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Collapse of Socio-economic Base of Bangladesh by Arsenic Contamination in Groundwater

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Abstract: Untreated groundwater, often enriched in arsenic-one of the most important pollutants and trace elements of the aquatic system recently regarded as the major threat to drinking water-was and is being extensively used as a source of drinking for the decades in rural and semi-urban areas of the developing countries which results in a high incidence of arsenic with deleterious effects on humans and food chain. In Bangladesh, India, Vietnam and other developed countries, arsenic contamination in groundwater is considered to be the key environmental health problem of the twenty first century. In Bangladesh arsenic was first detected in the district of Chapai Nawabgonj bordering the West-Bengal district of India in 1993; since then higher levels of arsenic (exceeding the WHO standard of 0.01 mg L⁻¹ and Bangladesh standard of 0.05 mg L⁻¹) have been detected in many regions of the country including 61 districts out of 64. It is estimated that of the 140 million inhabitants of Bangladesh more than 100 million are at the risk of arsenic hazard, such arsenic hazards collapses the societal structure and socio-economic backbone of poor people of rural Bangladesh. The study tries to discuss the chronological extent and severity of the biggest global arsenic calamity prevailed in Bangladesh, socio-economic impact of arsenic hazard on the poor people of rural society living more than seventy percent under poverty limit in Bangladesh. Specially due consideration was given on the socio-economic impact on arsenic victims particularly earning male family member, young male, married female and young female going to be married as well as arsenic affected family and their interaction with non-arsenic-victim of the society.

Key words: Arsenic, arsenicosis, arsenic victim, Bangladesh, groundwater, ostracism, superstition

INTRODUCTION

Extensive arsenic contamination of groundwater has become a major disquiet where the water supply, predominantly rural water supply, is profoundly reliant on groundwater extracted from shallow aquifers and common trace of arsenic in drinking-water identified as a significant health risk (McNeill and Edwards, 1997; Pontius *et al.*, 1994; Abernathy and Ohanian, 1993; Wu *et al.*, 1989; Chen *et al.*, 1988) and public health is severely endanger for its high toxicity and its ability to induce skin cancer after long term ingestion (Driehaus *et al.*, 1998) leading to an inevitable socio-economic collapse of the poor rural society living more than seventy percent people under poverty limit. Recent studies indicate that arsenic in drinking water is a matter of great concern and is considered more dangerous than it was in the past because of the collapse of socio-economic backbone of the poor society specially in the developing countries. The current assessment, which is subjected to

considerable debate, ranks arsenic in drinking water as a risk comparable to second-hand tobacco smoke and indoor radon gas causing sever social calamity to some extent although arsenic in drinking water was not detected as hazard even up to 1960. The occurrences of arsenic in groundwater environment has been reported in many places around the world particularly in Argentina (Nicolli *et al.*, 1989; Smedley *et al.*, 1998, 2001), Australia (Smith *et al.*, 2003), Bangladesh (Karim, 2000; Nickson *et al.*, 2000; Kinniburgh and Smedley, 2001; McArthur *et al.*, 2001; Ravenscroft *et al.*, 2001), Cambodia (Ahmed, 2003), Chile (Ahmed, 2003; Romero *et al.*, 2003; Caceres *et al.*, 1992), China (Inner Mongolia and Guizhou province) (Ahmed, 2003; Smedley *et al.*, 2001), Hungary (Ahmed, 2003), India(West Bengal) (Battacharya *et al.*, 1997; Acharyya, 1999; Acharyya *et al.*, 2000), Lao PDR (Ahmed, 2003), Mexico (Del Razo *et al.*, 1990; Arminta *et al.*, 1997), Mongolia (Ahmed, 2003), Nepal (Ahmed, 2003), Pakistan (Ahmed, 2003), Switzerland (Fabian *et al.*, 2003), Taiwan (Kuo, 1968; Tsang *et al.*,

1968; Chen *et al.*, 1994; Guo *et al.*, 1997), Thailand (Ahmed, 2003), the USA (Matisoff *et al.*, 1982; Welch *et al.*, 1988, 2000; Robertson, 1989; Peters *et al.*, 1999; Schreiber *et al.*, 2000) and Vietnam (Berg *et al.*, 2001). Among them, arsenic contamination in groundwater of Bengal Delta including Bangladesh has been regarded not only as the severest natural catastrophe of the world but also collapses the social base of public society as a new social tragedy where more than 100 million people in 61 districts out of 64 are at the risk of severe arsenic hazard.

