GROUNDWATER ARSENIC CONTAMINATION IN BANGLADESH

A. SUMMARY OF 239 DAYS FIELD SURVEY FROM AUGUST 1995 TO FEBRUARY, 2000

B. TWENTY SEVEN DAYS DETAILED FIELD SURVEY INFORMAITON FROM APRIL 1999 TO FEBRUARY 2000

APRIL 2000

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(From time to time between August 1995 and November 1996, SOES jointly worked with Geology Department, Rajsahi University, Rajsahi, Bangladesh, and NIPSOM, Mohakhali, Dhaka, Bangladesh in field survey)

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Summary

In this report of 239 days field survey in Bangladesh during last five years, we will provide the following information

(a) So far from Bangladesh we had analyzed 22003 hand tube-well water samples from 64 districts. Our result for five years, up to February 2000 shows that out of 64 districts in Bangladesh in 54 districts arsenic in groundwater is above 0.01 mg/l and in 47 districts above 0.05 mg/l. So far we have identified 918 villages where groundwater has arsenic above 0.05 mg/l. So far 32 districts had been surveyed for arsenic patients and in 30 districts patients with arsenical skin-lesions have been identified.

(b) So far we had analyzed in total around 11000 hair, nail, urine, skin-scale samples from affected villages (about 50% of samples are from those having skin-lesions and rest 50% from those do not show skin lesions). Over all around 90% of people have arsenic in their hair, nail and urine above normal level.

(c) All total 17896 people had been examined at random from the affected villages for patients having arsenical skin lesions and 3688 (20.6%) have been so far identified with skin-lesions We have their full identification and details of skin lesions.

(d) So far 833 deep hand tube-wells had been analysed for arsenic from all over Bangladesh (depth about 100 m to above 400 m) and in 181 samples arsenic has been found above 0.01 mg/l (21.73%) and in 76 samples arsenic has been found above 0.05 mg/l (9.12%).

(e) Arsenic from 15969 tube-wells had been analyzed with depth (6.4 m to about 400 m) from 47 affected districts having arsenic above 0.05 mg/l and the result clearly shows at the beginning about 15-20 m there is increase of arsenic in hand tubewells and then with increasing depth concentration of arsenic decreases. This is also valid for individual 47 affected districts where groundwater contains arsenic above 0.05 mg/l.

(f) From the information we had generated during field survey about number of users of 16410 hand tube-wells in 43 districts of Bangladesh, we made a simple calculation to know the number of hand tube-wells that exists in 43 districts. The calculated value shows that in 43 districts of Bangladesh where groundwater contains arsenic above 0.05 mg/l the number of hand tube-wells are 3.5 million.

(g) We have also calculated number of people exposed to arsenic contaminated water above 0.01 mg/l and above 0.05 mg/l from 43 districts and the values are 51 million and 25 million respectively.

(h) Do the arsenical skin lesions disappear with chelating agent, safe water, nutritious food and multivitamins!

(i) What percent of actual arsenic patients in affected villages we could really examine.

(j) We have evidences now from West Bengal, India that more and more tube-wells which were once safe to drink are getting arsenic contaminated.

Our report will also tell about 27 days detailed field survey information from 159 Villages highlighting

1. Early death in affected villages to those having arsenical skin lesions
2. Social problem in affected villages due to arsenical skin lesions.
3. Problems regarding hand tubewells coloured red/green by arsenic field testing kits.
4. Mental agony to those wrongly identified by field workers as arsenic patient.
5. Actual magnitude of calamity.
6. Death and suffering from cancer and gangrene among those who have/had arsenical skin lesions.

Even after 5 years field survey in Bangladesh, we feel we have seen only the tip of iceberg of the actual calamity. More we are surveying more and more affected area and people suffering from arsenical skin lesions are coming to limelight.

The magnitude of the arsenic calamity in Bangladesh surfaced only recently. In February 1998, the Guardian (UK) detailed the magnitude of the arsenic contamination in Bangladesh; the local chief of the World Bank has stated that tens of millions of people are at risk, and that 43,000 villages out of 68,000 are presently are at risk or could be at risk in the future. In the same report, the World Health Organization (WHO) was quoted to have predicted that within a few years death across much of southern Bangladesh (1 in 10 adults) could be from cancers triggered by arsenic. After analysing 2000 hand tubewell water samples from the eastern, southern and western Bangladesh, the British Geology survey reported early January 1999 that approximately 21 million people in that country were drinking water with arsenic level above 0.05 mg/l. More recently, Prothom Alo, a Bangladesh daily, reported on 31 March 2000 the findings of a study jointly done by the British Geology Survey and DPHE- Bangladesh. After testing 3534 tubewell water samples from 61 districts of Bangladesh, the study found arsenic levels in ground water to be above 0.05 in 249 Police Stations in 53 districts. According to this report, 58% of the water samples contained arsenic above 0.05 mg/l and 91% above WHO guideline value (0.01 mg/l).

During 1992, the School of Environmental Studies (SOES), Jadavpur University, while working on groundwater arsenic contamination in West Bengal, India, noticed something unusual in Gobindapur village, block (P.S.) Swarupnagar, North 24-Parganas district, West Bengal. It was found that in one family none of the members was showing arsenical skin lesions except a woman who came to West Bengal from Bangladesh (Village: Bansdoha, P.O.: Fatepur, District: Satkhira) after her marriage.

On being interviewed, the woman said that many of her relatives in Bangladesh had similar skin lesions. She further said that she had seen similar skin lesions among a few of her neighbours and also in some people living in two neighbouring villages (Uttar Sripur and Tona). The SOES, in its report on West Bengal's arsenic calamity, had stated that Bangladesh, too, in all probability, was arsenic-affected. During our survey in the arsenic affected areas of West Bengal, we had come across people with arsenical skin lesions from the district of Nawabganj in Bangladesh, which is close to West Bengal's Malda district. In course of time, we began to get more and more information about the arsenic problem in those parts of Bangladesh that border the arsenic-affected areas of West Bengal. SOES analysed the hair, nail, skin-scale, urine of patients who came to Calcutta for treatment, and most samples were found to be rich in arsenic. Director, SOES informed UNICEF-Bangladesh and WHO-Bangladesh during 1994 (letters published

earlier) that Bangladesh was, in all probability, arsenic-affected also and requested them to address the problem before it was too late.

Immediately after the international conference on "Arsenic in groundwater: cause, effect and remedy", held in Jadavpur University, Calcutta, India in February, 1995, medical people from Bangladesh hospitals started writing (letters we had published) to SOES that they had been getting, for some years, patients with similar skin lesions at the out-patient departments of their hospitals. But, the doctors stated they had failed to recognize them as arsenic patients. After the conference, more and more people suffering from arsenical skin lesions in Bangladesh started coming to Calcutta for treatment (patients came from the districts Faridpur, Nararanganj, Bagerhat, etc.). The patients who came to Calcutta for treatment, later brought hair, nail and water samples from their villages for arsenic analysis. During July 1995 Director, SOES, visited Dhaka and met officials of Health and NIPSOM and gave them the preliminary data on the arsenic affected areas of Bangladesh.

During August 1995, the Geology Department of Rajshahi University, Bangladesh (Prof. Hamidur Rahaman), worked jointly with SOES and analysed 600 water samples from a few bordering districts situated close to the arsenic-affected districts of West Bengal. Further two medical doctors (S.A. Ahmed and S.A. Hadi) from the National Institute for Preventive and Social Medicine (NIPSOM), Dhaka in Bangladesh also came in June 1996 with hair, nail, skin-scales and water samples. After that, SOES and NIPSOM worked jointly for 21days during August-October, 1996 on Bangladesh and covered 17 districts, collected 750 water samples, about 325 each hair, and nail and 20 skin scales from the affected areas and analysed them for arsenic.

In the meantime, representatives from the Dhaka Community Hospital, Bangladesh, came to Calcutta in November 1996 and analysed water, hair, nail, urine and skin-scale samples of arsenic victims from some districts of Bangladesh. For a detailed study, SOES carried out a joint survey with the Dhaka Community Hospital from 19 December 1996 to 7 January 1997 and covered 15 districts. Since then, the School of Environmental Studies is jointly working with DCH on arsenic groundwater contamination in Bangladesh.

Even after working 239 days in Bangladesh from August 1995 to February 2000, we still feel that we have only sighted the tip of the iceberg. Each time we did a survey, we got fresh information about new arsenic affected police stations and villages.

In April 1999, we had decided to survey all the villages in Police Station areas and districts from where we had information about people suffering from arsenical skin lesions. We decided to survey for 30 days - from April 1999 to February 2000. Ultimately, our survey lasted 27 days. The villages we surveyed had not been surveyed earlier.

Though we did a field survey for 27 days, we think we got to see only the surface. But we did get new information about 3 districts, 13 P.S. and 73 villages where we expect arsenic patients.

Finally, after about 5 years field survey in Bangladesh, it may be said without any shred of doubt that the arsenic calamity in Bangladesh is the biggest in the world. We feel that the magnitude of the problem in Bangladesh surpasses the aggregate problem of all the 20 countries of the world where arsenic contamination of groundwater contamination has been reported. A detailed survey on Bangladesh is needed to know the actual magnitude and severity of the problem in that country.

Summary of field survey from August 1995 to February, 2000

Total number of days surveyed: 239 (Two hundred thirty nine) days

239 days field study at a glance (August 1995 to February 2000)

Our field survey

Our field survey classified in 2 categories

Study-1: Water collection for arsenic and iron analyses and only identification of villages where people with arsenical skin lesions exist.

Study-2: Water, hair, nail, urine, skin-scale collection and clinical examination by medical team in affected villages.

Normally, for **Study-2** we had a total of 8 people in our field survey team. Among them two were medical people, a biochemist, one analytical chemist, environmentalist and experienced field workers. We usually began our field survey early in the morning and left the field only after sunset. We worked till late night to put the collected samples in order and to prepare for the next day. With our long experience of working in the affected areas of West Bengal, we have acquired the basic expertise in fieldwork. During our survey we faced many difficult situations, but by now we know how face and deal with agitated, frustrated villagers suffering from arsenic toxicity.

