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Socio-Economic Fallout of Arsenicosis in West Bengal: A Case Study in Murshidabad District

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SUMMARY

Millions of people are at risk due to high concentrations of arsenic in drinking water and thousands of them are suffering from arsenic related diseases (called Arsenicosis) in the state of West Bengal in India. The loss of human well being due to arsenicosis and health impact is multidimensional. Progress has been made over past two decades to understand the cause, magnitude and diversity of the arsenic problem and to try out some remedial measures. This article collects information from both official sources and first hand detailed field level personal interviews in 20 remote villages of Jalangi Block of Murshidabad district of West Bengal on arsenic remediation and social impact. Arsenicosis is found to have adverse impact on major constituents of human well being: labour productivity, income earning capacity, longevity, inter-generational poverty, and health status. Also, social exclusion enhances indirectly due to social attitude towards arsenic affected health disorders leading to social discontent. Any future arsenic remediation technology deployment needs very careful planning with a clear understanding of the complexity and the multiple challenges of the problem per se for social acceptance in an already intervened social context with living memories of non-functioning technologies in the field.

Keywords: Arsenic poisoning, Remediation technology, Socio-economic fallout, Social exclusion.

1. INTRODUCTION

In early 1980s, detection of arsenic at high concentrations in the groundwater of some districts in West Bengal added a new dimension to safe water access in rural areas and water security problems in the state. Health impact from drinking of arsenic contaminated water was first detected by Dr. Kshitish Chandra Saha, the former head of the Department of Dermatology of the School of Tropical Medicine, Kolkata. Experts considered the sources of arsenic in groundwater to be geogenic and held excessive withdrawal of groundwater responsible for leaching of arsenic into the aquifers (Chakraborti *et al*. 2009). Expert Committee also disclosed that the intermediate aquifer (second aquifer 20-80 metre below ground level (mbgl)) is affected with concentration level significantly above the safe limit WHO (World Health Organisation) guideline value, *i.e*. 10 µg/L. In some districts arsenic is also found in the third aquifer where there is no clay layer between the second and third aquifer. The lateral extent of contamination within the affected blocks was, however, not continuous and uniform. In West Bengal, approximately 79 to 111 blocks in 8 to 12 districts are detected with arsenic in groundwater (Chakraborti *et al.* 2009, Reports of Public Health Engineering Directorate, WB 2007). Around 24-26% of the total tubewell water samples have arsenic concentration above 50µg per litre (Reports of Public Health Engineering Directorate, 2006, Sengupta 2006). But if WHO standard of 10 µg/L is adopted, then in West Bengal itself 56% of population access water service points (tubewells) that are arsenic unsafe (Das 2011). Dermatological survey (Saha and Chakraborti 2001) found that in a population

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drinking the same contaminated water, all may not show arsenical skin lesions, although their hair, nail and urine might contain high concentration of arsenic. There is a possibility that many of the villagers are sub-clinically affected. Number of people taking the risk of drinking arsenic contaminated water greater than 50µg per litre is around more than 5 million with 10,134 people (including children) actually affected (Sengupta 2006). The current PHED (Public Health Engineering Directorate) status report of West Bengal (Reports of Public Health Engineering Directorate, 2007) of arsenic in West Bengal (on the basis of 1,32,262 water samples) concluded that at present the total population at risk in the state is approximately 28.7 million, 36% out of the total population of 80.21 million (Census India 2001). About 16.26 million people (35.48% of the total population of the State) covering 17,533 habitations are located in the potential risk zone of groundwater arsenic related threat and diseases (Report of National Institute of Hydrology 2010). The variation in the number of people at risk is due to variation in water sample tested and year of reporting of the various sources of information.

The spatial spread of the problem is under assessment continuously by independent experts, research laboratories (such as School of Environmental Studies-Jadavpur University or SOES-JU) as well as by the state government. The affected districts are Nadia, Murshidabad, Malda, South 24-Parganas, North 24-Parganas, Howrah, Hoogly and Burdwan. While research institutions are consistently investigating and maintaining statistics for longer period of time and for wider spatial coverage, government efforts started much later and cover fewer numbers of districts. A total of 1,32,262 water samples were collected and tested over the period of 2003-2006 from the eight districts of West Bengal under the Joint Plan of Action (JPOA) of UNICEF and PHED. They have covered almost all government installed tubewells in the arsenic affected areas. Of the 1,32,262 government tubewells 76,632 (57.94%) were detected to have arsenic concentrations of more than 10 µg/L and 33,755 (25.52%) tubewells of more than 50µg/L. In February 2002, Central Minister of Human Resource Development declared the problem of arsenic pollution in West Bengal as a National Problem, and financial allocation has continued since then for remediation purposes.

In this article in section 2 we try to provide the multidimensionality of the health problem emerging from drinking arsenic unsafe water. In section 3, we summarise the planned efforts through technology deployment so far towards remediation. Section 4 presents the socio-economic fallout by citing observations from our case studies. Concluding remarks are given in section 5.

