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Full Length Research Paper

The socioeconomic impact of Arsenic poisoning in Bangladesh

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The purpose of this paper is to propose a methodology to analyze the health effects, how people cope with the socioeconomic consequences of the disease and to predict the beneficial effects of various alternative mitigation methods and recommends governmental measures for prevention of Arsenic poisoning. This research has been evaluated by the Bangladeshi Health Care system for its ability to recognize, isolate, report and control cases of Arsenic. The statistics is provided through the latest Internet publications, literature on global and regional information on environment, and using the database of Bangladesh Demographic and Health Survey 2004. This research attempted to analyze how other international agencies are trying to prevent Arsenic in their countries, where the people are affected or infected by Arsenic. As preventive measures, surface water treatment including drinking or taking water from the pond, various educational program, support of Government and NGOs, using media materials and Pan American Center for Sanitary Engineering and Environmental Sciences (CEPIS) in Peru, called ALUFLOC and Danida and Water Aid developed technologies to remove Arsenic were mentioned.

Key words: Arsenic poisoning, alternative mitigation methods, governmental measures.

INTRODUCTION

The Arsenic poisoning, termed the biggest environmental disaster and a major public health issue in recent times in Bangladesh (Mahmood and Ball, 2004). The Bangladesh government recognizes Arsenic contamination of ground water as a serious health problem, and aims to mitigate the situation with international cooperation (New Nation, 2006).

Contamination of groundwater by Arsenic has been reported in many countries including Australia, Chile, China, Hungary, Mexico, Peru, Thailand, Vietnam, and the US, but the most seriously hit areas are Bangladesh and West Bengal (India). The contamination of ground water by Arsenic in the deltaic region, particularly in the Gangetic alluvium of Bangladesh, is said to be one of the most important natural misfortunes (Daily Star, 2006). The World Bank has offered $52 million in assistance to help the country find alternative drinking water sources, while the United Nations. Foundation has contributed $2.5 million (UNU, 2002)

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Arsenic

Arsenic (As) is a naturally occurring element in the earth's crust, and traces of Arsenic can be found throughout the environment. Arsenic is the chemical element that has the symbol As, atomic number 33 and relative atomic mass 74.92. Arsenic is a metalloid. It can exist in various allotropes, although only the grey form is industrially important. The main use of metallic Arsenic is for strengthening alloys of copper and especially lead. Arsenic is a common n-type dopant in semiconductor electronic devices, and the optoelectronic compound gallium arsenide is the most common semiconductor in use after doped silicon (Wikipedia, 2010).

Arsenic belongs to group V of the periodic table (Tutor, 2010). High concentrations of Arsenic have also been found in groundwater from areas of bedrock and placer mineralization, which are often the sites of mining activities. Arsenic concentrations of up to 5000 µg/L have been found in groundwater associated with the former tin-mining activity in the Ron Phibun area of Peninsular Thailand, the source most likely being oxidized arsenopyrite (FeAsS) (IGAIC, 2010).

Arsenic in soil can originate naturally, and past human activities may have added to these levels in some areas. Historically, the heaviest use of Arsenic in this country has been as a pesticide. The current predominant use of Arsenic is as a wood preservative. In ground water, Arsenic occurs primarily in two forms, As^{+3} (arsenite) and As^{+5} (arsenate). Organic Arsenicals are not known to occur at significant levels in ground water. Arsenic may change chemical form in the environment, but it does not degrade (Department of Environmental Protection, 2006).

METHODOLOGY

A systematic review was conducted from 1999 to 2010. Information was retrieved from documents available mainly in electronic database and on the websites of specialized agencies, using the terms Arsenic and impact on social economy in rural Bangladesh with other researchers work was undertaken, including 1 leading Bangladesh daily newspapers also analyzed. 47 research papers were retrieved from the database (websites) of several national and international agencies were browsed. The most important, being online collection from different journals on Arsenic related issues. These sites housed a number of reports on quantitative and qualitative studies, estimates of Arsenic cases, policy analysis of the existing Arsenic situation in Bangladesh, and government strategies. Histological observations were carried out and a cross-sectional prevalence study of Arsenic and socio economic impact in rural Bangaldesh was also held. A scrutiny of the abstract revealed that, some presentation posted on the websites, which was presented in international conferences and few other presentations were published in journals. Collected documents were skim read to cases, whether they contained information on Arsenic in conjunction with socio economic impact. Data accruing from the study analyzed Bangladesh Demographic and Health Survey 2004 database downloaded from the internet (www.measuresdhs.com) using SPSS Version 11.5. Wealth quintiles are prepared applying principal component analysis (PCA) as the PCA technique describes better measurement of wealth category compared to any other wealth measurement techniques (Vyas and Kumaranayake, 2006).