Summary of field survey from August 1995 to February, 2000

Total number of days surveyed: 239 (Two hundred thirty nine) days

Total area of Bangladesh	1,48,393 sq.km
Total population of Bangladesh	120 million
Total no. of Districts in Bangladesh	64
Total no. of Police Station in Bangladesh	490
Total no. of Villages in Bangladesh	68,000
No. of districts surveyed for arsenic in groundwater	64
No. of Districts, area and population where groundwater contains arsenic above 0.01 mg/l	54; 1,25,133 sq.km; 109,415,000
No. of Districts, area and population where groundwater contains arsenic above 0.05 mg/l	47; 1,12,407 sq.km; 93,483,000

No. of Police Stations so far surveyed for arsenic in groundwater	222
No. of Police Station where groundwater found more than 0.01 mg/l	179
No. of Police Station where groundwater found more than 0.05 mg/l	147
No. of villages surveyed for groundwater arsenic contamination	1063
No. of villages found groundwater above 0.01 mg/l	1015
No. of villages found where groundwater above 0.05 mg/l	918
Districts so far surveyed for arsenic patient	32
No of districts where arsenic patient identified	30
Police Station so far surveyed for arsenic patients	71
Police Station so far identified patients with arsenical skin lesions	67
Villages so far surveyed for arsenic patient	241
Villages so far identified where people suffering from arsenical skin lesions	214
Population examined from affected villages for arsenical skin lesions	17896
People identified having arsenical skin lesions	3688 (20.6%)
Total number of water samples examined for arsenic from hand tubewells	22,003
Total number of water samples found having arsenic above 0.01 mg/l (%)	73.34%
Total number of water samples found having arsenic above 0.05 mg/l (%)	53.47%
Total hair samples analysed from 210 villages where arsenic patient identified and percentage of samples having arsenic above toxic level.	4386; 83.15%
Total nail samples analysed from 210 villages where arsenic patient identified and % of samples having arsenic above normal level	4321; 93.77%
Total urine samples analysed from 20 Villages where arsenic patients identified and % of samples having arsenic in urine above normal level.	1084; 95.11%
No. of skin scale analysed and % of samples having arsenic above 1 mg/kg	705; 97.44%
Total no. of tubewell water samples analysed from 54 districts where arsenic in groundwater > 0.01 mg/l	21530
% of samples above 0.01 mg/l in 54 districts	74.95%
% of samples above 0.05 mg/l in 54 districts	54.64% 20987

Total no. of tubewell water samples analysed from 47 districts where arsenic in groundwater >0.05 mg/l	76.50%
% of samples above 0.01 mg/l in 47 districts	56.05%
% of samples above 0.05 mg/l in 47 districts	833
Total no. of deep tubewell (300 ft and above) water samples analysed	181 (21.73%)
No. of deep tubewell samples above 0.01 mg/l	76 (9.12%)
No. of deep tubewell samples above 0.05 mg/l	239
Total no. of days in field survey	97
No. of days for water collection and identification of villages where arsenic patient exist	142
No. of days for water, hair, nail, urine, skin-scale collection and clinical examination by medical team in the affected villages	

Firure-1: Shows the number of districts contains arsenic below 0.01 mg/l, between 0.01 mg/l and 0.05 mg/l, and above 0.05 mg/l.

Figure-2: Shows the districts from where we have so far identified people with arsenical skin lesions.

Table-1: Shows our water analysis report of 22003 hand tube-wells from 64 districts of Bangladesh during August 1995 to February 2000

Table-2: Shows water analysis report of 20987 hand tube-wells from 47 districts so far we have identified where groundwater contains arsenic above 0.05 mg/l

Table-3: Shows total villages we examined from arsenic contaminated villages and total number of people identified with arsenical skin lesions

Table-4: Shows our hair, nail, urine, and skin-scale analysis report

Summary of 27 days detailed field survey

After doing our field survey from August 1995 to March 1999 in Bangladesh, we realised that even after working for 212 days we had seen only the tip of iceberg. Every time we went on our field visit, we came up with more information about new affected villages and police stations. From April 1999, we planned to survey for 30 days to check out all the new information we had about the affected districts, Police Stations and villages. Finally we ended if with 27 days field survey from April 1999 to February 2000.

Round the year field survey is difficult in Bangladesh because of its climate. In a year, one can do field survey continuously only from middle of September to April. Sometimes, even that is not possible – for example when the whole of Bangladesh remained submerged under flood waters for 4 months in 1998 (July - October).

Our 27 days field survey was in this order

April 13 ,1999	=	1 day
April 15 - 19 , 1999	=	5 days
September 30 to October 5 , 1999	=	6 days
December 22 to January 1, 2000	=	11 days
February 10 to February 13, 2000	=	4 days
Total	**=**	**27 days**

Summary of the field survey during 27 days (from April 1993 to February 2000)

No. of districts surveyed for arsenic in groundwater	24
No. of districts, area and population where groundwater contains arsenic above 0.01 mg/l	24; 47,911 sq. km 49,844,000
No. of districts, area and population where groundwater contains arsenic above 0.05 mg/l	23; 45,732 sq. km 47,626,000
No. of new districts identified where groundwater contains arsenic above 0.05 mg/l	5
No. of police stations so far surveyed for arsenic in groundwater	42
No. of police station where groundwater contain arsenic more than 0.01 mg/l	41
No. of police station where groundwater contains arsenic more than 0.05 mg/l	39
No. of new police station found where groundwater contains arsenic more 0.05 mg/l	11
No. of villages surveyed for groundwater arsenic contamination	144
No. of villages found where groundwater contains arsenic above 0.01 mg/l	142
No. of villages found where groundwater contains arsenic above 0.05 mg/l	130
Districts so far surveyed for arsenic patients	24

No. of districts where arsenic patients identified	20
No. of new districts where arsenic patient identified	5
Police Station so far surveyed for arsenic patients	42
Police Station so far identified patients with arsenical skin lesions	37
New Police Station so far identified patients with arsenical skin lesions	16
Villages so far surveyed for arsenic patient	121
Villages so far identified where people suffering from arsenical skin lesions	98
Population examined from affected villages for arsenical skin lesions	6716
People identified having arsenical skin lesions	952 (14.18%)
Total no. of water samples examined for arsenic from hand-tubewells	3119
Total no. of water samples found having arsenic above 0.01 mg/l (%)	2545 (81.60%)
Total no. of water samples found having arsenic above 0.05 mg/l (%)	1767 (56.65%)
Total hair samples analysed	1054
% of hair samples having arsenic above toxic level	89.35%
Total nail samples analysed	1000
% of nail samples having arsenic above normal level	94%
Total urine samples analysed	41
% of urine samples having arsenic above normal level	97.5%
No. of skin scale samples analysed	115
% of skin scale samples having arsenic above 1mg/kg	100%

Figure-3: Shows our 27 days-detailed field survey route from April 1999 to February 2000.

Table-5: Shows the districts, police stations and villages we covered during 27

days field visit (All villages reported here are surveyed for the 1st time during 27 days field visit)

Table-6: **New districts, Police Stations and villages found during our 27 days field survey**

Table-7: **Shows the total water samples collected during our 27 days field visit and distribution of total samples in different arsenic concentration (mg/l) range.** It appears from the table that 81.6% of the samples have arsenic concentration above WHO guidelines value and 56.66% above maximum permissible limit.

Table-8: **Shows the total population we had examined and % of the people having arsenical skin lesions (adult male, adult female and children)**

Table-9: **Shows the arsenic analysis of hair, nail, some urine and skin-scales from the people of affected villages. Almost 50% of the samples (except skin scales) are from people having arsenical skin lesions and rest 50% from the people of some affected villages but have no skin lesions.**

Field Experience

Performance Evaluation of Field-Kits (tube-wells colored red/green)

In many villages while working in the field we had found tubewells were coloured 'Red' and 'Green' after testing by field kits. Red indicates unsuitable to drink where arsenic concentration is above 0.05 mg/l and Green suitable to drink where arsenic concentration is less than 0.05 mg/l. While working in field we collected time to time samples from tubewells coloured red/green and found after analyzing by FI-HG-AAS technique that some of them were not rightly coloured. SOES with NGO Forum Bangladesh jointly conducted a study to evaluate the efficiency of the field kits (GPL, NIPSOM, and MERCK) which are widely used in Bangladesh. After comparing 3 field kits with hundreds of synthetic and field samples we came to following inferences.

1. These kits are not suitable to measure the arsenic level below 0.08 mg/l with certainty.
2. These kits can produce false positive results even in very low concentration (<0.003 ppm).
3. Kits are only useful with certainty for measurement of arsenic more than 0.1 mg/l.

To justify our findings SOES jointly with DCH Bangladesh went to field and collected water samples from 2866 tubewells colored red/green after testing with field-kit. Out of them, 1143 samples were marked green and remaining 1723 were marked red. We analysed samples from the same source for arsenic by FI-HG-AAS in laboratory to cross check the status of the tube-wells in terms of green and red. We had standardized our FI-HG-AAS system from inters laboratory comparison as well using Standard Reference Material. We can determine arsenic up to 0.002 mg/l with 95% confidence level. According to the results obtained by FI-HG-AAS out of 1143 tubewells colored green by field kits, 1058 tubewells were found green and 84 tubewells red. Thus it appears that 91.8% of the tube-wells were correctly identified safe to drink by field kit method. Out of 1723 tubewells colored red by field kits, 849 were found red and the remaining 874 were green by our FI-HG-AAS system. Thus it appears that Field-Kit could correctly identify

49.3% tube-wells. Therefore it may be mentioned that field kit could not detect the actual status of 874 + 84 =958 tubewells. Most surprisingly out of 958 tubewells (false declaration), 843 tubewell were safe according to the results obtained by FI-HG-AAS. Where scarcity of uncontaminated water already prevails, declaration of tubewells, which were really safe as unsafe, would not only aggravate the problem of having drinking water but also causes mental agony. Simultaneously, it has a tremendous impact on socio-economic condition.

