

Case Study

# Water for People

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Researched and Documented by

  
**oneworld.net**  
OneWorld Foundation India  
[www.oneworld.net.in](http://www.oneworld.net.in)  
[owsa@oneworld.net](mailto:owsa@oneworld.net)

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## Executive Summary

Access to water and sanitation facilities varies greatly across districts in West Bengal. In 8 out of 19 districts, water is highly contaminated with arsenic, forcing people to take recourse to using water from the ponds shared with livestock. Consequently, West Bengal has one of the world's highest levels of water-related illnesses.

Combined with extreme poverty, these factors mean more than simply a health crisis and reach into every aspect of life for those less fortunate. Without water, education is no longer a priority, economic development comes to a standstill and the cycle of poverty cannot be broken.

In order to tackle these problems, Water for People started its work in India in 1996 with a small pilot effort to help eliminate the threat of naturally occurring arsenic in drinking water supplies. In collaboration with the Bengal Engineering and Science University (BESU), simple and locally manufactured arsenic filters were designed that could effectively treat water from public wellheads. The success of the pilot project and subsequent impact has encouraged its continuation till now.

Through the use of cost-effective and sustainable techniques, the wellhead filter units have brought many benefits to the people in rural West Bengal. It has eliminated the need to consume contaminated water, thereby bringing down the number of deaths caused by water-related diseases. The project has been conceptualised and designed by the BESU and has involved community members at every stage of its development- planning, construction, maintenance and monitoring. Local resources were used and owing to the employment of local technical knowledge, the project has the potential of effective continuation even after Water for People has withdrawn its functions from West Bengal. Because the model is revenue generating where people pay a very small amount per month for the water they use from these units, it is financially sustainable. The funds raised are enough to cover the costs incurred in working of the units as well as any other costs involved in the training of villagers.

Apart from these obvious benefits of the project, having access to clean drinking water, in a way where villages themselves are directly involved in the process in a variety of ways, has proven very empowering for the villagers. It has created local assets for the village - the wellhead filter units can be maintained using indigenous knowledge and expertise. Owing to the training received for participating in the construction, maintenance and repair of the wellhead units, many villagers have acquired critical technical skills which they can use for

seeking further employment elsewhere. Health and education standards have also improved significantly.

However, Water for People's work in West Bengal extends beyond mitigation of arsenic from drinking water. Realizing that sanitation is a priority for this region, it has been involved in establishment of toilets in remote villages, equipment of schools with water and sanitation facilities, and focusing on gender specific sanitation solutions in schools as well as community.

This report illustrates the success of the wellhead filter units in providing a viable and sustainable solution to safe drinking water needs of the rural people in West Bengal.

## Background

Arsenic is a naturally occurring semi-metallic compound commonly found in water in many parts of the world including India, Bangladesh, Taiwan, Japan, Mexico and parts of the US. Arsenic causes a sure and rapid death at high doses. Over an extended period of time, intake of drinking water contaminated with arsenic has deleterious effects on human health viz., cardiovascular and gastrointestinal problems, hematological, hepatic, renal, neurological effects, skin disorders, and cancers (particularly of the bladder and lungs)<sup>1</sup>.

In West Bengal region of India, an environmental health crisis of worrying proportions has been taking place for a long time; eight of 19 districts in the state have reported high arsenic concentrations. While the World Health Organization's (WHO) established limit of arsenic concentration in water is 0.01 mg/L, India's maximum permissible limit is 0.05 mg/L. In West Bengal, a population of approximately 30 million resides in arsenic-affected area spanning over 13,000 square miles. In 2006, the number of people using arsenic-contaminated water was estimated at 1.3 million and hundreds of thousands among them have since been diagnosed with chronic arsenic poisoning; millions more are estimated to be at risk. Extreme poverty compounds the problem since it prevents people from seeking adequate medical attention before irreversible damage is done.