MATERIALS AND METHODS

Groundwater samples were collected from pre-selected tube-wells of the selected study areas and subsequently tested to determine the arsenic concentration in groundwater using field kits, standard methods, Spectrophotometer, UV Spectrophotometer, AAS etc. Field kits were and are being used to determine arsenic content in groundwater of tube-wells in conducting rigorous water analysis in the field. Based on the concentration of arsenic, study were divided into mostly uncontaminated, uncontaminated, less-contaminated, sparsely contaminated, highly contaminated, severely contaminated and most severely contaminated area. Different types of questionnaire survey were conducted to evaluate the socio-economic impact of arsenic contamination on the poor rural society living more than seventy percent people under poverty limit in the study area. Socio-economic impact on arsenic victim specially earning male family member, young male, married female and young female going to be married as well as arsenic affected family and their interactions with non-arsenic victim of the society was investigated. Also relevant information and pertinent data were collected from other sources and analyzed subsequently to assess the severity of arsenic contamination. Socio-economic studies of arsenicosis were targetted to the poor people of three severely arsenic affected areas Samta of Jessore, Courtpara of Kushtia and Rajarampur of Nawabgang during 2002-2004.

RESULTS AND DISCUSSION

How does arsenic hazard extend in groundwater of Bangladesh?: In Bangladesh groundwater arsenic was first detected in the district of Chapai Nawabgang in 1993. Since then elevated levels of arsenic (exceeding the WHO standard of 0.01 mg L^{-1} and Bangladesh standard of 0.05 mg L^{-1}) have been identified in many regions of the country (Ahmed *et al.* 1997; Khan *et al.*, 1998;

Talukder *et al.*, 1998; Safiullah *et al.*, 1998; Ahmed *et al.*, 1998; Tanabe *et al.*, 1998). Estimates of affected population are being updated, as more data are becoming available. According to Dave (1997), about 23 million people are at high risk endangered by arsenic in Bangladesh. Data on arsenic contamination in tube-well water gathered so far suggest that the presence of arsenic in groundwater is highly scattered in nature. At many places, tube-wells at relatively close proximity showed very different levels of arsenic concentrations. This makes it difficult to delineate the affected areas and to estimate the population at risk. So far arsenic contamination of groundwater has been detected in 41 out of 61 administrative districts and an estimated 35 million people in Bangladesh are at risk of arsenic toxicity (Khan *et al.*, 1998). In accordance with survey findings of Dhaka Community Hospital (DCH) published in October 1997, 60 million people of 41 districts are at risk of arsenic contamination as water of tube-wells of 41 districts showed arsenic concentration above 0.05 mg L^{-1} (permissible limit of arsenic in drinking water for Bangladesh). According to a study report published jointly by the School of Environmental Sciences (SOES) of Jadabpur University of India and DCH, 50 million people of 29 districts of Bangladesh is at the risk of arsenic poisoning. Field survey conducted from August 95 to February 2000 by SOES and DCH shows that 100 million people of 54 districts of area 125,133 sq. km. is at risk of arsenic hazard where groundwater of 73.39% of tubewells contain arsenic above 0.01 mg L^{-1} and 9.3 million people of 47 districts of area 112,407 sq. km. is at risk of arsenic poisoning where groundwater of 53.47% of tubewells contain above 0.05 mg L^{-1} . (SOES and DCH, 2000). According to a recent estimate, 27% of shallow hand-tubewells have arsenic concentration exceeding 0.05 mg L^{-1} ; in acute arsenic problem areas more than 75% of shallow tubewells are contaminated with arsenic. Out of 64 administrative districts of Bangladesh, arsenic contamination has so far been reported in 61 districts. Arsenic problem alone has reduced the national safe water supply coverage by about 15 to 25%.

The extent of the arsenic problem can be described based on available field and laboratory analysis data. Although a very small number of wells have so far been tested compared to the total number of 7 to 8 million wells, it is possible to make an estimation about the probable arsenic contaminated wells based on the results of the large national surveys. Results from the DPHE/UNICEF field kit analysis, NRECA/ICDDRBR Rural Electrification Board survey, DCH/SOES patient based surveys, BGS/DPHE national hydrochemical survey, UNICEF/INFS arsenicosis prevalence survey may be utilized to describe

