested tubewells are contaminated. (Bangladesh uses 50 ppb and not the WHO 10 ppb as the cut off point)

About 35 percent of the households in the sample area have first hand experience of arsenic

contamination. 58 percent of these households (20 percent of the total sample) have shifted to alternate safe sources. However, the remaining 42 percent (15 percent of the total sample) are continuing to use contaminated tubewells, in the majority of cases because there is no alternative source. Only 1 percent of respondents were unconcerned about the consequences of arsenic poisoning.

As noted above, about 20 percent of households covered in the survey have shifted to alternative safe water supplies because of arsenic contamination; for the majority this has meant a switch from domestic to public tubewells. This shift can involve walking long distances to collect drinking water. Taking an average of all the households who have been forced to change their drinking water source in the three years prior to the survey, the average distance travelled to collect water has increased from 84 to 556 feet. The average time spent has increased from 9 to 27 minutes, so each affected household now spends, on an average, an additional 18 minutes every day fetching drinking water. About 2.5 percent of those surveyed in arsenic-affected areas, (or about one-tenth of the households who have changed their drinking water source due to arsenic contamination), now use pond or tank water. About 80 percent of these households report boiling the pond/tank water to make it suitable for drinking, a process which costs time and money.

Arsenic problem

87%
heard about arsenic problem

53%
know symptoms

35%
aware of serious health effects
(4% in control area)

Change in time/distance for collection of drinking water (by household who have changed source due to arsenic contamination)		
	EARLIER	NOW
Distance	84 feet	556 feet
Time	9 minutes	27 minutes

Household preferences among arsenic mitigation technologies



Based on earlier studies (BRAC Report, 2000; Study for BAMWSP, DFID and WaterAid Bangladesh,

2001), the following six technologies were selected for the study: (i) three-kolshi (pitcher) method, (ii) activated alumina method (household-based), (iii) activated alumina method (community-based), (iv) dugwell, (v) pond sand filter, and (vi) deep tubewell. These technologies are representative of arsenic reduction units (such as the three-kolshi

method), as well as technologies which make use of alternative safe water sources, such as pond sand filter or deep tubewell.

The survey data reveal that, based on consideration of risk and convenience (disregarding capital and recurring costs), the dominant preference is for community-based technologies. About 72 percent prefer a community-based technology as against 28 percent opting for household-based technology. After considering the capital and recurring costs of the six arsenic mitigation technologies, as well as the advantages and disadvantages of the technologies, about 76 percent of respondents expressed a willingness to pay for the use of one or more of these technologies. The overwhelming preference is for deep tubewells — the first option for 1,331 out of 1,854 respondents (72 percent). The three-

Box 3

Why do some households continue to drink arsenic-contaminated water and are reluctant to adopt safe water options? Case study of two villages

Jakariya (2000) has studied the adoption of safe water options in two arsenic-affected villages in Bangladesh, namely Vhagolpur and Kamarpara in Sonargaon/Jhikargachi *upzilas*. In these villages, more than 90 percent of the tubewells are arsenic-contaminated. Most people in the villages are aware of the safe water options and consider arsenic in drinking water to be a major problem. Yet, 80 percent of the people of Vhagolpur are still drinking contaminated water. This proportion is 14 percent among the residents of Kamarpara. The two villages differ in terms of presence of arsinocosis patients. While Kamarpara has 40 identified arsinocosis patients, Vhagolpur has none. The absence of any arsenic-affected patient in the village, the long-term practice of drinking tubewell water without any difficulty, better nutritional conditions, the long incubation period

of the disease, and the cumbersome process of obtaining water from alternative safe options are, according to Jakariya, some of the reasons why the villagers in Vhagolpur are reluctant to use alternative safe water options.

That convenience is an important factor influencing households' decision to adopt safe water options, is brought out by the fact that while most residents of Kamarpara are getting drinking water from deep tubewells in the village, the villagers living far away from the deep tubewells have been drinking arsenic-contaminated water in spite of the presence of a number of arsinocosis patients in the village. They have not opted for safe water options such as the three-pitcher method. Arguably, the inconveniences associated with the safe water options vis-à-vis the use of tubewells directly has been a key factor influencing their behavior.