Arsenic contamination as a major water problem in West Bengal has been reported to be a by-product of attempts to solve other surface-water related problems in the region. Water in this region is contaminated with industrial, agricultural and microbiological agents. Water extracted through shallow tube wells was for long promoted as a safe alternative to contaminated surface water. However, during the 1980s, some cases of arsenical dermatosis

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<sup>1</sup> Elangovan and Chalkh, 'Arsenic Pollution in West Bengal', NABARD Technical Digest, Vol.9, 2006

were reported in the districts of North 24 Parganas, South 24 Parganas, Nadia, Murshidabad and Burdwan. It was in the 1990s that the issue was widely recognized. By 2001, the problem had spread from a few villages to 2065 villages of 75 blocks in 8 districts<sup>2</sup>.

It was against this backdrop that Water for People started its work in the region in 1996. A pilot project was launched in North 24 Parganas for supporting arsenic-removal efforts and working to develop mitigation technologies appropriate for use in rural villages. Subsequently, domestic and wellhead arsenic removal units were designed to implement the same.

The project currently covers 6 districts namely North 24 Parganas, Nadia, Murshidabad, Purulia, East Medinipur and South 24 Parganas. Out of these, the arsenic mitigation programme runs mainly in Nadia and North 24 Parganas-arsenic concentration is highest in these two districts. In the rest of the 4 districts, Water for People's intervention is largely limited to borewell construction and sanitation programmes.

## Objective

Water for People is committed to helping eliminate India's arsenic crisis and to continue its mitigation efforts indefinitely. Currently, their goal is to provide total, sustainable coverage of water needs of people in West Bengal region of the country.

## Salient Features

1. Project implemented in 6 districts of West Bengal, more than 150 well head filter units Installed
2. Wellhead filter units- activated alumina is the main component for removing arsenic from source water.
3. Field Level Operations Watch (FLOW) used for monitoring the project progress- employs Android cell phone technology and Google Earth software
4. Local community involvement for operation and maintenance of wellhead filter units-local resources and knowledge used
5. Revenue generating, so sustainable. Per wellhead unit cost is INR 93,220; every rural household pays INR 10 per month to use water from the unit
6. Holistic developmental approach- not just arsenic removal, but improved sanitation.

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<sup>2</sup> Ibid

## Working Design

The process for treating arsenic-contaminated water is very reliable, simple and cost-effective. Water for People partnered with the Bengal Engineering and Science University (BESU) to develop arsenic-removal units for domestic use in rural areas. The design was conceptualised and designed by the BESU and has over time been modified according to local conditions of the districts where the initiative was employed. Initially, the wellhead filter was attached to hand pumps in districts where electricity supply was not regular. Now the wellhead filter units are being attached to power pumps, which also house a storage tank that can support drinking water needs even in the absence of electricity.

The in-home domestic units consist of two chambers- the upper chamber accommodates the pre treated activated alumina while the lower one stores treated water. The wellhead units consist of a stainless steel column that is 12 inches in diameter and 7.2 inches tall.

The filter media consists of a 51-inch layer of activated alumina and an 8-inch thick gravel bed. For easy regeneration and restoration of the media, it is enclosed in an impervious nylon bag with a pervious bottom through which treated water percolates to the lower chamber. This makes it easy to remove media bags for off-site regeneration and restoration. The filter media is replaced every 8 to 12 months- replacement is dependent on the volume of use and the arsenic and iron contents of source water.

Arsenic concentration in contaminated water varies from 0.01 mg/L to 0.05 mg/L. In some cases, the concentration level is even greater. After passing through the filter, arsenic concentration in the treated water is consistently below 0.05 mg/L, which is the maximum permissible limit by Indian standards. Water at each tube well is tested monthly and the activated alumina filter media is regenerated as needed. Usually, the concentration in treated water varies from 0.01 mg/L to 0.04 mg/L. When it nears 0.045 mg/L, the local water committee is notified to prepare for regeneration of the filter media.