2. HUMAN HEALTH IMPACT

There is large set of literature on the impact on human health of prolonged intake of arsenic-unsafe drinking water. But there is very limited study on the socio-economic fallout. In the arsenic affected villages, the following skin manifestations and other symptoms of arsenic toxicity were detected: diffuse melanosis, spotted melanosis, leucomelanosis, whole body melanosis, keratosis, dorsal keratosis, gangrene, skin cancer, etc. (Saha and Chakraborti 2001, Mazumdar *et al*. 1998, 1988a, b, c, 1999, 2000, Guha 2001). One study (Roy 2008) focuses on consumption of arsenic contaminated groundwater and economic welfare loss in the district of North 24 Parganas, and a second study (Das 2011) explores in detail the socio-economic impacts in Murshidabad district. Table 1 lists some of the physical manifestations of arsenicosis.

Table 1. Physical manifestation of arsenicosis

Darkening of skin in the body or in the palm
Appearance of black and white spots side by side on the skin
Rough dry skin often with palpable nodules in dorsum of hands, feet and legs
Cough, shortness of breath and sound in chest while breathing
Mild to severe abdominal pain, cramps and diarrhea
Enlarged liver and spleen
Physical weakness and burning body sensation
Spontaneous abortion, still birth, pre term birth among women
Cancer in lung, skin, liver, urinary bladder and kidney

Sources: Saha and Chakraborti 2001, Guha *et al.,* 1998, 2000

Table 2. District-wise report of ASD patients by 1998

District	Number of ASD Patients	Arsenicosis (Estimated Cases)
North 24-Parganas	1,428 (29.35)	60,000 (26.67)
South 24-Parganas	472 (9.70)	30,000 (13.33)
Nadia	968 (19.90)	45,850 (20.38)
Murshidabad	1,228 (25.24)	59,000 (26.22)
Malda	660 (13.57)	25,000 (11.11)
Burdwan	99 (2.03)	5,000 (2.22)
Hoogly*	0	0
Howrah*	0	0
Kolkata	10 (0.21)	150 (0.067)
Total	4,865	2,25,000

Source: Saha and Chakraborti 2001. [*Not surveyed]
Note: Figures in the parentheses represent percentages

In 1983, the number of arsenical dermatosis (ASD) patients in Murshidabad was 127. During the span of 5 years (1983-1987), the number increased to 1,217 (about 10 times). At that time, Murshidabad district was found to be the highest affected, followed by the district of Nadia. During the next 12 years (1987-1999), the SOES and Dr. K.C. Saha jointly surveyed different villages intensively with larger manpower, and then

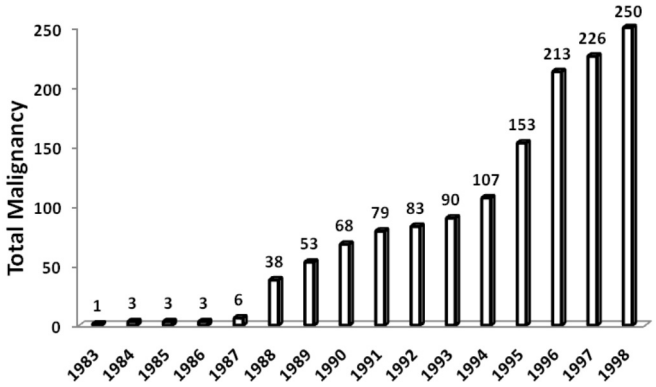
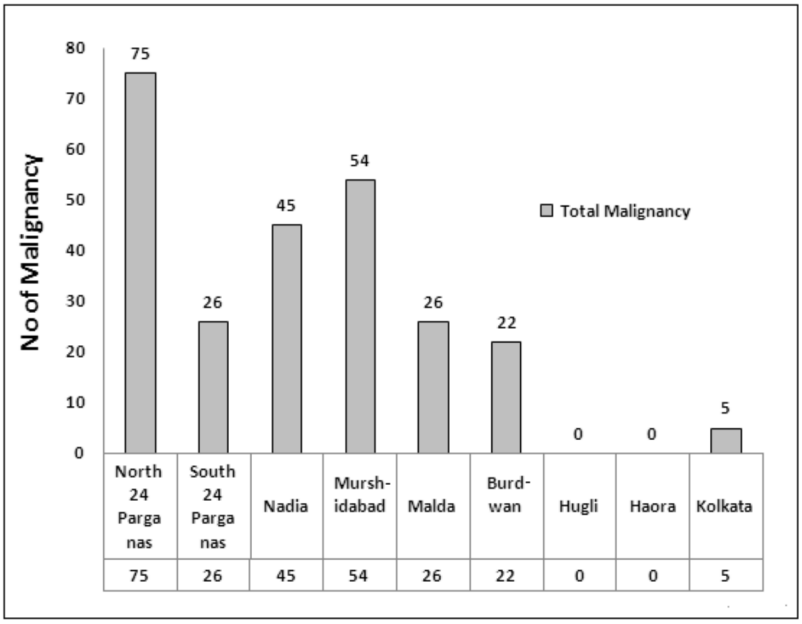


Fig. 1. Increasing incidence of malignancy due to arsenicosis in West Bengal

Source: Proceedings of International Workshop on Control of Arsenic Contamination in Ground Water, WB, 2000.

number of arsenic patients was found to increase more than 100 times (2,000-30,000). In this period, North 24-Parganas district was found to be the maximum affected with arsenicosis (Saha and Chakraborti 2001). District-wise report of ASD cases and the estimated cases of arsenicosis by 1998 are shown in Table 2.