Table 1

**Ranks given by the households to the six arsenic mitigation technologies
(in the survey of arsenic-affected areas)**

Technology	No. of households giving first choice (%)	No. of households giving second choice (%)
Three-kolshi (pitcher) method	291 (15.8%)	490 (26.6%)
Activated alumina (household-based)	88 (4.8%)	185 (10.0%)
Activated alumina (community-based)	61 (3.3%)	140 (7.6%)
Dugwell	44 (2.4%)	341 (18.5%)
Pond sand filter	29 (1.6%)	231 (12.5%)
Deep tubewell (handpump)	1,331 (72.2%)	234 (12.7%)

kolshi method is the second most preferred option with 291 (16 percent) ranking it first and another 490 (27 percent) ranking it second. Dugwell and pond sand filters are given very low preference in the ranking of technologies.

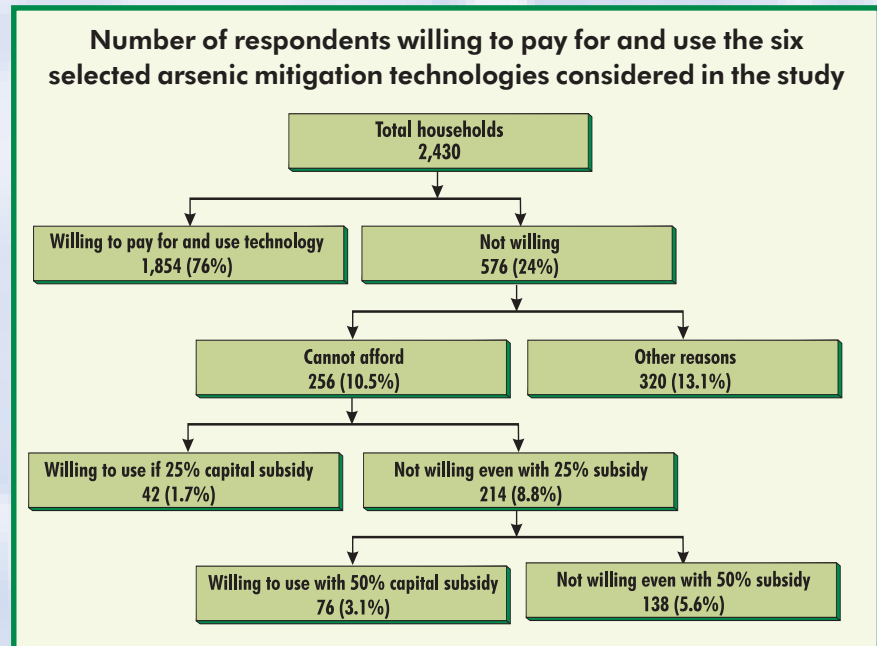
Experience with arsenic mitigation technologies



About 40 percent of those questioned report that they have used or are currently using one or more of the six

selected arsenic mitigation technologies included in the study. Of these 915 respondents, 891 have used/are using deep tubewell, 20 have used/are using the three-kolshi method, and 5 respondents have used/are using equipment based on activated alumina technology. Various problems were reported in using these technologies: low flow rate of water, clogging of filter, uncertainty of safe limits of arsenic removal, high recurring costs, difficulties in maintenance, etc. The most common complaint about government constructed, deep tubewells is the distance that individuals have to walk to collect water.

Figure 1



Perceived advantages of and willingness to pay for piped water systems



The survey results indicate that a piped water supply system would be considered a significant advantage. In the sample area, about

60 percent felt that piped water would mean clean water (referring to the physical properties of water e.g. being free from excess iron), 47 percent felt that piped water would be good for health and 48 percent felt that a piped water supply would be convenient. A largely similar response about the advantages of a piped water supply was also given in the control area. About 85 percent felt

Box 4

Shortcomings of arsenic mitigation technologies noted by the respondents in the survey

that piped water would provide clean water, 46 percent felt a piped system would be good for health and 37 percent felt that a piped water supply would be convenient. A related question about the advantages of a direct household water connection was also asked. Not surprisingly, convenience was seen to be the main advantage by more than 70 percent of the respondents in the sample and the control areas.