The analytical result obtain by FI-HG-AAS system for 2866 samples were compared with the status (green or red) of tubewells made by field kits at different concentration ranging from less than 0.003 to greater than 0.6 mg/l. The results shown in **Table-10** revealed that 1920 tubewells were safe according to FI-HG-AAS, but the kit indicated 1058 tube-wells were safe and the remaining 862 are unsafe. Therefore, in the lower level, 44.9% false detection was made. Also in this level, false detection was varying from 17.9% to 80.9%. The high percentage of violation was observed in 0.03 to 0.039 ppm and in 0.04-0.049 ppm. The possible reasons may be the semiquantative nature of the kits. Whereas in higher level, starting from the range of 0.05-0.06 mg/l to ppm to >0.6 mg/l false detection were significantly reduced from 15.79% to 4.17% in decreasing order except in one range of 0.06-0.07 mg/l. Therefore it appears field-kit may not be suitable to measure arsenic concentration to lower level. From our FI-HG-AAS we noted 665 samples below 0.003mg/l where field kit indicated more than 0.05 mg/l 398 thus 59.8% false detection. It appears 59.85% false detection of arsenic concentration level <0.003 mg/l is not realistic. It is also not consistent with our earlier observation (SOES-NGO Forum field-kits study) with trained field workers where we observed better performance of field kits at level <0.01 mg/l. But results of our analyses for 2866 field samples by FI-HG-AAS showed unreliability of field kit even at arsenic concentration level <0.003 mg/l. We feel field workers operating field kits may be responsible for such anomaly. The information /data we gathered during our field survey is narrated below:

(a) Field-kit users were mainly non-technical persons. They feel themselves important persons when they are in field as large crowd surrounds them and they eagerly wait for the comment of field workers on their tubewell contamination and skin lesions. Even we know the case (Abdul Mannan, Farakpur, Bheramara - 7040, Kustia Sadar) where one field worker tried to convince the engineer that his small moles on body are arsenical skin lesions.

(b) When field-kit workers get one after another tube-wells in some areas safe (below <0.05 mg/l) after testing, they are not happy to have the entire tube-wells safe. Consequently they decide to color at least few tube-wells red (this information we had received from a field co-ordinator).

(c) Quality of work gets diluted when an organisation makes a sub-contract of his contract.

(d) A page from our field diary as shown below will further explain it:

Date: 30.10.1999
Vill: Ganganandapur
P.S.: Jhikargacha
Dist: Jessore

We heard from the villagers a strange incident related to field testing and colouring of the tubewells in this village. A group of field workers after testing with their field testing-kits made a large number of tubewells red in this village. A next group came later for testing and after their testing they made some of the red tubewells green. A villager then approached to the field workers and requested them to test the water of two hand tubewells. After testing. it was said that one tubewell is green and another red. The villagers then assaulted the field workers. The reason,

the villager collected 2 glasses of water from same tubewell that field workers had coloured green only some time before.

Problem related to identification of arsenic patients by Field-workers

At the time of testing tubewells in many villages, field workers from different organisations told some villagers that they had arsenical skin lesions. The field workers handed over a card to each member **(Photograph-1**) where it is written about their arsenic concentration and whether they have arsenical skin lesions or not. But after our survey with dermatologist and examining them and analysing the water they were drinking, we found many of them are not arsenic patients.
A few examples out of many are given below.

i. Miss Susama Das (F/22) of villages Brahmankanda, P.S. Kotalia, Faridpur Sadar and Dist: Faridpur is a student of BA (Hons). The field surveyor told her that she is an arsenic patient but actually she is not. She said that she was suffering mentally after she was told that she was an arsenic patient. Her water is safe to drink. Similar is the case for Mr. Hasan Ali (M/45) of the same village.

ii. In district Sirajganj, P.S. Ullapara, village Bhadbara MD. Abu Taher, Abul Hossain, Mohatab Alam, Moniruddin were told they were arsenic patient by those testing with field kit, but actually they are not.

iii. Mini Aktar (F/14) of Nowdapara (Municipal area) P.S. Bheramara, district Kushtia was told that she was an arsenic patient. Her mother said that Mini cried for a few days on learning that. She is not, however, an arsenic patient. Similarly Abdul Mannan (M/50) was identified as an arsenic patient from same village.

iv. Amalendu Biswas, Ex-Chairman of village Satpar P.S./Dist Gopalganj told us that he became very upset after knowing that he was an arsenic patient. Field workers after examining him told that he had arsenical skin lesions. Our medical team examined Mr. Biswas and found he has no arsenical skin lesions. Mr. Biswas told that he now feels that he has got a new life.

v. Tajul Islam of village Kathalia, PS: Haziganj, Dist: Chandpur was also identified as an arsenic patient because he had black spots on his body (**Photograph-2**). But we found that those spots were not due to arsenic (we also analysed his hair, nail and water).

These are only a few examples that out of the many we met during our field survey that had been wrongly identified as arsenic patients.

Do the Arsenical Skin Lesions Disappear with Chelating Agent, Safe Water, Nutritious Food, and Multi-Vitamins!

So far as we know there is no medicine available for chronic arsenic toxicity. Chelating agents have not yet shown any positive evidence of cure for those suffering from chronic arsenic toxicity with arsenical skin lesions. In fact, chelating agent on principle is for acute toxicity. It is said that the only treatment for chronic arsenic patients is safe water, nutritious food, multi vitamins and some daily exercise. During our 13 years of field survey in arsenic affected villages in West Bengal, India, 5 years in Bangladesh and follow up studies of those taking safe water, nutritious food (with extra oral multivitamins) and interviewing a few hundred patients, we have been drawn certain inferences about the effect of safe water, nutritious food, multivitamins and daily exercise on those having arsenical skin lesions. The inferences are:

(a) If arsenic contaminated water is discontinued (even without nutritious food) when diffuse melanosis (blackening of skin) occurs, colour of the skin almost gets back its normal colour in most patients. With nutritious food and vitamins, the colour returns to normal quickly.

(b) If contaminated water is discontinued, when spotted melanosis just starts, the melanosis may fade away. Nutritious food and vitamins no doubt have a positive effect in this process. This is true for most affected people, but not all. This is also true of those getting very mild keratosis. Normally keratosis appears after spotted melanosis. However, there are exceptions.

(c) If the spotted melanosis and keratosis are quite visible (+), then safe water, nutritious food, multivitamins, and some daily exercise help in reducing the spotted melanosis and keratosis, but skin lesions do not disappear completely. During our interviews and follow-up studies, we found that in 20-40% cases there was a decreasing trend but the lesions had not fully disappeared (exceptions are there, however). In almost all cases, white spots (leucomelanosis) slowly replace black spotted melanosis. Overall survey shows that the affected persons feel much better when they take safe water, nutritious food, oral multivitamins and do a bit of daily exercise.

(d) In case of those having plenty of melanosis and keratosis (++ or +++), the discontinuation of contaminated water leads to the slow conversion of black spots into white spots and may be a gradual reduction of the existing keratosis. The keratosis may get reduced but do not disappear. There is, however, not aggravation of melanosis or keratosis.

(e) A few patients (n = 15) with severe melanosis and keratosis (++ or +++) from arsenic affected area of West Bengal were monitored for the last 5 years. In the beginning they had elevated levels of arsenic in their hair, nail and skin scale. However, after using safe water and with nutritious food and vitamins, the arsenic concentration in the biological samples slowly started decreasing. At present, the arsenic concentration in most of them is close to normal, but still they have substantial amount of melanosis (leuco) and keratosis. From time to time, they cut their keratotic lump but with time it grows again. A percentage of those having severe keratosis and melanosis are getting cancerous growth in their keratosis. Some patients have even died because of internal cancer (only a few were diagnosed). So far, from Bangladesh, we have identified 15 patients having cancerous growth among those with severe arsenical skin lesions. Some typical examples are cited.

1) Mamtaz (F/22) father is working in the Bangladesh Police. Mamtaz lived with her father in Chittagong from the time of her birth till she was 14. During this she had no skin lesions. She came to her native village (Vill: Mahimpur, P.S.: Begamganj, Dist: Noakhali) when she was 14 and stayed there for about 2 years. At the age of 16, she left for Dhaka and got

married. Mamtaz said that when she left Noakhali she had very mild - almost unnoticeable melanosis and keratosis. Her keratosis was detectable only after a bath when the skin was wet. Mamtaz told that after coming to Dhaka she noticed that her skin lesions were increasing with time. Now she has leucomelanosis all over her body (+) and keratosis spotted (+) on palm and sole.

If we believe what Mamtaz said that she had negligible skin lesions when she left Noakhali for Dhaka and after coming to Dhaka her skin lesions aggravated with time - then Mamtaz is an example showing that even after taking safe water (in Dhaka Mamtaz is drinking, for last six years, water which is safe with respect to arsenic), skin lesions can aggravate instead of diminishing. Shall we consider then that if the dose is high enough, the appearance of skin manifestation will take its course even if one drinks safe water (thanks to Dr. Abdul Hasnat Milton, NGO- Forum and Dr. Shahidullah Sikdar, Bangabandhu Sheikh Mujib Medical University who helped Dr.Chakraborti to meet the patient Mamtaz).

2) We met Mostofa Chowdhury (M/45, Vill: Chandipur Purba, P.S.: Ramganj, Dist: Lakshmipur) about 2 years ago (January 1998). At that time, he had severe skin lesions but no Gangrene and multiple suspected Bowens. We met Mostofa Chowdhury again on 11th April 2000. His one finger had been amputated **(Photograph-3**) and the condition of his keratosis is getting worse. He has also multiple Bowens (suspected). Mostafa Chowdhury was drinking safe water for last 3 years.