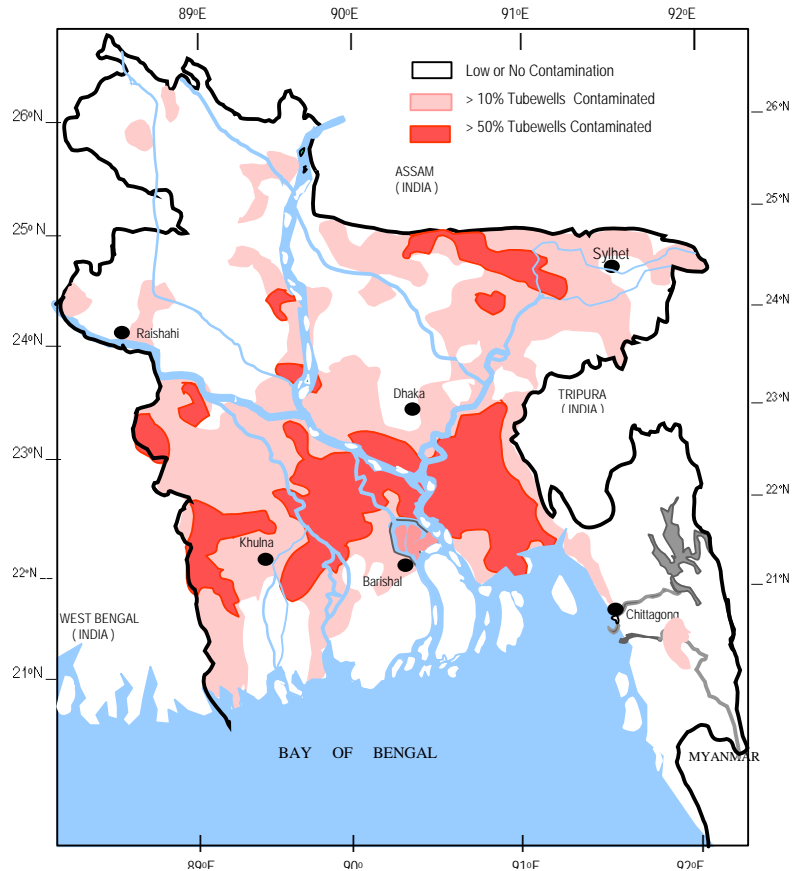


Fig. 1: Arsenic contaminated areas in Bangladesh

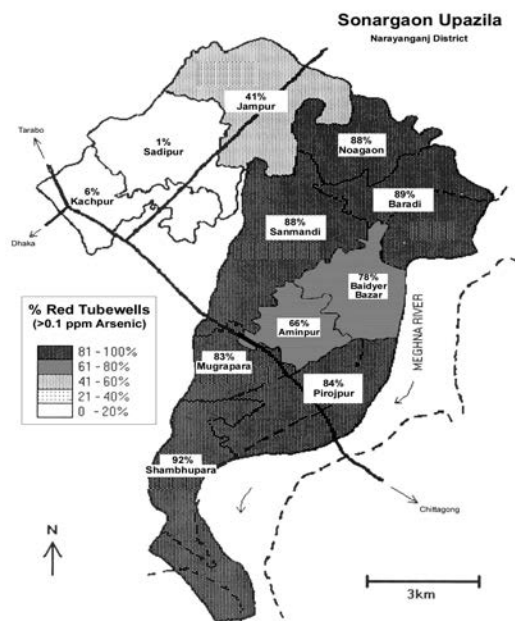


Fig. 2: Union-wise arsenic distribution in Sonargaon upazila of Naryanganj district (Redrawn after BRAC, 2000)

Table 1: National Arsenic Survey data based on Laboratory analyses (Ahmed, 2003)

Data source conc. (mg L ⁻¹)					Total	
	NRECA	DCH/SOES	BGS/DPHE	UNICEF/INFIS	Number	Percentage
<0.01	151	14960	2042	3469	20662	47
0.01-0.05	160	6460	611	1102	8333	19
>0.05	145	12580	881	1395	15001	34
Total	456	34000	3554	5966	44956	100

Table 2: Administrative areas with at least one tubewell exceeding drinking water standards

Type of administrative areas	No. of administrative areas				Total
	Bangladesh standard (50 µg L ⁻¹)		WHO guideline value (10 µg L ⁻¹)		
	Below	Above	Below	Above	
Divisions	0	6	0	6	6
Districts	8	53	1	60	61
Upazilas	184	249	39	394	433

the extent. Laboratory analyses by the NRECA, BGS/DPHE, DCH/SOES and UNICEF/INFIS surveys (Table 1) shows that out of about 44,000 tested wells, 34% have arsenic concentrations of more than 0.05 mg L⁻¹. Laboratory analyses conducted by different organizations such as BUET, BCSIR, BAEC etc., compiled in the BGS/MML (1999) report, show that about 35% of the wells have arsenic above 0.05 mg L⁻¹.