In 1984, the number of malignancy (in arsenicosis) incidence reported in Murshidabad was one. During the span of 15 years (1984-1998) malignancy incidence increased to 250 (Proceedings of International Workshop on Control of Arsenic Contamination in Ground Water, WB, 2000). Yearwise increasing trend of malignancy incidence (1984-1998) is shown in Fig. 1. In 1998, out of a total of 250 cases, 29.88 per



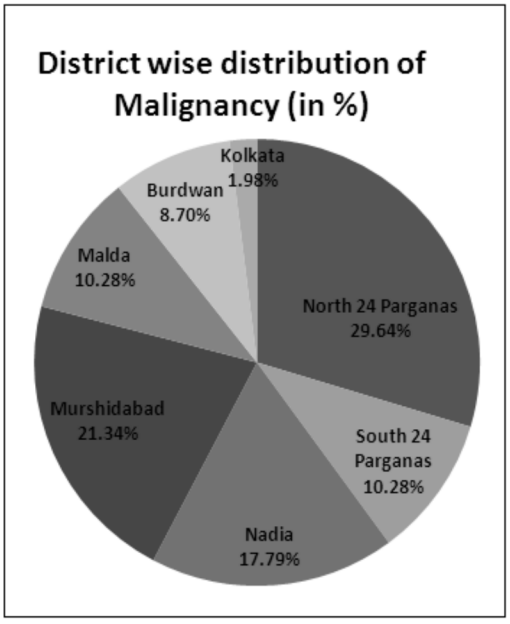


Fig. 2. District-wise cases of malignancy due to arsenicosis in West Bengal.

Source: Proceedings of International Workshop on Control of Arsenic Contamination in Ground Water, WB, 2000.

cent were from North 24-Parganas, 21.51 per cent from Murshidabad, 17.93 per cent from Nadia, 10.36 per cent from South 24-Parganas, 9.56 per cent from Malda, 8.76 per cent from Burdwan and 1.99 per cent from Kolkata (Fig. 2).

Government report also confirms increasing number of arsenical dermatosis cases (Report, Directorate of Health Services, West Bengal, 2001-2002). The number of arsenic patients and deaths due to arsenic related disease in West Bengal during the period 1990-2006 were 13,805 and 43 respectively (Reports, Directorate of Health Services, West Bengal, 2001-2002, 2005-2006, 2006-2007). Thus 0.31 per cent of the total arsenic patients died during the period. A detailed report is shown in Table 3. Generally around 4% patients suffer with liver problems due to arsenic exposure, many patients also suffer from lung problems, asthma and breathing troubles (Anandabazar Patrika 2001). Reportedly the number of such affected persons may be higher than the number recorded.

Table 3. Arsenic patients and death reports in West Bengal from 1990-2006

Name of the District	Number of Arsenic patients					Number of Deaths 1990 -2006
	1990-2003	2004	2005	2006	1990 -2006	
Malda	1,817	150	13	51	2,031	5
Murshi-dabad	2,728	23	39	34	2,824	4
Nadia	5,149	83	38	433	5,703	1
North 24-Parganas	1,074	26	60	115	1,275	10
South 24-Parganas	616	99	38	35	788	17
Howrah	11	0	0	0	11	0
Burdwan	196	13	0	0	209	5
Hoogly	4	0	0	0	4	0
Kolkata	957	2	1	0	960	1
Total	12,552	396	189	668	13,805	43

Sources: Reports, Directorate of Health Services, West Bengal 2001-2002, 2005-2006, 2006-2007.

There is a known positive correlation between total number of arsenic patients in the districts and average maximum arsenic concentration level in groundwater of the districts [r = 0.76] as well as average level of arsenic concentration in groundwater in the districts [r = 0.55] (Das 2011).

Remediation Efforts and Survey Method

Different researches and surveys reveal that access to arsenic-safe drinking water is the only way to get rid of the poisoning effects on health. No specific medicine has been invented to permanently protect people who have prolonged exposure to drinking arsenic water (Smith *et al.* 2000).

Public Health Engineering Department (PHED), Government of West Bengal, as the nodal department has been executing arsenic remediation measures/ schemes from 1994-1995 in the rural areas of the state with a strategy to ensure at least one safe source of drinking water for each habitation.