3) In January 1999, we identified Abdur Rahaman, an arsenic patient (Vill: Izrapara P.S.: Sarisabari Dist: Jamalpur), having ulcer on his thumb (**Photograph-4**). The ulcer aggravated **(Photograph-5**) within a year and in early January 2000 his whole hand had to be amputated. Abdur Rahaman was drinking safe water for last two and half years.

These are only a few examples out of many.

What percent of actual arsenic patients in affected villages we could really examine

After discussing with villagers, we feel we could examine only a small percentage (10-15%) of the total population in affected villages who have arsenical skin lesions. The reasons:

(a) In villages, the affected people think their disease is contagious and if other people get to know about their ailment they will be isolated; (b) young girls and women of conservative families do not want to be examined (**Photograph-6 & 7**); (c) people are frustrated and feel that there is no cure of the disease; (d) Since village roads are not good, people who are suffering seriously did not want to come to our camp travelling a long distance due to weakness; (e) normally, we were in a village during the day and at that time of the day most of the males were working in the field.

After an extensive field survey for 27 days we feel that we have got information of more villages where people have arsenical skin lesions. After 27 days field visits we have now information of 73 villages from 47 districts and also we have information of arsenic patient from 3 districts Chittagong, Manikganj and Narail.

We have evidences now from W. Bengal, India that more and more tubewells which were once safe to drink are getting arsenic contaminated.

Finally a detailed survey is necessary to know the actual number of people drinking arsenic contaminated water above 0.05 mg/l and people suffering from arsenical skin lesions.

Arsenic concentration with depth in hand tube-wells from 47 affected districts

We have the analytical information of arsenic from 15969 hand tube-wells with depth (from 6.4 m onwards up to depth 400 m) from 47 districts of Bangladesh where groundwater has arsenic above 0.05 mg/l. Our overall study shows arsenic concentration increases at the beginning with depth up to about 15-20 meters and then decreases with depth. The same trend we had observed in all 47 districts in Bangladesh where we have arsenic in groundwater above 0.05 mg/l. **Figure-4** shows the arsenic concentration with depth from 47 districts in Bangladesh for 15969 hand tubewells.

Population in Bangladesh drinking arsenic contaminated water above 0.01 mg/l and 0.05 mg/l from 43 districts

The number of people in Bangladesh drinking water contaminated with arsenic of above 0.01 mg/l, the WHO guide line value and above 0.05 mg/l, the maximum permissible limit in drinking water of Bangladesh is a cause of concern. A report published in January, 1999 by British Geological Survey jointly with Department of Public Health Engineering (DPHE), Bangladesh, states,"assuming a large uncertainty of ± 10%, the exposed population would lie in the range 18.5-22.7 million (Groundwater Studies For Arsenic Contamination of Bangladesh, Final Report, British Geological Survey, Mott MacDonald Ltd (UK), January 1999, page-6-2). Although, time to time, predictions on number of people exposed are made on the higher side but the scientific basis of the report is not available (Pratham Allo, Dec 20,1999;Dhaka, Bangladesh).

During our study for last 5 years in Bangladesh we had analysed 22003 tube-well water samples for arsenic by FI-HG-AAS from 64 districts of Bangladesh. In 54 districts we observed arsenic in groundwater above 0.01 mg/l and in 47 districts above 0.05 mg/l. So far we have found only in 10 districts where groundwater is safe to drink with respect to arsenic according to WHO guide line value. However, this does not mean that those districts which are at present safe or where arsenic is present less than 0.05 mg/l will remain safe in future. Only 2 years before we knew and reported groundwater of Rangpur, Jamalpur, and Bogura were safe to drink but now in many villages of these three districts not only we have observed arsenic in groundwater above 0.05 mg/l but many people are suffering from arsenical skin lesions.

To get an idea about number of people drinking arsenic contaminated water above 0.01 mg/l and 0.05 mg/l in Bangladesh; we made a scientific approach for 43 districts in Bangladesh. We had already identified 47 districts in Bangladesh where groundwater has arsenic concentration above 0.05 mg/l. Now from our duly filled-in questionnaire during fieldwork we got necessary information on the number of user for each tube-well for 16410 tube-wells from 43 out of 47 districts where groundwater contains above 0.05 mg/l of arsenic. Based on the relevant information collected by us and result obtained by our FI-Hg-AAS techniques for arsenic, an approach was made to calculate the number of user consuming drinking water contaminated with arsenic of above 0.01 mg/l and above 0.05 mg/l for each police station. For a district the calculated value of each police station based on actual observations were used to give weightage (percent/100) on the other police stations considering their relative location for which sampling were not done. Ultimately we calculated first the total number of peoples effected from 10

districts. Based on the values of these 10 districts, remaining 33 districts were calculated. Finally adding all these calculated values, we made the prediction of number of people exposed to more than 0.01 and 0.05 mg/l in 43 districts. We did not extrapolate our result to all 47/54 districts, as we do not have the available number of users in those districts.

Mode of Calculation

The following criteria we considered for our estimation:

(a) Ten districts we considered in the order, 3 from east (Lakshmipur, Noakhali, and Chandpur), 3 from the west (Jessore, Meherpur, and Kustia), 3 from south (Barisal, Khulna, and Faridpur) and one from northwest (Pabna). In these ten districts also we had adequate number of samples. The above selection was done at random with emphasis on covering the total area of 43 districts.

(b) We considered those districts where we have at least more than 100 samples from each police station and of 4 police stations from each district (Meherpur has only two police stations).

(c) The percentage was used as weight on number of population. Then distance of the location and number of people exposed to arsenic contaminated water were taken as criteria for calculating the total number of peoples exposed in districts.

The approach adopted for calculations is explained below taking Lakshmipur district as an example (**Figure-5**) and on the basis of our field study report of the same district (**Table-11).**

Lakshmipur has altogether 4 police stations (Ramganj, Raipur, Lakshmipur Sadar and Ramgati) and out of them, three police stations in northern side cover an area of 61 percent of the districts. Average population of these three police stations drinking arsenic contaminated water above 0.01 mg/l are 95.8%, 88.8% and 89.9% and above 0.05 mg/l are 84%, 80.9%, 82% respectively. The number of people in these 3 police stations is 601000, 245000 and 314880 respectively. The number of people exposed to arsenic with respect to number of tube-well samples in these three police station are 2215, 43839, 8299 above 0.01 mg/l and 1945, 39957, 7569 above 0.05 mg/l. The police station in the remaining area in Ramgati ; the population exposed to Ramgati are 3095 above 0.01 mg/l and 2747 above 0.05 mg/l. The number of people exposed will be the total population of each police station multiplied by weight. The number of people exposed in these four PS at two levels (>.01 & >.05 mg/L) are shown in **Table 11**. Therefore the total number people exposed in this district are 1350884 above 0.01 mg/l and 1286725 above 0.05 mg/l out of total 1504000. Percentage variation among 3 northern police station in Lakshmipur is not significant. Location wise, from Lakshmipur Sadar police station to Ramgati police station, the percentage varies from 84 to 69% with a difference of 14.3. Therefore, in 34% areas variation will not be more than 14%. If we consider the weight of 0.7, the number of peoples exposed will never be less than 2688000. That is why we have taken number given above as the number of people exposed. All the figures are given in **Table-12.**

Table-11: Peoples exposed in Lakshmipur district above 0.01 mg/l and 0.05 mg/l.

In this way the people exposed in other 9 districts were calculated and given in **Table-12**

Table-12: People exposed in other 9 district above 0.01mg/l & 0.05 mg/l

These results were extrapolated in other 33 districts where we have relevant information/data on number of user and arsenic concentration in tube-wells and final result shows that the total

populations exposed above 0.01 mg/l and 0.05 mg/l in 43 districts are 51590829 and 25045633 respectively out of total 85397000 people in 43 districts.

Our attempt for predicting the people exposed to arsenic from groundwater above 0.01 and 0.05 mg/l were initiated after we had analyzed 22003 hand tube-wells. The above prediction was made based on the number of samples already drawn, which may not be adequate for all the districts. Therefore, for validation of the prediction system and its refinement, further sampling would be done.

How many hand tube-wells are in 43 districts of Bangladesh?

Time to time predictions were made about the number of hand tube-wells in Bangladesh. The following information is available

1. Hussam et al in Env. Sci. Technol., ASAP article 10.1021/es 990146 S 0013-936 X (99) 00146-7, Web Release Date September 4, P 999 writes " WHO also reports that there are about 2.5 million tube-wells (wells with a metal casing) in Bangladesh and more than 95% of Bangladesh population of 120 million drinks well water.

2. British Geology and Department of Public Health, Dhaka, Bangladesh writes an another reports 4-5 million hand tube-wells are in Bangladesh (Ground water studies for arsenic contamination in Bangladesh, Final report, British Geology Survey Mott MacDonald Ltd, UK, January 1999).

3. M. A. Bhuyan Dept. of Water Resource Engg. BUTT- Bangladesh writes, on Groundwater: Bangladesh Perspective reported that according to a 1994 estimate (Wan, 1994), three were an estimated 2.4 million tube-wells in rural Bangladesh, of which about 900,000 were public tube-wells (Arsenic in Groundwater: Scratching for Alternatives to Rural Water Supply, P 15, March 22, 1999, Dhaka, Bangladesh NGO Forum for Drinking Water Supply & sanitation).

To know the approximate number of tube-wells in 43 districts of Bangladesh ,we made a simple calculation from our available data of field survey questionnaire. We know that 393845 people use 16410 hand tube-wells. Thus 24 people are using one tube-well. We know the total population of these 43 districts of Bangladesh is 85397000. So number of tube-wells in these 43 districts are 3596333(3.6 Million).

Twenty-seven days detailed field survey information (April, 1999 to February, 2000)

Field Survey: 13th April 1999 (District Narayanganj)

District Narayanganj; Police Station - Sonargaon; five villages surveyed.

We had surveyed this district and this police station earlier, but all the 5 villages we went to were new ones?

Figure-3 shows our journey route and **Table-13 & 14** show report of water analysis and patients with arsenical skin lesions.