Chandpur, Comilla, Lakshmipur and Noakhali of chittagong division, Faridpur, Gopalganj, Munshiganj, Madaripur, narayangang, Shariatpur and Sherpur of Dhaka division, Jessore, Kushtia, Meherpur and Satkhira of Khulna division are the most arsenic contaminated areas of Bangladesh (Fig. 1). There is variability in the pattern of occurrences. In the North-west and South-west regions, contaminated and uncontaminated wells are located close to each other whereas in the South-east, particularly in Chandpur, almost all the shallow wells are contaminated. Testing of all wells using field kits conducted by BRAC, UNICEF and BAMWSP show large variations in the percentage of contaminated wells in different upazilas, e.g., almost 100% contamination in Hajiganj in Chandpur district compared to almost none contaminated in Porsha in Naogaon district (Ahmed, 2003).

There is large variability in the concentration ranges of arsenic within an area. In certain areas the concentration ranges show normal distribution pattern, whereas in other areas bimodal or polymodal distribution patterns are shown. There are variations in concentration ranges even in village scales where areas of low and high arsenic regions can occur as reported from Samta village of Sarsha thana of Jessore district (AAN, 1999). Very high concentrations can occur in a restricted area as found in Nawabgang Sadar of Chapai Nawabganj district, Charruppur of Iswardi of Pabna district, Gopalgng Sadar of Gopalgang district, Kachua, Hajiganj and Faridgang of Chandpur district, Ramgang of Lakshmipur district,

Begamgang of Noakhali district, Kushtia Sadar of Kushtia district, Sonargaon of Narayangang district, Sreenagar of Munshiganj and Samta of Sharsha of Jessore district etc. (DPHE and BGS., 2000). These types of occurrences can be termed as hot spots.

Sonargaon is a severely contaminated upazilla under Narayangang district where all the wells have been tested by BRAC under a UNICEF/DPHE programme. The unionwise distribution of arsenic contaminated wells show that in eight unions most of the wells are contaminated (up to 89%) whereas in two unions only a small number of wells (>10%) are contaminated as shown in Fig. 2 (BRAC, 2000). The Dupi Tila sediments underlie these unions and most of the wells are developed there.

The study conducted by British Geological Survey (BGS), Department of Public Health Engineering (DPHE) and Mott MacDonald Limited (MML) in two phases examined 3534 distributed water samples from 61 districts except 3 hilly districts (DPHE, BGS and MML, 1999; BGS and DPHE, 2001) with an average of 58 samples per district and 8 samples per upazila. The study showed that arsenic concentration of 42% of all tubewell samples exceeded 10 µg L⁻¹ and 25% exceeded 50 µg L⁻¹. When only shallow tubewells are considered, 46 and 27% exceeded 10 and 50 µg L⁻¹, respectively. In case of deep tubewell (> 150 m) samples, arsenic content of only 5% exceeded 10 µg L⁻¹ and 1% exceeded 50 µg L⁻¹. The number of administrative areas with at least one sample exceeding Bangladesh Drinking Water Standard and WHO guideline value (BGS and DPHE, 2001) are shown in Table 2.

The percentages of shallow tubewells yielding water of various concentrations of arsenic prepared on the basis of BGS/DPHE test results are shown in Fig. 3 that provides information about the percentage of shallow tubewells producing water in excess of corresponding concentration.

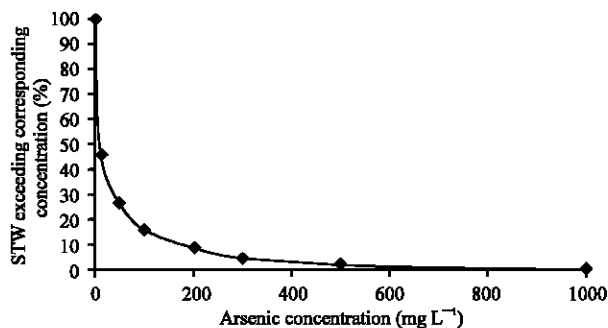


Fig. 3: Levels of arsenic content in STW water

Public health effected by arsenic contamination in Bangladeshi society:

Health affects of arsenic termed as arsenicosis may be categorized to cancer effects and noncancer effects. The carcinogenic role of arsenic compounds was first noted over one hundred years ago in the Hutchinson (1887) observation that an unusual number of skin tumors developed in patients treated with arsenicals. In a 1980 review of arsenic, the International Agency for Research on Cancer (IARC, 1980) determined that inorganic compounds are skin and lung are carcinogens in humans via inhalation. Arsenic exposure also interferes with the action of enzymes, essential cations and transcriptional events in cells throughout the body and a multitude of multisystemic noncancer effects might ensue. Thousands of poor rural people of Bangladesh living under poverty limit are severely attacked by both type of arsenicosis due to the long term exposure of arsenic contaminated water. As a result, the social scenario takes an ugly phase as the majority of arsenic patients in Bangladesh are unable to take proper treatment suffered by severe financial crisis and leads to the death day by day. A few clinical, large population based case-control epidermiological studies conducted by Tondel *et al.* (1999) identified a number of common arsenical manifestation and arsenic lesions such as different type of melanosis e.g., diffused melanosis, spotted melanosis, lucomelanosis, mucus membrane melanosis, different type of keratosis e.g., diffused keratosis, spotted keratosis, shyper keratosis, gangrene, squamous cell carcinoma and hyperpigmentation in palms and soles and non-cirrhotic portal fibrosis among the population affected by arsenic in Bangladesh. In a later stage the patches might develop into cancer and foot

will probably have to be amputated (Battacharaya *et al.*, 1997; Quadiruzzaman, 1996; Pontius *et al.*, 1994). Skin cancer, internal cancers of bladder, kidney, liver and lunges, neurological effects, hypertension, cardiovascular disease and diabetes mellitus, pulmonary disease and peripheral vascular disease are included to long-term health effects of exposure to arsenic (WHO, 2000). Characteristics skin lesions of arsenic toxicity indicates high exposure of arsenic which are distinctive in contrast to other clinical manifestations of arsenic intoxication including weakness, conjunctival congestion, edema, portal hypertension, bronchitis and hepatomegaly (Tondel *et al.*, 1999; Mazumdar *et al.*, 1992). Chowdhury *et al.*, (2000) examined 11,180 people (including children) at random; they registered 2,736 (24.47%) people with arsenical skin lesions in 27 districts of Bangladesh, who usually drink water containing above 0.30 mg L⁻¹ of arsenic. According to Tondel *et al.* (1999), in four villages of Faridpur, Narayangang, Nawabgang and Jessore district, arsenic concentration in groundwater ranged from 0.01 to 2.04 mg L⁻¹ and the prevalence rate of arsenic lesions was 30.1 and 26.5% for males and female, respectively. An estimated 20 million people are exposed to the risk of arsenic related ailment through drinking of arsenic contaminated water in Bangladesh (BGS and MML, 1999). About 7,600 arsenic affected patients have so far been identified in arsenic affected areas. The arsenic problem has emerged as a big environmental disaster and more than 50 million people are exposed to arsenic above the Bangladesh drinking water standard (DPHE and BGS., 2000; DCH. and SOES., 2000). DPHE, BGS and MML studies estimated that the population exposed to arsenic contamination would lie in the range 18.5-22.7 million (DPHE, BGS and MML, 1999). Total populations exposed to above 0.01 mg L⁻¹ and 0.05 mg L⁻¹ in 43 districts in Bangladesh were 51 and 25 million, respectively (SOES and DCH, 2000). Based on upazila statistics the exposure levels to As exceeding 50 and 10 µg L⁻¹ were 28.1 and 46.4 million, respectively (BGS and DPHE, 2001). Comparative scenario of total population exposed to arsenic risk in Bangladesh according to different sources is presented in Table 3.

Arsenic hazard causes social problems and breaks up societal ties:

According to the reports of the national newspapers and other relevant sources, a significant

Table 3: Total population exposed to arsenic contamination

Source	Year	Total population exposed to arsenic concentration above (million)	
		50 µg L ⁻¹ , WHO guideline value	10 µg L ⁻¹ , Bangladesh standard
BGS and MML	1999		20.0
DPHE, BGS and MML	1999		18.5-22.7
SOES and DCH	2000	25.0	51.0
BGS and DPHE	2001	28.1	46.4

Table 4: Identification and treatment of arsenicosis

Arsenic patient	Samta, Jessore		Rajarampur, Chapainawabgang		Courtpara, Kushtia		Total victim treated	Percentage of treatment
	Identified	Treated	Identified	Treated	Identified	Treated		
Within 1 year	0	0	1	0	1	0	0	0
Within 2 year	18	18	11	6	15	6	30	60
Within 3 year	5	5	4	3	4	2	10	20
>3 year	7	5	4	3	5	2	10	20
Total	30	28	20	12	25	10	50	100