Scientific information that the water of river-canal-catchments and deep aquifer withdrawable by tube well water are arsenic safe has motivated PHED to supply arsenic safe drinking water in two ways:

1. Supply of ground water from safe deep aquifer through deep tubewells.
2. Supply of surface water after proper scientific treatment.

In the 9th (1997-2002) and 10th (2002-2007) Five Year Plans, strategies of supplying water from safe sources such as surface water based pipe water supply scheme, and sinking tubewells at deeper aquifers continued. Supplementary arsenic remediation actions such as installation of Arsenic Removal Plant (ARP) for big diameter tube well and Arsenic Treatment Unit (ATU) for hand pump fitted tube well were also started.

Alternative remediation technologies tried out were varied. They are summarized in Table 4.

For understanding how successfully the arsenic remediation technologies are functioning on the ground, we focused on only one district, Murshidabad where 20 affected villages were covered. Each type of the technological options was visited on the ground to check their functioning status and usage patterns by the targeted beneficiaries. Besides conducting technology specific case studies, we interviewed 25 individuals using pretested questionnaire to understand the socio-

Table 4. Arsenic mitigation measures in West Bengal at a glance (up to March, 2008)

Measures/Schemes	Number	Population Coverage (in lakh)
1. New tubewells at deeper aquifer fitted with hand pumps	8,037	20.09
2. Ring wells	166	0.41
3. Arsenic Treatment Unit (ATU) with existing hand pump fitted tubewells	2,396	5.99
4. Arsenic removal plants for existing groundwater based Pipe Water Supply Schemes (PWSS)	12	1.90
5. New big diameter deeper aquifer tubewells for existing PWSS	08	1.20
6. New groundwater based PWSS	240	41.80
7. Nadia-Murshidabad groundwater based PWSS	01	1.12
8. Groundwater based PWSS (old submission)	04	0.47
9. Surface water based PWSS	05	29.52
Total Rural Covered Population		102.50

Source: Reports of Public Health Engineering Directorate, 2008

economic fallout. We selected and visited those villages which have high arsenic concentration in the district of Murshidabad (using reports of both government and non-government organizations) and where people are using tubewell water for drinking water purpose over the decades. Techniques for data collection included in-depth key informant interviews and focus group discussions. Both men and women were targeted as informants. The survey was done during the period May 2009 to July 2010.

Fig. 3. Picture of some Focus Discussion Groups in the Study Area

Focus Discussion Groups (FDGs; Fig. 3) generated rich details of social stigma, actions, beliefs, perceptions and attitudes about arsenic led health impacts (Carey 1995). This method was adopted in order to observe the debate and complexity in social concern. After an initial phase of participatory

Table 5. Details of remediation measures installed in the study area and the number of schemes surveyed.

Remediation Measures	Total Number	Total Number surveyed	Percentage of survey
New tubewells at deeper aquifer (Hand fitted).	800	100	12.50
Dugwell/Ring wells	5	5	100.00
Arsenic Treatment Unit (ATU) with existing hand pump fitted tubewells	99	70	70.71
Domestic filter (in BPL families)	25	25	100.00
Domestic filter (in Primary Schools)	3	3	100.00
ARP under Swajaldhara water supply scheme	8	5	62.50
New groundwater based PWSS	1	1	100.00
Surface water based PWSS	Not Installed		

Table 6: Focus discussion group composition

FDG	Participants invited	Respondents
Farmers (including local GP Pradhan)	25	18
Social activist and media personality	9	8
Local Non-Governmental Organizations (NGOs)	20	14
School Teachers	4	4

observation, four representative focus groups were selected (Table 6) and they were asked to deliberate on different issues (like technological, social and economic aspects) of arsenic problem in their area. In three of the focus groups, all participants were male. A number of women were invited but none were willing to participate due to the conservative customs of the local people. In the fourth focus group, we could however involve local women school teachers.

3. STUDY AREA, RESEARCH FINDINGS AND DISCUSSION

Twenty-four blocks (out of 26) are arsenic affected in Murshidabad district (Fig. 4) except for Nabagram