The survey data have been analyzed econometrically to obtain estimates of mean willingness to pay (WTP) for piped water supply. These estimates bear a clear testimony for a strong preference for piped water supply in rural areas of Bangladesh.

For the sample area (arsenic-affected), the estimated mean WTP for standpost is Tk 51 per month towards recurring cost and Tk 960 towards initial capital cost; the estimated mean WTP for domestic connection is Tk 87 per month towards recurring cost and Tk 1,787 towards initial capital cost. The estimated mean WTP of poor households (monthly household income up to Tk 3,500) is Tk 44 per

THREE-KOLSHI (PITCHER) METHOD

- Water flow rate is low
- Problem of clogging of filter
- Water is not available quickly — one has to wait

ACTIVATED ALUMINA METHOD

- Not sure of arsenic removal to safe limit
- Difficulty in getting chemicals, etc. for operating the technologies
- Water does not taste good
- High operation and maintenance cost
- Difficult to use/maintain

DUGWELL

- Bacteriological contamination is not adequately taken care of
- Needs to be kept in sanitary condition
- Water does not taste good

DEEP TUBEWELL

- Have to go very far to collect water
- One has to wait to get water
- Initial capital cost is high
- Water does not taste good
- Sometimes dirty water comes from the tubewell

month plus and an initial payment of Tk 838 for public standpost and Tk 68 per month plus an initial payment of Tk 1,401 for domestic connection. The estimated WTP for non-poor is significantly higher, as would be expected.

The mean WTP more than covers the actual O&M costs of piped water supply (estimate based on cost of on-going schemes). The average WTP for standpost is about 46 percent higher

than the actual O&M costs and that for domestic connection is 40 percent higher than the actual O&M costs. As regards poor households, their mean WTP for standpost covers the O&M cost by more than 26 percent and their mean WTP for domestic connection exceeds actual cost by 10 percent.

Turning to capital cost, the estimates of mean WTP for both poor and non-poor households are more

Table 2

Estimated mean willingness to pay — arsenic-affected area

Districts	Public Standpost		Domestic Connection	
	O&M (Tk/month)	Capital Cost Tk (one-time payment)	O&M (Tk/month)	Capital Cost Tk (one-time payment)
Chapai Nawabganj	48	913	79	1,625
Barisal	49	927	83	1,716
Chandpur	55	1,043	99	2,038
All	51	960	87	1,787
Poor	44	838	68	1,401
Non-poor	59	1,119	112	2,318
All	51	960	87	1,787

One Bangladesh taka = (approximately) US\$ 0.017 (as on August 2002).

than 10 percent of the actual capital cost (estimate based on cost of on-going schemes). The mean for all households is 18 percent of the capital cost for standpost and 17 percent of the capital cost for domestic connection. The non-poor are willing to pay 21 percent of the capital cost of standpost and 22 percent of the capital cost of domestic connection. Even poor households are willing to contribute significantly to the capital cost of piped water supply projects. They are on average willing to pay 16 percent of the capital cost of standpost and 13 percent of the capital cost of domestic piped water connection.

In rural water supply projects, 10 percent is often used as the share of capital cost to be borne by households. The estimates of WTP obtained in the study indicate that the rural households of Bangladesh would, in general, be willing to pay this percentage of the capital cost of piped water supply projects. Indeed, the estimates of WTP point to the possibility of recovering much more than 10 percent of capital cost from the rural households.

The estimates of WTP obtained for the arsenic-free (control) area are similar to those obtained for the arsenic-affected (sample) area. The estimates of WTP obtained for the arsenic-affected areas with large-scale shifts to public tubewells are somewhat higher in comparison with both the sample and control areas. Evidently, a strong demand for piped water supply exists not only in the arsenic-affected areas but also in (i) the areas free from the arsenic problem as well as (ii) the areas where construction of public tubewells (deep tubewells) have already provided access to arsenic-free, safe drinking water.

