ASSESSING THE EFFECTIVENESS OF THE SHAPLA ARSENIC REMOVAL FILTER

Md. Jakariya
Md. Quaiyum

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Research and Evaluation Division
BRAC
BRAC Centre, 75 Mohakhali, Dhaka 1212

Abstract

The study was conducted to assess the effectiveness of the Shapla Arsenic Removal Filter. The two villages of Sonargaon Upazila were selected, as the use of this filter was mainly concentrated there. A total of 50 Shapla filters were provided among the villagers by the International Development Enterprises, Bangladesh free of cost under the arsenic mitigation project, implemented by BRAC, in collaboration with Unicef and DPHE. Data were collected through interview and observation in mid – August 2002. The water of the functioning Shapla filters was tested for arsenic using Merck test kit from Germany during the survey. A total of 47 Shapla filters out of 50, were surveyed where about 92% of them were functioning. The arsenic concentration level in the water filtered of Shapla filters (72%) was within the tolerable limits (up to 0.05mg/L). The flow rate of 28% of the Shapla filters was 4 to 6 litres/ Hour and it was 2.4 to 2.9 litres/ Hour for another 28% of the Shapla filters. About 81% of the respondents did not know about the interval of testing water of Shapla filter. The teaching about maintenance of the Shapla filter to the respondents was universal (93%). After the latest testing, the water of about 74% of the Shapla filters was reported arsenic free (within the tolerable limits). But some of the respondents (22%) did not know the test result. The disposal of the non-functioned media (expired media)(78%) was all over. From this study it may be concluded that the majority of the Shapla Arsenic Removal Filters provided were functioning, although some of them were found highly contaminated with arsenic. In some cases the flow rate is very low and should be improved. Filter users should be informed about the result of testing in time. A proper management of disposal of expired media should be introduced.

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INTRODUCTION

A new threat of arsenic contamination in ground water was first detected in 1993 in Bangladesh. About half of the total population of this country are exposed to the threat of arsenic contamination. This disaster is worse in many aspects, then many other disasters. Causes of arsenic contamination in most arsenic affected countries are geological (Anonymous, 1997). The study conducted by Das et al. clearly indicated the existence of pyrite rich in arsenic in the region of alluvial sediments. It is hypothesized that due to heavy groundwater withdrawal, the geo-chemical reaction in the groundwater may be responsible for the leaching of arsenic from arsenic – rich pyrite. It is known that as long as pyrite is in deoxygenated water, it does not decompose, but if the water is aerated then pyrite decomposes (Das et al. 1996).

There are more than 10 millions tubewells in Bangladesh, of which 50% are polluted with excessive arsenic mixture. Arsenic contamination was found to be more in tubewells with a depth of 30 to 100 feet (Quadiruzzaman, 1996). The excessive level of arsenic in drinking water is redefining water from a 'life saver' to a 'threat' to human survival. Arsenic, a toxic element, is teaching a bitter lesson to humankind. Arsenic accumulates in the liver, kidney, heart and lungs. It is also deposited in bones, teeth and hair (Khan, 1997). Water mixed with a harmful dose of arsenic if taken for a long time may lead to serious skin diseases, swelling of lever, anaemia, anorexia, deafness, and fatal skin cancer (Rahman, 1996). If the presence of arsenic in one litre water is at the rate of more than 0.05mg, it is considered harmful for human body. The level of arsenic in natural water generally varies between 0.01 mg/L to 0.02 mg/L (Dahi, 1997). Millions of the total population could endure painful death over the next decades unless they are provided alternative safe water options. Although arsenicosis is not an infectious, contagious or hereditary disease, arsenic toxicity creates many social problems for the victims and their families (Khan & Ahmed, 1997).

Government and NGOs have been trying attentively to mitigate the arsenic problem. It has been great challenge to ensure safe drinking water among the affected communities. To provide safe drinking water is not easy as very little is known about the different technologies. Different safe water options are being provided through Government and NGOs to ensure safe drinking water. It is needed to now assess the technical effectiveness, applicability and community acceptance of different safe water options. There has been no

notable study in this aspect. This is the study one attempted to assess the effectiveness of the Shapla Arsenic Removal Filter.

The Shapla Arsenic Removal Filter is an indigenous household technology. It contains locally available crushed brick particles treated with iron salt. A local Bangladeshi professor, M. Fakhrul Islam, Chemistry Professor at Rajshahi University, developed it. The media is placed in a clay container. It is supposed that it will effectively filter arsenic for 4 to 6 months.