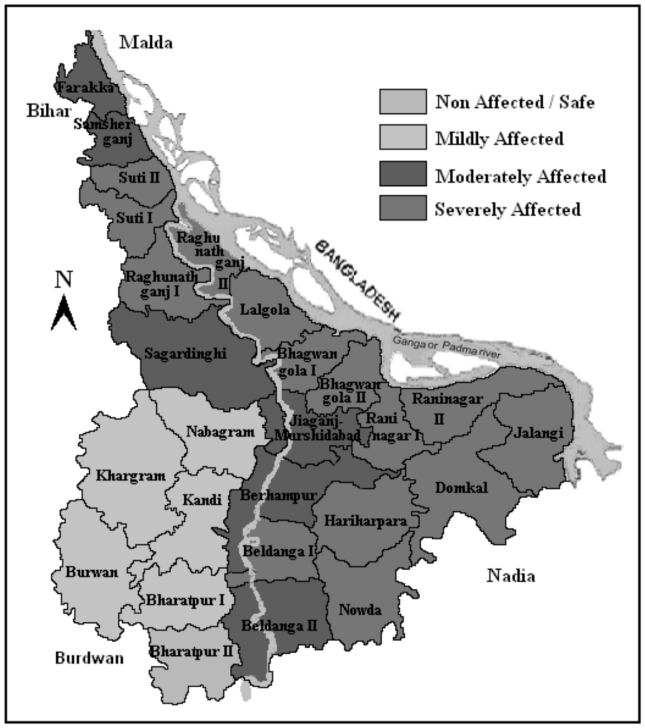


Fig. 4. Arsenic affected blocks in Murshidabad district as on 2011

Source : Das 2011

and Bharatpur-II- with arsenic concentrations ranging between 3-3000µg/L (SOES website). It was estimated that 2.5 million people, i.e. almost half of the total population in Murshidabad district (5,866,569 as per 2001 census), were consuming arsenic contaminated water (Rahman *et al.* 2005a, b, c). Our study area was Jalangi block where total 20 villages were covered.

3.1 Performance of Technologies to Supply Arsenic Safe Water: Field Experience

3.1.1Hand-pump with ATU

All these ATUs have been installed in arsenic affected villages by three different agencies representing technology manufacturers selected through tendering and engaged by PHED (65) or NGOs (5). Multiple households were interviewed independently in command area of each of the 70 ATUs installation. Except for five, 65 had become dysfunctional within one to eight months (on average) of the installation. The common villagers' perception was that millions of rupees were invested but the benefits from ATUs were almost zero as the technology became dysfunctional (Fig. 5). This has eroded confidence of the population towards remediation technology. Each technology used a medium (mostly activated alumina) as adsorbent which needed regular monitoring, regeneration and backwashing for maintenance especially in a high arsenic concentration water context. Installing agencies had sensitized community about the need for these steps but without any formal local capacity-building through training needed for long term maintenance and operation. Although there was a three months per year of maintenance contract for three consecutive years with the installing agencies, in practice it did not work in the absence of any institutional monitoring system. Although some local panchayats took initiative on voluntary basis by creating a committee to look after the maintenance, but due to lack of local maintenance and operation knowledge, it did not materialize. So the people's participation that was tried out by taking ten rupees per household per month did not work as water could not be delivered. Some success stories which could emerge initially faced conflict of interest among locally active political parties around the money collection from households as it had no legal or regulatory support. The technologies deployed failed to get social acceptance in the absence of a sustenance plan. Local people uprooted the defunct ATU's parts

and sold them off in recycle market or used those as containers to soak jute in water.

Only success stories of ATUs were mostly the installations at government offices such as the Zilla Parishad, SDO office, BDO office, and the offices of the gram panchayats.

3.1.2 Deep Tubewell with Handpump Attached

Villagers mostly prefer to use either their privately owned tubewells or nearby government tubewells. When the villagers are informed about the arsenic problem in shallow tubewell water, some started the use of water (mainly for the drinking purpose) from the newly installed deep tubewells provided by Zilla Parishad/PHED. However, only those were still functioning for which some villagers had taken the initiative to maintain, and maintenance was easy with local technical knowhow. However, they did complain about the lack of arsenic test results of the source water. Also it was mentioned that in many cases defunct tubewells were not repaired immediately, for some local Gram Panchayat took the initiative to remove such defunct deep tubewells but replaced them by shallow tubewells depths to gain large coverage with limited funds.

Initially in most of the villages, arsenic safe (then the Indian standard was As<50µg/L) tubewells were marked green and unsafe red (where water had concentration level As>50µg/L). But presently people are not able to distinguish between safe and unsafe tubewells as the painted colours have faded.

3.1.3 Dugwell

We surveyed all 5 dugwells that were installed in the arsenic affected pockets by the Government of West Bengal through Zilla Parishad. But social acceptance was very low. People said that they got used to a better technology such as tube wells so did not prefer going back to dugwells, some others have said that they find the water from dug wells with foul smell, some others have reported that water dried up soon after it was installed. Peoples' apathy to the technology was observable from the use of dug wells for storage space of hay stacks for cattle rather than as a water service delivery point. Also the maintenance service delivery model through NGOs did not actually happen at all.

3.1.4 Domestic Filter

Domestic filters were promoted by UNICEF and all installations were surveyed. User unfriendliness was the major complaint. Women who are the users found weight and size of the filters not easy for handling. They also complained about the filtering capacity of the equipment. Given large family sizes, the filters did not meet their demand for a large volume of water supply within a short period of time. The technical problems were reported by men. They had little knowledge about the life of the filter and the right time to change the medium letting extra costs to be incurred for this purpose. In Focused Group Discussions (FGDs) it came out safe disposal of the arsenic sludge was not happening.

