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Problems Affecting Availability of Arsenic Free Drinking Water

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Abstract

The main objective of the present study was to assess the problems affecting availability of arsenic free drinking water in Bangladesh in two selected arsenic affected areas namely Bhanga and Matlab upazilas under Faridpur and Chandpur districts, respectively. The adult male and female arsenic patients were the unit of analysis. Simple random sampling technique was followed in selecting sample. Data were collected by using both quantitative and qualitative methods. About three-fourths of the respondents belonged to high problem category. Age, education, farm size, number of training, extension contact, organizational participation and annual family income had significant negative relationship with the problems. Among the problems affecting availability of arsenic free water, "paucity of spare parts of arsenic removal devices in the community level", "scarcity of drinking water near household", "difficulty of storing rain water for long time due to lack of handy reservoir" and "lack of suitable reservoir for long time storing of harvested rain water" were the majors. Invention of low-cost arsenic free tube-well with easy distribution of spare parts through local government, provision of short duration training and arrangement of subsidy for establishment of arsenic free tube-well and rain water harvester especially for poor group of people is strongly suggested.

Keywords: *Problem, arsenic, drinking water.*

Introduction

Arsenic is a metalloid element that, once lauded for its beneficial effects, is now notorious for its toxicity and carcinogenocity. It is ubiquitous in the earth's crust, although generally consisting less than 1% of the most rocks, coals, and soils. Arsenic is a silent killer and undetectable in the early stages, arsenic poisoning takes between 8 and 14 years to show its impact on health, depending on the amount of arsenic ingested, nutritional status, and immune response of the individual (MoA, 1984).

The social consequences of arsenic crisis are far-reaching and tragic. There has been little or no social education concerning the treatment of persons affected by arsenic poisoning. Because of poor literacy and lack of information often confuse the skin lesions with leprosy, which among village people is considered a contagious killer. As a result, those who have early symptoms of arsenicosis do not disclose their conditions to avoid certain ostracism. Affected school-age children are prevented from attending school and are avoided by their friends and classmates. Adults are barred from attending cultural and religious functions (Rahman, 2003).

Considering the severity of arsenic contamination in drinking water, different programs have been undertaken by the Government and Non-government organizations (Anonymous, 2006). There are 25 organizations engaged in awareness raising in different parts of the arsenic contaminated areas at local and national levels working through a total of 60 projects and programs (Anonymous, 2005).

The only proven means to reduce the risks of arsenicosis is to reduce exposure to arsenic

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through the provision of water of acceptable levels to be considered of low-risk. Water supply interventions may be achieved through provision of alternative arsenic '' water sources or by removal of arsenic through treatment of water. This removal has problems associated with social aspects, costs, operation and maintenance and there may be risks of repeated contamination from sludge containing high level of arsenic. As a result, the primary focus of the mitigation effort in Bangladesh has been on the provision of alternative water sources (Anonymous, 2005). For smooth sailing of future programs regarding arsenic mitigation, it is necessary to document the problems being faced by the arsenic patients in the availability of arsenic free drinking water. In view of the above circumstances, it is, therefore, essential to undertake the present study with the specific objectives to explore the problems affecting availability of arsenic free drinking water and to find out the relationship between the selected characteristics of the respondents and their perceived problem confrontation.

Methodology

Arsenic contamination in ground water is much higher in the South-western and South-eastern part of Bangladesh where Faridpur and Chandpur are identified as the most devastating occurrence of arsenic contamination in ground water (Anonymous, 2004). Therefore, Matlab and Bhanga upazilas were purposively selected as the locale of the present study.

The arsenic patients of the selected areas were considered as the target population of the present study. For smooth execution of sampling procedure the lists of the target population were collected from the authority of upazila sadar hospitals of Bhanga and Matlab. The number of sampling population was 504 in Bhanga upazila and 250 in Matlab upazila that all together turned into 754 as a whole. A size of 150 patients was selected as sample of this study following formula of Kothari (2004) which was 20% of the total target population. The sample was drawn from the sampling population by applying simple random technique. The total sample was proportionately selected from both the locations.

Data were collected during August to October 2008. Participatory Rural Appraisal (PRA), Focus Group Discussion (FGD), Direct Observation and Case Study were also applied for triangulation of results.

