Field Note

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Water and Sanitation Program

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

THE WEST BENGAL PILOT PROJECT

Responding to community demands for safe drinking water in an arsenic affected area

South Asia Region

Many villages in West Bengal, India do not enjoy sustainable, safe drinking water supplies. The situation is compounded by the presence of small but harmful concentrations of arsenic in the groundwater, the source of most villages' meager water supply.

The Water and Sanitation Program–South Asia assisted local non-government organization, the Ramakrishna Mission Lokashiksha Parishad (the development unit of the Ramakrishna Mission at Narendrapur, West Bengal) in procuring funds from the Government of India for a community-based rural water supply pilot project to address the problem.

This note documents the lessons learnt from the pilot project.

THE PROJECT AT A GLANCE

Coverage:	115 hamlets in 13 blocks in the five West Bengal districts of North 24 Parganas, South 24 Parganas, Bardhaman, Medinipur and Bankura. 26 of these hamlets have arsenic-contaminated drinking water sources
Duration:	15 months: September 1998 to December 1999
Cost:	Rs. 70,32,000 (Rs. 45 = 1 USD August 2000)
Implemented by:	Village Water and Sanitation Committees, assisted by local Youth Clubs and Cluster Organisations, coordinated and facilitated by Ramakrishna Mission Lokashiksha Parishad
Technology:	Handpumps and arsenic removal plants (for individual households and communities) developed by the All India Institute of Hygiene and Public Health, Calcutta
Cost-sharing:	Villagers contributed Rs. 15,50,000 (30%) of the total construction cost of Rs. 52,00,000 – the Rajiv Gandhi National Drinking Water Mission, Government of India put in the remaining 70% - and continue to pay 100% of operation and maintenance costs

Background

IN MID-1998, a number of village youth clubs in West Bengal requested the assistance of a local non-government organization, the Ramakrishna Mission Lokashiksha Parishad (the development unit of the Ramakrishna Mission at Narendrapur) to assist them in solving the problem of shortage of potable drinking water in their villages. The Lokashiksha Parishad in collaboration with the Water and Sanitation Program–South Asia prepared a project proposal that resulted in funding from the Rajiv Gandhi National Drinking Water Mission, Government of India.

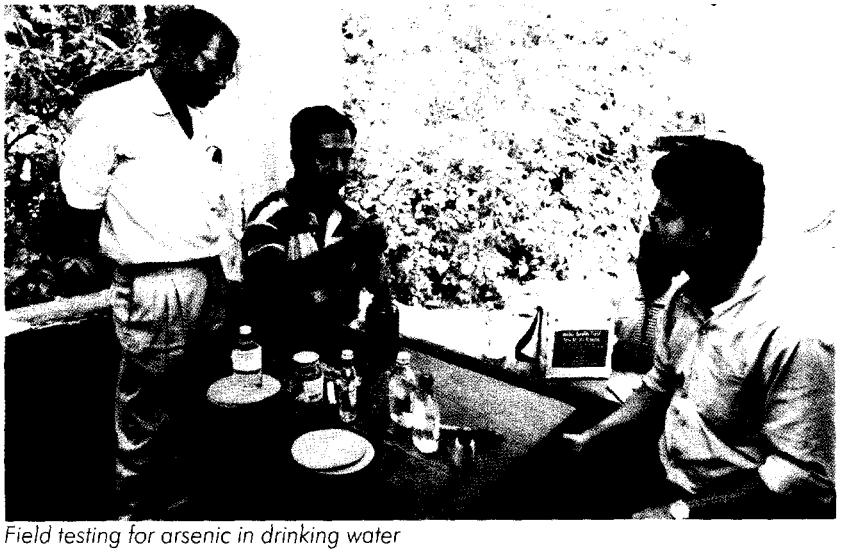
While primarily a project to supply safe drinking water to 115 hamlets in five districts, the presence of arsenic in the groundwater of 26 hamlets caused the project to look closely at the problem of providing arsenic-free water. During the project preparation, communities indicated that they were willing to contribute to the cost of the project and were prepared to operate and maintain the future infrastructure themselves.