A single wellhead unit serves 200 to 300 families in a village. One unit costs approximately INR 93,220 or US\$ 2,000. The wellhead unit for decontamination of water employs a simple technology to provide a highly effective, relatively inexpensive and easy to maintain solution for providing clean and safe drinking water to people who cannot afford it otherwise.

### The process of regeneration

After the regeneration of the filter media, the primary consideration is to deal with the captured arsenic in a safe and environmentally sensitive manner. The process of regeneration involves transfer of the spent activated alumina to a stainless steel drum that is mounted horizontally on an axis to allow for rotation. This transfer is followed by an acid rinse wherein hydrochloric acid is added to the drum in order to rinse the activated alumina. A handle is then turned to allow for the drum to spin, thereby agitating the media and enhancing the rinsing process. By doing this, the accumulated iron deposits are dissolved and dislodged from the surface of the activated alumina pellets. Subsequently, the acid is transferred from the drum to a sand bed nearby.

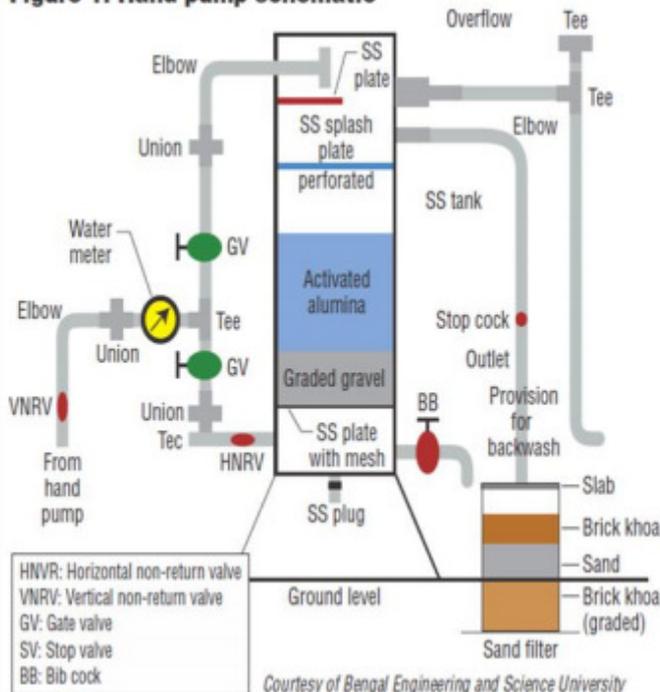
The sand traps the iron close to the surface. The drum is rinsed with water and a dilute solution of sodium hydroxide (caustic soda) is added for a rinsing step. Caustic soda extracts the absorbed arsenic from the media. This solution is transferred to the sand bed as well. Sand acts to capture the arsenic and prevents it from penetrating to the ground below.

Another rinse with hydrochloric acid is then performed and this is followed by a water rinse. The activated alumina is removed from the drum and stored for transport back to the treatment site. Regenerated activated alumina is almost as effective as a fresh filter bed in terms of its capacity to remove arsenic from source water.

Thereafter, the used solution is drained and collected in a separate plastic drum and the entire bed is rinsed with tube well water for half an hour. The process of regeneration ends with the mixing of spent acid, alkali and rinse water and adjusting the pH of the solution to about 6.5 by adding 10 per cent hydrochloric acid. This produces a thick, brown slurry, which is disposed of at the top of the filter. The arsenic-laden solids are intercepted and retained at the top of the filter.

The entire regeneration process, including the spent regenerant treatment, is completed in about 10 hours.

**Figure 1: Hand pump schematic**



To provide for a sustainable model, the wellhead units have been developed in a way so that their maintenance and repair can be done by community members themselves. Along the same lines, the aim is to create a culture of payment for value rather than that of dependency- local finance is employed so that the units can keep functioning and can also be extended with growth in population. By working this way, Water for People ensures that when the wellhead units reach the end of their useful lives, they can be replaced without seeking the support of another external development organization or donor.