In order to measure extent of the problems of the respondents regarding availability of arsenic free drinking water the researcher collected 20 relevant problem statements through FGD and direct observation. Based on judges' rating and results of pre-test 10 vital problem statements were finally selected. A 3-point rating scale was constructed to assess the extent of the problems which were 'high, 'medium and 'low with corresponding scores of 3', '2' and '1'. The total problem scores of a respondent were obtained by summing his/her scores for all the problem item statements which could range from 10 to 30 where, '10' indicating 'low problem' and '30' indicating 'high problem'. For a clear understanding of the problems in selected items, Problem Confrontation Index (PCI) was developed to arrange the problem statements in rank order by using the following formula:

Problem Confrontation Index (PCI) =

$$R_l \text{ X } 1 + R_m \text{ X } 2 + R_h \text{ X } 3$$

Where,

R_l = Number of the respondents with low problem

R_m = Number of the respondents with medium problem

R_h = Number of the respondents with high problem

Problem Confrontation Index (PCI) in respect of any problem item could range from 150 to 450.

Findings and Discussion

Selected characteristics of the respondents

In this section summary profile of the salient characteristic of the respondents are presented (Table 1) which indicate that more than three-fourths (78%) of the respondents were under young and middle aged categories. Four-fifths of the patient respondents had educational qualifications of different levels. A big majority of the respondents (80%) belonged to small and medium family groups. More than four-fifths (86%) of the respondents belonged to the landless to small categories of land holdings.

Table 1. Distribution of the respondents according to their selected socio-demographic characteristics

Characteristics	Categories	Respondents		Mean	S.D.
		Number	Percent		
Age	Young (up to 35 years)	37	25	43.5	10.67
	Middle age (36-50 years)	80	53		
	Old (51 and above years)	33	22		
Education	No education (0)	30	20	5.33	4.03
	Primary education (1-5 years)	58	39		
	Secondary education (6-10 years)	53	35		
	Above secondary education (11 years and above)	9	6		
Family size	Small (up to 4 members)	57	38	5.54	2.45
	Medium (5-7 members)	63	42		
	Large (8 and above)	30	20		
Farm size	Landless (up to 0.2 ha)	60	40	0.52	0.59
	Marginal (0.21-0.60 ha)	24	16		
	Small (0.61-1.0 ha)	45	30		
	Medium (1.01-3.0 ha)	19	13		
	Large (above 3.0 ha)	2	1		
Number of training	Low (1-2 no.)	145	97	0.53	0.74
	Medium (3-4 no.)	5	3		
	High (5 no. and above)	0	0		
Organizational participation	Low (up to 25 scores)	138	92	4.21	6.20
	Medium (26 to 40 scores)	6	4		
	High (41 scores and above)	6	4		
Extension contact	Low (up to 20 scores)	94	63	18.66	6.27
	Medium (21 to 25 scores)	34	23		
	High (26 scores and above)	22	14		
Annual family income	Low (up to 50 ‘000’ Tk.)	72	48	120.8	114.32
	Medium (51 to 75 ‘000’ Tk.)	45	30		
	High (76 ‘000’ Tk. and above)	33	22		
Annual family expenditure	Low (up to 45 thousands)	65	43	85.76	54.25
	Medium (46 to 60 thousand)	54	36		
	High (61 thousand and above)	31	21		

Almost all of the respondents (97%) experienced low training. Ninety two percent of the respondents had low organizational participation. A vast majority of the respondents (86%) maintained low to medium category contact with the sources of information. About half (48%) of the respondents belonged to the low income group followed by 30 percent of them medium and 22 percent under high income categories. A huge majority (79%) of the respondents belonged to low and medium annual family expenditure categories.

Problems affecting availability of arsenic free drinking water

Use of arsenic free water is inevitable in order to get rid of arsenic infection. But there are innumerable problems that create obstacles in getting arsenic free drinking water. The problems are natural, economic, social and situational. Among the confronted problems, faced by the respondents, ten were identified as fatal. Information furnished in Table 2 show that "paucity of spare parts of arsenic removal devices in the community level" ranked first, "scarcity of drinking water near household" ranked second, "difficult to store rain water for long time due to lack of handy reservoir" ranked third while "lack of proper knowledge for using sophisticated arsenic removal technologies" ranked fourth.