Objectives

- To respond to community demands for safe drinking water which are backed by a willingness to contribute towards construction and operation and maintenance (O&M) costs;
- To provide communities with affordable safe drinking water supplies and options for treating drinking water contaminated with arsenic; and
- To develop methodologies for a community-led participatory pilot project, which could be replicated.

Project Actors

- **Local communities** pay all operation and maintenance costs and contributed 30% of the construction cost of water supply systems and community arsenic-removal plants. Most of these villagers are poor daily wage agricultural laborers, marginal farmers or fishermen belonging to scheduled castes and scheduled tribes;
- **Village Water and Sanitation Committees (VWSC)** are representative village organisations that work in each project site;
- **Local Youth Clubs** which informed and motivated the local community in participating hamlets, collected contributions, managed local tendering and construction and now oversee operation and maintenance;
- **Cluster Organizations** which advised and monitored the activities of the Youth Clubs in its area and coordinated project implementation along with the Ramakrishna Mission;
- **Ramakrishna Mission Lokashiksha Parishad** an NGO that provided coordination and support to Youth Clubs and Cluster Organizations;
- **Rajiv Gandhi National Drinking Water Mission, Government of India** provided most of the financial support for the pilot project;
- **All India Institute of Hygiene and Public Health (AIIH&PH)** which provided the technical support for testing arsenic in groundwater and designing and installing arsenic removal plants;
- **Public Health Engineering Department (PHED) and the Panchayati Raj Department (PRD)** of the state of West Bengal facilitated the implementation of the project;
- **Water and Sanitation Program–South Asia (WSP-SA)** provided technical assistance and coordination.



Field testing for arsenic in drinking water

Scheme cycle

EACH VILLAGE that applied for assistance started on a cycle of activities termed the scheme cycle. The scheme cycle typically followed the following four phases:

Pre-planning phase

Representatives from the Lokashiksha Parishad, the Cluster Organization of the area and the local Youth Club held meetings with villagers to discuss the problem of potable drinking water faced by the village, possible technical solutions and the responsibilities of the local community under the pilot project. These responsibilities included:

■ forming a Village Water and Sanitation Committee (VWSC);

■ making contributions towards the cost of installing the proposed infrastructure (handpumps and arsenic removal plants); and

■ operating and maintaining the system.

Villages were selected to be part of the pilot project based on their declared willingness to share in the project costs.

Planning phase

Community mobilization campaigns and general training programs were held to enable villagers, VWSC's and Youth Clubs to actively participate in the project. Arsenic awareness camps were held in the worst affected regions jointly by the (AIIH&PH) and the Lokashiksha Parishad (292 camps were held during the duration of the project). These camps focus on:

■ *Generating awareness of the problem of arsenic* especially, the link between drinking contaminated water and the symptoms of arsenic poisoning,

■ *Testing water quality* using field test kits to test the quality of water from various tubewells used by the community.

■ *Demonstrating technical solutions* to arsenic contamination.

■ *Informing villagers about the proposed pilot project* including how communities can participate in the project and what their obligations would be.

Once the VWSCs were formed (93 committees were formed) the local Youth Clubs collected community contributions. Households participating in the project contribute 30% of construction cost, which was a one-time commitment of between Rs 120-300 per family and 100% of O&M costs which comes to between Rs 1 and Rs 3 per family per month.

Implementation phase

VWSCs were responsible for all construction: installation of handpumps and community arsenic removal plants where used. Of the 115 hamlets in the project area, 95 handpumps were installed (85 TARA, five suction pumps and five India Mark III). Community arsenic removal plants were fitted to some of the existing handpumps and other arsenic-affected villages received household treatment plants.

All project funds were given to the VWSCs to purchase the material, transport it to the installation site, drill the tubewells, install the handpumps and community arsenic removal plants, with the advice and supervision of members of the Cluster Organizations, Youth Clubs and representatives of the Lokashiksha Parishad.

