Social Difficulties Faced by Arsenicosis Patients in Bangladesh

A thesis submitted in partial fulfillment of the requirements for the degree of Master of Philosophy in Social Welfare

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Declaration

I sincerely declare that the thesis titled **Social Difficulties Faced by Arsenicosis Patients in Bangladesh** is an original work, which is an outcome of the study conducted under the supervision of **Professor Dr. Abdul Hakim Sarker, Institute of Social Welfare and Research, Dhaka University.** I further declare that the material embodied in the thesis has not been submitted in part or full for any other diploma or degree from any University or Institute.

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I am pleased to endorse the declaration made by the researcher about the thesis.

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Abstract

The thesis is an outcome of a field-study on **Social Difficulties Faced by Arsenicosis Patients in Bangladesh,** which has been prepared in partial fulfillment of the requirements for the degree of Master of Philosophy in Social Welfare. The facts on social sufferings of the arsenicosis patients were directly investigated in twelve arsenic-affected villages of the country. Along with 146 arsenicosis patients, their family members, local leaders, journalists, public health engineers, health officers, NGO workers were also interviewed for being acquainted with the contexts of the situation. The study has indentified various unexpected social experiences of arsenicosis patients resulting for their illness. Arsenicosis patients have to cope with social stigma as well as fear of isolation from the community. When tube-well in any household is marked as arsenic contaminated, it brings shame for that household owner in the community. When a person is diagnosed with arsenicosis, the disease is sometimes considered as the God's punishment to that household. Patients with skin manifestations generally face avoidance and abhorrence by their family members and community people as well. As skin is the vital part of a person's appearance, arsenicosis patients also feel ashamed to come outside and mingle with others. They cannot freely move across their own locality and join others in any public places. Thus, arsenicosis patients become the victims of social ostracism or social exclusion. Female arsenicosis patients face additional social problems compared to their male counterparts. Married women are shunned by their husbands especially in maintaining sexual relationship. They are considered unsafe to become pregnant and to be a prospective mother. Unmarried arsenicosis patients lose the prospect of getting married. Children with arsenicosis are not permitted to play with their friends and to continue going to school. Moreover, arsenicosis creates unemployment and increases poverty. Patients have common complication of physical weakness, which gradually makes them unable to work. They are sometimes dismissed from their work and become dependent on other family members. Sometimes, affected limb of a patient has to be amputated leading to permanent disability. In this way, arsenicosis increases poverty in the villages. In respect of health care service, patients have

difficulty in detecting their disease at the early stage. Wrong diagnosis and maltreatment are very common. Economic loss from improper patient management is also enormous. Patients with severe arsenicosis are in many cases affected by cancer that leads them to certain death. The death of those patients pushes their families to extreme poverty. Arsenicosis patients require urgent supply of arsenic-free drinking water that may not be available in most cases. Patients face difficulty in getting access to safe drinking water as well as to proper treatment from health care givers. Widespread presence of arsenicosis in a locality creates a chaotic situation. Other local factors like religion and politics add to the problem and thus bring about social instability. Local political influence has already been felt in the all processes associated with arsenicosis. The more arsenicosis cases appear in the fields, the more external influences on the crisis are being observed. Consequently, the sufferings of the patients increase in the fields. Therefore, the study recommends for implementing a comprehensive and holistic approach to overcome this worst situation. Achieving the ultimate solution of this complex situation, the fundamental intervention must be the identification and provision of arsenic safe drinking water. Dependence on groundwater must be reduced and the use of surface water and rainwater can be increased with complete precautions. People's perception and awareness on arsenicosis must be enhanced to decrease social sufferings. Moreover, to ensure the success of all interventions taken to combat the situation, community education and participation are essential. Furthermore, all of the above activities should be tied with effective follow-up monitoring to verify that the sufferings of the people have been decreased. It is further recommended in the study that **social work** by its very nature as an enabling profession is potentially able to play a key role in terms of supporting and preventing social consequences of arsenicosis. Based on several empirical findings, field experiences and many more observations in the fields, the emergence of social work intervention in this regard has been an issue of social workers and policy planners. By being an applied social science, social work can play a significant role in **public education, community mobilization, and community development** programs to reduce social difficulties of arsenicosis patients, their families and other community people as a whole. Finally, the study is

believed to be of vital utility to those who are interested in deepening their understanding of social issues associated with arsenicosis patients, organizations cooperating with others to support affected communities and those who share the belief that a well-coordinated effort will be effective to reduce the sufferings of affected communities.

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CHAPTER - 1

BACKGROUND AND INTRODUCTION OF THE STUDY

Arsenicosis is a kind of disease that is well known as 'arsenic poisoning'. It is a disease with no specific treatment. This disease is also described as an environmental poisoning and illness. Humans get affected by this disease mainly through drinking arsenic contaminated water. Bangladesh is recognized as the worst victim of arsenicosis in the world. This is a natural problem though it has been identified of late in this country. As more medical tests and research works were being performed and subsequently concluded, the extent of the problem became evident. Estimates vary on the issue that how many people are affected. Tens of thousands of people have already been showing skin discoloration and other more serious manifestations of arsenic toxicity. Children below the age of ten are also now showing signs of chronic arsenic poisoning. By 2002, according to the Government Health Department, the number of reported arsenicosis patients were 13,333 (DGHS, 2002). The exact number is believed to be much higher. Everyday the symptoms of arsenicosis disease are becoming more visible amongst community people. The death toll from arsenicosis is gradually rising with time and thousands of arsenicosis patients are passing days in dismal hopelessness.

People of Bangladesh are being suffered from arsenicosis due to their drinking water habit greatly dependent on underground tube well water. The groundwater source provides drinking water to about 97% of the total population. This extensive coverage was considered the country's successful attempt to provide safe drinking water to its general population as surface water sources were often polluted and diarrheal disease were widespread. This efficacy of public health effort was overshadowed when in 1993 an alarming discovery confirmed of arsenic

contamination in groundwater. In this way, arsenic contamination of tube-well water in Bangladesh is described as the largest known mass poisoning in history. The discovery of arsenic contamination was first identified in the northwestern part of the country. However, it was soon evident that the contamination was more widespread and not confined to any one local area. It is assumed based on different studies so far conducted that the population at risk may vary from 25 million to over 36 million.

Not only clinical symptoms but also a number of social and societal problems are aggravating the situation. Dissolution of marriage, avoidance of arsenicosis patients, arsenic panic in the affected areas, etc. have been reported in many areas. Patients' work ability is reduced by arsenicosis in many ways. Thus, there have serious economic consequences for patients and their families. Access to health care services for arsenicosis remains difficult for poor people and they face problems in receiving proper treatment. As a consequence of these factors, arsenic itself can be a shock from which poor people are unable to recover.

On the other hand, drinking arsenic free water, the only measure to prevent arsenicosis is in severe frustrating condition. Patients as well as their families and community members are still drinking arsenic contaminated water from tube wells. Because, arsenic mitigation or alternative safe water sources have not yet been determined and provided to the people especially to the patients. This situation has worsened the difficulties of the patients that also have profound social implications and consequences. Ignorance, misconceptions, mistrust, maltreatment, mismanagement, etc. have multiplied the problem of the people. The nutritional status is also important in relation to the development of arsenicosis. The poor are at the greatest risk of arsenicosis. Due to poor nutrition they are often more susceptible to arsenicosis and often have limited access to water supplies, particularly where arsenic contamination means they have to negotiate access to new water supplies.

Many national and international organizations have come forward to work on arsenic mitigation in Bangladesh. Few organizations are working for arsenicosis patients to

improve the patient management system and increase access to health care services. Both government and non-government organizations and many academicians at individual level are doing researches on clinical, technological, environmental and social aspects of the problem of arsenic and arsenicosis. Different information, education and communication (IEC) materials including learning materials in particular, have been and are being developed by different agencies which are very much important for mitigating massive arsenic poisoning in this country. But, the social problems of arsenicosis patients have not attracted the attention they deserve as most activities and discourses have focused on clinical aspects of the disease. Effective and sustainable management of arsenicosis patients also necessarily depends on considering the social issues related to it. This study was designed to meet that knowledge gap. The objective of this study was to focus on the social sufferings of the arsenicosis patients. Understanding the nature, variety and extent of the social problems of the patients and the people at risk was the key concern of the study. Qualitative field study method was used to gather factual data on social difficulties of arsenicosis patients that must be approached immediately. Otherwise, social stability would be threatened. It is expected that the outcome of the study will increase our efficiency to combat the deadly crisis of arsenic and arsenicosis in Bangladesh.

CHAPTER - 2

GENERAL ASPECTS OF THE PROBLEM

Arsenic: as a Natural Element

Arsenic is a chemical element in the nitrogen family. It is a crystal shape metalloid, which is brittle in nature. Arsenic is a group-V element in the periodic chart. Its atomic number is 33 and atomic weight is 74.92. This is a notorious poisonous metalloid that has three allotropic forms: yellow, black and gray. Although compounds of arsenic were known as early as the 4th century BC, the element was not identified as such until 1649 (Encyclopedia Britannica, 2007). Arsenic in is known as *'Senko Bish'* or *'Shankho Bish'* among the Bengali-speaking people. This term is also used in the Bengali books on medical science (Dhaka Community Hospital Trust, 1998).

History

The word arsenic is borrowed from the Persian word Zarnik meaning "yellow orpiment". Zarnik was borrowed by Greek as 'Arsenikon'. Arsenic has been known and used in Persia and elsewhere since ancient times. It has long been known that arsenic is acutely toxic. Anyone who drinks arsenic in water at 60 parts per million (ppm) will soon die (Wilson, 2007). As the symptoms of arsenic poisoning were somewhat ill-defined, it was frequently used for murder until the advent of the 'Marsh test', a sensitive chemical test for its presence. Due to its use by the ruling class to bump each other off and its incredible potency and discreteness, arsenic has been called *the Poison of Kings and the King of Poisons*. The use of arsenic as a deadly poison has been known since long years back. Arsenic was evidently used to kill the French emperor Napoleon Bonapart who was defeated and captured by the British force in the war of Waterloo. It was then publicized that Napoleon died in

stomach cancer, but many years later, when the hair and nail of the French Emperor were examined in the laboratory, arsenic was found in Napoleon's hair 13 times more than the normal level (Dhaka Community Hospital Trust, 1998). Arsenic has been used since 3000 BC. In the United Kingdom, for example, it was used to extract iron from iron ore. During the Bronze Age, arsenic was often included in the bronze (mostly as an impurity), which made the alloy harder. Albertus Magnus is believed to have been the first to isolate the element in 1250. In 1649, Johann Schroeder published two ways of preparing arsenic. The alchemical symbol for arsenic is shown opposite. In Victorian times, arsenic was mixed with vinegar and chalk and eaten by women to improve the complexion of their faces (Partington, 1935).

Types of Arsenic

Chemically there are two types of arsenic compounds: organic and inorganic. Inorganic arsenic is also of two types - Trivalent and Pentavalent. Trivalent arsenic compounds are known as arsenite and the Pentavalents are as arsenate. Inorganic arsenic is more toxic than the organic ones. On the other hand, Trivalent arsenic is 60 times more toxic than Pentavalent arsenic. Usually there are four types arsenic compounds exist in water. These are arsenite, arsenate, monomethyl arsenic acid and dimethyl arsenic acid. In the groundwater, arsenic predominantly occurs in the trivalent and pentavalent form. These two were found in the groundwater of Bangladesh and West Bengal (Ahmed, 2006).

Prominent Characteristics of Arsenic

Arsenic is very similar chemically to its predecessor phosphorus, so much so that it will partly substitute for it in biochemical reactions and is thus poisonous. When heated it rapidly oxidizes to arsenic trioxide, which has a garlic odor. Arsenic and some arsenic compounds can also sublime upon heating, converting directly to a gaseous form (Wikipedia, 2005).

Presence of Arsenic in Environment

Arsenic is found in nature as a free element. It is an ever-present element of the earth and is extensively disseminated around us. Therefore, the natural world itself is an adequate source of arsenic. But, it is occasionally found uncombined in the nature. Generally, it is found in association with such metals as antimony and silver (Encyclopedia Britannica, 2007). According to availability of natural elements in environment, the position of arsenic is 20^{th} (Dhaka Community Hospital Trust, 1998).

Arsenic is found in atmosphere, in the aquatic environment, in soils and sediments and in organisms. Different minerals of arsenic are mixed with underground rock. Arsenic poison can spread in air from the industrial wastes. Generally, nominal amount of arsenic also exist in water. Per liter natural water contains 1-2 microgram of arsenic (Dhaka Community Hospital Trust, 1998). Trace quantity of arsenic is also found in most of the fruits, vegetables, fish and meat. But high level of arsenic exists in sea water. Food of marine origin are much richer in arsenic than other foods. Arsenic unto 5 milligram could be found in per kilogram of sea fish. It means, human beings are receiving some quantity of arsenic through air, food and drinks everyday. But the arsenic doesn't cause damage of human bodies, as its extent is very minimum. The arsenic which are received through food is generally organic. Its poisonous effect is low compared to inorganic arsenic. Usually, a person can receive arsenic up to 150 microgram for per kilogram weight of his or her body without any efface. But, sensitive individual may fall sick for only 20 microgram arsenic (Ahmed, 2006).

There are a lot of arsenic in earth's bio-mass. Arsenic also exists in lava of volcano. Geothermal system and uranium and gold mines are the sources of arsenic. It occurs in the air in areas where coal is burnt, particularly near smelters and refineries (Dhaka Community Hospital Trust, 1998).

Beneficial Uses of Arsenic

Arsenic compounds have many beneficial uses and are applied for various purposes. They are mainly used in agriculture, forestry, medication and industrial processes. Arsenic tri-oxide is used in manufacturing of agricultural chemicals (pesticides), glass and glassware, industrial chemicals, copper and lead alloys and pharmaceuticals (Dhaka Community Hospital Trust, 1998).

In agriculture, lead arsenate was used, well into the 20th century, as a pesticide on fruit trees. Although it was resulted some neurological damage to those worked as sprayers. Besides, lead arsenate, copper aceto arsenite, sodium arsenate, calcium arsenate and organic arsenic compounds are also used as pesticides. In Australia, arsenic trioxide is used for treating termite infestations in houses (Wikipedia, 2005). Substantial amount of methyl Arsenic acid and diethyl arsenic acid are used as selective herbicides (Ahmed, 2006).

Chromate Copper Arsenate (CCA), sodium arsenate and zinc arsenate are used as wood preservatives (Dhaka Community Hospital Trust, 1998). CCA timber is still in widespread use in many countries, and was heavily used during the later half of the 20th century as a structural and outdoor building material, where there was a risk of rot, or insect infestation in untreated timber. Although widespread bans followed the publication of studies which showed low-level leaching from children's playground equipments into surrounding soil, the most serious risk is presented by the burning of CCA timber. Recent years have seen fatal animal poisonings and serious human poisonings resulting from the ingestion - directly or indirectly - of wood ash from CCA timber (the lethal human dose is approximately 20 grams of ash - roughly a tablespoon). Scrap CCA construction timber continues to be widely burnt through ignorance, in both commercial and domestic fires. Safe disposal of CCA timber remains patchy, and little practiced, there is concern in some quarters about the widespread landfill disposal of such timber (Wikipedia, 2005).

Arsenic has been used for many years for medicinal purposes. As medicine, arsenic is used since the fifth century BC when Hypocrites recommended the use of an Arsenic sulfide for the treatment of abscess. During the 18th, 19th, and 20th centuries, a number of arsenic compounds were used as medicines (Wikipedia, 2005). It used to be used as a cure for diseases such as syphilis and has been shown to assist in curing some leukemia (Wilson, 2007). Arsphenamine (by Paul Erlich) as well as Neosalvarsan was indicated for syphilis and Trypanosomiasis, but has been superseded by modern antibiotics. Arsenic trioxide (by Thomas Fowler) was used in a variety of ways over the past 200 years, but most commonly in the treatment of cancer. The FDA in 2000 approved this compound for the treatment of patients with acute promyelocytic leukemia that is resistant to ATRA (All-Trans Retinoic Acid) (Wikipedia, 2005). It was also used for the treatment of skin disorder, tuberculosis, asthma, leprosy, amoebic dysentery, etc. In Homeopathic treatment arsenic is used as a prominent drug. Moreover, the radioactive isotopes of arsenic have been used in medical diagnostic procedures (Encyclopedia Britannica, 2007).

Elemental arsenic has few practical industrial uses, one of which is to impart more nearly spherical shape in the manufacture of lead shot. It is also used in certain alloys to increase strength at elevated temperatures, in bronzing, and in pyrotechnics. Besides these, arsenic is used in the preparation at transistor and as a component of semiconductor (Dhaka Community Hospital Trust, 1998). As an important semiconductor material, Gallium arsenide is used in integrated circuits. Circuits made using the compound are much faster (but also much more expensive) than those made in silicon. Unlike silicon it is direct band gap, and s o can be used in laser diodes and LEDs to directly convert electricity into light (Wikipedia, 2005).

Furthermore, arsenic is used in the preparation at dyes, poisonous gas, as a preservative in tanning and in the industry of textile, paper, etc. During the 19th century, copper arsenate has even been used as a coloring agent in sweets. Some phenyl arsenic compounds such as arsenal acid are used as feed additives for poultry and swine (Ahmed, 2006).

Arsenic Contamination

Arsenic contamination has become a problem in many parts of the world. Arsenic mainly contaminates the air, surface and underground water. Contamination can derive from anthropogenic (men-made), natural (geological) reasons and from the both. It occurs as results of geological processes and different development activities like agricultural exploration of mineral resources and their processing by human being. The application of arsenic herbicides and pesticides represents a primary source of environmental arsenic contamination. On a local scale, significant air pollution with arsenic occurred from the burning of trash cotton plants sprayed with arsenic. The main sources of arsenic pollution in surface water include domestic and industrial waste, wooden power poles, base metal mining and smelting, and fallout of contaminated aerosols (Ahmed, 2006). Natural causes include dissolve of naturally concentrated arsenic into surface or underground water.

The Worldwide Extent of Arsenic Contamination

The problem of arsenic contamination took a severe shape in many parts of the present world. The contamination has been spread more or less in every continent. It took place in different states of the world due to various reasons. First of all, arsenic has been contaminated as a result of leaching from mine tailings in Australia, Canada, Japan, Mexico, Thailand, United Kingdom, and the United States. Arsenic was widely used as a pesticide. 20,000 tons a year was imported into the USA, and perhaps double that amount was used, to spray on crops in the USA alone. No attention was paid to the ultimate fate of the chemical, and in consequence, arsenic now appears in foodstuffs (Ahmed, 2006). Arsenic contamination in surface water has been reported from Bolivia, Chile, Greece, Mexico, Spain, and Thailand. Arsenic contamination in underground natural aquifers has also been reported from Argentina, Cambodia, China, Ghana, Hungary, Mongolia, Nepal, New Zealand, Philippines, Taiwan, the United States and Vietnam.