BPL families were provided with domestic filters free of cost. Local NGOs had given these families domestic filters through the gram panchayats. FGDs brought out that households indeed paid Rs. 25 for these filters to meet panchayat's transportation cost. Filters were no longer purifying water, rather they were used for storage of food grains, as storage space for drinking water brought from another cleaner source, and the rest were discarded as waste. It is evident from these observations that the filters have nearly no significance to rural households. They try to fetch drinking water from arsenic safe sources.

UNICEF's initiative to supply arsenic safe water at free of cost through NGOs to the children of rural primary school have also failed for almost the same reasons as above. The teachers were uncertain about who would clean or operate the filters. In some schools, in fact, domestic filter equipment was found alternatively used as containers for rice, vegetables, etc. for the Mid-Day Meal programme.

3.1.5 Arsenic Removal Plant (ARP) under Swajaldhara Water Supply Scheme

Despite the deploying agency's involvement in facilitating community participation all five that we surveyed were dysfunctional as the informal and voluntary nature of the committee without a legal standing led to malfunctioning, lack of trust among committee members, free riding, unwillingness of the villagers to pay for arsenic safe water to committee, and political conflict among smaller factions. Consequently,

a few ARPs were managed, operated and maintained by 3 – 4 families in the villages and they were the users as well. Women were found to be active decision makers in case of sharing of water among religious groups from the village sources. At some other places, because the villagers were not willing to pay money the operator of the plants refused to work and so the committee could not keep the plant under working condition. The excluded families are forced to resort to the arsenic contaminated water sources for procuring water for daily living. An important observation is that women fetch water from the deep tubewell in the next village rather than from the existing community based ARP in their own village. We have also observed that due to the non availability of electric supply in the village, the plants could not be operated. Success stories have champions behind them: like educated young man, women, and local Bazar Committee members who take the risk of initiating and leading the maintenance.

3.1.6 Pipe Water Supply Schemes (PWSS)

In villages where treated arsenic safe ground water was supplied through pipe, it was observed that these water taps were publicly used widely by women as points for washing clothes, utensils and vegetables and by men and children for bathing. These pipelines originate from distant treatment plants or pumping stations. It was found in some cases that most of the time these pipelines were damaged with poor quality of water running through them. Some of the damaged pipes kept overflowing as the supply was on. Both men and women, users of this water supply, complained of irregular supply and/ or discontinuity in supply for several days together. Additionally what made them vulnerable is that there was no local institutional arrangement to listen to their grievances, suggestions etc. The village panchayat and the community did not take ownership of the PWSS; most probably they were not even involved in planning and laying. In some places villagers lose interest to collect drinking/cooking water from the PWSS, since it takes long time queue to get service delivered. Sometimes when their turn comes water supply gets timed out.

Pilferage, breaking of the pipe to take water for irrigation, to fill personal storage tank for pisciculture, soaking of jute, construction of road, bridge etc., were being reported. Because of these reasons villagers were not getting the benefits of using PWSS for drinking water purpose. Some do not like the taste of that water and deem it unfit for drinking. Irregular supply due to frequent power cut make the supply unreliable. Lack of supply and huge demand led to frequent social conflicts. While surveying we observed wastage of piped water from the stand posts since the stand posts had no control tap. The concerned authorities were often indifferent towards these issues. Low flow rate made the women try to draw water out from the stand posts with various means.

In some areas it was found that comparatively rich households that have greater political influence diverted installation of Arsenic Removal Plants, dugwells and even stand posts of PWSS near their own houses for easy access. Monetarily better off educated households with greater access to information collect safe water