Table 1

Details of Project Costs

	AMOUNT (Rs 1,00,000)	FINANCED BY
Installation of hand pumps	43.7	GOI*1(70%) and beneficiary contributions (30%)
Installation of arsenic treatment units	8.0	
Capacity building and HRD	3.0	
Information generation and community participation	2.5	GOI*1
Development of water quality surveillance mechanism	3.0	
Administrative and supervision cost	3.6	
Studies and documentation	6.5	WSP-SA
TOTAL	**70.3**	

*1 *Government of India through the Rajiv Gandhi National Drinking Water Mission*

Post implementation phase

The VWSC and the local Youth Club organized the collection of monthly contributions for operation and maintenance, opened a local bank or post office account and deposited the amount collected in this account. A member of the local Youth Club and a member of the VWSC jointly operate the account. The money is used for repairs and replacement of parts.

Local Youth Club members trained by the AIIH&PH in water quality testing carry out regular arsenic testing of water samples brought by villagers using the AIIH&PH test kit. They also regularly supply villagers owning household arsenic removal plants with packaged doses of alum and bottles of pre-mixed bleaching powder solutions needed to run these plants.

The Arsenic Issue

Arsenic in drinking water

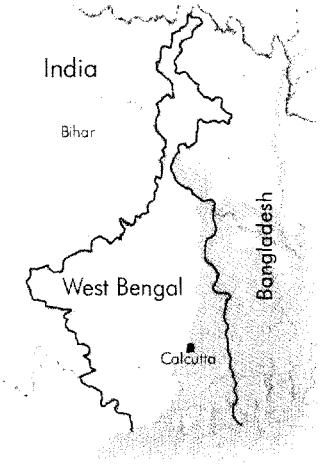
The presence of naturally occurring arsenic in drinking water has surfaced as a major problem during the last two decades. Minute concentrations of arsenic ingested through drinking water over a period of time result in arsenic poisoning: this may be manifested by arsenical skin lesions and dermatosis in the initial stages and by internal cancers and death in patients exposed to high concentrations over prolonged periods. The World Health Organization recommended limit for drinking water supply is 0.01 mg/litre (WHO, 1993); the permissible limit in India and Bangladesh is 0.05 mg/l.

Arsenic in West Bengal

In the late 1980s, high levels of arsenic were detected in the groundwater of West Bengal in India and in adjoining Bangladesh. Arsenic in drinking water currently affects

about 60 million persons in India and Bangladesh together though the extent of the problem is more widespread in Bangladesh (BGS, 1999). Presently in Bangladesh, a major arsenic mitigation project covering 600 villages is being implemented with World Bank assistance (*contact WSP-SA for more details*).

Arsenic knows no boundaries



Arsenic affected areas of West Bengal and Bangladesh

In West Bengal, arsenic has been detected in groundwater in eight of the 18 districts; the five worst affected districts are Malda, Murshidabad, Nadia, North 24 Parganas and South 24 Parganas. The depths of arsenic-contaminated aquifers vary in these districts but generally range from 10 to 80 meters below ground level.

ARSENIC IN GROUNDWATER IN WEST BENGAL

- AROUND 5.3 MILLION people (nearly 8% of the total population of West Bengal) are reliant on arsenic-contaminated groundwater (CGWB, 1999)
- Approximately 100,000 tubewells contain arsenic over the permissible limit of 0.05mg/l (SOES, 1999)
- It is estimated that around 300,000 people have arsenical skin lesions in West Bengal (Chowdhury et al, 2000)

Providing arsenic-free drinking water

If groundwater is contaminated by arsenic the following are two approaches to arsenic mitigation:

- seek arsenic-free water from another source, for example groundwater from another aquifer (usually a deep aquifer), treated surface water, rainwater harvesting; or
- provide some kind of arsenic-removal technology.

Many removal technologies have been tried over the past few years – the pilot project focused on low-cost options that can be used at either the community-level or the household-level.