Table – 4: Worldwide occurrences of arsenic contamination in water

Country	Potential Exposed People	Concentration (µg/L)	Environmental Conditions	Source
Argentina	2,000,000	1-2,900	Natural; and volcanic rocks	Groundwater
Bangladesh	> 29,000,000	1-4,730	Natural, alluvia	Groundwater
Bolivia	50,000	-	Natural and anthropogenic	Surface water, groundwater
Chile	500,000	100-1,000	Natural and anthropogenic; basin lakes, thermal, mining	Surface water
China	> 500	40-750	Natural; alluvial sediments	Groundwater
Greece	150,000	-	Natural and anthropogenic; thermal spring	Surface water
Hungary	400,000	2-176	Natural; alluvial sediments;	Surface water
Mongolia	> 400,000	1-2,400	Natural; alluvial and lake sediments; high alkalinity	Groundwater
Mexico	400,000	8-620	Natural and anthropogenic; volcanic sediments, mining	Surface water, groundwater
Nepal	-	-	Natural, alluvia	Groundwater
Spain	> 50,000	1-100	Natural; alluvial sediments	Surface water
Taiwan	> 100,000	1-1,820	Natural	Groundwater
Thailand	15,000	1-5,000	Anthropogenic	Surface water
Vietnam	> 1,000,000	1-3,050	Natural, alluvia	Groundwater
India	> 1,000,000	10-3,880	Natural, alluvia	Groundwater

Source: (Rahman, 2002, p. 194)

The latest contamination of drinking water has been identified in Bangladesh and India. Experts pointed out that there are some similar geological reasons behind this contamination in these two regions (Dhaka Community Hospital Trust, 1998).

Arsenic Contamination in Bangladesh

In Bangladesh, high concentration of arsenic has been found in hand pumped tube-well water. These tube-wells are mainly used to withdraw safe and clean drinking water from underground aquifers. Installation of tube-well is comparatively easier

and cheaper for the common villagers of Bangladesh. By 2000, the problem of arsenic contamination has been regarded as the largest mass poisoning of a population in history. The scale of this environmental disaster is considered much worse than the well-known catastrophe of the Chernobyl nuclear power plant accident in Ukraine (1986), or at Bhopal in India (1984) (Smith, Ligas & Rahman, 2000).

Background

Arsenic contamination of in groundwater was first discovered of West Bengal in India. When the problem was totally unknown in Bangladesh, it became evident in neighboring West Bengal during the mid-eighties. The first report of arsenic contamination in West Bengal, was published in 1983, and by 1988 massive contamination of groundwater in that province was confirmed (Shaha, 1995).

In 1995, School of Environmental Studies (SOES) Jadavpur University, India organized an international conference on arsenic in Kolkata. This conference brought the arsenic problem in West Bengal to wider audience, and at the same time highlighted the urgent need for serious studies across the border of Bangladesh (Shaha, 1995). Arsenic specialists in Kolkata, however, predicted that as the younger deltaic deposition stretched from West Bengal into Bangladesh, the latter might also have arsenic contamination of groundwater. The prediction held true as they found patients from the adjacent districts of Bangladesh with arsenical skin lesion going to Kolkata for treatment. They warned the government of Bangladesh and the WHO about the presence of arsenicosis patients in Bangladesh in the early nineties and accordingly Bangladesh Government began investigating in those directions. However, it was kept more or less unpronounced and neither the physician community, nor the public knew anything about it (Dhaka Community Hospital, n.d.).

The initial focus of investigation in Bangladesh was along the borders with West Bengal, India. It was of limited scope and area-specific. In 1993 (Kabir, Ahmed & Zaman, 1999), Department of Public Health Engineering (DPHE) first discovered the arsenic contamination problem in Barogharia union of Chapai Nawabganj district. This was followed by official identification of patients of arsenic intoxication in 1994 (Khan et al., 1997). Following the recognition of the problem massive surveys were undertaken both by the government and by non-government organizations. These national scale studies revealed the problem to be of an enormous magnitude engulfing almost the entire country. The first nationwide random sample survey discovered that the epicenter of arsenic contamination lies not in western frontier but in the southeast in the Meghna estuary area (Dhaka Community Hospital, 2000).

Regulatory Limits of Arsenic

The regulatory limits on arsenic exposure were set primarily to be sure that the acute toxic effects were avoided. The first regulatory limit of which was set as a result of a public inquiry (subsequent to arsenic being found in beer) of six members chaired by the physicist William Thompson, first Lord Kelvin, in 1903. They recommended that sake of liquids with more than 100 grains of arsenious oxide per gallon (which works out at about 90 ppb of arsenic or 0.09 ug/l). This was reduced two fold over the next century and until recently the limit set by Bangladesh, the United Kingdom, and the United States was 50 parts per billion (ppb). But the discovery that there are adverse effects of continuous chronic exposure led WHO to lower their recommendation to 10 parts per billion (10 ppb). The European Union (EU) enforced new standard for drinking water of 10 ppb in 2006 (Wilson, 2007).

World Health Organization (WHO) recommendations on the acceptability and safety of levels of arsenic in drinking water have dropped twenty-fold, from a concentration of 0.2 mg per litre in 1958 to 0.01 mg per litre in its 1993 Drinking Water Guidelines. In Bangladesh, the Department of Environment determined the acceptable limit of arsenic in drinking water of Bangladesh as 0.05 mg/l (milligram

per litre) in 1997 (Local Government Division, 2002). Bangladesh Standards for Testing Institution (BSTI), another regulatory body of Bangladesh, also set (in 1989)) the same permissible limit for arsenic (0.05 mg/l) in water (World Health Organization, 2000).

In other words, the standard of safe arsenic concentration limit in Bangladesh is 0.05 milligram in one litre of water. 0.05 mg/l (milligram per litre) can also be expressed as 50 µg/l (microgram per litre), which is same as 0.05 ppm (parts per million) or 50 ppb (parts per billion) respectively (Water Aid Bangladesh, 2007).

Magnitude of the Problem

A nationwide survey that examined 3,534 water samples (8 samples per Upazila) mostly from DPHE installed tube-wells located in 433 Upazillas form 61 districts (excluding the 3 hill districts) found that the arsenic concentrations ranged from less than 0.00025 mg/L to 1.670 mg/L. The mean concentration was about 0.055 mg/L, 27% of the "shallow" tube-wells, (wells less than 150 m deep) exceeded the Bangladesh standard for arsenic in drinking water (0.05 mg/L) and 1% 'deep wells' (greater than 150 m deep) exceeded the Bangladesh standard. About 9% of the tube-wells exceeded 0.20 mg/L, 1.8 % exceeded 0.50 mg/L and 0.1% exceeded 1.0 mg/L. Arsenic concentration as high as 4.7 mg/L has been detected in water sample from Bangladesh (BGS & DPHE, 2001).

In another survey with greater coverage, 30,000 tube-wells from 61 districts have been tested for the presence of arsenic in underground water by the different organizations. Water samples of 47 districts' were found to have arsenic above 0.05mg/1, and in 14 districts the arsenic concentration was more than 0.01 mg/1. In those 47 districts, where arsenic concentration crossed 0.05 mg/1 limit, 54.64% of the samples were found excessive arsenic concentration In this way, it became evident that in 47 districts arsenic in groundwater is above 0.05 mg/l and in 54 districts above 0.01 mg/l and thus around 77 million people are drinking arsenic contaminated water (Dhaka Community Hospital, n.d.).

Arsenic Affected Districts

The worst affected districts are Chandpur (90%), Munshiganj (83%), Gopalganj (79%), Madaripur (69%), Noakhali (69%), Satkhira (67%), Comilla (65%), Faridpur (65%), Shariatpur (65%), Meherpur (60%) and Bagerhat (60%) (NAISU, 2003). The least affected districts are Thakurgaon, Pnachagarh, Nilphamari, Natore, Lalmonirhat, Patuakhali, and Barguna, where none of the samples exceeded the Bangladesh limit. Mainly the southern half of the country is contaminated, but there are a few occurrences of contamination in the northeast as well. The north is either free of contamination or sparsely contaminated. Field and laboratory testing results done by different organizations have confirmed this general pattern although there are a few local pockets of contamination within the uncontaminated areas (Ahmed, 2006). Although not all tube-wells of the country are contaminated, there are thousands of pockets of contaminated underground water in at least two thirds of the districts of Bangladesh and the people living there are at real risk of developing arsenic toxicosis (Dhaka Community Hospital, n.d.).

Arsenic Problem in Bangladesh Compared to Other Countries

It is important to distinguish the problems in Bangladesh, West Bengal and, to a lesser extent, Inner Mongolia, Chile, Nepal and Vietnam, from the problems that have been found so far in the rest of the world. These situations have in common that they are an alluvial plain where arsenic has been brought down from the surrounding hills for millenia. It seems that no one has looked carefully at similar geological situations such as the Mekong delta or the Irrawaddy delta. In most of the world exposures above 50 parts per billion (50 ppb) are rare, and once observed, can easily be avoided. But the sheer scale of the problems in Bangladesh dwarfs the imagination. The catastrophe is much worse than the well-known catastrophe of the Chernobyl nuclear power plant accident, the Bhopal isothiocyanate leak or the Kuwait oil fires. For 90% of the Bangladeshi communities, pure water is still a long time away (Wilson, 2007).

Mitigation of Arsenic Poisoning

In Bangladesh, most arsenic mitigation activities follow a general strategy. After gathering preliminary data on affected locations, organizations test tube-well water with field kits. The field staffs undertaking testing usually inform people of test results and advise them not to use arsenic-contaminated water. They often paint the heads of affected tube-wells red color and the safe ones, green. The local population may or may not understand the messages given by the field staff, depending on how well the messages are communicated, how much time is taken to communicate, and the water users' own capacity to understand abstract information (Hanchett, 2006).

Different government, non-government and international organizations are working for arsenic mitigation in Bangladesh. The government has taken up Bangladesh Arsenic Mitigation Water Supply Project (BAMWSP) with a loan from the World Bank. The Government, national and international NGOs has used a number of techniques for mitigating the problem. Removal of arsenic from contaminated water can be achieved through filtration by passing the water through columns containing materials that have an affinity for arsenic so that arsenic is absorbed by the column as the water passes through the column. But, these methods are costly, and reliable and practical methods are still not available for mass use (Ahmed, 2006).

Household Based Arsenic Removal

A number of techniques have been developed to remove arsenic from drinking water at household level, that are small scale removal plants or filters. The available techniques include 3-*kalsi* method, *safi* filter, SOES-filter, 2-bucket system, passive sedimentation, etc. These techniques are used at household level where arsenic contaminated water is passed through a filtering unit to remove arsenic and make the water fit for drinking.

Shallow Tube-wells and Dug-wells

Very shallow tube wells and dug wells (less than 10m deep) have been found to be arsenic free in most parts of the country and are being considered as an alternative source of arsenic-free drinking water. However, microbial contamination in this type of groundwater is normally high, as is the amount of nitrate.

Pond Sand Filter (PSF)

This is a slow sand filter that utilizes pond water. A sand filter is constructed near a reserved pond and this can provide arsenic and bacteria free drinking water. However, maintenance is a major problem.

Rainwater Harvesting

Rainwater is also being considered as a source of arsenic-free water, at least during the monsoon. Rainwater is collected and stored in large earthen or ferro-cement jars for drinking.

Deep Groundwater

Deeper groundwater (>150m) has been found to be mostly arsenic-free so far, particularly in the coastal belt of Bangladesh. Deeper groundwater is considered a long-term source of safe drinking water.

Treated Surface Water

Surface water normally contains very large amounts of microbiological contaminants. Where available, surface water can be treated to provide safe drinking water.

Arsenic Removal Plant

Large-scale arsenic removal plants are also built to remove arsenic from the water supply in some municipal areas where piped water supply exists. A number of such plants have been built at Manikganj, Meherpur and Satkhira (Ahmed, 2006).

Commonly, but not universally, some kind of local water user group or committee is formed, although this is done with varying degrees of thoroughness and public

involvement. Usually after committee formation - but sometimes before or without it - an alternative water source or water treatment system is recommended and/or provided. The formation of committee and provision of arsenic-safe water frequently occurs some time after initial screening. All responsibility for operation and maintenance of that facility will be handed over to the 'community' within varying periods, but sometimes immediately after completion. It is not clear to what extent affected-communities are trained or otherwise prepared to assume this responsibility (Hanchett, 2006). Arsenic mitigation activities differ considerably in the degree to which they involve the general public in decision-making at each of these stages. It can also be assumed that there may be significant variation in the effectiveness of individual programs between different geographical areas of operation.

Geological Introduction

Geological evolution of Bangladesh is basically related to the uplift of the Himalayan Mountains and outbuilding of deltaic landmass by major river systems originating in the uplifted Himalayas. This geology is mostly characterized by the rapid subsidence and filling of the basin in which a huge thickness of deltaic sediments were deposited as a mega-delta out built and progressed towards the south (Imam, 2006). Padma-Brahmaputra-Meghna rivers of Bangladesh originated from Himalayan Mountains. This land is situated in low-lying alluvial region of a delta composed of confluence of these three rivers. Most of the land is flat and about 75% of the land is less than 3 meter above the sea level. About 700 tributaries and distributaries of these three mighty rivers crisscross this low-lying landscape having numerous surface water bodies and rich groundwater reserve (Islam & Miah, 2003).

Alluvial and deltaic processes of the mighty rivers like Padma, Brahmaputra, and Meghna have deposited nearly 85% of the recent sediments of Bangladesh and thus occupy the major portion of the Bengal basin. Many other smaller rivers also have their contributions, but to a lesser extent. There are about 230 rivers with a total

length of about 24,140 km. The active delta occupies the area south of the Ganges River and mostly west of the Meghna estuary. Most of the delta is less than 15 m above the sea level and the tidal zone is generally 3 m above that level. There are also some hilly regions in the northeast and the southeast and some high lands in the north and northwestern part of the country.

Composition of sediments depends on the rocks of their origin. Those associated with the river Ganges tend to be rich in clay and often contain silts, rather than clay. It is also known that sedimentary rocks generally contain more arsenic than other types of rocks (Dhaka Community Hospital, n.d.). Arsenic has originated from the arsenic-rich rocks in the region's river systems, deposited over thousands of years along with the sands and gravels which make up Bangladesh (UNICEF, 2006).

Arsenic Contamination of Groundwater

Groundwater is one of the components of the hydrological cycle, stored underground in rock layers called aquifers. The groundwater level over most of Bangladesh lies very close to the surface. Storing water in underground aquifers is a result of rainwater and surface water infiltration. This kind of infiltration is called percolation. When surface water from rain or flood reaches the upper level of the groundwater, it begins a long, slow journey towards underground. It moves at a rate ranging from a few millimeters to a few meters per day. The zone above the water table is called the 'unsaturated zone', and the zone beneath the water table is called the 'saturated zone'. The soils and rocks in the unsaturated zone remove the main impurities, while the rocks in the saturated zone filter and purify the water even further. Because of this process, groundwater is naturally free of pathogens and pollutants, usually of excellent microbiological quality, and of adequate chemical quality for both irrigation and drinking purposes (Ahmed & Hossain, 2006). In 1989, the Master Plan Organization (MPO) estimated a reserve of 25,750 million-meter cube (MMC) of groundwater in Bangladesh. Of this 1,686 MMC are unavailable and 900 MMC

remains in reserve for domestic cum industrial use and a maximum of 12,809 MMC is available for agriculture (Ahmed & Hossain, 2006).

Use of Groundwater

Groundwater has become the main source of drinking and irrigation water supply in recent Bangladesh. Though the exact figures are not available, it is assumed that 2-5% of total abstracted groundwater is used for household purposes and the 95-98% of abstracted groundwater in this country is used for agricultural purposes (Local Government Division, 2002). In 1997, Bangladesh claimed to have provided safe drinking water to about 97% of the population of this country. (National Plan of Action for Children, 1997) (Local Government Division, 2002). This said success was mostly achieved by massive use of groundwater through installation of hand tube-wells. Tube-wells have been used in Bangladesh since the 1940s (UNICEF, 1999). However, the problem of arsenic contaminated water has only recently become known due to the increasing number of tube-wells used over the past 20 years and the subsequent increase in the number of individuals drinking from them. Historically, surface water sources in Bangladesh have been contaminated with microorganisms, causing a significant burden of disease and mortality. Infants and children suffered from acute gastrointestinal disease resulting from bacterial contamination of stagnant pond water. Consequently, during the 1970s the United Nations Children's Fund (UNICEF) worked with the Department of Public Health Engineering to install tube-wells to provide what was presumably a safe source of drinking water for the population. These wells are inserted into the ground at depths of usually less than 200 m. At the time the wells were installed, arsenic was not recognized as a problem in water supplies, and therefore standard water testing procedures did not include tests for arsenic. During the 1980s, UNICEF's support for installing tube-wells decreased because the private sector was able to supply and install millions more of them. Presently, three out of four tube-wells in Bangladesh are privately owned (UNICEF, 1999). Exact numbers of these hand tube wells used for withdrawing water for household purpose are not known but the number may be anywhere from 6 - 11 millions (6,000,000 – 11,000,000) (Local Government

Division, 2002). Presently about 80% of the people in rural Bangladesh depend on groundwater for drinking. Urban water supply is also largely dependent on groundwater. In Dhaka City also, more than 95% of the supply comes from groundwater and the remainder is provided by treated surface water (Ahmed & Hossain, 2006).

In 1997, hybrid varieties of rice were introduced in the country with consequent higher demand for groundwater. It must be mentioned that history of irrigation in Bangladesh is not very old. This started mainly with the introduction of the high yielding variety of rice in the early sixties and the major development took place from early seventies. In 1982-83, groundwater represented 40% of total irrigation consumption that rose to 70% in 1996-97. In 2001, Bangladesh Agricultural Development Corporation (BADC) showed that out of a total land under irrigation, about 75.07% are irrigated by groundwater (Local Government Division, 2002, p. 51).

It is however observed that water from deep tube wells below 150 to 200 meters appears to be essentially free from arsenic contamination. Most of the arsenic contaminated tube wells are extracting water from the Upper or composite and Middle or main aquifers (150-200 meters). On the other hand, the top of a shallow aquifer, at a depth of less the 10 meters is much contaminated by arsenic and shallow dug wells are usually uncontaminated though they are highly contaminated with microbes and responsible for various diarrheal diseases (Islam, 2006).

How Groundwater in Bangladesh is Contaminated by Arsenic

How the underground water is contaminated with arsenic is still not clear. Since the problem was first discovered, a number of hypotheses were put forward to explain the source and origin of arsenic and how it is released to groundwater. These included both human-made (anthropogenic) and natural (geological process) causes.

Of the human-made ones, the use of fertilizers, pesticides, insecticides, waste disposal, and arsenic treated wooden poles for power grids were blamed for the contamination. On the other hand, natural cause explains arsenic in underground water as an natural origin. The natural geological formation of underground sediments in Bangladesh generally contains high concentrated arsenic. Distribution of arsenic contaminated groundwater is also related to the geology, with most of the arsenic contaminated tube wells drawing water from the Middle and Upper Holocene sediments. Arsenic is believed to be released from soil under conditions conducive to dissolution of arsenic from solid phase on soil grains to liquid phase in water. Among the few hypotheses initially proposed to explain the possible mechanism of arsenic release under ground, most scientists have settled to two hypotheses: (1) Oxidation theory, and (2) Reduction Theory (NAISU, 2003).

1. Oxidation Theory: It is believed that in the affected area excessive lifting of underground water for irrigation purposes has been gradually lowering the groundwater level causing movement of oxygen in the empty space created by water withdrawal. Oxygen can trigger oxidative changes in arsenic-containing rocks which is present underneath, the consequence of which is the release of inorganic arsenic into the water (Islam, 2006).

Arsenic is released from arsenic minerals through the oxidation process, which has been infiltrated the groundwater table causing widespread arsenic contamination and eventual poisoning. **Heavy withdrawal of groundwater** and the **fluctuating water table** plus the **thousands of boreholes** caused by the sinking of tube-wells, has caused the underground aquifers to become oxidized. This newly introduced oxygen into underground aquifers has the release of arsenic into water. When arsenic compounds encounter water and air, and the light pressure from the tube-wells helps to break down the compounds to be dissolved. If water is pumped incessantly over a long period of time, the quantity of arsenic will gradually increase.