The regeneration process is one of several ongoing maintenance activities paid for by a user charge. This is an essential prerequisite of filter installation. Every regeneration process involves a cost amounting to approximately INR 4,500 or US\$ 100. The typical user charge of INR 20 (US\$ 0.42) per month per family provides enough funds for regeneration and leaves some reserve for other operational costs.



## Monitoring and evaluation

Realizing that monitoring and evaluation is essential to fully understand the progress of work, implement proactive changes that reduce development time and improve success, Water for People developed an in-house mechanism called FLOW- Field Level Operations Watch. Developed by the Denver-based technology team of Water for People, FLOW is a visual, open-source mobile-based data monitoring and mapping tool. It was brought into operation in May 2011.

Combining Android-powered cell phone technology and Google Earth software, FLOW lets workers, volunteers, partner organizations, and others record data for tens of thousands of water points all over the world. It immediately enables all the stake holders to see what is working, what is in despair and what is broken. FLOW utilises GPS-enabled mobile phones to take pictures of the work sites and upload them instantly on the website, which can be accessed at <http://watermapmonitordev.appspot.com/>. The staff members used for this monitoring process belongs to Water for People. The organization is currently in the process of training partner organization staff members for the same.

Once uploaded, a zoom-able overview map is automatically created using Google Base Maps, and the raw data is available for more detailed analysis in an online database. Even if there is no network coverage, data is stored safely on the phone's secure digital, or SD, card and can be extracted even if the phone itself breaks.

FLOW does all this comparatively cheaply. The software itself is open-source, that is, free of cost; data hosting costs are minimal; and suitable Android devices are now starting to be priced below the US\$100 mark.

FLOW also provides a mechanism for collecting feedback from the community members. The cell phones used for the purpose are enabled with a questionnaire for the beneficiaries. The staff members on the field ask these questions to community members and enter their answers in the cell phone. This feature is currently in the process of refinement. FLOW broadcasts immediate, instant reports about whether the water and sanitation programs are working or failing, thereby introducing a major element of transparency, efficiency and accountability to their work. Water for People plans to start detailed monitoring of all its programmes in India from September 2011.



In addition, Water for People sends annual reports to the Denver office for regular programme monitoring.

### Feedback mechanism

Apart from the basic feedback collected from the user community through FLOW, the caretaker from each community can also write to the Water for People office with their concern.

## Methodology

Based on its existence in West Bengal for over 15 years, there is reason to believe that the arsenic mitigation programme of Water for People has impacted the lives of thousands of families in a positive manner. Moreover, the impact of the programme is clearly identifiable and measurable. Despite its efficacy, the programme has not been sufficiently documented.

In order to analyze the programme impact and verify good practice, existing documentation on the programme was studied. Based on this, a set of unique features and benefits were identified. These were confirmed and elaborated upon through a telephonic interview with the Technical Adviser of Water for People in Kolkata. Enhancements underway were also discussed at length.

## Key Stakeholders

### *Water for People*

Water for People is mainly responsible for facilitating contact between partner organizations and community members. It is responsible for the primary funding, advocacy and monitoring of the programmes. It periodically organizes, in collaboration with BESU, workshops at the district and state level to share the experiences of this initiative with different international, government and non-government organization. Pamphlets, case studies and short booklets are prepared for distribution. This is also the manner in which funds are mobilized for different programmes. For instance, in South 24 Parganas, the district administration partnered with Water for People in 2010 to establish 177 water points- in this case, 95 per cent funds were provided by the district administration. Water for People also monitors the programmes periodically.

### *Partner Organization- Bengal Engineering and Science University*

Bengal Engineering and Science University is Water for People's partner organization in West Bengal. The BESU is responsible for conceptualization and development of the wellhead units. Apart from the arsenic mitigation programme, Water for People works with other 13 partners in different districts on, for example, water and sanitation facilities in schools in South Purulia. Water for People does not provide complete financial coverage of the programmes- it covers about 60 to 70 per cent of the programme costs. Partners have the responsibility of mobilizing some funds from local communities to cover the remaining costs. BESU has provided training to the local community members for the maintenance and repair of the wellhead units.