Table 5: Nature of the treatment of arsenic patients in the study areas

Area	No. of arsenic patients treated				% of arsenic patients under		
	Self treatment	Government treatment	Treatment by NGOs and donor	Total	Self treatment	Government treatment	Treatment by NGOs and donor
Samta, Jessore	0	4	24	28	0.00	14	86.00
Rajarampur, Chapainawabgang	4	6	2	12	33.33	50	16.67
Courtpara, Kushtia	1	7	2	10	10.00	70	20.00

number of people are attacked by arsenic lesions of which a few dies but the majority becomes the burden to the family and the society; obviously severe social hazard emerges in the arsenic affected areas; a large amounts of financial loss are being incurred by the individual publics and families as well as by the government for arsenic health hazard and setback of social structure. The arsenic contamination problem has triggered a number of social and societal problems that were unanticipated and are still not fully recognized. Recent studies confirm the fact that worst arsenic problems are encountered by the poorest fraction of the society (WHO, 2000)-particularly those who are already undernourished. Social fallout of arsenicosis is enormous. Some of the already identified social consequences of arsenicosis based on the socio-economic study are discussed.

Social instability: Arsenicosis causes extreme instability in social life of Bangladesh where people are confused and not able to get arsenic free drinking water. People are becoming dispirited without having proper treatment for arsenicosis. Case study shows that arsenicosis are not or seldom identified timely and even identified patient are not treated properly and timely due to only financial inability but also ignorance as shown in Table 4. Out of 75 identified arsenicosis patient, only 42 patients are treated of which 20 patients from Samta are treated where treatment rate is about 92%. Due to ignorance and proper knowledge of arsenicosis can not be identified within one year of exposure of the disease.

Socio-economic study evidents that public awareness play a vital role against arsenicosis. In Samta of Jessore, identification of arsenicosis and treatment of arsenicosis is much higher than other two districts due to the much motivation, involvement and activities of NGOs and donors; in Samta about 86% arsenicosis patients are treated by NGOs and donors but only 14% are by government treatment with no self treatment as shown in

Table 5. In Rajarampur of Chapainawabgang and Courtpara of Kushtia arsenicosis treatment by NGOs and donor is very poor varying from 16.67 to 20% only where public motivation, involvement and activities of NGOs and donors are found very seldom; also self treatment of arsenicosis in Chapainawabgang is more than 3 times than Kushtia due to the better economic condition and financial status while self treatment in Samta of Jessore is almost nil due to very poor economic and financial condition.

Chaotic environment prevails due to people's ignorance of arsenic in water, arsenicosis or why they are getting sick out of drinking water from tube well. Problem of arsenicosis is hampering the socialization of a child due to the fear of becoming a victim of arsenicosis is working as a barrier towards the proper psychological and physical development of a child. Arsenic is producing social stigmatization and discrimination. Social conflict over contaminated water is towards destroying social harmony and network relationships.

Superstition: Due to the ignorance of arsenic contamination and arsenicosis among the people in the remote villages, superstitions, prejudices and fairy tales are constructed surrounding arsenic patients. People stay away from arsenic victims, neglect or become scared of them due to such superstition. Some think of it as act of devil or evil spirits or impure air and keep themselves and their family members away from arsenic patients. Out of such prejudices many arsenic patients in the remote villages are passing miserable lives. Due to such superstition and prejudices 30 to 80% patients does not take any treatment as shown Table 6. In Samta of Jessore where more than 70% people are illiterate, tendency of superstition is the highest in the level of 80% while in Courtpara of Kushtia where about 65% public are literate, only 30% arsenic patient remain untreated due to superstition and 70% due to financial crisis.

Table 6: Reasons behind arsenic patients untreated in study areas

Area	Arsenic patients untreated due to			% of patients untreated	
	Superstition	Financial crisis	Total	Superstition	Financial crisis
Samta, Jessore	8	2	10	80	20
Rajarampur, Chapainawabgang	6	6	12	50	50
Courtpara, Kushtia	3	7	10	30	70

Ostracism: Arsenic patients are often identified as patient of leprosy and remain ostracized (Mandal *et al.*, 1998). Children of arsenicosis patients are not allowed to attend social and religious functions as well as are denied to take water from neighbor's tube well. Arsenic victims are abandoned not only by society but also by their family members; in many cases husbands left wives or remarried and wives left their husbands temporarily for fear of being attacked by arsenicosis. None of the villagers keep contact with the patients or any member of their families or with their children; these families are not allowed to take bath in any of the village ponds, even people refrain from making new relationship with arsenic victim's families. Such situation was found to be severe in North Rajarampur of Chapainawabgang where low-cast communities live in.