Major objectives of the study were to:

- Assess the status of the functioning of the Shapla Arsenic Removal Filter;
- Assess the status of arsenic contamination level;
- Assess the status of flow rate;
- Assess the status of taking initiatives in testing water by the filter users;
- Assess the status of intention of the users in bearing the cost of changing container, media, and stand;
- Assess the status of volume of water getting through the filter by the users;
- Assess the status of preference in getting safe water options; and
- Assess the status of disposal of expired media.

MATERIALS AND METHODS

Study area

The two villages of Sonargaon Upazila were selected for this study. These villages were Kabilgong and Vairabdhi of Mugrapara Union.

Sample size and study period

A total of 50 Shapla Arsenic Removal Filters were provided among the villagers. All of these filters were supposed to be covered in survey. But it was possible to interview 47 respondents (user families). It was reported that the rest of the user families migrated elsewhere.

Data collection and Instruments

Two local persons, who were trained, collected data through interviews and observations using detailed structured pre-tested questionnaires. The water of the functioning Shapla filters was tested for arsenic using a Merck test kit of Germany during the survey. A container of 200 M.L was used in measuring the flow rate of water.

RESULTS

Functioning of Shapla filters

The majority of the Shapla filters provided to the villagers were functioning (91%) and the rest of the filters were non-functioned (9%).

Causes of non-functioning

The causes of non-functioning included ineffective media -the media had expired (17%), cracked container (17%), and stopped water flow (17%), and damaged tape (17%). About 17% of the respondents reportedly were using water from newly installed arsenic free shallow tube well instead of Shapla filter.

Arsenic contamination status

From about 72% of the Shapla Arsenic Removal Filters, water was found arsenic free (within tolerable limits). The rest of the filters (28%) water showed results with an excessive mixture of arsenic.

Flow rate

The flow rate of 28% of the Shapla filters was 4 to 6 litres/Hour. The other results were as follows:

3 to 3.8 litres/ Hour, 2.4 to 2.9 litres/ Hour, 2 to 2.3 litres/Hour, 1.7 to 1.9 litres/ Hour, and 1.5 litres/ Hour (28%, 28%, 7%, 7%, and 2% of the Shapla filters respectively).

Period of non-functioning

The majority of the non-functioning filters (75%) reportedly were non-functioning from the last 1-4 weeks. The rest of the filters had been non-functioning for the last 2-3 months (25%).

Status of initiatives in getting the filter fixed

About 75% of the respondents (filter users) did not take any initiative by themselves in getting the filter fixed. The rest of the respondents (25%) took the initiative.

Conception about the way of measuring the arsenic concentration in the water of Shapla filter

The extent of arsenic concentration in water is measured through testing. About 96% of the respondents mentioned the term "testing" as a way of measuring the arsenic concentration. The rest of the respondents (4%) did not know about it.

Testing frequency (how many times?)

It was expected that the persons from the concerned office test the treated water from time to time. The respondents reported the following number of times the persons from the office tested the water;

14-16, 8-10, 4-7, 1-3, 11-13, 17-19, 20-22, and more than 22 times (23%, 11%, 6%, 6%, 4%, 2%, 2%, and 2% of the respondents respectively). About 32% of the respondents could not specify any number. They said that testing was done many times. Some of the respondents (11%) said "do not know".

Conception about testing intervals

The majority of the respondents (81%) reported that they did not know in what intervals the water treated should be tested for arsenic. Other status of responses were as follows:
Water should be tested once a month (11%), once after every two weeks (2%), once a week (4%), and quarterly (2%).

Teaching the users about the maintenance of the filter

The teaching about the maintenance of the Shapla filter to the users was almost universal (93%). The rest of the respondents (7%) reportedly were not taught about maintenance.

Last period of testing water

The water filtered from the Shapla filter was most recently tested for arsenic before one month (39%), before 2 weeks (35%), before 2 months (15%), and before one week (9% of the respondents).

Result of water testing

The majority of the respondents (74%) reported that the results of the testing were arsenic free (within tolerable limits of arsenic). Some were arsenic contaminated (with excessive mixture of arsenic)(4%). About 22% of the respondents did not know the result, as the tester did not inform them.

Initiative of the users for testing water

It was reported that about 94% of the respondents did not take any initiative by them in testing water for arsenic. A very few users (4%) took the initiative to test the water. Those who took the initiatives were successful in testing water through village health worker.