## *Community*

About 100 families use a single wellhead filter unit. Community members are provided training by BESU to operate, regularly maintain and repair the units. The user community also collects a maintenance charge from the beneficiaries- initially the amount collected was INR 10 and has now been increased to INR 20 per family per month. This amount is used for day-to-day maintenance activities like the regeneration process, cleaning the platform, backwashing of the filter, water quality monitoring etc. A single bank account is opened locally for this purpose. Each community has 1 or 2 young members as caretakers- called Jalbandhu- of the wellhead unit. The eligibility for appointment as a Jalbandhu is basic- should be able to ride bicycle and move within the village, not be biased for any political ideology, and be accessible to community members. They are provided training by BESU. These caretakers are responsible for distributing the drinking water to the beneficiaries, cleaning the filter etc. The caretaker is from within the user community and is paid a monthly sum of about INR 1000. This payment differs from site to site.

## Lessons Learned

### Key Achievements

Till date, more than 150 wellhead filter units have been installed across 6 districts in West Bengal. 60 to 70 per cent of these sites are working well, with high involvement on part of the community and substantial funds for maintenance in the community's bank account. In the rest of the sites, even though people are getting clean drinking water, the community resource management system is not very strong. The most significant achievement of the arsenic mitigation programme is that even in districts where Water for People is not providing financial support any longer, the model has sustained itself in as effective a manner over time.

### Financial sustainability

The arsenic mitigation programme employs a revenue generating model. While Water for People makes the initial capital investment covering about 60 per cent costs, the partner organizations mobilise funds to cover the remaining costs. However, these funds are soon recovered since the user community pays a monthly amount to use the clean drinking water facilities. The amount thus raised covers the regular maintenance costs of the filter unit as well as leave enough to return the money to Water for People and BESU in instalments within a year. Owing to this model, financial sustainability of the program is ensured.

## Creation of local assets and skills

The wellhead filter units, once installed, are maintained by the community members- both in terms of its technical operations and its financial costs. Therefore, a single wellhead unit that serves about 100 families is the permanent property of that community.

The Jalbandhus were trained by BESU to provide operation and maintenance of wellhead filter units. There have been instances of the skills thus acquired being used for gaining employment elsewhere. For example, many Jalbandhus are using their skills to earn wages by working for other local and international organizations for hand pump maintenance. Apart from this, some of these organizations have periodically recruited the Jalbandhus as faculty members for training workshops on hand pump maintenance.

## Effective monitoring system

The FLOW mechanism innovated by Water for People addresses three key challenges of any mapping and survey project. First, it minimizes errors during the data collection phase because it provides an easy-to-use touch screen interface and combines all key tasks (answering questions, taking a picture and GPS location) into one simple application. Second, it facilitates monitoring and evaluation as project management staff can review incoming data in near real-time (if there is network coverage). Finally, it helps securing data from the field and making it available to stakeholders. Due to these obvious benefits, FLOW can be easily used by other organizations for monitoring and evaluating a variety of programmes.

## Replicable in widely diverse contexts

With minor alterations, the arsenic mitigation initiative is replicable in a variety of contexts. The major difference in these contexts has been found to be in terms of infrastructure- primarily the supply of electricity. In the absence of a regular supply of electricity, the wellhead filter units were attached to hand pumps, which are widely available in all villages.

## Holistic approach to development

While Water for People's work in India started with the arsenic mitigation programme in 1996, the organization has been involved in local partnerships with approximately 13 organizations to implement a SWASH (Water, Sanitation and Hygiene Programme in Schools), other drinking water programmes and household sanitation programmes.