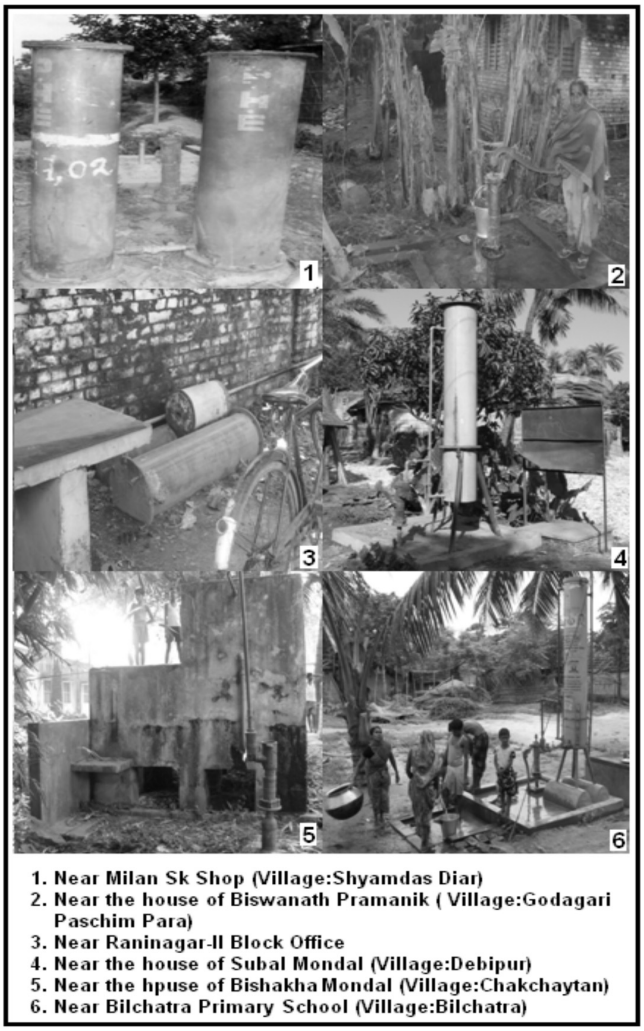


Fig. 5. Photographs of some defunct ATUs found in the survey area

Source: Das 2011

either personally by using their two wheeler, car or paying money to the low paid water vendors in the village. Some villagers stayed away from technology adoption because the plants were far away from their homes. During rainy season, women and children were reluctant to collect water over long distance because of the bad road conditions.

4. SOCIO-ECONOMIC IMPACT

Serious socio-economic fallouts as experienced by people are shown in Fig. 6.

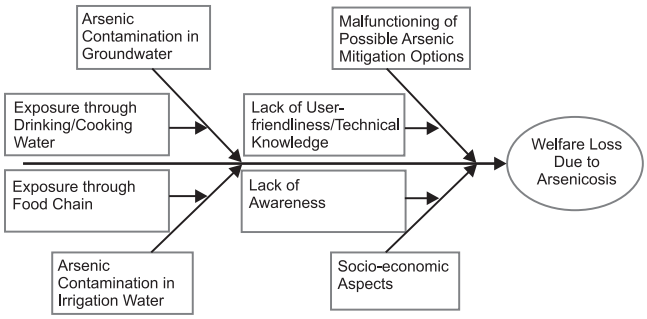


Fig. 6. Multiple causes of welfare loss in arsenic affected areas

Arsenicosis adversely affects labour productivity, lowering income earning capacity, loss of lifetime income in case of prolonged disease or death, intergenerational poverty, impoverishment, welfare loss etc. Arsenicosis also collapses societal structure leading to social instability, social exclusion, marriage related problems, depression, increasing child labour, brewing feeling of hidden hatred , superstition, early age deaths, etc.

During our field survey, there have been several kinds of sufferings and pains lodged by respondents which we categorise as sense of marginalization/ exclusion, social exclusion through divorce, cause of suicide, cause of high dowry, cause for child school drop-out and child labour, job loss and so on. From the case studies we could understand the various social and economic manifestations of arsenicosis.

4.1 Social Instability

People from all ages have come to know of the fatal effects of arsenic poisoning. No governmental or non-governmental initiatives have emerged as a permanent solution for this condition so far, even after such grave occurrences. For this, frustration and anger is brewing in the hearts of the villagers, which was reflected in the boycott of pulse polio campaign in 2005, and in observable apathy to interact with any researcher wanting to understand the problem. The administrative officials had convinced the villagers to carry the campaign forward and promised them that they would take necessary steps to provide arsenic safe drinking water which has so far not been realized.

4.2 Sense of Marginalisation/Exclusion

One of the arsenic patients (37, Male, casual worker) was hostile towards us when we met him. He said, "We don't think of arsenic anymore. What will happen thinking of it? We'll suffer for a year or two and then die. Many native and foreign *babu*s have come, clicked photographs, questioned us and then promised us, but nothing has been done in all these years."

4.3 Social Stigma

Another seriously arsenic affected patient (52, Female, housewife) told us within a few years of living at her in-laws, she could observe black and white spots on her body. Then she came to know that she was suffering from symptoms of arsenic poisoning. She got in touch with the nearby hospital and was given a free skin ointment which she religiously applied to her spots but she wasn't cured of those spots. A feeling of hidden hatred brewed within her since then. It has rather augmented her hatred for herself. She has stopped visiting her relatives and her parental house because of her bodily spots. The last time she had seen anybody from her parents' house was a decade ago when her father had expired. Her relatives have also discontinued visiting her in-laws' place because of arsenic contaminated water.

4.4 Cause of Suicide

A teacher in the village was financially well off. He owned landed property too. He was severely affected by arsenic and since he was financially well off his family had been able to spend enough money for his treatment. However, he died. His death shattered confidence among the villagers and also in the entire block. Despite being sedated to sleep most of the time, he had attempted suicide not being able to tolerate the

pangs of cancer. This was reported by his wife (50, Female, housewife). Post detection, his hand had to be amputed following which other body parts had to be operated as well, but none of this helped improve his physical condition. While narrating this story his elder brother broke into tears. For the patient, they had to sell off their property. Further, the patient's daughter had also attempted suicide when she found that no amount of expenditure was helping her father's disease.