Based on the estimated WTP functions, the value of arsenic-free

drinking water to rural households in arsenic affected areas of Bangladesh comes to Tk 10 to 13 per month. As a proportion of income, the willingness to pay for arsenic-free water is rather low — in the range of 0.2 to 0.3%. This is probably reflective of the long latency period of arsenicosis, high personal discount rate for future among rural households, and perhaps the limited level of information on the levels and dangers of arsenic contamination.

Arsenic mitigation technologies vs piped water systems



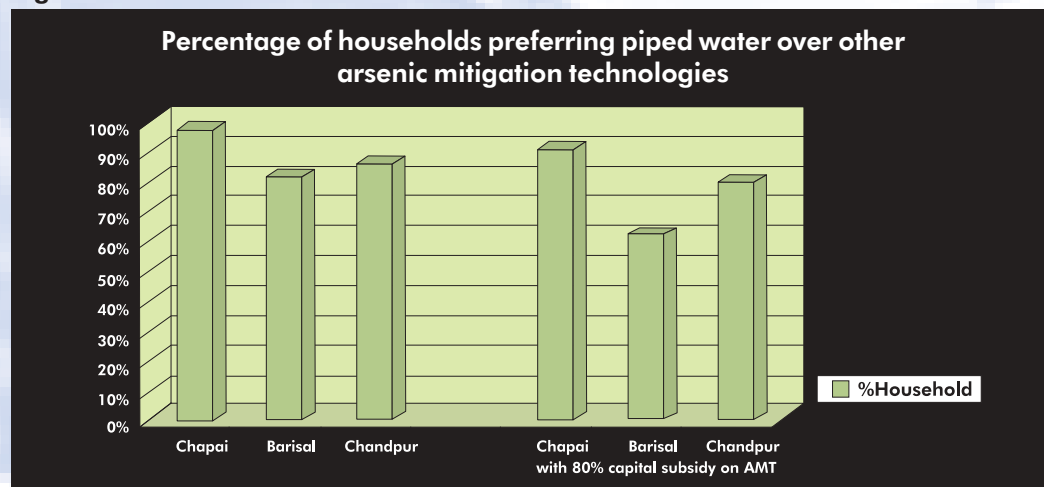
In the survey, the respondents were asked to state their preference between piped water supply and their most preferred arsenic mitigation technology (out of the six included in the study). The responses obtained to this question indicate clearly that the preference is predominantly in favor of piped water supply. About 89 percent of the respondents prefer piped water supply to other arsenic mitigation technologies (taking into account the costs and other aspects). Even when the respondents are asked to make a

comparison under the assumption that there will be an 80 percent capital subsidy on arsenic mitigation technologies, the proportion of respondents preferring piped water supply remains very high at about 78 percent.

The main reasons given by respondents for choosing piped water supply system over other arsenic mitigation technologies are (i) convenience and (ii) water which is free from arsenic as well as bacteriological contamination. Of the 2,023 respondents who chose piped water over other arsenic mitigation technologies, 69 percent gave 'convenience of piped water' as their main reason or one of the reasons for preferring this option.

The preference for piped water over arsenic mitigation technologies is very strong (90 percent respondents) among the respondents who have no experience of the technologies. But, the preference for piped water is almost equally strong among the households who have used or are currently using the arsenic mitigation technologies. About 90 percent of the households who have used three-kolshi methods or activated alumina technology, and

Figure 2



about 80 percent of the households who have used deep tubewells, expressed preference for piped water over their most preferred arsenic mitigation technology.

Policy implications



The study offers important insights for policy makers on the broad parameters that may provide a framework for addressing the arsenic crisis. The main messages are given below:

- w Unless household level filtering systems become affordable and convenient to use, and preferably easy to link to the shallow tubewells, the 'water miracle' of Bangladesh mentioned earlier may well be reversed. The convenience of the shallow tubewells is going to make it difficult to promote solutions like ponds and dugwells. Any alternative to tubewells not only has to provide access to safe water but also the convenience of the tubewell technology.
- w There is a strongly voiced preference for accessing piped-water systems. The density of rural settlements in Bangladesh and the growth of rural incomes in the last two decades may well have improved the affordability of piped-network systems. In terms of arsenic contamination, piped water systems, with their central treatment facility, are advantageous over the household level technology because the system can be managed and monitored at one single point. Furthermore, the treatment technology can be easily improved/alterd centrally as and when better alternatives become available. An added advantage is that a central filtration system also allows for the