Despite the substantial research that has been done on arsenic in drinking water and the many agencies grappling with this complex issue, there is no consensus on which arsenic mitigation approaches to follow. The following arsenic mitigation issues are still unresolved:

1. **Arsenic removal technologies,** in particular the many household-level and community-level techniques available today and ways in which consumers can make informed choices between the options;

2. **Arsenic detection,** in particular arsenic field test kits that can be used by householders or community groups and the question about whether the permissible limit should be dropped from 0.05 mg/l to 0.01 mg/l;

3. **Institutions** best suited to addressing arsenic mitigation and ways of working in partnership with community groups;

4. Enabling and supporting the development of **supply chains** between customers, distributors and suppliers for sustainable arsenic removal technologies and field test kits.

Arsenic treatment methods

The project made use of two types of treatment methods:

Community Arsenic Removal Plants designed by the AIIH&PH are fitted directly on the tubewell and water is drawn through a handpump. The plant uses conventional treatment processes adapted to community conditions. The primary arsenic removal process is co-precipitation through coagulation, flocculation, sand filtration and disinfection. Based on satisfactory results from the first plant fitted in 1996 by the AIIH&PH in Ashoknagar (South 24 Parganas district) three plants made by AIIH&PH were installed by the pilot project.

Household Arsenic Removal Plants: At the feasibility stage two household plants were considered: a sand filter plant based on the "two bucket" treatment unit used in Bangladesh and a similar plant that uses

THE STORY OF LAKSHMIPUR

IN NOVEMBER 1999, nine household arsenic removal plants were distributed at Rs. 125 per unit to villagers in Lakshmipur, Ashoknagar block, and North 24 Parganas district. A local potter offered to produce the pots and the candles reduced the production cost from Rs. 250 to Rs. 200. With a 50% subsidy from the pilot project, villagers have now to pay only Rs. 100 per unit and, by February 2000 another 148 families had come forward to pay their share and collect their household unit. Today, the potter is busy producing to meet the steadily rising demand.

Skin lesions as a result of ingesting arsenic in drinking water

a ceramic candle filter instead of the sand filter. The latter was developed into the RKM filter.

The RKM filter unit uses co-precipitation to remove arsenic through an adaptation of the two bucket system. 10 liters of arsenic-infected water are mixed with the coagulant (ferric alum) and oxidant (chlorine in the form of bleaching powder) in a plastic bucket, stirred and left to settle for two hours. After settling, 7 liters are poured into the uppermost of two clay pitchers *(kalshis)* placed vertically above each other (the remaining 3 liters are disposed of). The top pitcher contains a 'tripura filter' (a locally made cheaper version of more conventional ceramic candle filter) which filters the water by removing any suspended solids. The filtered water is collected for use in the bottom pitcher. Since October 1999, RKM have sold 135 filter units and packets of reagents (bleaching powder and ferric alum powder) sufficient for one month's supply are sold for Rs10.

Lessons Learnt

■ Communities are willing to pay for safe drinking water

Some demand-responsive projects have successfully collected 10% of construction costs from participating villagers contrary to popular beliefs that poor people are not willing to pay for water – a good example of this is the World Bank–assisted Uttar Pradesh Rural Water Supply and Environmental Sanitation Project (or Swajal project). This pilot project demonstrated that in some situations even poor villagers are willing and able to pay as much as 30% of the total construction cost.

Willingness to pay for arsenic mitigation is still an important and relatively untested question. The project shows that villagers that are acutely aware of the arsenic problem are prepared to pay for mitigation measures as shown in the success of the household filters; however this has not been proved at scale or with other technologies. Willingness to pay will be the crucial determining factor when considering development of effective supply chains to include the private sector.

■ Effective supply chains need to be developed for sustainable solutions

Pilot projects are often criticized for an over-reliance on outside intervention and thus not necessarily piloting sustainable approaches. The need to develop the local private sector to be able to supply arsenic treatment technologies and arsenic field test kits to consumers at prices they are prepared to pay is a key factor in developing long term solutions to the arsenic problem. This is explored further in a future WSP-SA field note.