4.5 Cause of Divorce

The arsenic victims are excluded not only by community, but also by their immediate family members. We have talked with one arsenic patient (40, Male, Casual worker). Due to severity of skin lesions and physical weakness, his wife asked for divorce despite conceiving his children, just for arsenic poisoning. Finally, his wife committed suicide when he did not give divorce.

4.6 Loss of Labour Power Due to Amputation

A 55 year old male casual labourer is another person who we had interacted with. He has melanosis spots all over his body and his left thumb has been amputed due to cancer. He reported that the doctor had told him that skin cancer had manifested due to continuous consumption of arsenic contaminated water. His working and earning capacity had also reduced gradually, and he too had to spend large amounts of money on his treatment.

4.7 Cause for Long-term Indebtness of Household

A 40 year old male casual worker had to remain admitted at the SSKM Hospital, Kolkata, for treatment of arsenic poisoning and ultimately half of his right hand had to be amputed. Because he had lost his capacity to work, his wife had to assume most of the family responsibilities. His wife worked as a cook in a school for the Mid Day Meal Scheme. They had a daughter. She was anxious as to how he would arrange for money for her studies. This apart, he was also anxious about money for her marriage owing to the fact that they lived in an arsenic affected village. The wife had borrowed money for her husband's treatment from others especially from her neighbours. This indebtedness caused her to be in mental depression.

4.8 Job Loss

Arsenic patients lose workability. As a result the unaffected people are preferred over the affected people as labourers by the contractors. This was reported by many patients. Difficulties of getting daily work and interruptions to daily labour are major consequences of arsenic poisoning.

4.9 Increasing Poverty

On the one hand, spending huge money for treating arsenicosis increases the economic burden of poor victims, and on the other hand inability to do hard work or losing of jobs reduces the earning opportunities thus resulting in increasing poverty. We had spoken to a widow with two minor sons. Her husband was an established businessman. The amount of money they had saved up was spent in getting medical care for arsenic. After his death, she started asking for financial help to her parents, siblings and later to her brother-in-law. But this way they could not sustain their family for long and she was eventually forced to take her sons out from school and send them off to work in other people's fields as daily wage labourers. Since they are children, they were paid less for the work they did.

4.10 Cause of High Dowry

Adverse consequences in social relations can be seen not only in the post marital situation but in pre marital stages as well. People are also reluctant to establish marital relationship with the families that are suffering from arsenicosis. One of the respondent's (51, Male, casual worker) daughter had a story to narrate along these lines. The mid-teenager had received proposals for marriage thrice which did not materialize because of the arsenic poisoning symptoms in her body. After searching for a suitable groom for a long time, although a boy agreed to marriage, his family had asked for a high amount of dowry which was beyond the means of the respondent's family.

In terms of percentages, people with arsenicosis are subject to different social and economic manifestations. For instance, arsenic patients are treated as untouchable (8%), men and women are finding it difficult to get married (12%), the rate of desertion of partner having such ailments is also rising among

married couples (4%), the patients are suffering from depression thinking of social exclusion due to arsenic threat (4%), etc., are shown in Table 7.

Table 7. Social and economic manifestations of arsenicosis

Social/Economic Manifestation	Percentages
Arsenic patients are treated as untouchable	8
Men and Women are finding it difficult to get married	12
Rate of disertation of partner having such ailments is also rising among married couples	4
Patients are suffering from depression thinking of social exclusion due to arsenic threat	4
Arsenic patients often try committing suicide	4
School of drop-out and child labour	12
Patients prefer to remain unidentified	4
High indebtness to meet treatment cost for arsenic ailments	20
Problem of selling cultivated products	4
Physical weakness and loss of earning capacity	20
Shrinking of job opportunities as few employers are keen to hire patients of arsenic poisoning	4
Self-employed are finding it difficult to keep their business running due to physical disabilities	4

Source: Field Survey

6. CONCLUSIONS

Statistics show arsenic unsafe drinking water is causing severe health impact and well being loss among the rural population in West Bengal. Since 1994 under the leadership of PHED, technology deployment for arsenic remediation was done. Small block level field investigation shows that 90% of the technology installations have failed. There are lessons to learn from these failure stories. Such failure stories raise questions about the robustness of the deployed technologies, level of maturation of the technologies, appropriateness of technology maintenance strategies, absence or flawed service delivery model, and non-sustainability of voluntary or informal institutional arrangements of community participation. Social fallout is leading to deep severe social discontent, apathy for further technological intervention, distrust for any new model or attempted solution for drinking water supply provision, alienation with the mainstream development process, a sense of growing marginalization, non-cooperation with any kind of knowledge dissemination unless supplemented by a guaranteed solution with long term vision. Future arsenic remediation technology deployment would need more careful planning for social embedding with a clear understanding of the complexity and the multiple challenges of the problem itself especially for social acceptance in an already intervened social context with living memories of non-functioning technologies in the field.

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