Arsenic removal techniques are composed of sophisticated parts which need proper care and management. Village people with their existing illiteracy levels are unable to handle and use these sensitive devices. Thus, there may be sudden collapse of devices which require addition of spare parts. But these spare parts are not available in the community level which leads to uncertain stop of using these devices. So, "paucity of spare parts of arsenic removal devices in the community level" may come as the most important problems. On the other hand, government has undertaken some measures to establish some arsenic free tube-wells in the community which are negligible in number in respect of excessive demand. Again, there are some NGOs, providing some mitigation options in the community

Table 2. Rank order of the patient respondents according to their problem confrontation index (PCI)

Description of the factors/ Problem statements	Extent of problems			Total	Rank order
	Low	Medium	High		
Paucity of spare parts of arsenic removal devices in the community level	12	45	93	381	1
Scarcity of drinking water near household	27	49	74	347	2
Difficult to store rain water for long time due to lack of handy reservoir	24	56	70	346	3
Lack of proper knowledge for using sophisticated arsenic removal technologies	26	53	71	345	4
High initial cost of establishing arsenic removal technologies / alternate water option measures	27	53	70	343	5
Shallow knowledge on negative consequences of arsenic infection	33	42	75	342	6
High maintenance cost of arsenic removal technologies / alternate water option measures	27	59	64	337	7
Poor cooperation of program personnel	36	67	47	311	8
Family members are reluctant and inattentive in carrying drinking water from a distance	51	66	33	282	9
Harvesting of rain water is a bothersome job	55	69	26	271	10

level. Besides, rich people themselves undertake costly initiative to install arsenic free deep tube-well as their own water source. But all these together are insignificant in number. So, poor villagers who do not have tube-well near their household were reluctant to fetch their drinking water from a distance. Consequently "scarcity of drinking water near household" ranked as second most important problems. Aziz *et al*. (2006) in a study also reported that lack of convenience of drinking water practices lead people to persist in drinking arsenic contaminated water.

In Bangladesh, rainfall is distributed throughout the year evenly. During rainy season there are ample rain fall throughout the country which it is not demand-led, unequally distributed and even uncertain also. So, it needs to harvest and store rain water during the season for the use of scarce period. But there are manifold problems in this procedure. Installation of rain water harvesting mechanism is costly, and so the most of our village people can not afford this. Again, storing of harvested rain water and maintaining it usable for long time needs suitable reservoir which is also far beyond their capacity to procure. These draw backs may escort "difficult to store rain water for long time due to lack of handy reservoir" in the third rank.

Again, it is said earlier that most of the respondents are illiterate; they are incapable of understanding the using procedures of modern instruments. They don't have even short durational training on the use of arsenic removal technologies. Resultantly, "lack of proper knowledge for using sophisticated arsenic removal technologies" ranked as the fourth problems inhibiting availability of arsenic free water.

To get the distribution of the respondents as per their problem confrontation regarding availability of arsenic free drinking water they were categorized into three groups. The observed problem confrontation score of the respondents ranged from 12 to 28 against a possible range of 0 to 30.

Table 3. Problem confrontation of the respondents regarding availability of arsenic free drinking water

Categories	Respondents			
	Number	Percent	Mean	SD
Medium (scores 11 to 20)	39	26	22.02	3.77
High (scores of 21 and above)	111	74		

Data presented in Table 3 indicate that about three-fourths of the respondents (74%) belonged to high problem confrontation category regarding availability of arsenic free drinking water followed by medium problem confrontation category (26%). Interestingly, none of the respondents fell under low problem confrontation category. The high mean value and tiny standard deviation value indicate the high and homogenous problem confrontation by the respondents. Therefore, all of the respondents found medium to high problem confrontation categories in respect of availability of arsenic free drinking water.

Relationship between the selected characteristics of the respondents and their perceived problem confrontation

In order to determine the relationships between selected characteristics of the respondents and their problems affecting availability of arsenic free drinking water coefficients of correlation were computed. The findings presented in Table 4 reveal that

age, education, farm size, number of training, extension contact, organizational participation and annual family income had significant negative relationship with the problems affecting availability of arsenic free drinking water.