2. Reduction Theory: According to the Mott MacDonald - BGS report, the groundwater arsenic problem in Bangladesh arises because of an unfortunate combination of three factors: a source of arsenic (arsenic is present in the aquifer sediments), mobilisation (arsenic is released from the sediments to the groundwater) and transport (arsenic is flushed away in the natural groundwater circulation). This process in itself is not responsible for the timing of the arsenic problem as it started thousands of years ago, probably shortly after the sediments were laid down, and may have been occurring ever since.

In an international conference organized by Dhaka Community Hospital (DCH) and School of Environmental Studies (SOES) at Dhaka in February 1998, it was agreed that the contamination was of geological origin, not a human-made one (Ahmed, 2006). Now it has been more or less generally agreed upon that the source of arsenic contamination is geological with mobilization of arsenic due some geochemical processes (Dhaka Community Hospital, n.d.). The intensity of arsenic problem has not been found to have any relationship with groundwater fluctuations. Similarly, the hot spots in Bangladesh are not located in areas of high withdrawal of groundwater for irrigation (NAISU, 2003). Natural processes of groundwater flushing would eventually wash the arsenic away, but this will take thousands of years. The flushing is particularly slow in the Bengal basin due to the low hydraulic gradients in such a large flat deltas.

Water Habit in Rural Bangladesh

Water is central to the way of life in Bangladesh and the single-most important resource for the well-being of its people. It sustains an extremely fragile natural environment and provides livelihood for millions of people. Unfortunately, it is not infinite and cannot be treated as a perpetual gift of nature to be used in any manner chosen. The unitary nature of water makes its use in one form affect the use in another. Its availability for sustenance of life, in both quantitative and qualitative

terms, is a basic human right and mandates its appropriate use without jeopardizing the interest of any member of the society.

From about 125 million Bangladesh's population, more than seventy-nine percent relies on groundwater as their main source of drinking water (Local Governent Division, 2004). Most of this water supplied by tube wells. There are about 10 million tube wells in 26 million households (BBS, 2003). The rural people use pond, lake and river water for washing, bathing and other domestic purposes. The urban people use deep tube-well water for the same. For irrigation, river water and groundwater from shallow level are used (Dhaka Community Hospital, n.d.).

According to DPHE source, in 1993-94 there were 855,996 hand/shallow tube-wells in rural areas and the number of deep tube-wells in 8 former coastal districts of Chittagong, Noakhali, Sylhet, Khulna, Barishal, Faridpur, Patuakhali and Jessore was 51,819 (Dhaka Community Hospital, n.d.). According to a research report, Majority of the villagers of Bangladesh obtain their drinking water from tube wells (71.3%), only few of them drink water from deep tube-wells (7.9%), fewer of them drink pond water (5.2%). Water for cooking was predominantly collected from ponds (42.5) or tube-wells (46.9%). Almost half of villagers had shared drinking water source (52%). There are people who drink from tube-wells knowing that those were contaminated by arsenic (29%). There are people who actually do not know about the contaminated status of the tube-wells they used (13.7%) (Ahmed et al., 2007).

Transformation of Surface Water to Groundwater

Surface water from ponds, canals and rivers was the traditional source of water in Bangladesh. People of both urban and rural areas also had a use of dug wells to collect water for drinking. In villages, ponds are found in almost all households. In most cases, 3/4 households share a common pond. A pond surrounded by few

households with their own "ghatla" (a flight of stairs, built of bricks at the bank of the pond) is a common setting in the villages of Bangladesh. It was also in practice of the village women that they used to go for testy and clean water to a distant pond of the village. Not only the villagers, but people of urban communities also used pond water for different purposes. They used to take bath, wash cloths, plates and dishes, cut fishes and vegetables in their nearby pond or river water. On the other hand, sanitation system in the villages was very poor. People had a habit to defecate in open places. Unhygienic latrines were built in places that naturally contaminated the surface water bodies. People ware unaware to drink contaminated water and to protect their water sources to be contaminated. Practically, there was not alternative water source that could provide water for drinking only.

Background of Installing Tube-well for Drinking Water

Drinking untreated surface water resulted widespread water borne diseases everywhere in the country. These diseases extracted a heavy toll on people's lives. Although survival is easier, diseases like diarrhea was quite common because of the poor sanitation resulting in microbiological contamination of surface water bodies by human feces. To overcome this problem considering the suitability of soil condition for groundwater extraction only few meters below the ground provoked the authorities to initiate installation of tube wells. The tube wells in fact a simple hand pump device fitted with pipes, which allows easy pumping of groundwater (Ahmed et al. 2007).

Historically it is known that the first tube well installation system in this region was undertaken in 1928 (Ahmed & Rahman, 2000). But, it was in the early 70s, the Department of Public Health Engineering (DPHE) started a massive program to install tube-wells with the support from UNICEF. A supply driven strategy and top-down planning were followed in implementing the program. The success of this program was remarkable. Millions of tube-wells, majority of them privately installed, now doted the landscape of Bangladesh.

Achievement of Tube-well and Changing Traditional Habit

The most important achievement of tube wells was supply of microbiologically safe drinking water, resulting substantial reduction of the diarrheal diseases. It took many years to shift people from their traditional surface water drinking habit to rely on tube well water. Initially, people did not accept this new idea because of many traditional beliefs and perceptions like unholy water, distaste, discoloration etc (Ahmed, 1999). Communication campaign was accelerated by government and non-government agencies to wean people from using surface water. However, during eighties with mass campaigns taking into considerations of the public behaviors there was rapid increase of tube well installation around the country. By nineties, 97% of the total population of Bangladesh was reported to have access to drinking water through tube wells (Ahmed et al. 2007).

Arsenicosis – As a Disease

'Arsenicosis' can be primarily described as a waterborne disease (Lenntech, 2006). It is a chronic illness resulting from drinking water with high levels of arsenic over a long period of time. It is also known as 'Arsenic Poisoning' (Psych Central, 2005). WHO defined arsenicosis (not finally declared: neither the terminology nor the definition) as, "Arsenicosis may be defined as a chronic health condition arising from prolonged ingestion (not less than six months) of arsenic above a safe dose, usually manifested by characteristics skin lesions, with or without involvement of internal organs." (World Health Organization, 2005, p. 7). This term of 'arsenicosis' is not finally accepted by all authorities to describe the illness due to arsenic poisoning. In the books of medicine, the term of 'arsenism' is used and discussed as an 'Environmental Poisoning and Illness' (Boon et al., 2006, p. 226).

Effects of arsenic include changes in skin color, formation of hard patches on the skin, skin cancer, lung cancer, cancer of the kidney and bladder, and can lead to gangrene (Psych Central, 2005). It can also cause for diseases of the blood vessels of the legs and feet, and possibly diabetes, high blood pressure and reproductive disorders (Lenntech, 2006). Natural arsenic contamination is a cause for concern in many countries of the world including Argentina, Bangladesh, Chile, China, India, Mexico, Thailand, and US. Because of the delayed health effects, poor reporting, and low levels of awareness in some communities, the extent of the adverse health problems caused by arsenic in drinking water is unclear and not well documented (Lenntech, 2006).

Toxic Effects of Arsenic in Humans

- Arsenic is a poison and its lethal dose for human is 125 milligram.
- It is 4 times poisonous than mercury.
- Toxicity depends on the amount of arsenic intake, which is classified into acute, sub-acute and chronic toxicity respectively. Drinking water contamination causes the last variety of toxicity.
- Most of the ingested arsenic is excreted from the body through urine, stool, skin, hair, nail and breath. In excessive intake, some amount of arsenic is deposited in tissues and inhibits cellular enzyme activities.
- Almost all organs are affected; but clinical symptoms appear insidiously after 6 months to 2 years or more depending upon the amount of arsenic intake.
- Chronic toxicity of arsenic is best discussed in terms of organ systems affected, viz. skin, liver, nervous system, cardiovascular system and respiratory system
- Arsenic Toxicity in Different Organ Systems Reported from Different Countries (Angelfire, 1998).

Table: 5 - Toxic Effects of Arsenic in Different Organs

Organ System	Problems
Skin	Symmetric hyperkeratosis of palms and soles, melanosis depigmentation, bowen's disease, basal cell carcinoma and squamous cell carcinoma.
Liver	Enlargement, Jaundice, cirrhosis, non-cirrhotic portal hypertension.
Nervous System	Peripheral neuropathy, hearing loss
Cardiovascular System	Acrocyanosis and Raynaud's Phenomenon
Hemopoietic System	Megalobastosis
Respiratory System	Lung Cancer
Endocrine System	Diabetes mellitus and goiter

Source: http://www.angelfire.com/ak/medinet/file5.html

Ingestion Time of Arsenic Contaminated Water

It is a chronic illness resulting from drinking water with high levels of arsenic over a long period of time. There are different opinions on the ingestion time for chronic arsenic poisoning. According to WHO (2005), it is not les than 6 months. Other seems that it is from 5 to 20 years (Psych Central, 2005).

Acute Effects of Arsenic

Arsenic poisoning may be acute or chronic. In the context of community drinking water supply, only chronic exposure is relevant (Psych Central, 2005). It has long been known that arsenic is acutely toxic. Arsenic is a poison and its lethal dose for human is 125 milligram (Angelfire, 1998). Anyone who drinks arsenic in water at 60 parts per million (ppm) will soon die (Wilson, 2007).

Chronic Adverse Effects of Arsenic

Chronic effects of prolonged low level exposure have recently showed up. Skin pigmentation, keratoses and skin cancers were found by Tseng in Taiwan in 1966 among people who drank from arsenic contaminated wells (but no effect was seen

below about 150 parts per billion (ppb), which might therefore be a biological threshold) and a very high incidence of lung, bladder and other cancers was found in Taiwan by Dr Chien-Jen Chen in 1986 and by Dr Allan Smith and collaborators in Chile in 1993. These convinced WHO to recommend lowering the regulatory level from 50 ppb to 10 ppb for arsenic in water. It appears that there are no data on humans to contest the idea that prolonged exposure to low doses is dangerous. The arsenic dose was equivalent to an average lifetime dose that would come from drinking water with about 25 ppb of arsenic therein (Wilson, 2007).

After several years of low level arsenic exposure, various skin lesions appear. These are manifested by hyperpigmentation (dark spots), hypopigmentation (white spots) and keratoses of the hands and feet. After a dozen or so years skin cancers are apprehended. Twenty or thirty years after exposure to 500 ppb of arsenic, internal cancers (lung, kidney, liver and bladder) appear among 10% of all exposed (Wilson, 2007).

Types of Arsenicosis

There is no widely accepted complete definition of what constitutes arsenicosis. Inorganic arsenic is a classified carcinogen that also has a multitude of non-cancer effects (IARC, 1980). The widespread effects of arsenic are perhaps responsible in part for the lack of a widely accepted care definition for arsenicosis. Furthermore, some symptoms of arsenicosis (such as shortness of breath) may be observationally indistinguishable from the health effects of other illnesses. It is not possible here to undertake a comprehensive review of the health effects of arsenic contamination of drinking water. The International Programme on Chemical Safety (IPCS) Environmental Health Criteria (EHC) is making a comprehensive health effect assessment, which will be finalised in 2000. Rather, the purpose of this section is to highlight some of the main findings of the literature on health effects, especially with respect to predictive use of the available information (World Health Organization, 2000).

According to the report of National Research Council, "Arsenic exposure interferes with the action of enzymes, essential actions, and transcriptional events in cells in the body, and a multitude of multisystem non-cancer effects might ensue" (National Research Council, 1999, p. 89). The most widely noted non-cancer effects of chronic arsenic consumption are skin lesions. The first symptoms to appear after initiation of exposure are hyper pigmentation (dark spots on the skin) and hypo pigmentation (white spots on the skin). Some physicians collectively refer to these symptoms as **melanosis**. Hyper pigmentation commonly appears in a raindrop pattern on the trunk or extremities, but also on mucous membranes such as the tongue (Yeh, 1973).

Over time, arsenic exposure is associated with **keratoses** on the hands and feet. Keratosis is a condition where the skin hardens and develops into raised wart-like nodules. These nodules become more pronounced over time, sometimes reaching 1cm in size (National Research Council, 1999). It is noted that skin cancers often appear at the sites of existing keratosis (Tseng et al., 1977). The time from exposure to manifestation is debated in the literature. It is likely that differing exposures to arsenic accounts for the heterogeneity in observations. The youngest age reported for patients with hyper pigmentation and keratosis is 2 years (Rosenberg, 1974).

For Bangladesh, a minimum time gap of five years between first exposure and initial cutaneous manifestations is suggested (Mazumder et al., 1998). The distinctive appearance of these skin lesions has meant they have been used as indicators of arsenic exposure, when it has not been possible to ascertain arsenic concentrations in well water.

Non-cancer Health Effects

Arsenic has been associated with a multitude of other non-cancer health effects. In China, arsenic poisoning is associated with peripheral vascular disease It is also known as Blackfoot disease (Tseng, 1977). This condition results in gangrene in the extremities and usually occurs in conjunction with skin lesions. Other cardiovascular problems such as hypertension (Chen et al., 1995) and ischemic heart disease have

been found to be associated with arsenic. Research into organ damage has concentrated mainly on the liver. The evidence of liver enlargement and non-cirrhotic portal fibrosis among a small sample of severely affected arsenic patients in West Bengal was found. In another study, it is also suggested pulmonary health effects of arsenic poisoning. They found restrictive lung disease among 53% of a small sample of severely affected arsenic patients in West Bengal (World Health Organization, 2000).

In terms of haematological effects, anaemia is commonly cited. Another widely suggested health effect is diabetes mellitus. In Dhaka, Bangladesh, a significant dose response relationship between arsenic exposure and diabetes mellitus among those suffering from keratoses is found (Rahman, Tondel, Ahmad, & Axelson, 1998).

Cancer Health Effects

In 1887, Hutchinson identified arsenic as a carcinogen because of the high number of skin cancers occurring on patients treated with arsenicals. The International Agency for Research on Cancer classified inorganic arsenic compounds as skin and lung (via inhalation) carcinogens in 1980. In the period following this classification, concerns have grown over the possibility of arsenic in drinking water causing a number of other cancers (World Health Organization, 2000).

The strongest epidemiological evidence on skin cancer effects comes from studies of arsenic contamination of drinking water in China. Villages in south-western China switched from surface water to arsenic contaminated well water for drinking in the 1920s. An early study found evidence of a dose response relationship between concentration of arsenic in drinking water and prevalence of skin cancer (Tseng et al., 1968). In 1981, International Programme on Chemical Safety (IPCS) estimated skin cancer risk from lifetime exposure to arsenic in drinking water at 5% for 0.2 mg of arsenic per litre, based on the findings of the study conducted. Based on the increased incidence of skin cancer observed in the population in China, the US Environmental Protection Agency (1988) has used a multistage model that is both

linear and quadratic in dose to estimate the lifetime skin cancer risk associated with the ingestion of arsenic in drinking water. With this model and data on males, the concentrations of arsenic in drinking-water associated with estimated excess lifetime skin cancer risks of 10-4, 10-5, and 10-6 are 0.0017, 0.00017, and 0.000017 mg/l respectively. Considering other data and the fact that the concentration of arsenic in drinking water at an estimated skin cancer risk of 10-5 is below the practical quantification limit of 0.01 mg/l as well as a view to reducing the concentration of arsenic in drinking water, provisional guideline value of 0.01 mg/l is recommended. The guideline value is associated with an excess lifetime risk for skin cancer of 6 persons in 10,000) (World Health Organization, 1996).

High levels of arsenic in drinking water are also associated with a number of internal cancers. However, it is difficult to quantitatively establish risk in many of the studies, due to problems in measuring exposure to arsenic. Chen and others (1985) calculated standardized mortality ratios (SMRs) for a number of cancers in 84 villages in southwestern China. Mortality from 1968-1986 was compared with age and sex adjusted expected mortality. Significantly, increased mortality was observed among both males and females for bladder, kidney, lung, liver and colon cancers. However, the authors were not able to directly estimate arsenic concentrations in well water. Chen and Wang (1990) were able to use data on arsenic concentrations in 83,656 wells in 314 precincts and townships, collected from 1974-1976 in China. The authors used a multiple regression approach to control for socioeconomic confounding factors, and compared age adjusted mortality rates with average arsenic concentrations in each township. They found a significant relationship with arsenic concentration and mortality from cancers of the liver, nasal cavity, lung, bladder and kidney for both sexes. One problem with this study for the purpose of quantitative risk assessment, is that the authors do not report the methodology used for calculating the average arsenic concentration for each township or precinct.

In 1998, Hopenhayn-Rich and others examined standardized mortality ratios (SMRs) for bladder, kidney, lung, liver and stomach cancers for 1986-1991 for 26 counties in

the Cordoba Province in Argentina. The authors stratified counties into low, intermediate and high exposure groups based on arsenic levels in their drinking water. The low and intermediate exposure counties were defined by the authors. Data for arsenic levels in the two high exposure counties were given. These levels ranged from 0.04 mg/l to 0.43 mg/l. SMRs were calculated using age and sex specific national rates for Argentina. Significant exposure-response relationships were found for the cancer in the bladder, lung and kidney. It is unlikely that smoking is a confounding factor, as deaths from chronic obstructive pulmonary disease (indicative of smoking) were not related to arsenic concentrations (World Health Organization, 2002).

The above-mentioned studies all utilised an ecological design and are thus susceptible to bias from confounding factors. However, the bladder and lung cancer results of these studies are also confirmed by cohort studies which may be less susceptible to this form of bias. These studies are also useful in providing data on the latency period of internal cancers. Cuzick and others, in 1992, studied a cohort of patients treated with Fowler's solution (potassium arsenite) in England from 1945-1969. In the follow up until 1991, a significant excess of bladder cancer mortality occurred. In addition, a subset of patients had exhibited skin lesions when examined in 1970. It was found that all patients who subsequently died of bladder cancer had also suffered skin lesions. Even after stratifying this subset according to dose group, the finding that all cases had skin lesions was highly significant. The authors suggested this provided evidence that skin lesions are a useful biomarker for susceptibility to internal cancers. The period between first exposure and death from bladder cancer varied from 10 years to over 20 years.

Tsuda et al. (1995) followed up a cohort of 454 residents in Japan who had used industrially polluted water for five years. The authors separated the cohort into low, medium and high exposure groups, based on arsenic concentration in local wells. The low group was exposed to less than 0.05 mg/l, the medium exposure group 0.05-0.99 mg/l and the high exposure group greater than 1 mg/l. A significant excess of

cancers occurred only in the group exposed to an arsenic concentration greater than 1 mg/l. This finding may be because the small sample size is unable to detect significant excess deaths in the medium exposure group. There may also be underestimation of the effect due to the relatively short period of exposure. Significant excess deaths from lung cancer (nine deaths) and urinary tract cancer (two from bladder cancer and one renal pelvis cancer) were observed in the high exposure group. In contrast to the findings of Cuzick and others, the authors found excess cancer mortality among those both with and without skin lesions present: "The results demonstrate that negative skin signs are no assurance of low risk for cancer development." (Tsuda et al., 1995, p. 207). The authors note that the period from first exposure to death from lung cancer varied from 11 to 35 years, with a mean of 26.7 years (World Health Organization, 2000).

The results from the above-mentioned studies of cancer indicate strong evidence that exposure to arsenic is related to skin, lung and bladder cancer. Although more established assessment on health effects of arsenic is being prepared by International Program on Chemical Safety (IPCS). It is likely that arsenic causes a number of other cancers. But the epidemiological evidence so far has not been consistent for other sites in the body.