## Challenges

The arsenic mitigation programme, as well as other initiatives of Water for People, has performed remarkably well in India. However, some challenges have been faced from time to time. Fund mobilization remains the most important challenge for Water for People as well as the partner organizations. Also, community's interest and level of participation differs from site to site. In about 40 per cent of programme sites, the programme has met with mediocre success since community participation is only minimal.

## Going Further

Within West Bengal, Water for People is aiming at hundred per cent coverage of the 6 districts it presently operates in and, therefore, there are no plans to scale up the programme to any other districts within the state. However, there are plans to move to Kankurgachi locality of Kolkata since the water and sanitation conditions in the area need urgent attention. Moreover, Water for People plans to expand its operations, for providing both water and sanitation facilities, to Bihar, Chattisgarh and urban slums of Delhi. Currently, discussions are underway with organization already working on these issues in these particular states. The programme is likely to be launched towards the end of 2011.

The Arsenic Task Force, consisting of engineers from different government departments, is also keen on working with Water for People to expand the wellhead filter technology to other pockets of West Bengal where arsenic contamination is a major problem. There are plans to scale up the programme but fund mobilization remains a major problem. Till date, in terms of the sanitation programme, the focus has been on household sanitation disposal of human excreta but now there are plans to start a urine harvesting programme wherein urine can be used to harvest crops. This would radically reduce water consumption for irrigation purposes while safely recycling valuable nutrients from urine into the soil. This way a valuable resource would be created from what is usually regarded as a waste product.

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*Research was carried out by OneWorld Foundation India (OWFI), Governance Knowledge Centre (GKC) team.*

*Documentation was created by Research Associate, **Aditi Dayal***

*For further information, please contact Naimur Rahman, Director, OWFI, at [owusa@oneworld.net](mailto:owusa@oneworld.net)*

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## Appendix A – Interview Questionnaire

### Background - Scope

1. What were the criteria for choosing West Bengal for implementation of the pilot project? (e.g. poverty, arsenic levels etc.)
2. Which districts are currently covered under the project? On what basis are districts/municipalities chosen where the program is to be rolled out?
3. How many staff members are working on this program in West Bengal? Please give an overview of your organizational structure in India and any partner organizations and their roles.

### Working Design

4. According to our research there are 6 key features of the programme. Can you explain these unique aspects in detail:
  - a. Wellhead filter technology
    - i. How was the wellhead unit designed? Which organizations were involved in the process and what were their precise roles?
  - b. Involvement of community members and partners for operations
    - i. Water for People focuses on making community members the central players in all its endeavours. What exactly is their role in the program? What training is provided to them? How is their local knowledge used?
    - ii. In terms of building partnerships with government, private sector and development organizations, how does that take place? How are these identified? What is their exact role in the program?
    - iii. Once the community and partner organizations have been identified, what role does Water for People play in connecting them? Is it only a facilitator?
  - c. Use of local resources and knowledge
  - d. Revenue generating financial model
    - i. How is revenue generated and what are the major areas under which they are spent? Please give a break-down of costs per month or annum for each.
  - e. FLOW M & E model
    - i. Please describe the monitoring and evaluation mechanism innovated by Water for People (FLOW- Field Level Operations Watch). Which technology/software does it employ?
    - ii. Is there a mechanism for collecting feedback from the community members and partner organizations?
    - iii. What were the program targets and how far has it been achieved? Please provide data on the current levels of program achievement in terms of number of wellhead units installed, the number of villages and people benefiting from them etc.

f. Holistic approach to poverty reduction- from arsenic mitigation to improved sanitation and education

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i. Are there any other initiatives that Water for People is involved with in these districts? For instance, promoting gender specific solutions in schools. Has this led to an increase in school enrolment rates?

Impact

5. Could you provide examples where Water for People's program has been highly successful and where it has not succeeded as per expectations? For example, are there any instances of villagers using this training to gain employment elsewhere? What were the reasons for this?

6. Are there any plans for expansion to the rest of the state of West Bengal? Any other states in India? Are there any other initiatives in planning?