Diminish working ability: Arsenic gradually kills people. Dark spot on the skin, early symptom of arsenicosis, gradually turns to the nodules and become more pronounced depending on person's exposure to water containing arsenic. Limbs can be affected by gangrene, internal organs including the liver, kidneys and lungs can be affected and in extreme cases cancer can occur in skin and internal organs. The victims become crippled and incapable of doing hard labor, gradually lose strength to move.

Marriage related problems: People become reluctant to establish marital relationship with those families suffering from arsenicosis giving birth to unlimited anxiety for parents of unmarried adult children. Arsenic victims are not able to find spouse; young woman and men are advised to remain unmarried. Like other problems divorce is also prevalent among arsenic victims; many couples live separately from their spouses, even many women are either getting divorce or becoming abandoned by their husbands. According to Socio-economic survey 3 couple of Rajarampur of Chapainawabgang district have been living separately from their spouses for more than one year, It is reported that 12 couple of 5 than as at Chapainawabgang district is living separately from their spouses (Bearak, 1998).

Impact on women: Like cooking, cleaning, feeding children and animals, woman play key role in water carrying.

Women have no options, when supplies are limited, of contaminated water except for searching pure water from any source. Arsenic in tube wells often force woman to talk up to few Kilometers to get arsenic free water. They become burdened with additional responsibilities, which often force them to compromise with cultural ideology of *parda*. To cope with the crises of arsenicosis woman often play the key role not only through carrying arsenic free drinking water but also through providing nutritious food to the victims, drawing upon their savings, selling their very own assets and drawing upon network relationship (Sarker, 1999).

Women are the worst victims of ostracism. They are doubly vulnerable: by the disease itself and by becoming excommunicated or outcast. Because arsenicosis like melanosis, spotted melanosis, keratosis, ulcer Keratosis etc. change the complexions of victims and make them physically weak, these women's marital tie becomes weaker (Sarker, 2001). Due to the socio-cultural position of women in society, unmarried women, women abandoned by husband and families live inhumanly. Woman suffering from arsenicosis are the most negligible among all victims of the disease. Due to the patriarchal nature of society women are abandoned, separated or divorced by their husbands. Concerned study conducted in Santa of Jessore, Rajarampur of Chapainawabgang and Courtpara of Kushtia involving 55 female victims at the verge of social violence reveals that women with arsenicosis are subject to domestic violence such as dowry ranging from 38.88% in Chapainawabgang to 42.85% in Kushtia, divorce ranging from 14.29% in Kushtia to 17.385% in Jessore, separation ranging from 14.29% in Kushtia to 17.385% in Jessore, desertion ranging from 8.7% in Jessore to 14.29% in Kushtia, physical torture ranging from 7.14% in Kushtia to 11.11% in Chapainwabgang and ploygomy ranging from 5.56% in Chapainwabgang to 7.14% in Kushtia as shown in Table 7.

On average women with arsenicosis are subject to social violence such as dowry 40%, divorce 16.36%, separation 16.36%, desertion 10.91%, physical torture 9.1% and ploygomy 7.27% as shown in percentile diagram of Fig. 4.

Relevant study conducted by Sarker (2001) showed that women with arsenicosis were subject to domestic violence such as dowry (41.7%), divorce (16.7%),

Table 7: Effect of arsenicosis on women in terms of domestic violence

Domestic/Social violence	Samta, Jessore		Rajarampur, Chapainawabgang		Courtpara, Kushtia		Total victim	Average percentage (%)
	Victim	%	Victim	%	Victim	%		
Dowry	9	39.13	7	38.88	6	42.85	22	40.00
Divorce	4	17.385	3	16.67	2	14.29	9	16.36
Separation	4	17.385	3	16.67	2	14.29	9	16.36
Desertion	2	8.70	2	11.11	2	14.29	6	10.91
Physical torture	2	8.70	2	11.11	1	7.14	5	9.10
Polygomy	2	8.70	1	5.56	1	7.14	4	7.27
Total	23	100.00	18	100.00	14	100.00	55	100.00

Table 8: Domestic/Social violence compared with Sarker (2001)

Domestic/Social violence	Dowry (%)	Divorce (%)	Separation (%)	Desertion (%)	Physical torture (%)	Polygomy (%)
Concerned study	40.0	16.36	16.36	10.91	9.1	7.27
Sarker (2001)	41.7	16.70	16.70	8.30	8.3	8.30