The Effect of Diet on Chronic Arsenic Exposure

An important issue for coping with arsenic exposure is the effect of diet. A general issue can be stated: there is frequently more than one cause of a cancer or a lesion. For example lung cancer can be caused by cigarette smoking or asbestos or both together, in a synergistic way such that the risks multiply (rather than add) when both are present. In the USA it has been found that people who have a good diet of fresh fruit and vegetables (5 servings per day) have half the risk of many cancers, including lung cancers caused by cigarettes, as those without a good diet. By analogy, one might expect that the lung cancer risk from arsenic will be less among those with a good diet. Unreliable indications from Bangladesh suggest that a good diet reduces skin lesions, and the effect is seen in West Bengal, but the effect is

small and it is assumed that effort is better spent on obtaining pure water. Nonetheless, epidemiological studies to confirm this are highly desirable. Khaliquzzaman and Khan have calculated the "Arsenic Exposure of Bangladesh Population through Food Chain" using known amounts in food. However, the amount is less than from drinking water but not much less (Wilson, 2007).

There are several specific chemicals that have been suggested that would either (i) help to prevent arsenic lesions by rapid removal of arsenic from the body or (ii) help to cure arsenic lesions. The specific chemical that has come to the mind of many health experts is selenium. It was noted in the 1930s that effects of excess selenium can be counteracted by adding arsenic to the diet because As and Se combine. Does the inverse take place? It is reported that areas with high incidence of arsenical lesions have low selenium in the water. Some victims have low selenium levels. Does adding selenium to the diet really help, either to prevent the lesions from forming (possible), or to treat them afterwards (less possible)? Professor Zuberi of Rajshashi University has suggested methionine to reduce the arsenic lesions. Dr. OGB Nambiar has suggested that ferrous sulphate, after conversion to sulfide by bacteria in the colon, absorbs arsenic and assists safe excretion. The evidence for these remains indirect, and there may be (as suggested above) competing adverse effects. Only good epidemiology can tell and this is under way in several places (Wilson, 2007).

Treatment of Arsenicosis

In 2002, WHO declared that there is no known specific treatment for arsenicosis and the wise intervention for arsenicosis is to stop consumption of arsenic contaminated water (World Health Organization, 2005). Recently published books of medicine also acknowledged that there is no benefit of specific treatment in chronic arsenicosis toxicity (Boon, 2006, p. 226).

The first stage in treating arsenicosis patients should be the immediate cessation of consumption of arsenic contaminated water. Once this has been achieved, the emphasis should be on the provision of a diet, high in protein (preferably meat) and vitamins, to aid the methylation of inorganic arsenic in the body. The chelating agents DMPS (dimercaptopropane sulphonate) and DMSA (dimercaptosuccinic acid) are recommended as treatment drugs. DMPS is considered more efficacious than DMSA in aiding the elimination of arsenic from the body, but DMSA is preferred for wide spread application because of its lower risk of side effects. However, these drugs are very expensive. Chelation therapy has been demonstrated to be effective in the treatment of acute arsenic poisoning. Its value in treatment of chronic poisoning remains undemonstrated (Guha, 1996).

Palliative care may be the only affordable treatment in rural areas of Bangladesh, where expensive drugs and protein-rich diets are unlikely to be available to the vast majority. In the case of keratosis, application of ointment containing salicylic acid can help to soften the skin and ease the pain of the patient (World Health Organization, 2000).

Prevention of Arsenicosis

Arsenic toxicity can only be prevented avoiding arsenic contaminated water in drinking and cooking. Surface water such as water from ponds, lakes and rivers is free from arsenic but such water carries high risk of contamination of waterborne pathogenic bacteria and viruses that cause diarrhoea, typhoid fever and certain types of viral hepatitis. Boiling of water can eliminate most of these pathogenic agents and is the usual recommended method to ensure safety of surface water. However, in the villages the practice of boiling drinking water is not easy to implement because of the cost factor involved as cooking fuel in the villages is still wood and dried straw, the supply of which is scarce. Then also there are cultural preferences for drinking fresh pond water for its supposedly better taste (Islam, 2006).

WHO recommended in 2002, "As there is no known specific treatment for arsenicosis till today, the prudent intervention for arsenicosis is to stop consumption of arsenic contaminated water" (World Health Organization, 2005, p. 8). The books of medicine prescribe for taking preventive measures in absence rather than any specific treatment for patients. Even they declared clearly that there is no benefit of specific treatment in this particular occasion of physical disease. Medical science books refer, "the emphasis should be on the prevention of exposure to arsenic in drinking water" (Boon et al., 2006, p. 226).

Arsenicosis in Bangladesh

In the very early stage, Dhaka Community Hospital (DCH) and SOES (School of Environmental Studies) conducted surveys for arsenicosis patients in 64 districts and found patients with arsenical skin lesions in 32 of them. They examined 24,664 people in the affected villages and 33.6% of them were diagnosed as patients with arsenical skin manifestations. A Total of 2,167 hair samples, 2,165 nail samples, 220 skin samples and 830 urine samples were analyzed and an average of 94% of them were found to have arsenic concentration above the normal limit.

According to National Arsenic Mitigation Information Center (NAMIC), by 2005 a total of 38,430 patients have been identified among 6,60,34,962 populations residing in 57,582 villages located in 270 Upazillas of 54 districts of Bangladesh (NAMIC, n.d.). Another study, published in 2006, stated that there are an estimated 40,000 cases of arsenicosis in Bangladesh. Moreover, it will be more than 2.5 million in the next 50 years (Russel, 2006).

According to the Director General Health Service (DGHS) source, by August 2002 the total number of arsenicosis patients was 13,333 (NAISU, 2003). The latest report that is available in our hand is the annual report on arsenicosis 2008, published by DGHS. This report revealed about 24,375 confirmed arsenicosis patients in

Bangladesh. This result has been published after completing 'door to door searching for suspected arsenicosis patients program' throughout the country.

In one study carried out by ICCDR,B involving 6,000 individuals with symptoms of arsenicosis, it was found that melanosis is most common, occurring in approximately 94% cases, followed by keratosis in 68%, leukomelanosis in 39% and hyperkeratosis (severe degree of skin hardening) in 37% cases. This indicates that a person may exhibit more than one type of arsenicosis symptoms (Islam, 2006).

People at Risk

DPHE and BGS estimated that the population exposed to arsenic contamination more than 0.05 mg/l (> 50 ppb) would lie in the range 18.5 - 22.7 million. However, they finally gave an estimation of the number of population exposed to arsenic concentration above 0.05 mg/l (50 ppb) and 0.01 mg/l (10 ppb) to be 35 million and 57 million respectively. (Based on Upazila-averaged statistics the exposure levels to arsenic exceeding 0.05 mg/l (50 ppb) and 0.01 mg/l (10 ppb) were computed as 28 million and 46 million respectively, but the BGS report states that they consider the larger figures to be more reliable (NAISU, 2003).

Some other report estimated more as many as 109 million (at 100 ppb) or 93 million (at 50 ppb) are potentially at risk of arsenic poisoning (Dhaka Community Hospital, 2000). WHO, in a report, predicted that in most of the southern part of Bangladesh almost 1 in every 10 adult deaths will be a result of cancer triggered by arsenic poisoning in the next decade (Smith, Lingas & Rahman, 1997). It is clearly one of the worst cases of mass poisoning in human being in the history.

CHAPTER - 3

METHODOLOGICAL ORGANIZATION OF THE STUDY

Major Concerns and Rationale of the Study

Arsenic is a natural element. Its creation and existence in the earth is also natural. When this element starts contaminating the underground water, it appears as a natural disaster to human society - a threat to public health as well as it is an environmental crisis. As rural people of Bangladesh use underground water for drinking, they become victimized due to this natural cause. Common people suffer from multiple difficulties and finally they have to face the threat of death or sometimes die also. Is this victimization only due to the nature, or there are some human-made contributions? To understand, why and how this natural factor has introduced a human crisis is the concern of the study.

Arsenic poisoning is responsible for the disease - arsenicosis. In Bangladesh, a significant number of people have been identified as arsenicosis patients. Besides, physical difficulties, patients in different parts of the country have been facing multiple problems in their families and communities. They become victim of social disgrace, stigmatization, misconceptions and maltreatment. Reports on such incidents have been published in national newspapers on a regular basis for public awareness. Therefore, the issue of social aspects of arsenicosis has become a major concern of the present study.

Few social studies have also acknowledged some social difficulties that have been experienced by arsenicosis patients. Stigmatization, superstition, ostracism, instability, etc. and many other social aspects were identified in those studies. Nevertheless, the nature and causes of those social problems have not been studied under concrete

social context. Moreover, to what extent arsenicosis is responsible for 'social stigmatization' has not yet been determined. It would definitely be very difficult to approach the situation, unless the above questions are not been answered properly. Therefore, it appears as another key focus of the study.

As a human service profession, 'social work' has scientifically approved instruments to combat social problems. To attain sustainable solution to the problem of arsenicosis, social work needs to understand the social situation both distinctively and comprehensively. Finding out the appropriate approach of social work that best fit for solving the problem, is also very necessary in this regard. In this way, it comes out as a fundamental demand of the study. The justification of studying social sufferings of the people of Bangladesh caused by arsenic poisoning in the context of their real life situation is rooted in the above practical gaps of knowledge that have not been encountered by any research work (as far as known).

Objectives of the Study

1. Apart from physical difficulties, to know all other sufferings of the arsenicosis patients,
2. To verify and check the reports published in newspapers about social distresses of the patients,
3. To understand the nature and variety of social difficulties of the patients,
4. To identify the major causes of the patients' social sufferings and why the number of the patients is increasing,
5. To know about how people of Bangladesh adopt and coexist with a known health risk and helplessness,
6. To identify and recommend appropriate societal and social work approaches to deal with such problem.

Study Design

The overall study was aims at satisfying the broad social question on what changes had come in the social relationships of the patients due to arsenicosis. The study was

designed to generate qualitative data, which would enable some degree of in-depth information in order to develop a more holistic picture as to how social causes increase the sufferings of arsenicosis patients or vise versa. Qualitative data were collected through observation checklist. Watching, listening, interviewing, photographing and recording the patients were carried out by the researcher himself in the selected arsenic affected villages. In order to portrait a complete picture of the situation, information were also taken from the patients' family members and their community people. The researcher shared directly with the arsenicosis patients and with local leaders, NGOs workers working on arsenicosis, and the government officials, like Civil Surgeons, Thana Health and Family Planning Officers, Medical Officers, Health Assistants, and Public Health Engineers.

The Fields of the Study

The study was carried out in 12 villages of Bangladesh, where the prevalence of arsenicosis had been reported. These villages are located in top four top arsenicosis prevalent divisions in the country: Dhaka, Chittagong, Khulna and Rajshahi.

Table – 1: Geographic Locations of Selected Villages:

Division	District	Upazilla	Union	Village
Dhaka	Kishoreganj	Bajitpur	Halimpur	Nagarbhanda
			Boliardi	Osmanpur
		Karimganj	Kadirjangal	Hatrapara
Chittagong	Chandpur	Chandpur Sadar	Sakhua	Raghunathpur
		Haziganj	Purba Barkul	Raicho
			Purba Hatila	Hatila
		Shahrasti	Pourashava	Niz Mehar
			Tamta	Alipur
Khulna	Jessore	Chaugacha	Jagadishpur	Marua
		Sharsha	Bagachra	Samta
Rajshahi	Chapai Nawabganj	Nawabganj Sadar	Pourashava	Rajarampur
			Ranihati	Baharam
Total	4	8	12	12

Eight upazillas were purposively chosen from the four districts of the selected divisions. The Upazillas were Bajitpur and Karimganj (in Kishoreganj District of Dhaka Division), Chandpur Sadar, Shahrasti and Haziganj (in Chandpur District of Chittagong Division), Chaugacha and Sharsha (in Jessore District of Khulna Division), and Nawabganj Sadar (in Nawabganj District of Rajshahi Division).

Two villages, **Nagarbhanda** and **Osmanpur** of Bajitpur upazilla, **Hatrapara** of Karimganj upazilla, **Raghunathpur** of Chandpur Sadar upazilla, **Raicho and Hatila** of Haziganj upazilla, **Niz Mehar** and **Alipur** of Shahrasti upazilla, **Marua** of Chaugacha upazilla, **Samta** of Sharsha upazilla, **Rajarampur** and **Baharam** of Nawabganj Sadar upazilla were selected as the fields of the study.

Selection Criteria of the Fields

Following the main objectives of the study, the basic principles of fields-selection have been determined. Those are: (1) reports published in national dailies about arsenicosis patients, (2) the number of patients, and (3) known period of prevalence of the disease in the concerned area.

The study was conducted in two phases. In the first phase, data collection was started in two villages of Jessore where,

- the presence of arsenic in drinking water is known for a long time,
- villagers have been suffering from arsenicosis in almost all households,
- a significant number of patients have died of this disease, and
- interventions for both safe water options and treatment for patients have been taken by a number of govt. and non-govt. organizations.

Samta- a village of Sharsha Upazilla in Jessore district is known for massive attack of arsenicosis in Bangladesh. Marua is a village of Chaugacha Upazilla in the same district. These two villages have been selected to observe and investigate the most severe effect of arsenicosis.

Among the list of most arsenic contaminated districts, according to NGO forum, Shahrasti and Haziganj Upazilla of Chandpur district are ranked as first and third with 98.62% and 98.25% contaminated tube-wells. The study was also conducted in five villages of the same district. Similarly, the problem of arsenic and arsenicosis was first detected in Chapai Nawabganj district, in 1997. To understand the present situation of the area, two villages were selected for study.

However, the data collected from the above fields in the first phase, could not clearly reveal the situation of early stage of arsenic and arsenicosis patients' detection in a locality. This evidence led the study to find for another field where the problem of arsenic and arsenicosis had just struck the people's attention and worry. As a result, the subsequent data collection conducted in another three villages of Kishoreganj. Like Chandpur and Jessore, Kishoreganj district was not considered as an arsenic prone area. Since the detection of the problem of arsenic and arsenicosis in Bangladesh, no incidence of death was reported from Kishoreganj. During the time of the study, news reports were published on several death incidents in Nagarbhanda village, which drew the public attention for the first time. In this way, Nagarbhanda along with two other affected villages of that district was selected for study. Selected villages of Kishoreganj district were **Osmanpur** and **Nagarbhanda** of Bajitpur Upazilla, and **Hatrapara** of Karimganj Upazilla.

Number of Patients Observed

A total of 146 purposively selected arsenicosis patients were interviewed and observed in the fields. Among them, 80 (54.79%) were male and 66 (45.21%) were female patients.

Table - 2: Patients Distribution as Observed in the Fields

District	Upazilla	Union	Village	Number of Patients Observed		
				M	*F*	*Total*
Kishoreganj	Bajitpur	Boliardi	Osmanpur	4	2	6
		Halimpur	Nagarbhanda	4	4	8
	Karimganj	Kadirjangal	Hatrapara	3	1	4
Chandpur	Sadar	Sakhua	Raghunathpur	1	2	3
	Haziganj	Purba Barkul	Raicho	5	6	11
		Purba Hatila	Hatila	4	6	10
	Shahrasti	Pourashava	Niz Mehar	10	8	18
		Tamta	Alipur	11	10	21
Jessore	Chaugacha	Jagadishpur	Marua	9	7	16
	Sharsha	Bagachra	Samta	12	7	19
Nawabganj	Sadar	Pourashava	Rajarampur	8	4	12
		Ranihati	Baharam	9	9	18
Total	**8**	**12**	**12**	**80**	**66**	**146**

The total number of identified patients in the selected villages is provided by Upazilla Health Complex Offices and somewhere by the local NGOs working on arsenicosis. Though there were the patients' lists in some Upazilla Health Complex Offices, patients were selected and interviewed when they were seemed to satisfy the interest of the study. Entering into a village, it was generally started with asking the villagers about their neighborhood. The researcher asked them from where they do drink water and whether they know anything about arsenic poisoning or arsenicosis. In this way, the researcher tried to reach to the patients in the fields.

To supplement the perceived data collected from the patients directly, family members of the patients (32), local educated elders (10), local union council members (11), local health assistants (12), local journalists (7), Upazilla health and Family planning Officers (6), Medical officers (8), NGO Workers (10), Civil Surgeons (2), DPHE Engineers (5), were also interviewed. Patients were observed in both their houses, workplaces, community gatherings and hospitals to realize and actualize the level of social difficulties and their effects in the patients' life.

Methods of Data Collection

The prominent method of data collection used in the study was the **Field Interview**. Unstructured, nondirective, in-depth interviews involved asking questions, listening, expressing interest and recording what was said. The discussion process in the interviews was tried to direct for insights, feelings and cooperation of the arsenicosis patients and other participants and to reveal subjective meanings. The questions and the order in which people were asked were tailored to specific people and situations. Few **Focus Group Discussions** (FGD) were also conducted with few groups of arsenicosis patients. Sometimes, other people also took part in the discussions. The social context of the interview was noted and seen as important for interpreting the meaning of responses.

To supplement Filed Interviews, the techniques of **Observation** method were also utilized in the study. A **Checklist** was followed as a guideline of the observation. Watching, listening and taking notes, cameras and voice recorders were the key tools in the field to collect valuable qualitative data. Secondary data were collected from Department of Public Health Engineering (DPHE), Director General Health Service (DGHS), Upazila Health Complex (UHC), NGOs, Hospitals, and Internet and used with appropriate references in different parts of the study.

Period of Data Collection

With a short and preliminary methodological and instrumental preparation, data collection was started directly visiting, observing and studying arsenicosis patients in the field. But, the total study had taken place through a period of more than two years, from Chaugacha Upazilla of Jessore district on April 2007 to Nawabganj Sadar Upazilla of Nawabganj district on July 2008. The time of data collection in the selected areas has shown in the table below:

Table – 3: Period of Data Collection

Field Name		Time of Study	
District	***Upazilla***	***Month***	***Year***
Jessore	Chaugacha	March	2007
Jessore	Sharsha	June	2007
Chandpur	Chandpur Sadar	July	2007
	Haziganj	July	2007
	Shahrasti	July	2007
Kishoreganj	Bajitpur	May	2008
	Karimganj	May	2008
Nawabganj	Nawabganj Sadar	June	2008

Various govt. agencies like DPHE, DGHS, and NIPSOM as well as non-govt. agencies like ICDDRB, DCH, YDFH, NGO Forum, Water Aid Bangladesh offices were visited and their officials were interviewed during the time gap between July 2007 to May 2008. Published and unpublished data, articles, reports and documents of a number of organizations were gathered and rigorously checked with the field experiences. These secondary data sources were also verified in the later part of the field data collection and used in different parts of the report.

Techniques of Data Analysis

In the study, data were collected in the form of text, written words, phrases and symbols to describe arsenic affected people, their behavior and events in social life. The form of data analysis involved inferring from empirical details of the patients' social life. The features of the evidences that have gathered internally compared with related evidences. The processes, causes, properties or mechanism within the evidence were tried to identify first and then the patterns of similarities and differences, and aspects that are alike and unlike were examined.

Analysis of data begun early in the study during the time of data collection. The results of that early data analysis guided the subsequent data collection. General ideas, themes and concepts were used as analytical tools.

Limitations of the Study

To study the social aspects of arsenicosis patients including the women in particular, was definitely a difficult task. More specially, working with qualitative methodological techniques and tools were more challenging. Various socio-cultural constrains had to overcome, divert and finally include into the research observations. It was full of excitement of observing people during the time of their cultivation, harvesting, heavy rainfall and floods. However, it appeared very difficult to travel to, live in and collect data from the villages of different parts of this country.

Getting access to data from govt. offices sometimes appeared impossible. Concerned offices, like DGHS, DPHE, UHC and office of Civil Surgeon had to visit several times for information. Sometimes, they were not found for information about their interventions to address the problem of arsenic and arsenicosis.