Table 4. Correlations between the selected characteristics of the respondents and their perceived problem confrontation

Independent variables	Correlation of coefficients (r)
Age	-.192*
Education	-.355**
Family size	.034
Farm size	-.183*
Number of training	-.243**
Organizational participation	-.207*
Extension contact	-.270**
Annual family income	-.165*
Annual family expenditure	-.135

* and ** Correlation is significant at the 0.05 and 0.01 level, respectively

It implies that increasing age, education, farm size, number of training, extension contact, organizational participation and annual family income of the respondents decrease their problem confrontation in availability of arsenic free drinking water. Since there is limited scope to increase age, farm size and annual family income of the respondents by the external agencies, there is more than enough opportunities to help them increase their education, number of training, extension contact and organizational participation.

Rahman (2000) in a study also found negative significant relationships between education, farm size, organizational participation and training exposure of the farmers and the constraints faced in practicing organic farming. Rahman and Kashem (2004) reported that education, farm size and total annual income of the potato growers had negative relationships with their problem confrontation. Similarly, Hosen *et al.*, (2005) revealed significant negative relationship between family farm size, family annual income and extension media contact of the rural women in ASA with their barriers to entrepreneurial income generating activities.

Suggested solutions of the problems

In order to find out the possible solutions of problems that affect in the availability of arsenic free drinking water the respondents along with the key informants imparted some appropriate suggestions also. The suggestions provided by the respondents and the focus group discussants were more or less same and presented in Table 5. They demanded easy distribution of spare parts of arsenic removal devices, installation of more arsenic free tube-well throughout the community, GO/NGOs initiatives to minimize high initial cost of establishing arsenic mitigation options. According to their opinions, introduction of simple and appropriate technologies can reduce the high maintenance cost of arsenic mitigation options. Simplification of arsenic removal technologies and arrangement of short training would be able to increase users' knowledge. More frequent contact with the villagers in different levels would make them sincere in learning harmful effect of arsenic. Introduction of low cost and simple rain water harvester and reservoir can help them in easy collection and storing of rain water for long time. Local government institutions may be employed in distributing spare parts of arsenic removal devices to make it more popular and available in the community level.

Table 5. Suggested solutions of the problems affecting availability of arsenic free water

Sl. No.	Problem statements	Probable solutions
1.	Paucity of spare parts of arsenic removal devices in the community level	▪ Distribution of spare parts of arsenic removal devices through local government
2.	Scarcity of drinking water near household	▪ Installation of more arsenic free tube-well throughout the community
3.	Difficult to store rain water for long time due to lack of handy reservoir	▪ Introduction of simplified mechanism to store rain water for long time
4.	Lack of proper knowledge for using sophisticated arsenic removal technologies	▪ Simplification of arsenic removal technologies ▪ Arrangement of short training
5.	High initial cost of establishing arsenic removal technologies/alternate water option measures	▪ GO/NGO can take initiative to install more arsenic free tube-well ▪ Supply of low cost arsenic removal devices among the villagers
6.	Shallow knowledge on negative consequences of arsenic	▪ More individual, group and mass contact with the villagers
7.	High maintenance cost of arsenic removal technologies/alternate water option measures	▪ Introduction of simple and appropriate technologies
8.	Poor cooperation of program personnel	▪ Program personnel behavior should be sincere and should be friendly and amicable in dealing with the villagers
9.	Family members are reluctant and inattentive in carrying drinking water from a distance	▪ Installation of more arsenic free tube-well throughout the community
10.	Harvesting of rain water is a bothersome job	▪ Development of low cost rain water harvester

Installation of more arsenic free tube-well throughout the community may lessen insufficiency of drinking water near household and encourage family members in using arsenic free water. On the other hand, personnel of arsenic mitigation programs can behave sincerely and friendly with the villagers for their spontaneous participation in the programs' activities.

Conclusion

"Paucity of spare parts of arsenic removal devices in the community level", "scarcity of drinking water near household", "difficulty of storing rain water for long time due to lack of handy reservoir" and "lack of proper knowledge for using sophisticated arsenic removal technologies" were found as important problems affecting availability of arsenic free drinking water. The Department of Public Health Engineering (DPHE) may initiate the invention of low-cost arsenic free tube-well and rain water harvester as well and arrange easy distribution of spare parts through local governments. Provision of subsidy can be arranged for establishment of arsenic free tube-well and rain water harvester especially for the poor. Increased and effective extension contact by the health assistants and short duration functional training may be helpful in decreasing intensity of the problem.

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