Socio-economic background of rural Bangladesh

Access to a safe water supply is one of the most important determinants of health and socioeconomic development (Cvjetanovic, 1986). The recognition of the importance of a safe water supply led to an emphasis on the provision of appropriate facilities in developing countries (UNICEF, 1998). The socio-economic status of Bangladesh is similar to that of other developing countries. Most of the people are ignorant about various aspects of public health, a wide range of superstitions and false beliefs being prevalent in these communities. These low levels of socio-economic discrimination (Barkat et al., 2002). However, in one study in Laximipur, Bangladesh, identified that better economic conditions leading to maintaining better nutritional status of population may have a role to prevent arsenocosis, at least partly (Dhar et al., 1998). One study says that, the Arsenic problem will have major economic impacts throughout Bangladesh, affecting agriculture and other related industries including water management and public health, as well as the overall national economy (UNU, 2001). According to a report in the Bulletin of the WHO [2000; 78(9): 1093-1103] Bangladesh has the largest Arsenic contamination in ground water in history. The potential severity of the problem is estimated to be greater than that from the chemical accident at Bhopal, India in 1984 and the nuclear accident at Chernobyl, Ukraine in 1996 (Glimpse, 2002). The Public Health Department of Bangladesh (DPHE), a national agency under the Ministry of Local Government Rural Development and Co-operatives, is entrusted to provide a safe water supply, sanitation and drainage facilities throughout the country (except for three major cities). DPHE is the focal point for initiating a national policy framework and development plan for water supply and sanitation under the guidelines of the Ministry of Local Government and Planning Commission of the Government of Bangladesh.

DPHE is responsible for planning, designing, implementing and monitoring water supply and sanitation projects in both rural and urban areas of the country. It provides necessary technical support to local governments, selecting locations of water sources, infrastructure, operational training for maintenance of water supply, and sanitation facilities. It assists councils in the promotion of health and hygiene through education programs conducted by union WATSANs water supply and sanitation committees (DPHE website). Although switching to tubewells helped control waterborne diseases, this success has come at a price. The shift to groundwater created another problem, millions of people have been exposed to water naturally contaminated by Arsenic-rich rocks (Frisbee and Richard, 2002)