■ Projects need a good communication strategy

Villagers need to be informed about the problems of drinking arsenic-contaminated water and about the features of the project if they are to participate effectively in the project. This was done effectively through various arsenic awareness camps in the pilot project. It could be further improved by distributing local-language leaflets, playing a video especially produced for the project, and by ensuring a high degree of participation by local villagers, for example posters, leaflets, banners and loudspeaker announcements can precede the actual camp.

■ Inter-village exposure visits are effective

Villagers who visited other hamlets where community arsenic removal plants had been in operation (e.g. Ashoknagar) and were able to speak to villagers who were using household arsenic removal plants returned convinced of potential benefits of participating in the pilot project. While awareness camps can be a useful introduction to these issues, exposure visits enable villagers to speak to peers about potential project benefits and are more effective in securing participation.

Table 2

Comparative Performance of Arsenic Treatment Plants

Treatment method	Capacity (l/d)	Households served*	Construction cost (Rupees)		Operational Cost (Rupees)	
			Total	Per family**	Per year	Per family per month
Community-level	7,500	150	16,000	32	4,400	2.50
Household-level:						
Sand Filter	600	12	450	11.25	182	1.27
RKM Filter	50	1	200	100	120	10

* Calculated on the basis of 10 liters per person per day, or 50 liters per day for a family of five. Two candles have to be fitted to the RKM filter plant to provide this amount of potable water per day.

** Household contribution calculated as 30% for community plants and 50% for the household plants. These costs, based on construction by AIIH&PH, should decrease with commercial production.

Bhaduri Mondal with grandson

"I have been drinking water from this tubewell for 25 yeqrs but did not know that it was contaminated with arsenic and was the cause of suffering in my family. I want to do something about this so that my grandson does not suffer as we have."

■ Future projects need clear objectives

The primary aim of the pilot project was to tackle the drinking water problem by providing handpumps at convenient locations to save women the labor and time involved in collecting water from long distances. The treatment of arsenic was seen as part of this larger problem. However, given the severity and complexity of the arsenic problem, a separate project aimed exclusively at arsenic-affected areas might be necessary.

Conclusion

ALTHOUGH the project is small, it contributes to a growing body of knowledge that suggests that poor villagers faced with acute drinking water shortage and arsenic-contamination are willing to pay for a safe, reliable water supply. Villagers have paid 30% of construction costs for water supplies and arsenic treatment facilities ranging from Rs. 100 to Rs. 500 per family and started paying all operation and maintenance costs.

The pilot project has contributed to field testing low-cost household and community arsenic removal plants. Although community plants are cheaper than household plants for the quantity of water supplied, communities need to make their own decisions as to which technology is best suited to their needs.

Long term solutions to arsenic mitigation will rely on the development of sustainable private sector supply chains to supply arsenic removal plants at commercial rates that consumers will buy. The pilot project showed that at a village-level, involvement of the private sector could bring down the costs of household units. Developing the links between suppliers, distributors and customers at scale is a major challenge to overcoming this problem.

The project has demonstrated the effectiveness of existing grass roots community organizations when coordinated by a reputable NGO in involving the local community in implementing and operating drinking water supply schemes. Research is still needed to identify ways of scaling up these community-based approaches to the whole state and country.

Finally, new initiatives proposed to tackle arsenic contamination in West Bengal tend to focus on the technical issues concerning detection, measurement and treatment of arsenic in drinking water. Little attention is being paid to community-level social and institutional issues in project implementation. The lessons of this pilot project will be useful in planning and designing future community-based projects to address the problem of arsenic in drinking water.

Water and Sanitation Program
- South Asia
55 Lodi Estate,
New Delhi 110 003
India

Tel: 011-469 0488/9
Fax: 011-462 8250
E-mail: wspsa@worldbank.org
Website: http://www.wsp.org

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The Water and Sanitation Program is an international partnership to help the poor gain sustained access to improved water supply and sanitation services. The Program's main funding partners are the Governments of Australia, Belgium, Canada, Denmark, Germany, Italy, Japan, Luxembourg, the Netherlands, Norway, Sweden, Switzerland, and the United Kingdom; the United Nations Development Programme, and The World Bank.

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