However, the important thing in the study was to produce knowledge on how arsenicosis patients cope with the effects and changes in their personal, family and social life. In order to undertake such a vigorous task a good budgetary provision along with adequate work force support should be there to meet up normal requirements of the study. In this case, serious constrains were available to have restricting influence upon the progress of the study smoothly. However, for the interest of an academic achievement, earnest attempts through physical lobour and intellectual means were taken to complete the task systematically.

CHAPTER - 4

SITUATIONS IN THE FIELDS

Village – 1: Samta

(Union: Bagachra, Upazila: Sharsha, District: Jessore)

Around four thousand people live in the village Samta with 48.95% literacy rate. Total land area is 3.2 square kilometer. A small river called Betna is flowing beside the village. There are 789 households in Samta. Only 275 households have access to electricity. Main source of drinking water is tube-well in 574 households and dug-well in 196 households. More than 50 percent houses are 'kucha' by structure. In addition, main income source of 305 households is agricultural labor (Bangladesh Bureau of Statistics, 2006). According to a survey conducted by Dhaka Community Hospital (DCH), there are 279 tube-wells in Samta. After complete screening, DCH identified 242 tube-wells with high concentration of arsenic. Only five tube-wells were found safe (Dhaka Community Hospital, 1998). Besides this, Miazaki University of Japan, the Japan-based Asia Arsenic Network (AAN) and Bangladesh Institute of Preventive and Social Medicine (NIPSOM) carried out a study at Samta in March 1997. According to the study, there were 284 tube-wells in the village and only 10 of them were arsenic-free (Asia Arsenic Network, 1998).

In the primary stage of detection of arsenic poisoning in Samta, NIPSOM started arsenic mitigation through three-pitcher filtration system in 248 households. As this procedure was very time-consuming, local people rejected it. NIPSOM then installed a Pond Sand Filter in front of the house of a villager named Faruq Hossain (43). This system was also not effective in the dry season due to unavailability of water. In March 2000, AAN completed a 3-year pilot study project in Samta. The project consisted of three major activities; namely research, community participation and

measures for safe drinking water and management of patients. DPHE with the assistance of UNICEF operated communication and tube well screening activities in Sharsha upazilla in June 2002. They also implemented mitigation program with different safe water options in 2003-2004 (NAISU, 2003).

In respect of the problem of Arsenicosis, Samta is known as the worst village of Bangladesh. Describing the earliest situation of Samta, the local health assistant of the village said,

> *"Ten years ago, arsenicosis was totally unknown to the villagers. Even we, the health workers, were also not oriented with arsenicosis at that time. Nobody could understand the reason behind the unknown disease, which affected people's skin, hands and legs. When the villagers observed that, the doctors could not diagnose their disease, misconceptions started to spread out. People started believing that it was a curse of the God on their village. Few of them thought the disease as leprosy."*

According to the local people, there was a time when nobody wanted to marry any girl from Samta, or to choose bridegroom from the village. Symptoms of arsenicosis were found among 97 percent of its population. In Samta, 28 people have already died from arsenicosis. It is not very hard to determine the time from when the people of Samta started drinking arsenic contaminated water. It is not less than 20 years that the tube-wells in Samta got arsenic-contaminated. However, arsenicosis was first detected in January 1997, when a team of experts led by Dr. Dipankar Chakraborty of Jadavpur University, Calcutta, carried out a study at the village. They found at least 330 people infected with skin lesions and identified Arsenic poisoning as the main reason behind it. They realized that the number of actually affected people was higher than that number of identified cases. While conducting preliminary survey, the hair, nail and urine specimen of 334-suspected people were collected for arsenicosis test. Among them, only 99 persons had visual symptoms of arsenicosis and the rest had other physical difficulties. A terrible picture appeared when the samples were tested in the laboratory. The laboratory-test showed the presence of

arsenic at dangerous level in the urine of 324 people (97%), in the hair of 284 people (85%) and in the nails of 321 people (96%) (Dhaka Community Hospital, 1998).

The researcher visited the village on June 2007. He observed 19 arsenicosis patients of Samta. From among the interviewed patients, one housewife named Rizia Khatun (36) said,

> *"Five or six years ago, my skin was manifested with black spots. My mother-in-law did not permit me to cook food for the family members. Even she told me not to give breast feed to my newborn baby. Not only my mother-in-law, but me also believed that my disease could communicate to my baby. However, my husband was much sympathized to me. Before me, arsenicosis affected one of the elder brothers of my husband. He went to Dhaka for treatment, but I did not."*

Rizia also informed the researcher that the villagers still believe that arsenicosis is a curse of Allah, but they are sure about the disease is not communicable. After being affected by arsenicosis, a new deep tube-well was installed inside their household. From then, they all started drinking from that tube-well. She reported that her skin lesions started disappearing but she had been feeling new pain in her stomach for few months. Few hard patches have been developed in her husband's finger. Doctors told that he has also been suffering from arsenicosis. Both of them were then taking preparation to go to Yamagata Dhaka Friendship Hospital for treatment.

Another villager named Rezaul (34), son of Lokman Mondal (50), escaped from the death, but his family was devastated due to the curse of arsenicosis. His mother Fulsurat Begum (38) died of arsenicosis. After being affected by arsenicosis, Rezaul was admitted to the nearby Buruzbagan Thana Health Complex in critical condition. He received treatment there for three months and returned home safely. He still feels very weak while walking even a short distance. Now he is unable to do any work. Rezaul said that they could not know the reason of the death of his mother Fulsurat who died five years ago. Actually, at that time, the doctors also had no idea about arsenicosis. They were rather surprised to see her body was being rotten day by day.

Describing about his sister Masuda (22) and stepmother Aklima khatun (32), Rezaul however said,

> *"We are two brothers and three sisters. My sister Masuda is the only member of my family who is not affected by arsenicosis. She is given married in another village named Dhewli. After the death of my mother, my father married again. The paternal home of my father's second wife was in Gatbaria village in Jhikorgachha upazilla. Due to the widespread fear of arsenicosis in our village, she did not continue her new conjugal life with my father. She came only once to Samta but after being acquainted with the panic situation of arsenicosis in Samta she went to her own village and did never come back."*

Rezaul lost only one member of his family. Ranu Ara (22) lost all five members of her family. Her father Daud Ali (48), two brothers, Yunus (24) and Aiub (19), mother, Nihar Banu (39), and sister Rowshan Ara (26) died of arsenicosis. Her uncle, Ayet Ali (46) and cousin Answer Ali (23) also died due to this mysterious disease. Three members of Selina's (38) family also died of arsenic in Samta. Her husband Abdus Sttar Babu (49), son Lalon (17) and mother Shonavan Bibi (65) died in last 3 or 4 years.

The researcher observed few rehabilitation works taken by AAN and JICA in Samta. Those programs notably helped the affected families for their survival. The researcher visited a handicraft-training center operated by AAN and interviewed one of the trainees named Amina (15). He also visited the house of Amina and interviewed her parents. Amina's father Afser (40) was suffering from cancer due to arsenic poisoning in his lung. Mr. Afser received operative treatment on his lung from Yamagata Dhaka Friendship Hospital. He said,

> *"I was an agricultural labor and could sufficiently earn for my family. After being affected by arsenicosis, I became unable to hard physical labor. Then I started small business in the nearby bazaar. Within one year, the disease became more severe. People of the Japanese NGO detected cancer in my lung and sent me to Yamagata Dhaka Friendship Hospital. Receiving surgical treatment in Dhaka, I am not feeling well. I am living on the bed,*

with no work, no income. I am in debt of about 1 lakh taka. My only hope is my daughter Amina, if she can earn and provide for her family."

Deaths due to cancer are continuing in Samta. In respect social sufferings of the patients, the situation of Samta has greatly changed. A number of government and non-government interventions have successfully improved the awareness level of the villagers. In contrast, the economic difficulties of the families of arsenicosis patients have been decreasing day by day. An overall panic situation has been observed all around the village.

Village – 2: Marua

(Union: Jagadishpur, Upazila, Chaugacha, District: Jessore)

The village, Marua is 7 kilometers or more away from Chaugacha upazilla sadar.There are 3,783 people and 582 households in that village. According to the latest census-report, 42.33% villagers are literate. Only 25 households have access to electricity. Agriculture is the main source of income in 244 households. A large number of household-structures (69%) are kucha. There are 581 tube-wells in Marua (Bangladesh Bureau of Statistics, 2006). 27 years ago, there was only one tube well in Marua. The government installed that tube-well nearby the mosque of the village-bazaar. This tube-well is now abandoned due to high concentration of arsenic. The villagers had to abandon around 100 tube-wells for the same reason. Now, there are 276 operative tube-wells. During the last 5-10 years, these tube-wells were installed in the villages that are comparatively deeper than others installed before. However, recent screening programs have identified that 100% operative tube-wells in Marua are arsenic-contaminated. There are only 6 pond sand filters (PSF) to provide safe drinking water to all villagers.

Marua is administratively situated in Jagadishpur union. Jagadishpur is the smallest union among 11 unions of Chaugacha Upazila. Only nine villages constitute this union with 3,614 households. In 1998-2005, as stated by National Arsenic Mitigation

Information Center (NAMIC), the highest number of arsenicosis patients in this Upazila was detected in Jagadishpur union. Among 275-suspected patients, 133 were found from this union, which represents 48.36% of the upazilla. In Marua, only 122 arsenicosis patients were found, which represents the highest 91.73% patients of Jagadishpur union. In 2007-2008, Director General Health Service (DGHS) through Upazila Health Complex identified 149 arsenicosis patients in that village. Screening report of NGO forum has showed almost double the figure of DGHS. According to NGO forum, there are nearly 300 arsenicosis patients in Marua, 70 of them have been passing with severe condition.

In response to the crisis of arsenicosis, government health officials first reached Marua in March 2000. In 2001, Asia Arsenic Network (AAN) and Japan International Cooperation Agency (JICA) started working on Tube-well screening, arsenicosis-patient management and arsenic-mitigation activities in Marua. Asia Arsenic Network (AAN) registered about 200 arsenicosis patients from Marua in 2000.

People of Marua first came to know about arsenic and arsenicosis through radio and television in 1998. By this time, they had already lost 8 people without proper treatment. Even the families of the deceased arsenicosis-patients could not know about the cause of their death. It is assumed that Rokeya Begum (42) was the first victim of arsenicosis in Marua. She had suffered from maltreatment for 3 years. She was diagnosed as arsenicosis patient at an Indian hospital and finally died in 1998. Her husband Shukkur Ali (50) also died later on in 2001. In 1991, Akhiron (65), Anisur Rahman (17) in 1992 and Shahidul Islam (17) in 1998 died of arsenicosis. All of them died without knowing that they were affected by arsenic poisoning.

Altaf Uddin (48) was the general secretary of village arsenic mitigation committee. He was a school-teacher by profession. Arsenicosis killed him in 2004. Altaf Uddin's wife Sofura Khatun (37), daughters Rita (18) and Mita (16), and only son Rubel (12) have also been suffering from arsenicosis. Abdul Aziz (46), the younger

brother of Altaf Uddin, has been suffering from cancer in his respiratory system for 3 years. Arsenicosis is supposed to be responsible for developing cancer in the organ. He said,

> *"We were the most educated family of this village. We installed the first tube-well in the village and consequently we become the worst victim of arsenicosis in the village. It appears very difficult to live in the village due to severe crisis of safe drinking water. Economically well-off families are now leaving the village and try to migrate to the town."*

Maherun Khatun (28), another victim of arsenicosis, has been suffering from leucomelanosis. Her husband Akram's (41) forefinger has been amputated as **squamous cell carcinoma** was developing in his finger. Her daughter Maqsuda (9) was also affected by arsenicosis. Maherun faced a different experience with her daugher's problem. She said,

> *"Sir! I did not allow my daughter to continue her school when her hands and chest were pigmented with white spots. Because, it would be very difficult to manage her husband when people know about her disease. Therefore, I sent her to my brother's home at the town for treatment. When she stopped drinking from arsenic contaminated tube-well, her symptoms of arsenicosis started disappearing. At that time, my husband and I were also affected by arsenicosis and we were reluctant about drinking from community based safe water sources. After one year of treatment, I brought my daughter back to home. But, she is facing another problem right now. She does not want to go to school due to her study gap. Moreover, her friends also do not want to play with her due to unknown reason. They may think that my daughter's previous problem might communicate to them."*

NIPSOM was the first organization to provide some arsenic purifier powder to some families. During the last 5/6 years, almost all tube-wells of the village have been identified as arsenic-contaminated. In 2001, Asia Arsenic Network (AAN) completed Mobile Arsenic Center (MAC) program in Marua. Mobile Arsenic Centre consisted of a team of experts, including a chemist to examine water quality, medical

experts and environmental engineer to find most suitable safe water options and a social worker to conduct awareness education. MAC was also equipped with necessary transportable instruments, chemicals and medicines for the patients (NAISU, 2003). AAN identified arsenicosis patients and gave proper treatment. They installed various household based and community based arsenic removal technologies in that village.

By the interventions of various organizations, people of Marua have experienced with almost all alternative safe water options provided by NIPSOM, AAN, JICA, and DPHE. During the field visit, almost all alternatives safe water options were found abandoned by the villagers. They described about two main reasons to me for rejecting those options. Primarily, new water options are not as easy sources as tube-wells were. In addition, the life of new water options is limited and needs regular servicing.

Akkas Ali (46) died in 2005 due to arsenicosis. He became penniless in saving his life from arsenicosis. His brother Lutfur Rahman (44) is now unemployed due to arsenicosis. He was a transport worker. After having surgical treatment on his lung in Yamagata-Dhaka Friendship Hospital, he became unable to any physical labor. Lutfur expressed his despair to the researcher as,

> *"I am not worried about me. I am highly worried about our children. What will happen to them in future? We are now failing to extract safe water from 900 ft. underground. From where our children will collect drinking water when they will grow up."*

During the time of the study in Marua, the successful performance of a social worker in the village has been observed. The whole community was highly cooperative and participating to any intervention activities. They were comparatively more sensitized about their problem than all other fields of the study. They were highly aware of the situation and eagerly expecting for a sustainable solution. They are organized under village arsenic mitigation committee and youth committee. Through monthly

contribution, they collect the maintenance cost of Pond-sand filters and Dug-sand filters.

During the time of field visit in Marua, Japan International Cooperation Agency (JICA) and Department of Public Health and Engineering (DPHE) were jointly installing a deep tube-well in the village. At their first attempt, they failed to get arsenic free water from 900 ft. deep of the underground. They then decided to go 1200 ft. deep to the underground. According to the Sub-assistant engineer of Department of Public Health Engineering (DPHE), DPHE have been implementing a program of pipe-water supply program in Paranpur of Jessore Sadar Upazila. According to him, pipe-water supply programs are being implemented at household level in areas of sadar upazilla and deep tube-well programs are being implemented at community level in rural areas of other upazillas. As DPHE found all other safe water options ineffective, they decided to apply only the above two options to mitigate arsenic in drinking water.

Village – 3: Raghunathpur

(Union: Sakhua, Upazila: Sadar, District: Chandpur)

Raghunathpur is the most populated village among the fields of the present study. Total population of this village is 11,084, with 53.66% literacy rate. There are 2,411 households in the village. Of which 91.23% are kucha structure. Raghunathpur is frequently affected by riverbank erosion of Meghna. Therefore, people are not interested to build pucca houses there. The main source of income of (the highest) 520 households is business and 1,290 households (more than 50%) have access to electricity (Bangladesh Bureau of Statistics, 2007).

According to National Arsenic Mitigation Information Center (NAMIC), there are 282 tube-wells in Raghunathpur. Among them, 85.82% tube-wells are arsenic contaminated and only 40 tube-wells are safe to drink from. In 2003, Bangladesh

Arsenic Mitigation Water Supply Project (BAMWSP) under the Department of Public Health Engineering (DPHE) conducted the screening program (phase-III) in Raghunathpur and DPHE identified 154 arsenicosis patients in that time (NAMIC, n.d.). In 2007, health assistants of Upazilla Health Complex (UHC) under Director General Health Service (DGHS) completed the door-to-door arsenicosis-patients detecting program and identified only six arsenicosis-patients in that village (DGHS, 2008). No death case of arsenicosis-patient has been officially reported as yet. During the field visit in Raghunathpur, the villagers have also verified this information.

Very recently, just before 1/2 years earlier of the study in Raghunathpur, Department of Public Health Engineering (DPHE) implemented a house-to-house water supply project through pipelines. A deep tube-well, operated by electric pump, was installed nearby the bazaar of the village. Primarily, water is reserved in a tank and than supplied to the households. Interested house-owners have to connect to the main water supply-line at their own expense. In addition, villagers have to pay Tk. 30 per month for water supply.

Raghunathpur is the only filed of the study, where the problem of arsenicosis has been disappearing. The number of suspected arsenicosis-patients, during the first-time screening, has been declined due to 4 years of drinking arsenic-free water. Moreover, there is no incidence of new arsenicosis case in Raghunathpur. However, the sign of arsenic attack in that village is still carrying by a young-girl named Parul Akhter (16). During last 2/3 years, she went through very painful maltreatment by the doctors of both Chandpur and Dhaka. She spent large amount of money but could not recover from the toxic effects of arsenic. Finally, the doctors of Thana Health Complex detected her as an arsenicosis-patient. By this time, she severely lost her health and her study in the school has been totally stopped. Sitting in the front-yard of Parul's house, the researcher observed critical skin manifestation in her hands and legs and suspected that she has been suffering from hyperkeratosis of palms and soles. She is now taking nutritious foods, more vegetables, antioxidant

vitamins and arsenic-free water. Her family and neighbors are very sympathetic to her problem. They do not avoid her and sincerely wish her recovery. However, her parents are still worried about education and marriage.

Among other patients of Raghunathpur, Shiraz master (41) is a tailor by occupation. His skin lesions have become static for 4/5 months, neither increasing nor decreasing. He has no pain, no irritation, and no secretion. However, he went to Upazila Health Complex, but the doctors did not pay any attention to his problems. He also faced some difficulty when he stayed in his tailor-shop. *"My palms became manifested due to unknown disease. People disliked coming to my shop because of my bad-looking palms. Very recently I came to know that my palms were distorted because of chronic arsenic-toxicity"*, he said. However, he started drinking from deep tube-well for one year. As a result, he recovered from that unbearable social difficulty over time.

Kulsuma (15) is also a beautiful young girl of a very poor family. When the researcher reached her home at Raghunathpur, he found almost nothing that could be recognized as a household. Only one small tin-shed house with no yard, no fence, no trees and not even a kitchen. As her mother works in a garment-factory in Dhaka, her elder sister uses the kitchen of their relatives and neighbors. There is no furniture, only few plates and dishes are, in the room. Her father died 5 years ago. Kulsuma showed her tongue to the researcher and told him about dark spots on the skin of her body. He guessed that she was suffering from melanosis – the primary type of arsenicosis. Her symptoms of arsenicosis have appeared as hyper-pigmentation or dark spots on the skin of her body and tongue. She does not have any pain and has not gone to doctor or hospital for treatment. Actually, she has no financial ability to pay for her minor, as she considers, health complain. Furthermore, she is a very young girl and feels disgrace to disclose her problem like dark spots on her skin. The researcher asked her about her education. She said,

> *"When I was under treatment of Upazila Sadar Hospital, my teacher once told me not to come to school before I become cured completely. Actually, my skin*

problems at that time were increasing. I also became very weak. My classmates were very empathetic to my physical difficulties. But, they carefully tried not to sit beside me in the classroom."

Kulsuma's only hope is that the spots on her skin have started disappearing since last few months as she has stopped drinking water from arsenic contaminated tube-well.