The dilemma

Cases of Arsenic poisoning began surfacing in the 1980s (WHO, 2000; British Geological Survey/DPHE, 2000; Caldwell, 2003, Adeel, 2001a, b). The first Arsenicosis patient was diagnosed in West Bengal, India in 1983; the first Bangladeshi patient was diagnosed in 1987. The government probably knew as early as 1985 when Bangladeshis started going to India for skin complaints, diagnosed as Arsenic poisoning. By 1993, the DPHE confirmed Arsenic in a tubewell in Chapai Nawabgang, a village in the Rajshahi Division (similar to a province) and found eight Arsenicosis patients. At about the same time (1995), Arsenic in drinking water was internationally recognized at the first International Conference on Arsenic (Frisbee et al., 2002). In recent days, the awareness about Arsenic poisoning has risen in Bangladesh to a significant extent (Aziz et al., 2006). Now, an estimated 45 to 49% of Bangladesh's 21 million tubewells are thought to be pumping Arsenic contaminated water (Frisbee et al., 2002). More than 14,000 people have been identified as suffering from Arsenic-related diseases and an estimated 20 to 35 million (Caldwell, 2003; WHO, 2000; Adeel, 2001a, b) are exposed to drinking water in which the concentration of Arsenic exceeds the Bangladeshi drinking water standard. Bangladeshis are also at risk due to irrigation of farmland with Arsenic contaminated water. Arsenic has been found to be above permissible limits in vegetables, fruits and cereal soils irrigated with crops grown in contaminated water, raising fears that the entire population is at risk. Researchers have found that food, including rice (a major staple of the Bangladeshi diet) cooked with Arsenic-contaminated water contains high levels of Arsenic (Dhaka University and Commonwealth Scientific and Industrial Research Organization as cited in Mortoza, 2002). Researchers are examining whether Arsenic in food will affect individuals who consume it. The developmental effects on children resulting from the ingestion of Arsenic have also not been extensively investigated but it is probable that children are more sensitive to Arsenic induced toxicity than adults (Mahmood and Ball, 2004). Furthermore, malnutrition, which is a common in the poor, shows a strong association with Arsenicosis. This is because malnutrition increases the susceptibility to Arsenicosis (Ahmad et al., 2007; Sarkar and Mehrotra, 2005). The UN estimate that upward of 57 million people in Bangladesh, around 50% of the country's population, is at risk for cancer because of contaminated well water (Adeel, 2001a, b). Officials noted that the number of people at risk exceeds the number of people infected with HIV worldwide. Within a decade, one-tenth of the deaths in much of the south of the country could be caused by Arsenic; because Arsenic contamination has been found in all 64 districts, the number of proportion of deaths attributable to Arsenic could be higher. Although, Bangladesh is ranked second in terms of the availability of ground water, the Arsenic problem will affect agriculture, water management, and the economy as a whole, as well as the health of individuals and families (WHO, 2000). This paper analyzes susceptibility and the economic impacts of the urban and rural populations of Bangladesh to Arsenic, assesses the risky behavior of contracting Arsenic and assesses how people cope with the socioeconomic consequences of the disease and to forecast the positive effects of various alternative mitigation techniques with special emphasis on the current social status of the people of Bangladesh. The available options for safe water can be classified by source: groundwater, surface water and rainwater. Recent years have seen increasing acceptance of strategies for incremental improvement in the environment and health in general and of demand-driven approaches to water supply and sanitation in particular.

Groundwater

The simplest and most immediately achievable option is the sharing of tubewells that are currently low or free from Arsenic. Arsenic-containing wells may still be used safely for laundry-washing for example, and a simple color coding (like that used for "traffic lights") may have a significant impact on community Arsenic exposure if carefully and continuously backed up by awareness raising and educational activities (WHO, 2006).

The Shapla Arsenic

The filter technology invented by Prof. Islam operates based on the absorption of Arsenic through the reaction with activated iron oxides impregnated in crushed brick particles and simultaneous filtration. Arsenic absorbing media production involves the activation of crushed brick particles of proper size by iron salts and heating the solution at a specific temperature for a specified time, resulting in the formation of dispersed activated iron oxides in and on the pores and edges of brick particles (BSS, 2005).

Alcan filter

Arsenic mitigation options were chosen in consultation with BRAC and based on their wide experience providing alternative water options to Arsenic exposed populations in the country. This system runs water through an activated alumina medium which efficiently removes Arsenic (ICDDR,B, 2004).

Danida research project

Danida has conducted research on Arsenic removal in Noakhali, Bangladesh (similar to a state in the US) since November 1998. The research looks at the use of a mix of alum and $KMnO_4$. These ingredients are introduced into a large bucket, which is drained off after 1 to 1.5 h into another bucket. The cost of chemicals for an average family is Tk. 10/US $0.2 per month (WHO, 2006).

CEPIS/PAHO ALUFLOC

The WHO PAHO Pan American Center for Sanitary Engineering and Environmental Sciences (CEPIS) in Peru has developed a technology called ALUFLOC for Arsenic removal at the household level. It has been tested in Argentina. ALUFLOC is a sachet containing chemicals that are added to a bucket of Arsenic contaminated tubewell water. After about 1 h of treatment, the water is safe for consumption. Preliminary field results suggest that, ALUFLOC is effective in reducing Arsenic content to safe levels (WHO, 2006).

Surface water

Surface waters (rainwater, rivers, lakes, etc) are typically low in Arsenic and therefore, potentially attractive drinking water sources in Arsenic-rich areas. However surface waters are frequently contaminated with human and animal faecal matter and other materials that are unsafe. Such contamination originally led to the preference for groundwater sources in Bangladesh (WHO, 2006).

Surface water treatment

Treatment of surface water can be achieved by several means. Slow sand filtration is a typical method for treatment in rural areas and small towns. Water passes slowly through a large tank filled with sand and gravel. Fine particles are filtered out and microorganisms are inactivated by a thin layer formed on the surface of the bed (Schmutzdecke) (WHO, 2006).