The money needed for buying container, media and stand

All of the respondents (100%) did not know the amount of money needed for buying container, and stand. About 88% of the participants did not know the amount of money needed for buying media. A few number of participants mentioned the amount of Tk.50 to 80 (7%), Tk. 81-110 (2%), and Tk. 141-170(2%) was needed for buying media. To buy a Shapla filter including all, it was reported that Tk.301-400 (29%), Tk. 401-500 (57%) and Tk.501-600 (14%) was needed for purchase.

Opinions in bearing the cost of changing container, media, and stand

About 48% of the respondents expressed their opinions in favour of bearing the cost of changing container, media, and stand by themselves. Other respondents mentioned BRAC (10%), IDE (2%) in connection to bearing the cost. About 25% of the respondents reported that they did not know who would bear the cost. Some of the respondents (10%) mentioned - the donor agency and those who provided the materials.

The place where container, media and stand are available

The majority of the respondents (58%) reportedly that they did not know where to get the container, media, and stand of Shapla filter. BRAC and IDE were mentioned as the places to get the materials concerned (35% and 2% of the respondents respectively). Some of the participants (2%) mentioned the bazar as the place to get the materials.

Volume of water coming from Shapla filter daily

The respondents reportedly were getting water 26-30 litres (27%), 21-25 litres (25%), 16-20 litres (16%), 10-15 litres (9%), 4-9 litres (5%), 36-40 litres (7%) and 31-35 litres (2%) daily. About 9% of the respondents did not know the volume of water, they were getting daily.

Number of times filling the filter with water daily

The majority of the respondents (57%) reportedly were filling the filter with water thrice a day. The other respondents stated the following:
Twice a day (32%), Four times (9%), and once a day (2%)

Water in terms of taste among the filter users

The water from Shapla filter was tasted more by the majority of the respondents (90%). About 10% of the respondents preferred the taste of the water from green marked tubewells to any other option.

Fulfilling the needs of the users

The majority of the respondents (73%) reported that the water from the Shapla filter was being used in meeting only the drinking needs. The rest of the respondents (27%) reportedly were meeting both drinking and cooking purposes through the water from Shapla filter.

In case of insufficient water, the use of other options for drinking purposes

About 71% of the respondents reported that they were using water from green marked tube wells whenever they got insufficient water from their Shapla filters. That the water from red marked tube wells was being used by about 17% of the respondents, is a matter of concern. The rest of the respondents were using water from rain water (8%) and river (4%).

In case of insufficient water, the use of other options for cooking purpose

The majority of the respondents (54%) were using river water for cooking purposes. They used other options like green marked tube well (24%), pond (8%), red marked tube well (4%), canal (4%), rainwater (4%) for cooking purposes.

Option preference

The option preference status were as follows:
Shapla filter (74%), Green marked tubewell (15%), Rain water (7%). About 4% of the respondents did not mention any option.

Had the functioning filter ever been non-functioning?

About 75% of the respondents reported that for not once were their filters were non-functioning. Among the rest of the respondents the majority (91%) mentioned that their filters were non-functioned for a single time. The rest 9% of the respondents reported that filters were non-functioning three times.

Causes of non-functioning

About 27% of the respondents mentioned the media had expired and damaged tape as the causes
of non-functioning. Other responses were as follows:
Stopped water flow (18%), Cracked container (9%), Odor (9%) were the causes of non-functioning.

The use of other options during non-functioning of the filters

About 41% of the respondents used river water for cooking purposes. The other respondents used green marked tube well water (29%) and filter from other households (6%) for drinking

purposes mainly. About (24%) of the respondents reported that they used red marked tube well water for drinking purposes during the non-functioning of the filters.

Duration of non-functioning

About 75% of the single- time non-functioning filters were non-functioning for 1-7 weeks. The rest of the filters (25%) were non-functioning for more than 21days.

The last period of changing the media

The media was changed at the latest prior to 3-4 months (47%), prior to 1-2 months (29%), prior to 5-7 months (11%), prior to 2-3 weeks (3%). About 5% of the respondents reported that the media was never changed in their filters.

Bearing the cost of media

About 25% of the respondents said that BRAC bore the cost of media. Another 25% of the respondents reported that they did not know who borne the cost of media. A very few respondents (8%) mentioned IDE in this context. Other status of responses were as follows: Those who provided the first filters free of cost, (11%), office (25%), and donor (6%)

Disposal of expired media

The majority of the respondents (78%) reported that the disposal of the expired media was all around. In some cases (5%), the disposal was maintained in a specific hole for waste. Some of the respondents mentioned that the disposal of the expired media was in the drain and pond (8%).