As there are no tubewell installation regulations and restriction in Bangladesh, we found many families had more that one tubewell. Even in joint families, 3 to 4 tube-wells are not so uncommon. Installation of a shallow depth tube-well is not expensive (around 100 US $ for 10 m depth hand tube-well) in Bangladesh. The exact number of hand tubewells in Bangladesh is not available. The estimated range is 4-5 million including both govt. and private [Pratham Alo (a daily newspaper) Bangladesh, December 20, 1999].

Important findings of 13th April field survey

On 13th May, out of the five villages we surveyed village Darikandi under P.S. Sonargaon, District Narayanganj, is the most affected. In this village, in the Molla family, 17 out of 21 members have arsenical skin lesions **(Photograph-8**). Out of 9 children below 11 years, in this family, 7 have arsenical skin lesions. Ajmair Hussain (M/7) and Sayed (M/8) both have melanosis & keratosis. So much skin lesions in children are not so common. This indicated that arsenic concentration was very high in their tubewells. They had dismantled their old tubewell and installed with those pipes a new tubewell in their backyard, thinking that the present one will be safe. They were drinking from newly installed tubewell. When we surveyed, they did not know the arsenic concentration of the newly installed tubewell. We found arsenic concentration in their tubewell, i.e. of the water they were drinking to be 1.5 mg/l. In that family lives a woman, Astna (F/25), who has arsenical skin lesions, had an abortion done and was pregnant again at the time of our visit (**Photograph-9**). In this small village Dorikandi we found 3 shallow hand tubewells and all were highly arsenic contaminated (Waresh Koroni 2.5 mg/l, Awan 1.6 mg/l, Joynal Abedin 1.7 mg/l).

Field survey: 15-19 April 1999

During 15 to 19th April we covered 5 districts, 8 Police Stations and 26 villages.

Districts and Police Stations and number of villages covered were

Districts	Police Stations	No. of Villages
Nawabganj	2	3
Rajshahi	3	3
Munshiganj	1	6
Manikganj	1	6
Mymensingh	1	8
Total 5	**8**	**26**

All these five districts we had surveyed earlier for arsenic in hand tube-wells, but this was the first time we surveyed Munshiganj, Manikganj and Mymensingh for arsenic patients. All the 26 villages were surveyed for the first time for arsenic patients. Out of these 5 districts, in Manikganj, we could not so far from our preliminary survey identify patients with arsenical skin lesions, although we had identified villages where ground water contained arsenic more than 0.05 mg/l.

Figure-3 shows our journey route. **Table 15 & 16** show reports of water analysis and patients with arsenical skin lesions

Important Findings of 15-19 April Field Survey

Field Survey: 15th April 1999 (District Chapai Nawabganj)

In the village of Maharajpur Mintola of the police station Chapai Nawabganj, district Chapai Nawabganj in the family of Afzar Hussain (M/33), his wife Hanifa (F/30) and all three minor daughters, Rojina (F/10), Rajia (F/6), Silpi (F/5) have arsenical skin lesions **(Photograph-10**). Afzal mainly stays outside the village because of the nature of his job and drinks from the contaminated home tube-well only occasionally. He has no skin lesions. The tubewell from where they are drinking water for last 12 years has arsenic concentration 0.17 mg/l. Normally, even if the nutrition status is poor we do not get skin lesions in such young children drinking arsenic-contaminated water of concentration 0.17 mg/l, and this is one of the few cases we observed during our survey in Bangladesh. In the village of Chandipur, of district and police station Chapai Nawabganj, the arsenic concentration of the tubewell from which the family of the principal, MD. Sadiqar Alam, of Ala Baks Memorial College fetches drinking water, had the arsenic concentration 0.26 mg/l and all the 5 members of his family have the arsenical skin lesions. The nutrition status of the family is quite good. We went to Chandipur village just before evening and found 32 arsenic patients within 2 hours. We believe there are many patients in Chandipur village of Chapai Nawabganj.

In the village Jagannathpur, P.S. Shibganj of District Chapai-Nawabganj, Tashima Khatun (F/15) has severe skin lesions (++). The tubewell water she was drinking contains arsenic to the tune of 0.16 mg/l. The tubewell was installed 7 years back and she said that she got skin lesions within 2 years of drinking its water. She said she drinks about 6-7 liters of water per day. In the DPHE office of Chapai-Nawabganj there is a roof top rainwater-harvesting unit **(Photograph-11**) but no one drinks from that source (which is not properly maintained either). In the DPHE office area there is a Tara pump (depth 162 m) and its arsenic concentration is 0.11 mg/l **(Photograph-12).**

Field Survey: 16th April 1999 (District Rajshahi)

In the village of Harirampur, P.S. Bagha, district Rajshahi, many people are affected. We found 27 patients in this village from our preliminary survey. This was one of the areas known to be affected from our survey of August - October 1996. At present, all are drinking safe water but skin lesions are still persisting. This is one of the villages in Bangladesh where many children are affected. We found that out of 27 patients 9 were children between ages 4 and 12 **(Photograph-13). Photograph-14** shows Ferdosa (F/8) whose skin lesions - spotted melanosis (leuco) - are visible.

Pinjra Begam (F/26)

In the Miapur Paschim Para village of Charghat P.S., Rajshahi district, there was a woman named Pinjra Begam (Pinjara means cage, Begam means queen). She got married at the age of 15 to Masud Rana, who works in a Mill. Pinjara's mother in law, Howa, said that Pinjara was really pretty when she got married to his son. After marriage she started getting dark and within 2-3 years got skin lesion and deteriorated fast. The villagers said she was the most arsenic affected woman in that village. When we went to her house, she was in Rajshahi Medical College and suffering from lung cancer. Pinjra had a daughter, Sapla (F/7), who has skin lesions; a son, Arif (age 5), and another son Jyoti, who is eight months old. Arif and Jyoti have no skin lesions but all have high arsenic in hair and nail. Pinjra’s condition worsened after her last child Jyoti was born. Finally, Pinjra died last year. **Photograph-15** shows Pinjara's three children and mother-in law.

Social problem

In the Harirampur village of Bagha, P.S., district Rajshahi, Tafikul Islam (M/24) reported that he got an interview for a job in the army, but was not selected due to his skin lesions.

Field Survey: 17th April 1999 (District Munshiganj)

In this field trip we found, for the first time, arsenic patients in Munshiganj district.

Earlier, on the basis of the results of our analysis water samples from Munshiganj, we expected arsenic patients from there. We found arsenic patient in villages Duhuri and Khidripara of Louhojang; P.S. Piyoshi Begam (F/28) has arsenical skin lesions with a non-healing ulcer **(Photograph-16**) for couple of years.

Field Survey: 18th April 1999 (District Manikganj)

Manikganj District (*no patient so far confirmed*)

Although in many villages of Manikganj district we have found arsenic in groundwater above 0.05 mg/l, we have not found any arsenic patient so far. We got information from NIPSOM that in Police Station Singair of JAMSA Union in Sarasia village there were arsenic patients but we could not identify any patient in that village. We have found that in DPHE office the hand tubewell contains arsenic (0.085 mg/l) (P.S. Singair). Mr. Hasmal, mechanic of the office, told use that although he knows the tubewell of DPHE office is arsenic contaminated people are drinking water from the DPHE tubewell because there are no safe tubewells nearby. However, after analyses, we have found many tubewells in the area that are safe to drink (less than 0.05 mg/l), as per the maximum permissible limit in Bangladesh. The tap water of that area contains arsenic 0.034 mg/l.

Field Survey: 19th April 1999 (District Mymensingh)

In this trip, we identified arsenic patients in Mymensingh district for the first time.

In the village of Anandipur, P.S. Mymensingh Sadar of Mymensingh, we found arsenic patients.

In the family of Dr. Giasuddin Talukdar, we identified 3 patients. **Photograph-17** shows Ayatulamin (M/40) having melanosis and keratosis.

We had found a dug-well **(Photograph-18**) in the area installed in the Bengali year 1344 (English 1937). Villagers said this well was the only source of drinking water in the village 15 years back, but no one uses it any more as people have access to tubewells. The dugwell was well maintained by villagers when they were drinking from that well.

Death

Mr. Jahangir, who belonged to Talukdar family, died in 1995 at the age of 38. His family members said that he had severe skin lesions**.**

Field Survey: From 30th September to 5th October 1999

In this trip, we identified arsenic patients in Rangpur district for the first time.

From 30th September to 5th October, we covered 6 districts, 9 police station areas and 21 villages. We had surveyed the other 5 districts earlier. All the villages/part of the villages covered in this trip had not been surveyed earlier.

Figure-3: Shows our journey route and Table-17 & 18 show report of water analysis and patients with arsenical skin lesions.

Districts, Police Stations and villages covered are reported below

Districts		Police Stations	No. of Villages
Rangpur		1	2
Gaibandha		1	1
Kushtia		1	1
Meherpur		2	7
Jessore		1	3
Jhenaidaha		2	5
Faridpur		2	3
Total	**7**	**10**	**22**

Important findings of 30th September to 5th October 1999 field visit.

Field Survey: 30th September 1999 (District Rangpur)

Before this trip we had no idea that Rangpur district had arsenic patients. In our earlier report a year before, we predicted on the basis of our water analyses results that probably the ground water of Rangpur is safe to drink. But later on we not only encountered higher arsenic concentration in Rongpur but also a large number of arsenic patients. From village Pathaksikhar, P.S. Pirgachha, we had analysed 79 samples for arsenic in groundwater and out of that 33 samples were found to have arsenic above 0.05 mg/l, and 10 have arsenic above 0.5 mg/l. From Pathansikar, we had examined at random 195 villagers including children. Out of them 24% were found to have arsenical skin lesions and, incase of adults, the figure was 35.5%. Thus, we had underestimated Rongpur district from the point of view of arsenic contamination. The villagers of Pathaksikhar said that that we had seen only 10-15% of the total population affected with arsenical skin lesions from the village.