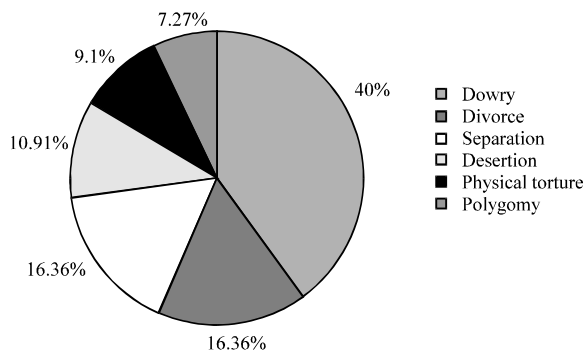


Fig. 4: Pie-chart of arsenicosis on women in terms of domestic violence

separation (16.7%), desertion (8.3%), physical torture (8.3%) and ploygomy (8.3%). Findings of the concerned study can be well compared with Sarker (2001) as tabulated in Table 8.

Arsenicosis increases the economic burden of poor:

Arsenicosis is more prevalent among the poor, who are forced to take contaminated tube well water and suffered with dietary deficiency affecting the toxicity of arsenic in human body due to the financial inability to buy arsenic free bottled water and nutritious food against arsenic toxicity. It is evident from the study that most of the people affected by arsenicosis are extremely poor. Lack of financial ability to get treatment for arsenicosos further deteriorate the condition of arsenic victims. Due to financial crisis, 20, 50 and 70% identified patients can not treated timely in Samta of Jessore, Rajarampur of Chapainawabgang and Courtpara of Kushtia as shown in Table 7. Spending huge money for treating arsenicosis increases the economic burden of poor. Moreover cost to obtain arsenic free drinking water also diminishes household income.

The poor victims become incapable of hard labor, which result into increasing poverty and continuous ill

further compounded by social attitudes. Unfortunately arsenic victims are treated as untouchables and lose their jobs as arsenicosis acts as a barrier to have access to job for unemployed. As a result arsenic victims fail to contribute towards economic development of the country because they are refused work.

Yet another societal impact is that on livelihoods of families that lose head of household or “bread-earners” to the disease. There is a need for serious consideration of alternative livelihoods for people who may be affected by arsenicosis as well as for orphans and widows of those who pass away.

CONCLUSIONS

Arsenicosis due to taking of arsenic contaminated water collapses societal structure leading to enormous social fallout such as social instability, superstition, ostracism, diminishing working ability, marriage related problems, domestic violence to the women. Due to ignorance and proper knowledge of arsenicosis can not be identified within one year of exposure of the disease. Socio-economic study evidents that public awareness play a vital role against arsenicosis. Due to the ignorance of arsenic contamination and arsenicosis among the illiterate people in the remote villages, superstitions, prejudices and fairy tales are constructed surrounding arsenic patients and do not take treatment against arsenicosis. Arsenic patients are often identified as patient of leprosy and remain ostracized keeping them inactive in social activities. The arsenic victims become crippled and incapable of doing hard labor, gradually lose strength to move and ultimately leads to death. People become reluctant to establish marital relationship with arsenicosis patients and their families giving birth to unlimited anxiety for parents of unmarried adult children suffered by arsenicosis. On average women with arsenicosis are subject to social violence such as dowry around 40%, divorce 16%, separation 16%, desertion 9%,

physical torture 8.5% and ploygomy 8%. Spending huge money for treating arsenicosis increases the economic burden of poor. Sometimes arsenic victim family lose head of the household or “bread-earners” due to the arsenicosis. Such kind of unavoidable social hazards signal arsenic contamination in groundwater as a looming disaster.

To tackle the social instability hailed from arsenicosis and to protect the collapse of socio-economic base of Bangladesh the following mesusre should be taken of.

- Identifying the causes of arsenic contamination; in this regard detection of source of arsenic in ground aquifer and release mechanism of arsenic from solid medium to liquid phase should get the priority to plan and design the proper remedial action against arsenic contamination.
- Exploring for alternative safe water sources such as surface water sources like river, lake and ponds as well as rainwater harvesting.
- Modification of drinking water standard, scientific research on arsenic contaminated water treatment technologies.
- Identification of arsenic patients in the preliminary stage before long term exposure of arsenic.
- Proper treatment of identified arsenic patients in time.
- Improving nutrition facilities to arsenic patients and fighting against undernourishment.
- Raising public awareness against arsenicosis, superstitions, prejudices and fairy tales etc.
- Effective participation of the civil society in remedial measures against arsenic contamination and arsenicosis treatment.
- Create suitable employment scope for the arsenic victim heads of the household or bread-earners.
- Provide financial assistance and relief to the arsenic victim families specially arsenic victim females.

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