Rainwater

Rainwater harvesting is a recognized water technology in use in many developing countries around the world (WHO/IRC 1997). UNICEF has promoted dispersion of the technology since 1994 in Bangladesh. The rainwater is collected using either a sheet material rooftop and guttering or a plastic sheet and is then diverted to a storage container. Water is not collected during the first few minutes of a rainstorm to avoid contamination by dust, insects, bird dropping, etc (WHO, 2006). Rainwater harvesting is largely capital intensive and is dependent on the availability of suitable roofing materials for guttering and storage tanks. Rainwater harvesting has proven to be successful in places including China (Taiwan), Sri Lanka and Thailand (WHO, 2006).

Dug well

Before the (cheap and simple) tube well was introduced, many villages dug wells to obtain surface water. However, many, if not most, were NOT carefully installed, dug, covered, and chemically treated, and they were full of bacteria. Successful projects involving sanitary dugwells exist in other countries, and some that may be successful have been reported but not yet in the detail to convince the skeptics that no coliform bacteria exist. Wells must be remote from latrines, old or new.

Grameen Bank now has a similar list. They must be covered to prevent entry of animals and refuse but is aerated to allow oxidization. Water is taken out by a connected tube well and pump, making them as easy to use as a tube well. They are located at a distance from latrines including past latrines with their buried organic waste if possible. In many wells, the water is pumped by electricity to an overhead tank for which PVC pipe leads to half a dozen taps in individual houses or between houses. This system of running water is very popular (Harvard, 2010).

A field-kit by the National Institute of Preventive and Social Medicine

BRAC (Bangladesh Rural Advancement Committee), an international non-governmental organization, has tested a simple and low-cost procedure of tubewell water, which can be implemented at the community level. This study demonstrated that a change in the water source ensuring safe water by introducing an effective, affordable, and simple procedure can be helpful to overcome the Arsenic contamination problem (Chowdhury et al., 1999).

Technology choice

The choice between technologies should take into account their cost effectiveness in providing Arsenic free and microbiologically safe drinking water. Different options may have very different balances of cost between, for example, capital and recurrent costs and may impact differently on the household costs of water management. However, the criteria of sustainability and acceptance by rural users must be incorporated in the calculation of cost effectiveness. This should aid the decision making process regarding which mitigation method(s) to implement (WHO, 2006).

DISCUSSION

Economic and social conditions of the affected families

Like any other disease, loss of productive hours has a negative impact on family income and on the economic conditions of poor families. As Arsenicosis is a 'new disease', patients move from doctor to doctor for diagnosis despite the lack of proven treatment; patients usually spend a lot of money on treatment even before diagnosis. Such substantial expenditures over a prolonged period of time worsen the economic conditions of poor families (APSU, 2006). As a result of misconceptions about Arsenicosis, it is often identified with contagious diseases. As a result, patients are ostracized which adversely affects their livelihood. For example, job loss as a result of arcenosis symptoms has been reported as has, decline in business (for example of a shopkeeper or a peddler). Women with Arsenicosis usually suffer the most. There are reports of broken marriages and problems in getting married. Thus, the adverse attitude towards Arsenicosis patients contributes to worsening economic conditions of families with Arsenicosis patients (APSU, 2006).

Economic differentials in social and economic impacts of Arsenicosis

Apart from the health effects, Arsenic poisoning also causes a wide range of social problems and economic loss. One study suggests a significant relationship between socio-economic status of a household and social and economic problems caused by Arsenicosis of a family member. The lower income group (Tk. 2500) group was significantly more likely to report facing social problems than higher income groups (APSU, 2006).

The role of socioeconomic status in Arsenic poisoning

In Bangladesh, it is likely that access to tubewell drinking water will be at least partially determined by social status. Therefore, the observed relationship between Arsenicosis prevalence and household income could be due to social barriers to access to Arsenic-free water for poor households (WHO, 2006). There are also significant socio-economic barriers to switching wells as most wells are privately owned and there may be reluctance to sharing a water source. Privacy in another issue, because tubewells are usually installed near household latrines. Moreover, women, who traditionally collect water, are not usually allowed to leave their immediate household unaccompanied. Another point to consider is that, if the density of users at each well increases, this may affect the aquifer and the water source may, in turn, become Arsenic contaminated (Willingness to pay for Arsenic-free, 2003). Economic status was found to be a key factor determining acceptability and the price that households were willing to pay for Arsenic removal technology. Although most households showed a preference for the features of the more expensive technology, namely Alcan, very few could realistically afford this technology individually (Willingness to pay for Arsenic-free, 2003).