Village – 4: Raicho

(Union: Purba Barkul, Upazila: Haziganj, District: Chandpur)

There are 3,540 people live in the village Raicho. It is a village with very low socio-economic level. Literacy rate in the village is 46.45%. There are 853 households in the village, of which 93.9% houses are kucha in type that are built of bamboo and tin. The main income source of (the highest) 29.3% households is small business. Only 300 households have access to electricity and the main drinking-water source of 773 households is tube-well. Total number of working tube-wells in this village is 155, which indicates that one tube-well is shared by minimum five households. Only 57 households use pond water (Bangladesh Bureau of Statistics, 2007).

In 1998-2002, Department of Public Health Engineering (DPHE) under Bangladesh Arsenic Mitigation Water Supply Project (BAMWSP) examined tube-wells of Raicho during the first phase of countrywide screening program. They reported about high arsenic contamination in 94.28% tube-wells of Raicho. They identified 31 arsenicosis-patients in that time (NAMIC, n.d.). However, the latest arsenicosis-patients' detection program stated about 45 arsenicosis patients in Raicho. Upazilla Health Complex (UHC) under Director General Health Service (DGHS) implemented that patient detection-program in 2008 (UHC, Haziganj). No death case of arsenicosis-patient has been reported yet.

As part of arsenic mitigation activity in 2001, DPHE installed three new tube-wells in Raicho for community use that are about 900 fit deep. Though those three tube-wells are still in use, they are not sufficient at all for nearly 900 households. In

August 2006, United Nations Industrial Development Organization (UNIDO) under the project of 'Improving Human Security by Mitigating Arsenic Poisoning in Bangladesh' installed a Community Based Arsenic Removal Unit (CBARU) at uttar Raicho. It is the only CBARU in the whole Purba Barkul union.

UNIDO project office is not a long way from Raicho. This office is also used as a health service center, run by UNIDO. Interestingly, it is observed that a homeopathic doctor was providing free medication for arsenicosis. Every Friday, patients from many distant areas come to get homeopathic medicine. This is the only health center of UNIDO in Haziganj. The doctor informed the researcher that he gave medication to 50-100 patients every week. One patient may need medicine for several times. The patients told me that the medicine that they are receiving is very effective in reducing their health problems.

After the first time tube-well screening, the alternative idea was very simple; i.e.; to change the underground water level and draw water from deeper aquifer. Few solvent villagers instantly installed new tube-wells and abandoned the old ones.

Raicho is well known by its two parts: Uttar (north) Raicho and Dakkhin (south) Raicho. The average socio-economic condition of Raicho is down. Low income, poor housing and illiteracy have driven the villagers' life toward hardships. Dakkhin Raicho is more underdeveloped than the other part of the village. During the time of field visit, more patients are observed in Dakkhin Raicho. Few of them are in cancer stage. According to the local health assistant of Upazilla Health Complex Tayemunnesa (40), people of Dakkhin Raicho are also very reluctant to the children's vaccination program. The researcher went to the village for several times and stayed all daylong. What he observed is their poor economic condition that makes them unwilling to pay attention to any new problem. They are still drinking from red-marked tube-wells. Answering to a question of the researcher, a young housewife named Sufia Begum (26) said,

"It is very difficult to manage daily food for us. Though Doctor apa (health assistant) told us to drink arsenic free water and go to hospital for treatment, we could not do that. Because, going hospital is also a matter of money. Tell us, how we can go to hospital and manage new tube-well for drinking."

Moreover, people of Raicho do not believe fully that there is poison in the fresh and clean tube-well water. They presume that the lesions on palms and soles of few of them will not cause for death. They are even not ready to go to doctors with these problems. There is a small Hindu community known as 'Sarder Bari' in Raicho, consists of 30-40 households. These Hindu people largely involve in 'frying rice' (muri bhaja) by occupation. It can also be considered as their small business. What he observed, during his stay in that village, is that the Hindu community is more aware than the Muslims, in respect of collecting safe drinking water from a distant source even if the source is located 2-3 miles away from their households. Besides this, the Hindus are cooperatively well off than the Muslims in Raicho.

During the time of the study, eight arsenicosis-patients in Raicho were interviewed. Three of them were male and the rest were female. Among the male patients, the researcher observed Abdur Rashid (42) was in a severe condition. His whole body was full of hard patches. He was a rickshaw-puller. Now, he have lost his ability to work and even becomes very tired when walks for a few minutes. Day by day, he is becoming thinner and thinner. Arsenic is ingested in his body through drinking tube-well water for 15 years. He has been suffering from arsenicosis for 7 years. All of this information has brought out when the government Health Assistant took Abdur Rashid to the Upazilla Health Complex as a suspected arsenicosis-patient. He did not spot drinking from arsenic contaminated tube-well red-marked by Department of Public Health Engineering (DPHE) in 1998-2002.

Village – 5: Hatila

(Union: Purba Hatila, Upazila: Haziganj, District: Chandpur)

Total population of the village Hatila is 7976 with 57.14% literacy rate. Total households of Hatila are 1035 where 93.9% houses are built by tin and bamboo. The main income of 205 households comes from agriculture labor and 282 households earns from their own agriculture, forestry and livestock. Therefore, only 434 households have access to electricity. The main drinking water source of 992 households is tube-well. Only a few 24-households drink from ponds (Bangladesh Bureau of Statistics, 2007). Total number of operative tube-wells in Hatila is 292, and 89.73% (262) of them are arsenic contaminated. Only 30 tube-wells were found safe.

In 1998-2002, Department of Public Health and Engineering (DPHE) started screening and mitigation program in Haziganj under Bangladesh Arsenic Mitigation and Water Supply Project (BAMWSP). At that time, the highest number of arsenicosis patients was found in Purba Hatila union. Amongst 552 arsenicosis-patients of all 11 unions of Haziganj upazilla, 321 (58.15%) patients were detected from Purba Hatila union. Very recently (in 2008), Director General Health Service (DGHS) has conducted a door-to-door suspected arsenicosis-patients screening program all over the country. This latest screening program has detected 45 arsenicosis-patients in Hatila (the selected village from Purba Hatila union for the present study). This number was only 13 during the first-time screening conducted by Department of Public Health and Engineering (DPHE) in 1998-2002.

During the field visit in Hatila, the villagers informed about the death of one arsenicosis-patient in 2005. The name of the dead patient was Motaleb Mia (45). From the description of his wife named Morsheda (38), it can be assumed that Motaleb died of skin cancer. He did not receive any treatment except few vitamin tablets from Upazila Health Complex. He became physically disabled to work for the last 5 years of his life. Morsheda, with her three young children passed those days

through tremendous hardships. However, Morsheda could not leave her husband and children. She even worked as maidservant to bring food for her family and medicine for her husband. Moreover, she came to know from the doctors of Upazila Health Complex (UHC) that arsenicosis is not a communicable disease. She believed the doctors' words. She was unable to take her husband to any private treatment service. Morsheda is still fighting with her fate. She is running a small poultry firm by borrowing microcredit from an NGO. Now, she is very aware of health risks from drinking arsenic contaminated water. Everyday, her eldest daughter Marzina (15) collects water from an arsenic-free tube-well, 100-150 meters away from their household.

In Hatila, fifteen arsenicosis patients were interviewed for the study. Among them, seven patients were male and eight patients were female. Patients were seem to be very aware of arsenic contamination. They collect water from arsenic free tube-wells installed by Department of Public Health Engineering. Few of them use boiled pond-water for drinking. A newly installed Community Based Arsenic Removal Unit (CBARU) with the support of Japanese technology is also providing arsenic-free water to the villagers of Hatila. A project of United Nations Industrial Development Organization (UNIDO) has being been implemented in Haziganj and Shahrasti upazilla during my study in those areas. UNIDO has also distributed few Household Based Arsenic Removal Units (HBARU), named as 'Read-F', in their project areas including Hatila. Patients' families have the priority to receive those filters. Though the number of distributed filters were very limited compared to the demand in Hatila, the difficulty of the poor patients and their frustration to get a filter for safe drinking water was observed. It is, as the researcher understood, the politics of the village and the nature of power structure deprived the poor from getting filters.

Patients of Hatila received treatment and medicine from Upazila Health Complex for two years. Their names were registered at the hospital and they were provided with health cards to get free medicine. On the other hand, they had to go through a lot of trouble to receive that service. Recently, patients are also receiving homeopathic

medicine from United Nations Industrial Development Organization (UNIDO) office, which is proved very effective for them. However, there are patients in Hatila, who claim that their symptoms of arsenicosis are growing. When I observed those patients, I found them with some physical complications that require, may be, surgical treatment. According to me, they have already crossed the primary stage of the disease that may not be cured only by drinking arsenic-free water, nutritious foods, antioxidants and ointments. On the other hand, Upazila Health Complex has no provision of providing any other treatment than medicine to those patients.

Patients of Hatila faced no dissolution of marriage, separation between husband and wife, social exclusion or any other reported social difficulties due to arsenicosis. Few patients experienced avoidance and abhorrence due to widespread misconceptions about the skin lesions and spots of arsenicosis patients in the early stage. These occurred especially in public places like tea stalls, and in markets or bazaars, or in public transports, etc. For example, Rafiqul Islam Akhand (45) of Hatila is an owner of a small tea-stall by the side of the main connecting road of the village to Upazilla Sadar. He has been suffering from arsenicosis for about 10 years. When his fingers and palms were exposed with hard patches and his skin was pigmented with white spots, even his regular customers avoided his stall for tea. He described his experiences as,

> *"My customers suspected my symptoms of arsenicosis as leprosy, eczema, etc and considered those problems communicable to them. Few years ago, a Japanese study team picked me up to Dhaka and provided treatment in a hospital for several weeks."*

Rafique was also suffering from respiratory illness due to arsenicosis. He is better now and running his tea-stall again.

Sitting in front of the tea-stall of Rafique, Mr. Sharazul Haque (55), a school-teacher of Hatila informed me that before the Japanese-team detected Rafique as an arsenicosis patient, the villagers had very little idea about the problem. By the case of Rafique, they could visibly introduce with this deadly disease. They also

remember the event when Department of Public Health Engineering (DPHE) marked their tube-wells with red and green colors and told them not to drink from red-marked tube-wells. The researcher joined with few customers sitting on the benches of Rafiques's tea-stall and discussed the situation of arsenicosis in Hatila with them. He observed that the villagers of Hatila are more aware of arsenicosis now than before.

Village – 6: Alipur

(Union: Tamta, Upazila: Shahrasti, District: Chandpur)

Alipur is one among 163 villages of Shahrasti Upazilla. There are 3218 people live in this village with 60.93% average literacy rate. There are 591 dwelling households in Alipur, 92.55% of them are 'kucha' by structure. The main income source of (the highest) 131 households is agricultural labor. Only 190 households have access to electricity. Tube-wells are the main source of drinking water for 583 households, whereas only two households collect water from ponds (Bangladesh Bureau of Statistics, 2007). Among total operative tube-wells of Alipur, 98.85% tube-wells are contaminated with high-level of arsenic – one of the highest arsenic-contaminated villages in the country.

In the midst of the selected upazillas for the present study, the highest number of (568) arsenicosis-patients were identified in Shahrasti Upazila. In the sample village Alipur, fifty arsenicosis-patients were detected during the second-phase of countrywide screening program in 2001-2003. United Nations International Children's Emergency Fund (UNICEF) implemented that screening program in Shahrasti. Tube-wells were tested and patients were identified through a combination of house-to house survey and community based health camps (NAISU, 2003). By 2008, the total number of arsenicosis-patients have been increased to 203, which has been identified and registered by Director General Health Service (DGHS). The

number of arsenicosis-patients in Alipur is the highest among all other sample-villages of the present study.

In Alipur, 21 arsenicosis-patients were observed for the study, of which 11 were male and 10 were female. The villagers reported about the death of three arsenicosis patients during last 3-5 years. About five patients were found who needed immediate surgical treatment. The rest of them, as visually understood, were suffering from skin lesions on their chest, palms and soles. All of them had been suffering from malnutrition. Few patients were taking part in Arsenic-Selenium Clinical Trail Project that was jointly implementing by Texas-tech University, USA, Apollo Hospital, Dhaka, Mother and Children's Health Institute, Dhaka. The project started on April 2006 and supposed to end in March 2008.

During the time of field visit in Alipur, the activities of the field-workers of the project were also observed. After giving the medicines (vitamin-E and Selenium) under trail for 24 weeks to the patient under experiment groups, the field-workers were collecting photographs of the patients' upper chest, specimen of blood, nail, hair and urine to examine the effect of the given medicines. Participant-patients of the trail project expressed their frustration to the researcher about the project. It is realized that the severe scarcity of safe water source, uncertainty in curing by medicines under study, difficulty in receiving service from govt. hospital with their shortage of medicine and complexity in management, high cost of surgical treatments in private hospitals for patients suffering from cancer have been generating the mass frustration and panic among the villagers of Alipur. In addition to this situation, the social relationships between individuals and families of the village have been threatened when they have to appear in an uneven competition to get services from any service providers. Because, any care-giver or service provider comes with any activity, (arsenic mitigation or patients' management) is very limited in scope and scale. Thus, the role of local government authorities, locally operative NGOs, local political leaders, locally powerful individuals, and families, local groups with vested interests, and their interrelationships have serious negative

consequences on the social stability. This situation can easily be observed in Alipur and all other villages of Shahrasti.

Village – 7: Niz Mehar

(Union: Pourashava, Upazila: Shahrasti, District: Chandpur)

Niz Mehar is a newly included village in the Shahrasti Pourashava. There are 3457 people live in this village with 55.23% average literacy. Total number of dwelling households of the village is 662 and 92.55% of them are made of 'kucha' houses. The main income source of (the highest) 125 households is business, and only 288 households have access to electricity. The primary source of drinking water in 571 households is tube-well. Only 21 households have access to tap water, which comes through pipelines (Bangladesh Bureau of Statistics, 2007). Total number of operative tube-wells in this village is 195 and 99% of which are contaminated by arsenic.

In 2001-2003, United Nations International Children's Emergency Fund (UNICEF) conducted the first screening program in Niz Mehar. In that time, tube-wells of that area were tested and arsenicosis-patients were identified through a combination of house-to- house survey and community-based health camps (NAISU, 2003). UNICEF then detected only 32 patients in Niz Mehar, whereas Director General Health Service (DGHS) identified 134 arsenicosis-patients from the same village in 2006-08. During the researcher's stay in Niz Mehar, it appeared to him that the number of arsenicosis-patients was more than the above two estimates. This observation is supported by a survey conducted by Arsenic Selenium Clinical Trail Project in Shahrasti upazilla. The survey was conducted on 121 arsenicosis-patients who had only white-spots on their upper chest. However, patients with other physical complications had not been included in the survey. If that were done, the number of patients would have increased to more than 300.

Patients of Niz Mehar are very aware of their problem. The researcher found that the people were trying to drink arsenic-free water from different sources. When he came to the village, he found a teen-aged boy sitting in a small grocery shop that was located just at the border the village. His name was Raqibul Hasan Rubel. As his father went to the town, he was running the shop. He asked Rubel about the situation of arsenic and arsenicosis in his village. He found him (Rubel) very concerned about arsenic. He told him (the researcher) that he was an arsenicosis patient and he (the researcher) saw his small scratched palms very painfully. He (the researcher) asked him about the source of his drinking water. Very interestingly, he showed him (the researcher) a container of water full of rainwater. He brought the container from home for drinking. The researcher had a chance to see the female patients of the village who were taking part in the clinical trial project. As per the project's requirement, field workers had to take photographs of the upper-chests of the male, female, adult, and adolescent patients. Moreover, samples of urine, blood, nail and hair were also collected for examination. Answering to a query of the researcher, a housewife named Marzina (31) said,

> *"I am willingly taking part in the project. I know that the given drug may not cure us. But I don't have any other way. Besides, NGO officers told me that they would install a deep tube-well inside my household. The tube-well will effectively meet the demand of safe water for other members of my family."*

If the villagers were not adequately sensitized earlier, it would be impossible to get access to them.

Not only the patients but also other villagers of Niz Mehar, who are at high risk of being exposed to arsenicosis, had only one demand - supply of safe arsenic-free water. Practically, they did not inform me about any kind social difficulty that they were experiencing in their families and in the society. Naturally, the parents had a common anxiety about the future of their children who were passing their adolescence and had skin lesions.

Mr. Ruhul Amin (53) - a well-known school-teacher of Niz Mehar - died on February 2006 after being diagnosed with cancer due to arsenicosis. People of Niz Mehar mourned a lot due to his death. They do not want to be affected by cancer like Ruhul Amin. They realize that they have to drink arsenic-free water to save their children's life. However, they do not know how they will get the safe drinking water.

Village – 8: Rajarampur

(Union: Pourashava, Upazila: Sadar, District: Chapai Nawabganj)

Rajarampur is a village of Nawabganj Pourashava under Sadar Upazila of Chapai Nawabganj district. Around six thousand five hundred people live in Rajarampur, 55.07% of them are literate according the population census report 2001. Among 530 households of Rajarampur, 52.6% of the households' structure is kucha' by type, while 22.77% of them are 'semi-pucca'. 340 households have access to electricity (Bangladesh Bureau of Statistics, 2005).

The National Institute of Preventive and Social Medicine and the School of Environmental Studies conducted the first study in the Rajarampur village. They found that 29% of the 294 tube-wells tested had arsenic concentrations greater than 50 mg/l (Ahmed, 1997). In 1998-2002, Department of Public Health Engineering (DPHE) implemented mitigation and community development program in Rajarampur under Bangladesh Arsenic Mitigation Water Supply Project (BAMWSP). They identified that 87% of the tube-wells of Rajarampur were contaminated with high level of arsenic. They also detected 96 suspected arsenicosis patients in that village. In 2008, Director General Health Service (DGHS) in its latest annual report reported about 111 arsenicosis patients in Rajarampur.

In-depth interviews of 12 arsenicosis patients were conducted in Rajarampur. Among them 8 patients were male and 4 were female. Finding female patients for interview was very difficult in Rajarampur. Most of them were suffering from both

melanosis and keratosis. All of them were living in very poor economic condition. They could not even afford the cost of transportation to go to the Upazila Health Complex to collect free medicine. In the initial stage of the discovery of the arsenic problem in Bangladesh, during 1997-98, three arsenicosis-patients died in Rajarampur. Those patients could not receive proper treatment from hospitals. Because, the doctors at that time were not properly trained about the disease, said Upazila Health and Family Planning Officer of Upazila Health Complex.

Rajarampur has recently been connected with water supply project through pipelines. Department of Public Health Engineering (DPHE) has implemented this project. Poor villagers including the patients still have the problem of getting access to the piped water because they have to connect their households to the main pipeline at their own cost. Moreover, they have to pay 30 taka per month for such water.

Patients of Rajarampur did not suffer from any of the above mentioned social difficulties in their families and society. However, arsenicosis has made few of them almost disabled for any physical labor. This situation has significant impact on the income of the patients. In this way, arsenicosis has been notably contributing to push the patients and their families to permanent destitution.

Village – 9: Baharam

(Union: Ranihati, Upazila: Sadar, District: Chapai Nawabganj)

Baharam is located in Ranihati union of Chapai Nawabganj Sadar upazilla. This is the largest upazilla among the selected upazillas of the present study. Baharam is one of the 211 villages of the Sadar Upazila. Total population of this village is 3535, with only 34.46% literacy rate. There are 498 households in Baharam. The main source of income is business in 212 households. Other sources of income of the villagers are agriculture, forestry and livestock, and agricultural labor. Only 122 households have access to electricity (Bangladesh Bureau of Statistics, 2005).

Total number of operative tube-wells in this village is 269. In 2002, 98% of the tube-wells in Rajarampur were found to be contaminated with arsenic and 137 patients were affected by arsenicosis. However, in 2008, the latest Suspected Arsenicosis-patients Detection Program enlisted 147 patients from the village. No incidence of death caused by arsenicosis has been reported yet.