- treatment of pathogenic contamination of surface water, enabling perhaps a return to surface water — which is free of arsenic contamination — for rural communities but in the context of a more convenient technology.
- w In this context, the policy challenge facing Bangladesh in exploring the potential of piped-water systems in rural areas is to assess the feasibility of delivering these through alternative organizations that are responsive to rural consumers. In particular, it will be important to assess the potential of delivering network systems through independent (non-public) service providers. Bangladesh's experience with rural cooperatives managed by the Rural Electricity Board (REB) and major NGO delivery in areas as diverse as educational services to micro-credit suggests that Bangladesh already has local organizations that can play the role of such service provider. Most importantly, the piped water network systems introduced in the Bogra area by the Rural Development Academy (RDA) suggest the potential of such systems in the context of Bangladesh.
 - w The estimates of willingness-to-pay obtained in this study are indicative of the possibility of introducing a demand-driven program to expand rural drinking water similar to the one currently being applied in India, and other parts of the world, with the potential of perhaps having an even higher contribution from households. This hypothesis can only be tested by actively pursuing piped water pilots on the ground to engage in active learning or 'action research' to complement the assessment provided through this study. Several pilots are currently on-going.
 - w But, though the choice for piped water is very high, it will be important not to offer households a one-point solution. There is still a statistically significant number of households that will prefer other technologies. While the areas sampled in this study do reflect broadly the socioeconomic profile of rural Bangladesh, there are some rural areas where the density and income levels of villages may warrant a household technology. Keeping open the option of choice is very important especially in a context where technologies and technology costs may evolve very rapidly. But it should be remembered that the study suggests that the preference for piped-water is driven less by arsenic issues and more by convenience factors reflecting perhaps a growing

structural change in the preferences of rural households for water services. This change is largely independent of the arsenic crisis but nevertheless strengthened by it.

- w The study brings out clearly the low level of knowledge and awareness about the health implications of arsenic contamination even in arsenic-affected areas. Needless to say, for a national crisis of the magnitude that is facing Bangladesh, the breadth and depth of household information on arsenic contamination, its seriousness, and technology options available need to be expanded. The need for improving public awareness is essential.
- w The arsenic crisis is bringing 'public goods and government' back into the drinking water sector (since the issues involved are of dissemination of information, ensuring choice and options, monitoring of water quality, and most importantly in managing the introduction of a network system). These dimensions of the arsenic crisis clearly raise the issue of the role of local governments in the drinking water sector in Bangladesh. In Bangladesh's unitary structure of government, local governments have not been given the space to emerge as key players in the management of service delivery at the local level.

Yet, local governments are by nature closest to a crisis of the sort being experienced in the drinking water sector where actual solution paths being adopted will be specific to the local context. The arsenic crisis has opened the door for rethinking the role of local government in Bangladesh. Can local governments be empowered to manage a community-based response to the arsenic crisis? Can local governments support the emergence of independent service providers in rural areas, thus drawing on existing NGO capacity? These are critical issues of local governance being brought out in the open as a direct result of the arsenic crisis.

- w Another issue only indirectly raised by the study is the role of water quality monitoring. In the euphoria of the private sector led approach to drinking water delivery, the issue of monitoring water quality was ignored in Bangladesh. The contamination has now raised the issue of institutionalizing water monitoring approaches in the country. Establishing the standards, creating an independent water regulatory agency, developing a monitoring process, linking this with local governments are all policy issues that have to be addressed even as rapid solutions to the arsenic crisis are developed.

Concluding remarks

It goes without saying that the study described above has only scratched the surface of an important crisis in the rural sector of Bangladesh. But it has done so in an important way, by using a methodology to assess and interpret data from communities themselves. If nothing else, the study suggests that in taking forward approaches to institutional change in the rural drinking water, the principle of listening to rural communities first and foremost must remain the guiding force in defining a way forward for addressing the arsenic crisis in Bangladesh.

Prepared by

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