FINDINGS

Arsenicosis and economic status: The poor suffer most

As a result of the high coverage and low cost of the technology, the poor used to pay little for water in the rural areas Table 1. Those who did not own any private or community tubewells managed to collect water from the nearby government tubewell or private tubewells that were usually plentiful in the neighborhood. Although due to the prevailing social barriers, access to Arsenic-free water always may not be possible but because of social and religious reasons, drinking water is not usually denied to anybody in rural Bangladesh (Chowdhury, 2002). Thus, the 'tubewell revolution' ensured provision of one of the basic human needs-safe drinking water-for the rural poor in Bangladesh. The high service level of tubewells requires little time for collecting water, which has indirect but positive impacts on the economic conditions of poor families (Chowdhury, 2002).

Another study showed that the majority of Arsenicosis patients (71%) belong to the low-income group, while 29% are middle class. No patients were from the high-income group. All of these patients were from rural areas of the country and the majorities were related with the traditional occupations of the country, like cultivation (53%). In addition to lower levels of educational (81.5 %), most of the patients with chronic Arsenicosis were suffering from malnutrition (91%) (Sikder et al., 2002).

Knowledge level regarding Arsenic issue

Data from the 2004 Bangladesh Demographic and Health Survey, a nationally representative survey, were used in this analysis; the survey methodology is described elsewhere. Overall, 84% of households had heard about Arsenic. The richest group (quintile) of people is significantly more aware of Arsenic knowledge (97%) than the poorest quintile (69%) Table 2. However, in terms of divisional coverage, Khulna division (95%) people have

Table 1. The costs of different alternative technologies in comparison with shallow tubewells.

Alternative technological options	Unit Cost Taka	No. of family/Unit (Family size = 5	Installation cost/person Taka
Shallow Hand Tubewell	5 000	50	20
Rainwater Harvesting	6 200	1	1240
Dug/Ring Well	35 000	25	280
Deep Tubewell	45 000	50	180
Pond Sand Filters	35 000	50	140
Arsenic Removal Filters			
--Community type	75 000	25	600
--Household type	450-2 500	1	90-500

(Chowdhury, 2002).

Table 2. Heard of Arsenic by wealth quintiles and regions.

Heard of Arsenic by wealth quintiles				Heard of Arsenic by region			
Wealth quintile	**Number**	**Row (%)**	**Column (%)**	**Region/ Division**	**Number**	**Row (%)**	**Column (%)**
Poorest(n=2364)	1622	18	69	Barisal (n=632)	494	6	78
Poorer(n=2197)	1750	20	80	Chittagong (n=1816)	1502	17	83
Middle(n=2026)	1730	20	85	Dhaka (n=3364)	3053	35	91
Richer(n=1959)	1828	21	93	Khulna (n=1289)	1220	14	95
Richest(n=1933)	1879	21	97	Rajshahi (n=2753)	2051	23	74
				Sylhet (n=624)	488	6	78.
Total(n=10479)	8809	100.0	84	Total (n=10478)	8808	100.0	84.
Chi-square trend: p=0.000				Chi-square trend: p=0.000			

Sources: BDHS 2004 database.

more knowledge than any other divisions and the people in Rajshahi division have the lowest level (78%), Tabel 1. Overall, it can be concluded herewith that, the poverty prone people are more vulnerable in terms of Arsenic knowledge compared to others, because it is shown that, the range of deference between inter-wealth index category of people is much more higher thatthe range of inter-divisional coverage. Among 84% of people those who heard about Arsenic, Table 3 exploring the statistics about, if they collect drinking water from any tubewell, whether the tubewell has been tested for Arsenic poisoning. Table 2 shows that, 90% of the population depends on tubewell water, as their safest drinking water source. However, almost half (48.67%) of the tubewells remained unmarked (in other words untested for Arsenic poisoning) and this is an alarming situation for the nation and in this regard; either Government and/or other associate agencies can have their instant attention in terms of testing these tubewells for Arsenic poisoning. This would help the nation to know that, the water they are collecting from the tubewells, whether it is Arsenic free or not. However, there is a study where it was found that, the study population's exposure to sources of Arsenic related information did not result in adoption of avoidance measures (Aziz et al., 2006).