The researcher visited Rajarampur on June 2008 and studied the situation of arsenicosis-patients in the village. He closely observed nine male and nine female arsenicosis-patients. Other than insufficient health care service and limited sources of safe water, the patients did not tell him about any social problems that were due to the disease of arsenicosis.

Village – 10: Osmanpur

(Union: Boliardi, Upazila: Bajitpur, District: Kishoreganj)

Total population of Osmanpur is 1150, with 48.67% literacy rate. There are 221 households in this village, with 88.41% 'kucha' houses. Only 68 households have access to electricity. The main source of drinking water in 215 households is tube-well. There are 67 operative tube-wells in the village, with 43.28% of them being contaminated with arsenic (Bangladesh Bureau of Statistics, 2007).

Only two arsenicosis-patients were detected from Osmanpur in 2002-2005. In 2008, the number of arsenicosis-patients had increased to 11. No incidence of death due to arsenicosis has been reported yet. Two doctors of Upazila Health Complex (UHC) have recently participated in a workshop on arsenicosis at Dhaka. Upazila Health and Family Welfare Officer told me there was no supply of medicine for arsenicosis patients. Therefore, the patients were unwilling to come to UHC merely for advice. It takes about 100 taka to travel to and from UHC. Moreover, patients of Osmanpur

were showing primary physical symptoms with no pain or discharge that would not make them interested to go to a doctor.

In respect of spread of arsenic contamination and prevalence of arsenicosis, Osmanpur may not be a suitable place for study. To understand properly the primary social situation on how a new health problem like arsenicosis originates in a community, the researcher has chosen the village Osmanpur as a potential field. A study, conducted by Rural Advancement Committee (RAC) Bangladesh, reported that 13.02% of the tube-wells of Boliardi union in Bajitpur Upazila were not tested for arsenic contamination. After practical inquiry, he realized that those tube-wells were installed after completion of the countrywide screening in 2002-2005. The villagers told me that they did not examine the water-quality of the newly installed tube-wells. In fact, they could not even tell me about the place where tube-well water could be tested. The people of Osmanpur are not aware about the problem of arsenic contamination and arsenicosis. When Director General Health Service (DGHS) were implementing countrywide door-to-door arsenicosis-patients identification program, the villagers came to know that some of them had been suffering from arsenicosis. He visited a household with five arsenicosis-patients. Abdur Rahim (35), Abdul Zabber (31), Kabir Uddin (28), Adbur Rashid (25) and Mokhles (22) are five brothers. The skins of all five brothers are pigmented with black spots; their palms and soles are full of hard patches. They described that their parents, who died 3 years ago, also had skin lesions. It seemed to the researcher that the parents of five brothers died of chronic arsenic toxicity. All of them used to drink from the same tube-well at their home. They still do not know whether their tube-well is contaminated or not. The brothers took me to a woman who was also affected by arsenic poisoning. Her name is Parvin Begum (42). She had no idea about arsenicosis. Very recently, local health assistant of Upazila Health Complex detected and enlisted her as a suspected arsenicosis patient. Describing her experience with her skin lesions to the researcher, Parvin said,

> *"I never attended to my skin lesions. These minor problems have been developed on my skin over many years. My husband also did not bother those*

problems. We took it as usually. More especially, these lesions do not have any irritation or secretion."

During his 2-day stay in Osmanpur, the researcher had several discussions with the patients and the villagers. He repeatedly observed their confusion about arsenic contamination in their tube-wells and skin lesions on their palms that might cause cancer and death.

Village – 11: Hatrapara

(Union: Kadirjangal, Upazila: Karimganj, District: Kishoreganj)

Total population of Hatrapara is 5685, with 43.7% average literacy. There are 883 households in this village, with 88.85% 'kucha' houses. The main income source of 340 households is agriculture and primary of source of drinking water in 864 households is tube-wells. Only 188 households have access to electricity (Bangladesh Bureau of Statistics, 2007). Total number of working tube-wells in this village is 169. 24.85% of the tube-wells in Hatrapara are arsenic contaminated. During 2002-2005, Department of Public Health Engineering (DPHE) identified only three arsenicosis-patients in Hatrapara. In 2006-2008, Director General Health Service (DGHS) reported about eight arsenicosis-patients in the village. No incidence of death due to arsenic has been reported yet from Hatrapara.

Kishoreganj upazilla, indeed, is not a red-spotted area for arsenic contamination. During the first countrywide screening in 2003, only 14 patients were detected in the entire upazilla. During the researcher's visit to Hatrapara, he found complete ignorance of the villagers about arsenicosis. Arsenic contaminations in about 25% of the tube-wells could not draw the attention of the people. Furthermore, they did not suffer from any severe physical problem at that time. As a result, they did not stop drinking from the red-marked tube-wells. Gradually, few of them started being affected by arsenic poisoning. Symptoms of arsenicosis became visible among them. Finally, during the time of door-to-door searching for arsenicosis-patients, eight

patients have been detected from Hatrapara. There were people who could not tell anything about the recent patient screening program. He assumed that both screening and mitigation programs have been conducted in Hatrapara carelessly. The number of patients in the village must be more than the above figures. However, among the eight reported patients, six of them are from the same family. Among them Ibrahim (17) was in severe condition (photograph – 18). Ibrahim's father Abdus Subhan (48), his mother Ambia (38), brothers: Ismail (20), Alamin (12), and sister Nazama (10) were being clearly exposed to arsenic poisoning.

Mr. Abdus Sobhan is a poor farmer. In 2004, he installed a new tube-well inside his household. His family, as well as the families of his two brothers shared the same tube-well. When I first visited him at his home, he was looking very sick. He came out of his home with his son Ibrahim. Ibrahim did not tell anything to me. He also looked very sad.

Ibrahim was thought to be the first arsenicosis patient in that village. His father Abdus Sobhan initially took him to the village doctors who gave him medicines for skin diseases. He also went to several 'kabirajs' (indigenous healer) for his cure. Finally, he went to a private clinic in Karimganj Sadar and spent about twenty thousand taka for the diagnosis and treatment of his son and wife. Then his other sons, only daughter, and he himself were affected by this mysterious disease. The whole family is now known as an arsenicosis family in the village. They are living in a disgraceful situation in their community. In Abdus Sobhan's own words,

> *"I was puzzled when THO (thana health officer) sir told me not to drink water from my won tube-well. I was one of the latest tube-well owners of my village. I was unable not manage money for many years to have a tube-well of my private use. I, then jointly with my cousin's family installed a tube-well recently. It would be very shameful for us to go to other's households to collect drinking water again. Neighbors feel disturbed when we go inside their households to collect water. It is also impossible for me, on the other hand, to install another tube-well."*

After all, Abdus Sobhan has to install a new tube-well. He does not know what the future holds for him.

Village – 12: Nagarbhanda

(Union: Halimpur, Upazila: Bajitpur, District: Kishoreganj)

Nagarbhanda is a remote village in Bajitpur Upazila. There are 1673 people live in this small village. Total number of households in Nagarbhanda is 355 (Bangladesh Bureau of Statistics, 2007). In 2002-2005, Department of Public Health Engineering (DPHE) identified 113 operative tube-wells in the village, 38.94% of them were found to be arsenic contaminated (NAMIC, n.d.).

In Nagarbhanda, there are 26 households with arsenicosis-patients. Very surprisingly, 23 of them are from a single 'Bhuiyan Bari'. Three patients already died of skin cancer caused by arsenic poisoning. All patients, who passed away, are also from the same Bhuiyan Bari. Shafiuddin (45) died in 2004, Nilu Mia died (45) in 2005 and Sultan Mia died (42) in 2007. In Bhuiyan Bari, there are ten tube-wells and nine of them are arsenic contaminated. Only one tube-well is found to be arsenic-free, that was installed by Department of Public Health and Engineering (DPHE) for community use.

In the past, there was only one source of quality drinking water in the whole community. It was a dug-well, also excavated by the ancestors of Bhuiyan Bari. The dwellers of Bhuiyan Bari abandoned the dug-well 3 or 4 years ago because individual tube-well has been installed in all the households by this time. In addition, collecting water from tube-well is easier than from the dug-well. However, it appears very unfortunate to abandon all of their privately installed tube-wells due to arsenic-contamination.

Shahjahan Master (45) is the most respected elder of Bhuiyan Bari. He is a high-school teacher by profession. Describing their miseries created by arsenic poisoning, he said,

> *"My family is the worst victim of arsenicosis in Nagarbhanda. We lost everything due to this disease – our fame, dignity and huge amount of money. We are the most educated, respected and well-off family of the village. Our family has almost been isolated from the community due to this disease. Moreover, broadcasting the news of arsenic poisoning in our family on the media has also increased our sufferings. Officials from Health Complex and Public Health Department, reporters from Newspapers and TV channels, as well as NGO workers have severely damaged our status in the community. It appeared more unbearable than the three valuable lives of my family taken by arsenicosis. And at the end, no practical help has yet been received by my family members."*

During 2003-2005, DPHE detected only 3 arsenicosis-patients in Nagarbhanda. In 2006-2008, according to the list provided by Upazila Health Office, 26 arsenicosis-patients have been detected from the same village. The researcher observed several patients with severe physical complications. They were Mokhlesur Rahman (35), Renu Mia (47) and Rabeya Khatun (55). He also interviewed patients with moderate physical symptoms; they are Mezbahuddin (38), Humayun Mia (52), Abu Siddique (60), Farida Khatun (42), and Moni Akhter (24).

The researcher could not identify any organization working on arsenic and arsenicosis in Nagarbhanda. Local leaders are trying to draw the attention of NGOs to work on arsenic problem in the village. Local journalists and ward members are very worried about the situation. Only DPHE and UHC with their limited services had responded to the problem when reporters wrote the stories on death incidents in Nagarbhanda.

According to his observation, not all tube-wells of Nagarbhanda are screened for arsenic-contamination. As stated by Rural Advancement Committee (RAC)

Bangladesh, a local NGO working in Bajitpur, 18.43% tube-wells of Halimpur union were not tested for arsenic. During his stay in Nagarbhanda, he also identified a number of households with unscreened tube-wells. Very interestingly, some of the villagers are not even interested in testing their tube-wells. A villager named Abdur Razzaq (42) said, *"Arsenic poisoning is nothing but a new conspiracy of the NGOs in our country."* Many of the villagers, in fact, consider the problem of arsenic as propaganda of the newspaper. Besides, some of them do not know where they can go to test their tube-wells' water.

CHAPTER - 5

ANALYSIS OF THE FINDINGS

Social Aspects of Arsenicosis

Every individual in a community maintains a number of social relationships and goes through a diverse social situation in his or her lifetime. These relationships are greatly influenced by the existing social, political, economic and cultural factors of their own society. Therefore, any abnormal situation in the social, political, and economic systems of a society in turn affects all individuals and groups living in it.

When any disease affects the people of a community, they naturally confront a set of physical, mental, economic and social difficulties. Social difficulties caused by a disease vary from one community to another. Such variation may depend upon the environment, and lifestyle of the people in the community. Numerous factors in the society might contribute to the social problems for a patient. As all the factors are not equally present in each and every patient in the same society, the nature and extent of the sufferings faced by each patient may be unique in its own way.

The social sufferings of the arsenicosis patients were probably first reported by Dhaka Community Hospital in 1998 (DCH, 1998). Dr. Mahbuba Nasreen, in 2002, from the Department of Sociology, Dhaka University, also identified various social difficulties faced by such patients; these difficulties include 'superstition, ostracism, marital problems, discrimination against women, increased poverty, diminished working ability, deaths of the patients and social instability' (Nasreen, 2002).

Suzanne Hanchett in an article published in 2004 in Arsenic Policy Support Unit (APSU) nicely defined social aspects of arsenicosis as – "Social, cultural, and

economic factors that influence the impact of arsenicosis on people's lives and socio-economic patterns identified in epidemiological studies; people's perceptions and priorities and other social, cultural, and economic factors that influence the public's responses to the crisis; and the institutions and programs that can or do address the problem – the people who manage and implement them, and their apparent social effectiveness" (Hanchett, 2004).

Discussions on social aspects of arsenicosis have been found in few research publications. Those publications are 'social problems of arsenic victims' (DCH, 1998), 'social issues associated with arsenicosis in women' and 'arsenicosis and poverty' (Hanchett, 2004), 'social costs of arsenic poisoning' (Moinuddin, 2004), 'social fallacy of arsenic' (Uddin, 2002), 'socio-cultural impacts of arsenicosis' (Haque, n.d.) and others. In 2002, WHO also recognized the effects of arsenicosis 'in relationships within the family and the mental health of the sick' in its report prepared in cooperation with the Department of Health in Sustainable Development (World Health Organization, 2000, p. 19).

Nature of Social Difficulties

As social and cultural patterns all around Bangladesh are homogeneous, it is found the nature of social difficulties caused by arsenicosis to be very similar in almost all fields of the present study. Arsenicosis patients have various unexpected social experiences that are due to their illness. Arsenicosis patients have to cope with social stigma as well as fear of isolation from the community. When tube-well in any household is marked as arsenic contaminated, it brings shame for that household owner in the community. When a person is diagnosed with arsenicosis, the disease is sometimes considered as the God's punishment to that household. At the very early stage, arsenicosis start affecting the skin and palms of the patients. As skin is the vital part of a person's appearance, arsenicosis patients feel ashamed to come outside and mingle with others. Patients with skin manifestations generally face avoidance

and abhorrence by their family members and community people as well. They do not receive invitation in any social functions or gatherings. They also cannot freely move across their own locality and join others in any public places. Thus, the arsenicosis patients become the victims of social ostracism or social exclusion. Female arsenicosis patients face additional social problems compared to their male counterparts. Married women are shunned by their husbands especially in maintaining sexual relationship. They are considered unsafe to become pregnant and to be a prospective mother. Unmarried arsenicosis patients lose the prospect of getting married. Children with arsenicosis are not permitted to play with their friends and to continue going to school.

Arsenicosis creates unemployment and increases poverty. Patients have common complication of physical weakness which gradually makes them unable to work. They are sometimes dismissed from their work and become dependent on other family members. Sometimes, affected limb of a patient has to be amputated leading to permanent disability. In this way, arsenicosis increases poverty in the villages.

Patients have difficulty in detecting their disease at the early stage. Wrong diagnosis and maltreatment are very common. Economic loss from improper patient management is also enormous. Patients with severe arsenicosis are in many cases affected by cancer that leads them to certain death. The death of those patients pushes their families to extreme poverty. Arsenicosis patients require urgent supply of arsenic-free drinking water that may not be available in most cases. Patients face difficulty in getting access to safe drinking water as well as to proper treatment from health care givers. Widespread presence of arsenicosis in a locality creates a chaotic situation. Other local factors like religion and politics add to the problem and thus bring about social instability.

Gender and Arsenicosis

Epidemiological studies to date present conflicting information on whether males or females tend to be affected more by arsenicosis. Studies on large population found significantly higher prevalence of arsenicosis symptoms among males than among females (Ahmed et al., 1999). Another study has also revealed that arsenicosis causes less skin lesions but higher rate of lung diseases among women than men (Hanchett, 2004).

In almost all fields of the present study, the number of male patients was more than that of female patients except in Chandpur district. BAMWSP screening report also identified larger percentages of women arsenicosis patients in the same district (NAMIC, n.d.). The possible reason may be, according to a prominent Public Health Engineer living in Chandpur, the commercial location and moving character of male residents of this district. Though Chandpur is the most severely arsenic-contaminated district in the country, males residents of this area do not drink water from their own contaminated tube-wells on a regular basis, unlike the female residents. A considerable number of the male populations of the area live outside their home due to the nature of their employment.

Women with Arsenicosis

In my study, I found women with arsenicosis are in more vulnerable situation. The gender difference can be assumed as the main reason behind this situation (Hanchett, 2004). Women in rural communities are shy and do not like to talk about about their health problems. It is considered not womanly to bother their male relatives with their health problems, even when they feel very sick. On the other hand, there is some social pressure on women to attend carefully to others' health needs. In most families, wives are on an average less educated, younger, and have less earning capacity than their husbands. According to the cultural orientation, wives tend to eat last and least in their households. Therefore, women living in poor families are most

likely to be malnourished. When husband suffers from arsenicosis, the wife definitely takes care of him. But, in case of the wife's disease, she receives the least attention by her husband and other family members. During the visit in the fields, some opposite observations have also been made by the researcher. Some family members including the rich relatives are seen spending a large amount of money for their women patients. Husbands are seen borrowing money to continue the treatment of their wives suffering from cancer.

Due to social norms, women in families are often last to receive nutritious food and to have access to safe drinking water even when they are arsenic-affected. There is some disagreement as to whether women accept this standard on their own or imposed by males, who do not want to attend women for medical appointments.

Moreover, female patients encounter more social problems due to the disease. In Bangladesh, women's attractiveness lies in their beauty that is often judged by their pale complexion. It becomes very difficult for unmarried women suffering from arsenicosis to get married. On the other hand, married women with arsenicosis are sometimes abandoned by their husbands. This is supported by a study which found that women with arsenicosis are frequent victims of ostracism. They were doubly vulnerable: by the disease itself and by their family members (Moinuddin, 2004). But, only a few such cases have been found in the fields of the present study, where women are completely ostracized due to arsenicosis.

Family members and neighbors sometimes refuse to take food cooked by the affected women. In another research paper, it is revealed that the female patients are forced out of the society due to arsenicosis (Moinuddin, 2004). But, no such incidence has been observed in the fields of the present study. According to another study, women suffering from arsenicosis are subjected to domestic violence such as dowry (41.7%), divorce (16.7%), separation (16.7%), desertion (8.3%), physical torture (8.3%) and ploy (8.3%) (Haque, n.d.).

Women with visible arsenicosis symptoms are said to be more likely to suffer socially than do the men. A serious consequence for women having arsenicosis lesions is that they have difficulty finding work in jobs where they have close contact with other people they work for, for instance working as maids or tailors. This sort of difficulty is economically catastrophic for self-supporting women or female household heads.

Among all other household activities, collecting and carrying water for household use are considered to be the responsibilities of the wives and girls of the families. Arsenic contamination in adjacent tube-well water often compelled them to collect and carry water from long distances. National Water Policy has also identified the same problem, as "Lack of access to safe water supply in the rural areas is a special hardship for women who have to carry water over long distances, with significant impact on their health and productivity." (National Water Policy, 1999, p. 10). Another important observation of the study is that women are comparatively less aware of arsenicosis. They often fail to take the opportunities of obtaining information from outside sources. This situation has indeed increased their sufferings.

Children as Victim of Arsenicosis

Children are the worst victims of arsenic in Bangladesh. Impact of arsenic poisoning on the lives of the children and the social costs are enormous. Concerned organizations including the Director General of Health Service (DGHS) have no specific information on how many children in the country have been suffering from arsenicosis. In the fields of the present study, arsenic affected children were not found to be that many. Among 1,044 total arsenicosis patients, only 17 were children. Why the number of child arsenicosis cases is not as high as those of adults? According to the doctors, the time and amount of arsenic ingestion are the key factors in causing the disease. As children do not drink as much water as the adults

do, the concentration of arsenic in their body is low compared to the grown-ups. In addition, the period of drinking arsenic contaminated water is longer for adults than for children.