Many villagers in Pathaksikhar are suffering from serious arsenical skin lesions **(Photograph-19**) and and all these patients were drinking contaminated water having arsenic concentration 0.94 mg/l. The villagers told that they are noticing arsenical skin lesions for the last 10 years.

All melanosis are not arsenical

While working in Padhanskhar, we encountered an ice-cream seller named Mohit Mia of village Deo-doba under P.S. Sundarganj, district Gaibandha. Mr. Mohit has skin lesions similar to severe spotted melanosis **(Photograph-20)**, but he has no keratosis. Such melanosis without keratosis is very uncommon. In the evening we went to his village in Gaibandha district and met his family. We found that his father and brother too had similar skin lesion but to none rest of the family members. His father said he had seen similar skin lesion on his father's body. We confirmed that Mohit's skin lesion melanosis was not due to arsenic by analysing water, hair, nail samples the whole family.

Field Survey: 1st October 1999 (District Kushtia)

We had surveyed Kushtia district earlier. But in this survey we went to new affected villages. We had got information about these villages during our previous surveys.

In this survey, we got a quite well to do arsenic affected family, known as the Molla family (village Islampur, PS. Bheramara, District: Kushtia), which started drinking their tubewell water from 1971 and began noticing skin lesions from 1990. Out of the 28 people in the family in the age range of 5 to 80 years, most of the adults (number = 18) had arsenical skin lesions. The youngest victim was Sahadul (M/14), who got skin lesions about 2 year's back. Children at the age group one and half year to 11 years in that family had no skin lesions. The arsenic concentration in drinking water of the tubewell they installed in 1971 and they used till October, 1997 is 0.57 mg/l. The family started drinking safe water from a deep tubewell from November 1997. At present, the arsenic concentration in drinking water is less than 0.003 mg/l. They are a rich family of that area and getting nutritious food. Those suffering reported that after drinking safe water for the 2 years were feeling better. But most members of the family said their skin lesions had not subsided. Some of them reported about 20% decrease of skin lesions. (**Photograph-21** is of the whole family).

Death

Montaj Ali of this family, who had severe arsenical skin lesions, died of liver cirrhosis in 1996

Field Survey: 1st October 1999 (District Meherpur)

In Chatian village of P.S. Gangni, district Meherpur, we came across a poor family. Ersad Ali (M/50) was the head of family and is seriously affected by arsenic. One of his legs had been amputated because of cancer (**Photograph-22**). Ersad Ali's son, Bajhur Rahaman (M/33), is also seriously affected and has a non-healing ulcer on left hand's small finger (**Photograph-23**). Out of 10 member of Ersad Ali's family 7 have arsenical skin lesions including a child, Milton (M/10). There is no deep tubewell in the area and they also do not know which tubewell is safe to drink from. I asked them why they do not fetch water from the nearby tubewell belonging to a family whose members had no skin lesions. What Ersad Ali said was shocking. He told me, "The government knows my condition and promised me that a deep tubewell will be installed near my home, but till today they have not done it." Ersad Ali further murmured, "I may die but will drink this water until a deep tubewell is installed." The arsenic content in Ersad Ali's tubewell is 0.37 mg/l.

Field Survey: 2nd October 1999 (District Meherpur)

We have reported above (October 1, 1999) about the family of Islampur village in Kustia district where we surveyed an entire family of 28 people with ages ranging from 5 to 80 years and found 18 adults had arsenical skin lesions. The youngest victim is 14. The family is well to do and get nutritious food. In Bagoan- Kagipara, P.S. Meherpur we also got a poor family of 22 members in the age range of 6 to 60, and out of them 21 have arsenical skin lesions and the severity of skin lesions much higher than the Islampur population. Six children out of seven below 11 were found to have arsenical skin lesions. The arsenic concentration in drinking water of the Bagoan-Kagipara family was 0.69 mg/l. The family is very poor **(Photograph-24).** Most of its members have vitamin deficiency. We had also compared daily food intake and it appears that due to the poor nutrition status of this family its members are more affected compared to the Molla family of Islampur, Kustia. During our field survey in West Bengal, India and Bangladesh we had noticed

many cases where poor people suffering with arsenical skin lesions but drinking almost same concentration of arsenic contaminated water for people getting better nutrition are not suffering.

In village Dhaolmari of district & P.S Meherpur, we met Lucus Biswas (M/36) a serious arsenic patient, whose one finger has been amputated (**Photograph-25**). Mr. Lucus Biswas said that within one year after the installation of his tubewell in 1984, he started getting blacking joints on his hand and leg, and within 2 years started getting skin lesions. In 1997, he came to know his problem was due to arsenic. Mr. Biswas got non-healing ulcer on his finger in 1987 and it had is amputated in May 1998.

Field Survey: 2nd October 1999 (District Meherpur)

Stadium para (Ward No. 9) of district Meherpur, P.S. Meherpur, is one of the worst arsenic affected villages I have seen in my 13 years of survey work in West Bengal and 5 years in Bangladesh. Out of the 112 people we had examined from Stadium para, 47 had arsenical skin lesions. Many of them have severe skin lesions. MD Kitab Ali has ulcer for last 10 years (**Photograph-26).**

Death from Stadium Para

From Stadium Para so far 9 people, who had severe arsenical skin lesions, have died. Most of them died at an early age. Villagers said many of those who died had non-healing type of ulcer. Those who died were AbuTaleb (M/30), Joyuddin (M/53), Sahad Ali (M/28), Atar Ali (M/35), Majira (F/35), Mamtaj (F/32), Jamat (M/45), and Arjima (F/25).

Field Survey: 3rd October 1999 (District Jessore)

Most of the people are drinking from hand tube-wells which were colored red by field surveyors who had used arsenic field testing kits in village Ganganandarpur of Jessore district, P.S. Jhikargachha. The pity is that out of 89 tubewells in the village 98 % (by FI-HG-AAS method) are not safe to drink. Villagers are drinking arsenic contaminated water as they have only a few safe sources at the end of the village. This is a large village and the total population is about 8000.

From our analytical report we have found that the arsenic concentration in most of the tubewells is a little above the maximum permissible limit. So people are not showing arsenical skin lesions. Only we have found a few people (n=14) with arsenical skin lesions. They have been drinking contaminated water having arsenic around 0.15 mg/l. The villagers are also not so poor, and that is one of the reasons people are not showing skin lesions, as their nutrition level in better. Out of 381 people we examined for arsenical skin lesions, we found only 14 had skin lesions.

Field Survey: 4th October 1999 (District Jhenaidaha)

Achintanagar village of P.S. & district Jhenaidaha, is a uinque village. In this village, we encountered a family with 31 members and all were drinking arsenic contaminated water from a single hand tubewell having arsenic 0.52 mg/l. Members of this family were in the age group 5 to 50 years. Out of these 31 members, 6 had no arsenical skin lesions. Even 5 children in the age range 9-14 had arsenical skin lesions. The family is socio-economically poor.

Photographss-27, 28 & 29 show the whole family and a young boy (Ariful Islam, M/14) and young man Sayed Mondal (M/25) having arsenical skin lesions.

The old members of the family told that they installed the tubewell 10 years back and they started getting skin lesions after drinking its water for 2 years. There is no deep tubewell in this village.

Field Survey: 5th October 1999 (District Faridpur)

While working in village Brahamankanda under P.S. Faridpur Sadar of Faridpur district we encountered an arsenic patient, a student of Bachelor of Arts. He lives in Boalmari Thana's Kamaleswari village of Faridpur district. We went with him to his village. It was a very remote village and one can reach there only after crossing a couple of rivers and walking a long distance. We identified 17 patients in our short survey. In this village, we found patients with arsenical skin lesions who were drinking water having 0.103 mg/l. of arsenic **(Photograph-30**). People of Kamleswardi did not know that they were drinking arsenic contaminated water and suffering from arsenical skin lesions. We feel many interior villages of Bangladesh have not yet been surveyed for arsenic contamination.

Field Survey: From 22nd December 1999 to 1st January 2000.

During this period we surveyed nine districts. Out of them, 8 districts we had already surveyed earlier and identified patients with arsenical skin lesions. During this period, along with these 8 districts, we surveyed a new district, Sirajganj, for arsenic patients in places where we found the groundwater more than 0.05 mg/l of arsenic. We could not identify arsenic patients in Sirajganj in this preliminary survey (we surveyed only in 2 villages).

Our survey route is presented in **Figure-3** and water report of the survey and patient status of the newly surveyed area presented in **Table 19 & 20** respectively.

All the villages/part of the villages surveyed during this trip had not been surveyed or reported earlier.

Details about the district, P.S. covered and number of villages surveyed reported below

District		Police Station (P.S.)	Village
Sirajganj		1	2
Pabna		1	9
Kushtia		2	6
Faridpur		3	7
Gopalganj		2	5
Chandpur		5	33
Lakshmipur		2	4
Noakhali		1	2
Madaripur		1	3
Total	**9**	**18**	**71**

Important Findings during Field Survey from 22nd December1999 to 1st January 2000.

Field Survey: 22nd December 1999 (District Sirajganj)

We could not identify any arsenic patient from the villages Bhatbera, Bhairab of P.S. Ullapara of district Sirajganj where groundwater contains arsenic above 0.05 mg/l.

Field Survey: 22nd December 1999 (District Pabna)

In Sujanagar P.S. of Pabna district there is Ahamadpur Village. This is a big village having a population of over 10,000. There are 7 areas in this village named Uttarpara, Dakshinpara, Madhyapara, Miapara, Khondokarpara, and Hafezpara. During our study we could study only Uttarpara.

After examining 180 people from the village Uttarpara, we found 33 arsenic patients with skin lesions. We feel we had seen only a small section of Uttarpara. Some of the other areas also have arsenic patients (according to villagers). In this village some small children are affected. Astma (F/11) is one of them, who have both keratosis and melanosis (**Photograph-31).**

Death

Khokon (M/18) and Selenia (F/22) died at early age and had severe arsenical skin lesions.