Intensity of untested tubewells by wealth quintiles by regions

Table 4 make highlights that, the unmarked/untested tubewells are more or less equally distributed among the four lowest wealth quintiles, but this could be noted that the rate of unmarked/ untested tubewells are lowest in richest quintiles and moreover the difference between richest and any other quintile is statistically significant. On the other hand, some divisions are more vulnerable (Table 3).

For instance, untested/unmarked tubewells are highest in Rajshahi and Dhaka division. Sylhet, Barisal and Khulna divisions are comparatively in safer side in terms of testing and marking of tubewells for Arsenic

Table 3. Arsenic marking on tubewells.

Marking information	# of HHs	% of HHs
Red marked	599	6.80
Green marked	2852	32.38
Unmarked	4287	48.67
Do not Know	170	1.93
Do not collect from tubewell	901	10.23
Total	8809	100.00

Sources: BDHS 2004 database

Table 4. Intensity of unmarked/untested tubewells.

Unmarked/ untested tubewells by Socio-economic status			Unmarked/ untested tubewells by region		
(Wealth quintiles)	Households	% households	Region/ Division	Households	% households
Poorest	877	20.46	Barisal	291	6.8
Poorer	900	20.99	Chittagong	768	17.9
Middle	852	19.87	Dhaka	1180	27.5
Richer	922	21.51	Khulna	328	7.6
Richest	736	17.17	Rajshahi	1474	34.4
Total	4287	100.00	Sylhet	246	5.7
			Total	4287	100.0

Sources: BDHS 2004 database.

poisoning.

Red marking tubewells (risk area/group) by socio-economic status and divisions

The red marked tubewells are found among the poorest and middle category of people highest and lowest in the richest category of people (Table 5) and in terms of divisional analysis, Dhaka and Chittagong is the highest and Barisal and Rajshahi is the lowest (Table 4). One possible reason of becoming lowest Arsenic intensity in Barisal region is because of river based area. Overall, people in the poorest category are deprived in terms of both knowledge and achievement in getting drinking water from tested tubewells.

Coping with Arsenicosis

Once a family member becomes sick, a variety of coping methods come into play, depending upon the status of the afflicted person. A major amount of attention is paid to the effects of illness of the breadwinner, usually the father. Coping with the burden of treatment costs constitutes a first important issue for the family. However, adoption of methods to obtain Arsenic free water for the bread-winner would also allow the other household members the opportunity to safe drinking water.

In Bangladesh, Pryer (1989) found that "large" medical expenditures are paid out of the sale of assets. It would need to be ascertained whether these assets are factors of production, such as land, that affect future income, or are smaller assets like beds, tables, chairs, fan or radio. It has also been found that, intra-household labor substitution takes place in case of chronic illness to preserve income. For example, family members (the breadwinner’s wife and mother) could work additional hours. The children in the family may sell goods or foodstuff at the market. Another managing mechanism may be decreasing food consumption or other consumption of other basic needs of items such as clothing, education and housing. Pryer (1989) also established that some households accumulate large loans to finance lost income due to the breadwinner’s illness.

The economic burden of Arsenicosis was revealed in a study, which found that the total of 7930 “years lived with disability” resulted in 1908 “disability-adjusted life years ”in case of Arsenicosis (Molla et al., 2004). Coping is likely to differ between rural and urban areas. For example, the economy of poor households in urban areas is likely to be connected much more closely with the urban manufacturing sector, offering in principle a wider variety of coping mechanisms. Evidence on coping with illness

Table 5. Distribution of red marking tubewells.

Identified red marked tubewells by Socio-economic status			Identified red marked tubewells by region		
Wealth quintiles	**Households**	**% households**	**Region/ Division**	**Households**	**% households**
Poorest	137	22.8	Barisal	8	1.3
Poorer	120	20.0	Chittagong	217	36.3
Middle	141	23.6	Dhaka	239	39.9
Richer	128	21.4	Khulna	95	15.8
Richest	73	12.3	Rajshahi	10	1.7
Total	599	100.0	Sylhet	30	5.0
			Total	599	100.0

Sources: BDHS 2004 database.

among urban slum residents in Dhaka City is available from Desmet et al. (1998). For daily wagers they found that "sacrificing holidays" is the first coping strategy following loss of income due to illness, followed by intra-household labor substitution, and foregoing consumption of commodities. Taking loans and using cash savings rank fourth and fifth in the list of coping strategies. On the whole, expenditure for basic need items such as staple foods, education, clothing and education does not seem to be affected (WHO, 2006).