DISCUSSION

The study revealed that though about 92% of the Shapla Arsenic Removal Filters were functioning but about 28% of them were contaminated with excessive arsenic mixture, which were being used for both drinking and cooking purposes. This is a matter of great concern. During the survey, a wide variety of water flow rates were counted. In some cases, more than 40 minutes were spent to collect one litre water, which should be improved.

It was noted earlier that about 75% of the respondents (filter users) of the non-functioning filters did not take any initiative themselves in getting the filter fixed. It means that the majority of the respondents of the non-functioning filters did not have any interest in getting the Shapla filter fixed due to lack of awareness. Therefore, awareness raising activities should be added to in providing, supervising, and monitoring of the filters.

The majority of the respondents did not know at what intervals the water of the Shapla filter should be tested for arsenic. A variety of responses were counted in this context. A guideline relating the testing intervals should be developed and followed accordingly.

Ensuring water quality needs an arrangement of water testing on a regular basis, which was not found in this study. The holders of the Shapla filter should be taught about maintenance, which will ensure the lasting and effective functioning of the filter. A few number of respondents reported that they were not taught about maintenance.

The tester should inform the users about the result of testing water immediately after the test result found. Some of the respondents reported that they did not know the test result. If water is contaminated with excessive arsenic mixture, the use of water should be stopped from both drinking and cooking purposes at once. In this study it is clear that no effective supervision including follow up and monitoring was maintained to the users who were using arsenic contaminated water for both drinking and cooking purposes.

The majority of the respondents did not take any initiative to test the water filtered for arsenic themselves. Respondents thought that it was not their (respondents) duty to take initiative for

testing water, as they were not motivated. Individual initiative is an important factor to ensure sustainable use of the Shapla filter.

Information related to the cost of changing container, media, and stand as well as the places where from they can be purchased easily, should be clear to the community members including existing users. It was reported that the majority of the respondents did not know these aspects.

For the first time all Shapla filters were given among the villagers concerned at a free of cost. Then after who will bear the cost of changing container, media, and stand? In response to this question, about 48% of the respondents reportedly expressed positive notion towards bearing the cost of changing materials by themselves. It is supposed that cost of changing materials will be borne by the filter users. They should be well informed about it by the service provider.

It was reported that the filter users were getting water daily at different volumes within the same capacity of the filters. There might be some reasons, which included filling the filter with water irregular, and lack of proper maintenance of the filters.

Though the water from the Shapla filter was tasted more as well as Shapla filter was preferred to any other option by the majority of the respondents. But the majority of the respondents did not take any initiative to test water for arsenic by themselves and about 50% of the respondents reportedly were reluctant in bearing the cost of changing container, media, and stand by themselves.

In the case of insufficient water from the Shapla filter and during the state of non-functioning, it was reported that some filter users used water from red marked tube well for both drinking and cooking purposes. This is a matter of great concern on which we should think and do something positively as soon as possible.

In the most cases, the disposal of the expired media was all over which might pollute the environment. Use of safe places/ holes for disposing the non-functioned media may be the solution to this problem.

CONCLUSION

From this study it may be concluded that the majority of the Shapla Arsenic Removal Filters provided were in functioning, although some of them were found highly contaminated with arsenic. Testing water for arsenic was not maintained on regular basis and should be regular. In some cases flow rate is very low and should be improved. All but all respondents know that it is clear about presence of arsenic in water through testing. But the majority of the respondents in testing water for arsenic have not taken any initiative. Some users do not know the latest results of the testing. Filter users should be informed about the result of testing in time. It is clear that Shapla filter is preferred to any other option by the majority of the respondents. But it has been reported earlier that about 47% of the respondents have expressed their opinions in favor of bearing the cost of filter themselves. Disposal of non-functioned media- expired media, in most of cases has been here and there which is another area of concern. A proper management of disposal of expired media should be introduced.

PROGRAMME IMPLICATIONS

Based on the study findings, the following measures are recommended for the programme management:

- The concerned staff and cadres should play a more active role in motivational work through frequent household visits (users' households) for effective functioning of the Shapla filters
- Testing water treated for arsenic on regular basis should be ensured. Flow rate should be improved
- The staff and cadres concerned should educate the users in raising awareness on the importance of regular maintenance of the filters and taking initiative for getting the filter fixed if it is non functioning
- The users should be well informed about the result of testing water for arsenic each time by the tester
- The amount of cost of container, media, stand and the place, where these are available for purchase should be clear among the users as well as other community members
- Expired media should be disposed in safe places/ holes.

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