During our work in Pabna, we got the information that in 21 villages in Bera P.S. there are arsenic patients with skin lesions. These villages are:

Tangbari, Ahmedpur, Haridebpur, Noyabari, Kashinathpur, Kazipur, Dayalnagar, Puran Masundia, Talimnagar, Talebnagar, Masundia, Trimohini, Ujan Kaya, Khan-A-Bari, Bora-Naoga, Fakira Kandi, Kazibhat, Natun-Varenga, Meoloipara, Monakhosa, Joradaha.

Field Survey: 23rd December 1999 (District Pabna)

In the same Sujapur P.S. we also surveyed the highly affected villages Sayedpur, Sayedpur (West), Mobarakpur, Birahimpur.

Sayedpur is another seriously affected village and the people are suffering for about 10 to 15 years. A large number of people are affected. People were hostile to us at the beginning but yielded after a long discussion and became friendly. In this village, in Seikh family, six people died at an early age. They had severe arsenical skin lesions.

People died in Seikh family at early age:

1. Titu (M/13)
2. Lutfer (M/45)
3. Jalil (M/35)
4. Muktar (M/30)
5. Aktar (M/32)

In this village, there is no safe deep tubewell and the villagers have no idea which tubewell is safe to drink from. An old man, Khallilur Rahaman (M/60), said that he had to walk a few kilometres even at this age to get drinking water from nearby river. Many young men in this village have arsenical skin lesions (**Photograph-32).** We identified 30 people in this village as suffering from arsenical skin lesions. Arsenic concentration in hand tubewells in this village is quite high (0.4 to 0.7 mg/l).

In the village Mobarakpur we have identified Hossain Ali (M/58) as one who has arsenical skin lesions, and the biopsy of his ulcer has revealed malignancy (**Photograph-33**). Hossain Ali's hand-tubewell, whose water he had been drinking, has an arsenic concentration of 0.29 mg/l.

Near village Mobarakpur there is another village, Birahimpur. In this village very small children are affected with arsenical skin lesions. In the family of Sayed Seikh (M/38) his children Sufia (F/10), Surya (F/7), Milan (M/13), Rabiulal (M/8) and wife Aleya (F/35) all have arsenical skin lesions (**Photograph-34**). The child Rabiual (M/8) has severe spotted melanosis (**Photograph-35**).

Field Survey: 24th December 1999 (District Pabna)

On 24th December we surveyed the village Sayedpur- Middle of P.S. Sujanagar. We identified a young girl, Nargis (F/15). All the fingers on her left feet have been amputated because of cancer. She has severe arsenical skin lesions (**Photograph-36)**. Nargis do not believe her illness is from the water so still she drinking the same tubewell water (arsenic 0.57 mg/l). Arsenic content of her urine was 650 µg/l.

In this village, we identified Farhad (M/12) and Swapna (F/11) both of whom have have arsenical skin lesions. They came from Banderban to this village one-year ago and both of them and after drinking arsenic contaminated water (0.69 mg/l) both of them got the skin lesions (**Photograph-37**) within one year. Banderbon is hilly area and safe with respect to arsenic in drinking water. Before coming here they were drinking water in Banderbon from streams.

A typical exception had been observed in the village Ujankaya of P.S. Sujanagar. In the family of Niamatali (M/40), his wife Ajibakhatim (F/31) and son Johurul (M/18) all three have the arsenical skin lesions but daughter Silpi (F/15) has no skin lesions although all were drinking from same tubewell having arsenic concentration 0.69 mg/l. The same is true from Ullas Molla (M/16), drinking arsenic contaminated water 0.66 mg/l from the same village.

Field Survey: 25th December 1999 (District Bheramara)

A family where many died at early age with arsenic skins lesions and a few still borne babies.

In the village Fakirabad P.S. Bheramara there is the family of Harsen Molla (M/70). At present, in Molla family 5 adults are alive and all have arsenical skin lesions. Three children of the family below age 11 have no skin lesions, as they are drinking safe water from a nearby deep tubewell (declared safe). They discontinued their tubewell about 7-8 years ago. The contaminated tube-well of the Molla family is no longer there. Mr. Harsen Molla, who is the guardian of the family, is suffering for the last 20 years but is still strong, compared to young members of his family. Meera (F/35) is the 3rd wife of Harsan Molla. Meera said she got married to Harsen when she was 24 and Harsen was at that time 59 years old at that time. Meera got skin lesions after one year of her marriage. Meera got 6 children in 6 years but the first 4 issues were still born. Two children are still alive. Harsen told that 25 years back they had installed the tubewell and with in a few years they started getting skin lesions. At that time the family was big but one after another they died and all had arsenical skin lesions.

Harsan's mother died first (1985). After that in 1987 his 2nd wife died. Harsen then got married to Meera. Daughter Jharna, son Khairul died at the age of 14 and 10 on the same day. After that his son Lalmia's wife Sajeda died (of cancer) and she too had given birth to a stillborn baby. After 2 years of Sajeda's death Lalmia died of cancer. At present, in the Harsan family, Harman's one son from his 1st wife, 2 sons from his 2nd wife and 2 boys from his 3rd wife Meera are alive**.** **Photograph- 38** shows Harsan (M/70) and his son Rezaul (M/30).

Field Survey: 26th December 1999 (District Madaraipur)

In the village of Golabari-gajirchar, P.S. Madaripur Sadar, District Madaripur, we found all 20 adult men and women out of total 70 had arsenical skin lesions. Out of 70, 50 are below age 18 and they have not skin lesions. The people were drinking water from 3 hand tubewell and the arsenic concentration of these 3 tubewells was 0.83, 0.80, 0.61 mg/l respectively. Socio-economically, this village appears sound. For the last 8 years, they are drinking safe water from a nearby deep tubewell (arsenic concentration less than 0.003 mg/l). Most probably due to this reason the young generation is not affected.

Field Survey: 27th December 1999 (District Gopalganj)

In the village Charbarfa, PS and Dist: Gopalganj, there is Fazlar Rahaman (M/65). His wife and 3 children are affected, but although Fazlar Rahaman was drinking the same water, he has no skin lesions. His one son died at an early age. He had severe skin lesions, while another, Bellal Fakir (M/22), too has severe skin lesions (**Photograph -39).**

Death

Imam Fakir, son of Fazlar Rahaman, died at the age of 28. He had severe skin lesions.

A Source of Safe Water

In Gopalganj district there is a big water body known as Chand-beel, under PS Kashiani. The Beel covers an area of about 200 sq. km. In some areas around this beel there are villages on higher grounds. The houses in these villages are isolated from one another and to go from one house to another one needs a boat round the year. During the rainy season part of these houses are submerged under water (**Photograph-40**). Villagers said that the situation had not changed over the last 100 years. People travel by boat round the year. It is a huge water body, but proper utilization of its water has not been done. Although we got some information of arsenic patients from villagers around Chandbeel, we could not survey any village except Singa, as travel by boat was extremely time consuming and the houses were far away from one another.

Field Survey: 28th December 1999 (District Madaripur)

Datterhat village of PS Madaripur Sadar, Dist: Madaripur is highly affected. Villagers were not aware that they were drinking arsenic-contaminated water and that their skin lesions were due to arsenic toxicity. Some of them suspected that the water they were drinking was not good. So they avoided taking drinking water from their own tubewell but kept using the water for cooking and washing food. Some of them even drank that water from time to time. All 4 hand tubewells in the village have arsenic concentration 0.57, 0.63, 0.73, 0.60 mg/l respectively. Out of the 130 people examined for arsenical skin lesions, 26 were found to have arsenical skin lesions and some of them, such as Runia Begum (F/25) (**Photograph-41**), had serious lesions. Since in this village people were drinking contaminated water from time to time, we analysed the urine of 10 children below 14, and of 14 young adults. It was found that all of them had arsenic in urine much above the normal level (range 113 to 810 µg/l). All of them had arsenic in nail above the normal level and in their hair above the toxic level.

Death

Ekles (M/22) and Abdul Khalek (M/45) both died of myocardial infraction and had severe skin lesions.

Field Survey: 28th December 1999 (District Faridpur)

Faridpur is one of the districts we identified as arsenic affected in 1995. The more we are surveying this district the more affected areas and arsenic patients are coming to light. One of the NGO-Forum's officials, Mr. Sahidul Islam, told us during a discussion on 26th December 1999 those many of those tubewells they found safe earlier was now predominantly contaminated.

We could survey 2 villages: Gajhata (P.S. Nagarkanda) and Sadipur (P.S. Faridpur Sadar) in Faridpur district on 28th December, and in both the villages many people were found to be affected. Nasima (F/35) of Sadipur village had spotted melanosis all over body up to her neck (not common) along with keratosis (**Photograph- 42**).

Field Survey: 29th December 1999 (District Chandpur)

From the beginning of our survey in 1995, we were aware of the arsenic problem in Chandpur district. The number of affected villages keeps increasing as we do more and more survey. During this survey we had prior information about 2 villages in P.S. Shahrasti of Chandpur. But when we went to these villages we got information of many others. On 29th December alone, we surveyed 11 villages of Shahrasti, and in all these villages we had identified arsenic patients.

In village Kherihar, PS: Shahrasti, many people are seriously affected. Khalilul Rahamn (M/29) has all the symptoms of arsenical skin lesions **(Photograph-43).**

Death

In Kheriher village, wife of Abdul Gain (M/45) died of cancer at the age of 39. She had arsenical skin lesions, according to her husband.

At the end of the day's work, the Chairman of the locality, Mr. Anwar Hossain (M/35), welcomed us. He told us that the people were unaware of the arsenic problem. We found Mr. Hossain, too, was arsenic affected, but he did not know that also.