It is important to prevent the increase of Arsenicosis for both health and economic reasons. However, drug treatment to eliminate Arsenic from the body is a bit time consuming and may be associated with some expense, leading to the conclusion that palliative care, including application of ointment in the case of keratosis, may be the only affordable treatment in rural areas of Bangladesh. Bangladeshi villagers affected by Arsenicosis are likely to lose a significant amount of productive time. In addition, the disease may become a burden on villagers' overall financial and time resources (WHO, 2006). In this context, it can also be noted that till date no chelating agent has shown definite success in removing Arsenic from the body (Das and Sengupta, 2008).

Governments and international NGO's commitment

The former Bangladesh State Minister for Youth and Sports, Mohammad Fazlur Rahman, said that the present government has been working relentlessly to make Arsenic-free water available throughout the country. He said: "This is a part of the government's scores of epoch-making programs for the speedy progress and prosperity in national economy to bring about a positive change in rural life" Daily Star (2006). Here, this can be noted that Governmental strategies already adopted to combat the disease in Bangladesh and West Bengal (Ghosh et al., 2008). Today international agencies such as the World Bank, UNICEF, UNDP, WHO, BRAC, ICDDR,B and the Rotary have accepted that this is a problem of national and international importance. UNICEF has funded projects to examine filters (Swash, 2003). Four technologies have thus far been approved by the government (Daily Star, 2004).

Conclusion

From the review, it is evident that poor families are suffering more from the Arsenic problem in Bangladesh. They are being exposed to Arsenic through drinking water and they have less access to alternative safe drinking water sources. Poverty related malnutrition also appears to be making them more vulnerable to Arsenicosis. Once sick, the loss of productive hours and expenditures on 'treatment' contribute to the worsening of their economic condition (Chowdhury, 2002). A graver impact of Arsenicosis for the poor may be their vulnerability to social taboos because of their condition. Mitigation methods need to be implemented urgently, not least for reasons of poverty alleviation. It is important to assess the future health and socioeconomic impacts of alternative mitigation methods, so that policy-makers in Bangladesh can take informed decisions (WHO, 2006). In particular, important discussion and analysis will be needed on alternative financing strategies for hot-spot areas, thereby specifying the roles of donors, local and central Government, and households (WHO, 2006).

Finally, it is clear that the technologies introduced to supply Arsenic free safe drinking water are only short-term emergency solutions for areas severely affected by Arsenic contamination. The longer-term solutions may include the provision of a piped water supply to the population and the optimal use of surface water (Jakariya et al., 2005). This is most unfortunate for the victims; as like HIV/AIDS, it has the potential to affect almost all families in Bangladesh. This is creating and will create a loss of productivity damaging the economy (Mahmood and Ball, 2004). A bigger tragedy is that, despite the passage of time, there has been no fresh thinking on what promises to be a massive social and environmental problem. "There were many occasions "when a stitch in time could have saved us nine" be it in politics or in economics." (Daily Star, 2006).

Given the millions of people in Bangladesh who are currently suffering from Arsenic poisoning, health policy-makers (WHO, 2006) with the help from researchers need to devise policies capable of counteracting this threat. They need to show that, an increasing number of people will suffer from Arsenicosis, if mitigation methods are not implemented rapidly. It is also important to demonstrate the social and economic effects on households with Arsenicosis patients, and how mitigation methods can reduce the burden of those effects. Above all, Bangladesh should immediately implement appropriate Arsenic and water supply and sanitation policies to benefit the people of this country. In addition to that, Bangladesh government should include in the national policies about implementing the beneficial effects of various alternative mitigation methods, as well as governmental measures for prevention of Arsenic poisoning. Any action taken must address the needs throughout the country because Arsenic contamination is not limited to particular geographic areas. Only by addressing the problem at a national level can the negative effect on economic growth be diminished.

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