Field Survey: 30th December 1999 (District: Chandpur)

In Bangladesh, during 1970's, a large number of deep tubewells of big-diameter were installed. In Santia P.S. of Pabna, hundreds of such deep tubewells were drilled. When these deep tubewells operate, shallow tubewells become dry. We learnt of some cases in which the upper layer of the soil had collapsed along with the pump house. We saw it in village Asrafpur, PS: Kachua Dist: Chandpur **(Photograph-44**). Ali Ahamad Mia said that in 1972 the deep tubewell near his village was installed (8" diameter pipe). Up to 1995 it was perfectly all right. From 1996 sand started coming out with water. Later, large quantities of sand started coming out with water, and one morning, Mr. Ali Ahmed found that the pump house had collapsed and there was big crater around the pump house.

On 30th December we had identified arsenic patients from 5 villages of Haziganj P.S. in Chandpur district. Our survey was only partial in all these villages.

Death

In the village Belghor of P.S. Haziganj, Rokia Begum (F/30), who has arsenical skin lesions, reported that her husband died of liver cancer. Arsenic concentration in the water they were drinking is 0.49 mg/l.

In Belghar, we have found 2 hand tubewells a few meters apart - one of them is arsenic contaminated (red) another green (**Photograph–45).**

Field Survey: 31st December 1999 (District Chandpur)

On 31st December, we surveyed Police Station Chandpur Sadar and Faridganj and identified 11 villages. Although we covered all these 11 villages in one day and identified people with arsenical skin lesions in all these villages, we have no hesitation in saying that we have just done some preliminary work and have not surveyed them in detail.

Death at early age

In the village Uttar Chandpur of P.S. Faridganj many people are affected. This is one of the villages that had been identified as arsenic affected in the middle of the 90's. Those who died at an early age with arsenical skin lesions were:

Meherunissa (F/40), Sarwar (M/14)

Saria Begam (F/40), Mukta (F/5)

Social problem

Jesmin Aktar of village Paragabdiogang, P.S. Faridganj, is 20 years old and has severe arsenical skin lesions. In her family, all have arsenical skin lesions. She was married to Humayun of Daskhim Dhanua village, PS. Faridganj. Her husband is now in the Middle East. Jesmin finds it difficult to live with her mother-in-law, but she can't go back to her parents. This is because after the death of her mother, his father married again, and her stepmother does not want her.

Field Survey: 1st January 2000 (District Lakshmipur)

On 1st January we surveyed 4 villages: Sripur, Ratanpur, Komardia and Ghatlabag of P.S. Ramganj, district Lakshmipur. In Sripur village, many are affected, including children. There are about 200 members in one family and many of them are affected. We made a partial survey in these villages.

Death at early age

In Sripur village Monowar (F/30) and Faruk (M/18) died. Both of them had severe asenical skin lesions.

Field Survey: 10-13th February 2000

During this period we covered six districts. Out of them, we surveyed for the first time the two districts of Gazipur and Kishoreganj for arsenic patients and identified some patients. Details of districts, Police Stations and villages surveyed are given below.

Districts	Police Stations	No. of Villages
Gazipur	1	2

Kishoreganj		1	5
Lakshimipur		2	20
Noakhali		1	1
Comilla		1	3
Narsingdi		2	2
Total	**6**	**8**	**33**

Figure-3: Shows our survey route & Table- 21 & 22 show water analysis and patient status report.

Important Findings during Field Survey from February 10-13, 2000.

Field Survey: 10th February 2000 (District Gazipur)

Earlier, we had found that in the groundwater of Gazipur district arsenic above 0.05 mg/l. Arsenic patients were identified in village Khirati of Kapasia Police Station. Abdul Rab (M/35) (**Photograph-46**) was severely affected, and other than severe keratosis, he also had plenty of suspected Bowens.

There is a very big water body known as Goswabar Beel in Khirati. Villagers said that earlier people used to fetch drinking water from this beel where water is available throughout the year. During the rainy season, the beel gets connected with river Brahmaputra.

Field Survey: 10th February 2000 (District Kishoreganj)

In Bhairabpur Bazar (Pourosova), P.S. Bhairab, district Kishoregunj, we identified some patients who were taking drinking water from the Pourosava tubewell. This tubewell was installed about 40 years back and the affected people reported that it was the only tube-well in that area 40 years ago. And not only are they drinking from this tubewell but their parents and grandfather used to do the same. But recently, over the last 5-7 years, they are seeing skin lesions appearing on their bodies. Dr. Momtazul Hoque (Medical Officer, Thana Health Complex, Bhairab, Kishoreganj) said that during his childhood, his family drank from the same tube-well. Recently the tube-well was dismantled.

There is a jute mill in Police Station Bhairab in Kishoreganj district. About 1000 workers are working in this mill and there is a colony where some of the workers live. All the hand tubewells of this colony have been dismantled. So we could not get the concentration of arsenic people were drinking, but we got plenty of workers having arsenical skin lesions. Abdul Awar (M/40) is one of them (**Photograph-47**). He has both keratosis and melanosis.

Field Survey: 11th February 2000 (District Lakshmipur)

We had gone to village Daspara of P.S. Ramganj in 1996 for survey of arsenic patients. At that time, we detected high arsenic in drinking water. During that time, we could not get any information about arsenic patients. During this survey we identified many patients. Abdul Mannan (M/27) has skin lesions and is also suffering from Gangrene (**Photograph-48**). The arsenic content of his tubewell is 0.96 mg/l. Mr. Mannan was married about 6 years back and he has a daughter Tahamina (F/2). Mannan's wife Sufia (F/20) who has no arsnical skin lesions called us and narrated how quickly Mannan is getting worse. She asked us whether Mannan

would be all right! We arranged to amputate his feet. This was recently done in Dhaka Community Hospital. **Photograph–49** shows Mannan with his wife. We have found many unfortunate couples in arsenic affected villages. In village Ramnagar of Ramganj P.S., we identified a woman, Mafuja Begam (F/40), with arsenical skin lesions with predominant melanosis on tongue (**Photograph-50**) , which she noticed 2-3 years ago.

In Fatepur village we met Noorjahan (F/50), a woman with multiple ulcers on her body (**Photograph–51**).

Social problem

Arsenic patient; Anima Begam (F/25, Vill: Chandipur Purba, P.S.: Ramgar) was married when she was 15 years old. Within one year of her marriage her husband (Photograph-52) sent her back to her parents.

Field Survey: 12th February 2000 (District Noakhali)

In the village of Roghunathpur, PS: Chatkhil, Dist: Noakhali, many people are affected (Abu Sahid Y/41, Sohag, M/15, Amina F/45 etc.).

Field Survey: 12th February 2000 (District Lakshmipur)

Village Paschim Somalia of PS Ramganj is highly affected. We could only make a partial survey. Parvir Aktar (F/30) is an arsenic patient. She has severe arsenical skin lesions **(Photograph-53).**

During the late afternoon, we came to a crowded local Bazar. We had identified many villagers at this Bazar. Kalumia (M/60) from Darbeshpur village was a serious patient, who had, along with keratosis, melanosis suspected multiple Bowens (**Photograph-54**).

A disaster in village Aiyanagar, PS: Ramganj, district Lakshmipur

When we reached Aiyanagar it was getting dark. Villagers (Photograph-55) who had come get them examined surrounded us and to have their water samples tested, for they were not aware which of their tubewells were contaminated. After some time we were examining the patient with the help of torchlight. Villagers were so keen that we could not leave without examining them. We found 30 patients with arsenical skin lesions out of 150 people examined. The villagers said that in that village there were about 1000 people and in every family there was at least one patient.

Iayanagar village should be surveyed properly to know the magnitude of the calamity Our survey could cover only an only a small part of the total.

Death

In Iayanagar village, Anwar Hossain (M/30), Ebrahim Bhuina (M/45) and Maochana Mia (M/45) died and they had severe skin lesions. These were only a few cases of death out of many, the villagers said.

Field Survey: 13th February 2000 (District Comilla)

Children found affected with lower arsenic concentration

Comilla district's Eruani village of PS Laksam was surveyed. Eruani is a very big village. It has 3 parts: Madhyapara, Purbapara and Paschimpara. We could survey only Madhyapara and for a while Paschimpara. Normally, we do not find arsenical skin lesions in children unless the arsenic concentration in drinking water is quite high (around 0.75 mg/l) or the nutrition status is very poor, in which case a moderate arsenic concentration of around 0.5 mg/l can cause skin lesions in children. But in some villages of Bangladesh also in Madhyapara of Eruani village we have found children like Tahamina (F/8), Parvin (F/11) and Saiful (M/10), whose nutrition status appeared to be good, but have arsenical skin lesions drinking water having 0.25 mg/l of arsenic. All the children in **Photograph–56**, of Eruani village have elevated level of arsenic in hair, nail and a few have skin lesions.

Paschimpara of Eruani is highly affected. Here children are also affected - like Hasina (F/10), Nargis (F/8) **(Photograph-57**) who belong to a poor family and drink arsenic contaminated water having 0.17 mg/l of arsenic. Many villagers drinking that tubewell are affected. Villagers of Paschimpara are not aware of the arsenic concentration in their drinking water. Even a pregnant woman, Phulnar (F/23), who has arsenical skin lesions, also drinks, contaminated water **(Photograph-58).** However, the worse arsenic affected man of the village is Oidur Rahaman (M/30). He has severe keratosis (**Photograph-59**).

Village Eruani needs a detailed survey to know the magnitude of the calamity.

Conclusion

Even after our 239 days field survey during last 5 years in Bangladesh we feel we have seen the tip of iceberg of actual calamity. More we are surveying more and more affected villages and people suffering from arsenical skin lesions are coming to limelight.

Our most important observation is that people who had severe skin lesion during our earlier survey now are becoming victims of gangrene, cancer. **Table-23** shows some gangrene/cancer patients we examined in different districts.

Table-23: Patients who have/had severe arsenical skin lesions and later suffering from gangrene/cancer.

We predicted and warned in 1994 about the danger of arsenic problem in Bangladesh, which later came true. We are again informing based on our last five years study in Bangladesh that situation is more alarming. To combat the situation we need a collaborative effort and proper management.

The complete report with Tables, Figures and Photographs can be purchased (US $ 50).