Regardless of the number of children with arsenicosis, it has been clearly understood from field experiences that they have been growing up with a number of wounds in their body and mind because of arsenicosis. Difficulties especially multiply in areas, where the misconception still exists, that arsenicosis is communicable and contagious. For instance, children love to pass their time playing with their friends in groups. But, the parents in arsenic affected localities do not want their children to play with the affected children. School-going children with the disease of arsenicosis are, sometimes, told by the teachers not to come to the schools. Even the parents of affected children are also reluctant to let their children with skin lesions to play with other children and to go to school. Specially, girls are stopped from going to schools by their parents when arsenic toxicity starts deforming their skin's color and complexion. They fear that if people know about their daughters' problem, it may ruin the prospect of their marriage. On the contrary, boys usually do not stop going to school unless any other physical complications along with skin lesions make them unable to attend classes. Adults suffer frustration and helplessness due to the fear about what their children would drink in the future. The more they realize that the situation of safe drinking water supply is worsening gradually, the more frustrated they become.

Education, Occupation, and Income of Arsenicosis Patients

No large-scale national patient-screening program to date has collected the socio-economic information of the patients. The only reliable information on this has come from limited regional studies. Studies related to socio-economic conditions of the people always became useless for the respondents. The practical situation in severely

affected villages does not permit to go only for socio-economic studies. Once, people are informed about arsenic contamination in their tube-wells, they simply demand for alternatives. Areas, where installing arsenic-free tube-well is even beyond the capacity of the rich people, mass frustration is a great obstacle to any socio-economic studies. I also faced some embarrassing situations in the fields during my study.

Field experiences have clearly demonstrated a strong association between poverty (indicated by landlessness, income, and no education) and the prevalence of arsenicosis. Patients with little education, low income and occupational status are comparatively unwilling to go to hospitals with their primary complications. They have also been observed very reluctant to collect safe water from a distant source. When I asked them why they are not serious about their skin lesions, they simply answered, 'we are unable to buy foods for ourselves. How we can afford to go for treatment'

Arsenicosis Related Morbidity

The overall morbidity rate in Bangladesh is estimated to be 165.1 per 1000 population. It was estimated in 1994-95 that, on average, people in rural areas are ill 91 days of every year (males 90 days and females 92 days); and both men and women lose an average of 18 working days per year because of illness (BBS, 1997). Diarrhoea accounted for 5.5 percent of all morbidity in 1997, and diarrhoea prevalence was 16.5 per 1000. The prevalence rates during this period for some other water-and sanitation-related diseases were: dysentery 9.3/1000 and typhoid 2.6/1000 (Hanchett, 2004). Arsenicosis is, of course, one of many health problems affecting the Bangladesh population. The government central database does not have any information on arsenic-related morbidity. Even, arsenicosis is not enlisted in the disease profile that is mandatory to maintain and send to DGHS every month by Upazila health complexes. Moreover, no studies have also been conducted to check

for arsenicosis related morbidity. During the time of field visit of the present study, villagers were asked to inform about the death incidents of arsenicosis patients in their locality. Accordingly, 49 death cases have been identified. Relatives of dead arsenicosis patients described their painful experiences of the patients. According to the patients' death certificate, those who died at hospitals, most of them have died of cancer. Hospitals also do not maintain the list of death cases of arsenicosis.

Misconceptions and Prejudices

Traditional beliefs and perceptions about all kinds of diseases in the villages of this country are generally unscientific. People commonly believe diseases as the punishment or test from God. Like all other diseases, people also have their own ideas about arsenicosis. Fields with minimum or small prevalence of arsenicosis are observed more superstitious. Those in highly affected areas who know more about the disease are likely to think differently. The major causes of developing and sustaining misbeliefs about arsenicosis is the unavailability of specific treatment. Moreover, the disease does not show immediate improvement even after abiding all instructions provided by the health care givers. This causes more misconceptions to grow among the people about the disease. The very common misconception among the rural population is that arsenicosis is communicable. This wrong-belief is widespread in areas where arsenicosis cases have been detected recently. Increase of public awareness activities by different NGOs slowly caused this misconception to disappear to a certain extent. Besides, when people also observe that the disease affects few of their family members but not all of them, they start realizing the truth. People also have fear of transmission through sexual relations and pregnancy. Misdiagnosis of arsenicosis as skin disease at early stages is also very common in arsenic affected communities. Village doctors, homeopathic practitioners, and local 'kabirazs' (indigenous local physician) also provide treatment of skin disease to the arsenicosis patients due to the lack of orientation about it.

There are people in the fields, who believe that the disease has technically spread over Muslim community by the non-Muslim countries. Some of them believe it as an experiment of the developed world. As Muslims need Halal (religiously approved) water to drink and to use in different religious activities, their water is chemically contaminated to spoil their rituals. As to manipulate people's belief about arsenic poisoning, foreigners are spreading the viruses of the disease in the removal units or filtration processes. People have hard time to believe the poisonous effect of arsenic contaminated water in tube-well as the taste and color of such water are no different from those of arsenic-free water.

Social Ostracism

Social ostracism is also termed as Social exclusion by many researchers. At the early stage of the prevalence of Arsenicosis in a community, people identified the disease as leprosy. As a result, patients are ostracized at either household or village level. The nature and extant of ostracism vary in different ways at both household and community levels.

Ostracizing arsenicosis patients is somewhat originated from two misconceptions. The first one is the belief that arsenicosis is a kind of punishment from the god, while the second belief is that arsenicosis is communicable to others. From widespread fear of contagion, family members often abandon the victims of arsenicosis at their household. Specially, women are the worst victims of ostracism. Married women are shunned by their husbands. Few incidences are found where husband and other family members refuse to take food prepared by women with arsenicosis. The problem is more serious in case of children with arsenicosis. They are not allowed to attend schools or to play with their friends. At the community level, arsenicosis patients are not allowed to go to public places and to attend in social functions and festivals. They face discrimination and are avoided by others.

Moreover, patients as well as their close relatives are not allowed to use public tube-wells and village ponds.

Divorce and Separation

Available social studies showed that women are divorced by their husbands due to arsenicosis (Moinuddin, 2004). There are also instances where wives left their husbands in fear of being affected by arsenicosis (Haque, n.d.). Field observations of the present study have identified only two cases where husbands have gone for second marriage due to arsenicosis of their first wives. Husbands, in some cases, avoid sexual relationship with their arsenicosis-affected wives. Villagers of Samta in Jessore have experienced some incidences that are simple disruption of conjugal relationships in some families. However, no specific case of divorce or separation due to arsenicosis has been observed in the fields of the study. Nevertheless, arsenicosis has caused an undesirable impact on developing marital relationships. People are hesitant to form marital relationship with families having arsenicosis.

Increase of Unemployment

Arsenicosis reduces work ability of the patients and creates unemployment. Physical weakness is a common complain of all arsenicosis patients. Without sufficient nutritional supplements, patients rarely regain their previous health condition that is lost by arsenicosis. Low-income patients cannot afford medicines and nutritious foods. Consequently, they lose their working capacity and gradually become unable to work. Sometimes they shift to jobs where less labor required. Sometimes they have to leave their jobs voluntarily. There are cases when their employers told them not to come to work.

Another cause of unemployment is widespread fear of contagion. Patients with visible arsenicosis symptoms like skin lesions face difficulty in finding work where

they have close contact with the people they work for, for instance as tailors or running a tea-stall. This sort of difficulty is economically catastrophic for self-employed patients.

Limbs and internal organs like the liver, kidney, and lungs of patients became affected in secondary stage of arsenicosis. The affected limbs then need to be amputated that virtually makes them crippled. Gangrene due to arsenicosis also makes the victims unable to do any work. A number of patients have been interviewed in the fields who were in good health but they have lost their health due to arsenicosis and now fully unemployed. A survey also showed that about 54% patients lose employment due to arsenicosis (Journal of Environmental Science and Health).

Increase of Poverty

Financial difficulties due to arsenicosis are devastating. It is generally observed in all fields of the study that arsenicosis patients are mostly poor. People living in poverty are generally the main victims of arsenicosis. The majority of serious arsenicosis cases are normally found in the poorest section of the studied villages. The possible cause behind this situation can be a many. First of all, if detected at an early stage, arsenicosis can be prevented simply through stopping arsenic ingestion in the body. Poor families are not interested in spending money to install a new tube-well for drinking water, while only one or two family members may have very little physical complications due to arsenicosis. People have more urgent and competing concerns in the villages. As s result, prevention of mild arsenicosis is at the bottom of their priority list. Secondly, the infection of arsenicosis is highly related to the nutritional deficiency. Insufficient nutrition is common problem to all in this country especially to the poor. This situation has also made them easy victims of arsenicosis.

More arsenic ingestion takes poor arsenicosis patients in a stage where costly surgical treatment in needed – the kind of treatment that is not provided in the local health complexes. Naturally, few of the poor patients can afford to go to modern urban hospitals for treatment. In addition, almost all patients in secondary stage are found to be unable to do any physical work. Besides, some patients lose their employment due to widespread fears of contagion. Consequently, arsenicosis in a poor household brings the family under poverty line.

Patients, who had financial means to go for treatment, became poor due to the high costs of treatment and medicine. They went from one hospital to another, from one consultant to another, stayed many days in clinics, but still could not be cured. Without any satisfactory development of their health, patients come back home and live with absolute uncertainty. Several households have been observed who have lost their only earning member due to arsenicosis. Naturally, the entire situation brings extreme pressure on the patients and their families' economic condition and increase poverty in the affected villages.

Difficulty in Testing Tube-well Water

Department of Public Health and Engineering (DPHE) in partnership with national and international NGOs implemented the task of testing all operative tube-wells of the country during 1998-2005. Contaminated tube-wells are painted with red-mark and safe ones with green-mark. Surprisingly, DPHE did not seal the red-marked tube-wells that were still in use by the people. Absence of arsenicosis right at that time, inability to install a new tube-well, and above all, lack of awareness let some people continue drinking from red-marked tube-wells. In addition, as groundwater level has been continuously going down, green-marked tube-wells are gradually going to be contaminated after the time of screening. DPHE or any other organization has not yet conducted any monitoring or follow-up screening of the

tube-wells. People are still drinking from those tube-wells which were tested about 4-7 years ago.

As part of its service, DPHE office has to maintain a monthly status report of all hand-pumped tube-wells of the whole Upazilla. But, no preventive measures have been taken in the light those status reports. The real situation in fields is different from the mysterious status reports. The severe crisis of safe drinking water is not properly documentd in any of the reports by the DPHE offices.

DPHE offices at Upazila level are responsible to receive and examine water samples from villagers for arsenic contamination. But, it is commonly observed in all studied fields that people are not interested in testing their tube-wells by their own initiatives. They usually do not go to DPHE office for testing.

There is a degree of shame associated with having an arsenic-contaminated tube-well in a family. People sometimes are seen removing the color from their tube-well after testing. Specially, poor families with no specific complications of arsenicosis do not trust the report that their tube-wells are arsenic contaminated. Even if they believe that the report is true, they can not afford to install new tube-wells.

Difficulty in Detecting As Arsenicosis Patient

Patients usually suffer multiple problems in case of inaccurate or delayed diagnosis of the disease. Specially, the patients of arsenicosis suffer more, if their disease is not detected in the early stage. Early detection of arsenicosis and drinking arsenic-free water can save the lives of the patients with very simple and regular medication. Otherwise, the disease turns into severe physical complications like cancer.

In the fields of the study, health service providers have discharged many patients after early detection of arsenicosis. As dermatological changes appear in almost all

cases of arsenicosis, doctors without any orientation about the diagnosis of arsenicosis primarily misinterpret those manifestations as skin disease. Moreover, patients with complications in internal organs like lung, bladder, prostate, liver and urinary tract are not properly diagnosed, when arsenicosis is also a factor of their complications. Before 1998, health sector of Bangladesh was entirely unaware of arsenicosis. By this time, unidentified number of patients had died without knowing the actual cause of their death and a good number of patients have reached to cancerous or pre-cancerous stage. In addition to health problems, patients suffer both economically and mentally when they were not properly diagnosed. They usually go through repeated wrong diagnostic tests to satisfy the false assumptions of the doctors. Consequently, uncertainty surrounding the diagnosis causes mental stresses to the patients and their family members. This in turn worsens their health conditions.

In recent times, Director General Health Service (DGHS) have started giving orientation on arsenicosis to the Health Assistants and Medical Officers of Government Health Service. In all Upazila Health Complexes, at least 2/3 medical officers are available who have training on Diagnosis and Management of Arsenicosis. The latest database of the arsenicosis patients have been developed on the basis of primary detection of suspected arsenicosis cases by the Health Assistants at the village level and then clinical examination by the trained medical officers at the hospitals.

Another aspect of arsenicosis case detection in Bangladesh is the absence of laboratory investigations for arsenicosis. No laboratory for arsenic test has yet been established by any public and private health service providers. Though laboratory diagnosis is not essential for confirmation of arsenicosis as per approved protocol, it is important to determine the visible skin lesion of probable arsenicosis patients as a verified manifestation of arsenicosis through clinical procedures first, then by conducting arsenic test if necessary (according to WHO Arsenicosis Patients Detection Algorithm). Besides, patients have a common belief that diagnostic tests

should be carried out for any health problems and thus their expectations are not met when diagnosis of arsenicosis is based solely on clinical examination. Based on such type of belief, there are few cases with very early complications of arsenicosis who are not inclined to approach the disease timely and properly.

Difficulty in Getting Treatment

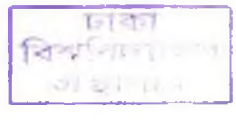
A number of factors are involved in treatment and management procedures of arsenicosis patients. To start with, the nature of arsenicosis attack does not induce the patients to go for treatment at the early stage. Arsenicosis is a disease of slow onset and a chronic condition, which usually starts with skin manifestations. At the primary stage, the exposed skin lesions generally do not contain any pain, irritation, discharge or any other physical discomfort. Although no medicinal cure has been found for this chronic disease, it is evident that the symptoms are reversible up to certain point if a patient stops ingesting contaminated water, takes dietary supplementation, and participates in simple but long-term clinical management over several years. In this context, early detection of arsenicosis cases is considered very important. However, the psychosocial situation of the patients makes it very difficult to come for testing at the early stage. That is why, the Government decided to send Health Assistants for door-to-door searching for suspected arsenicosis patients. Health Assistants prepared the list of suspected arsenicosis cases and sent the patients to Upazila Health Complex for clinical examination and treatment.

Receiving treatment from health centers depends on time and cost factors. Locations and service-quality of health centers in rural areas are not favorable for easy access to healthcare services. Patients often have to use a variety of transportations in addition to walking because of poor infrastructure. This requires considerable time and both direct costs of transport and indirect costs through loss of income. Moreover, once patients reach the health centers they often spend time waiting because of the limited number of doctors dealing with large numbers of patients.

Patients' satisfaction tends to be minimal when they are not asked for any diagnostic test, and are not prescribed high doses of medicine. They all are advised to use arsenic-free water for drinking and cooking, take antioxidant vitamins, nutritious food and to external use of an ointment on the fragmented places of their skin. As a result, once they come back from health centers, they do not feel taking any further steps.

Finally, the provision of free emergency medicine for the poor patients cannot be maintained without any or with limited supply of medicine to the health centers. It remains a question to both the hospital authority and the patients as well that, in comparison with the medicines of other diseases whether the prescribed medicines for early arsenicosis patients are urgent or not. However, patients, in practice, sometimes receive regular doses of vitamins and ointments from health centers without any cost. According to the instruction from Health Directorate, patients are provided with a health card for regular record and follow-up treatment. These services may not be available in all centers and if available, may not be on a regular basis. In most cases, patients are told to buy those medicines at their own expenses, and usually the poor patients do not buy them.

Through continuous ingestion of arsenic contaminated water, patients with early skin manifestations of arsenicosis. Government health centers do not provide indoor service for patients of secondary stage of arsenicosis who needs surgical treatment. When a patient crosses this threshold, he/she still needs medical assistance to recover from the illness and to survive. For instance, amputation may save the life of a patient suffering from gangrene. Palliative drugs may also be administered along with micronutrient supplement.



Difficulty in Using Community Water Sources

Different community based arsenic-free safe water sources are installed in the arsenic affected villages by different government and non-government organizations. For instance, Community Based Arsenic Removal Unit (CBARU) is a very new technology implemented by UNIDO. Besides, Pond Sand Filters (PSF), Dug-Well Send Filters (DWSF), Deep Tube-Wells (DTW) and Tara Hand-pumps are also installed in different locations of the fields where the study has been conducted. These water sources are in great use by the common people; but they are very limited compared to the demand. All of those community-based safe water sources, except deep tube-wells, have some sort of arsenic or bacteria removal filters. All of these water sources, including deep tube-wells, require active participation by community people for installation, maintenance and use.

Arsenicosis patients and their families must get the priority of access to any community water sources. But, in most cases, community water sources are not installed in a location that is easily accessible by the patients. Locations of community safe water sources are selected mainly by the donors of the land according to their choice and convenience. As arsenicosis patients generally live in somewhat poorer section of a village, they have to go a long way to avail themselves of those sources. Moreover, the community based arsenic removal units are also not properly maintained by the community people. Apparently, it appears as everybody's responsibility is nobody's responsibility. Lack of proper orientation of the villagers in using a common water source is observed in many fields of the study. NGOs, once install a unit of safe water supply, do not follow-up for extended service of that unit.

Use of Homeopathy in the Treatment of Arsenicosis

From most of the fields, no evidence has been found as of significant effect of any medicine on arsenicosis. But, an interesting observation in the fields of Chandpur must be considered as an exception. A homeopathic doctor has been observed

providing medication for arsenicosis patients under a UNIDO project. Patients from many distant areas come to receive treatment from him. According to the doctor, arsenic generally attacks each and every organ of human body. Since the time Haniman, the father of homeopathy, arsenic is widely used as a useful medicine. 'Arsenicum Album', the known homeopathic medicine, cures the symptoms that Arsenic causes. The patients also expressed their satisfaction on the improvement of the physical complications through homeopathic medicine. It is generally perceived from the field experiences that patients do not bother on whether allopathic or homeopathic or any other medicine is scientific to cure their disease. They simply want a curing medicine with low cost. In Bangladesh, there are only 645 registered homeopath doctors (DGHS, n.d.). Numerous non-registered homeopathic doctors can be found in the village level. It has been observed in the fields that there is at least one homeopath (mainly non-registered) doctor practicing in every village bazaar. Due to low-cost medication, poor people go to them first for treatment. The nature of primary arsenicosis symptom, skin lesions, also tempts the poor patients to take homeopathic treatment. For quick recovery, people go to pharmacies and buy costly allopathic capsules. Homeopathic doctors have not received any formal orientation on prevalence of arsenicosis in Bangladesh. Following necessary research and analysis, homeopathic medicine can also be included to supplement the arsenicosis patients' management process in Bangladesh.

Disappearing Symptoms

Arsenicosis patients with very early stage of arsenic exposure are observed to have their skin lesions disappeared when they have started drinking arsenic free water. A number of patients have been indentified in the fields who had primary level skin lesions a year or two ago. They have reported that after stopping drinking from arsenic contaminated tube-wells their symptoms of arsenicosis have started disappearing. But, once a higher amounts of arsenic is concentrated in one's body, it

creates different complications to the affected person even if he or she continues drinking arsenic-free water.

Changing Attitudes

People's attitude toward arsenicosis patients depends on their perceptions about the disease. Naturally, people with no or low educational backgrounds have poor understanding of arsenicosis. However, it has been observed in the fields that, a cautiously managed public education program can compensate for educational differences and raise awareness level of the less or un-educated people.

The Government has very limited as well as one-time intervention program to increase people's awareness and to change their attitude toward arsenicosis. Small-scale advocacy meeting and video CD exhibition at union level have meager effect on people's mind and attitude. The awareness activities are scheduled to cover a whole upazilla within five days only. It is not very effective to conduct all those participatory programs in an upazilla generally with at least 100 hundred villages and 300000 populations. However, the government has successfully oriented its workforce in fields on arsenicosis. Trained health assistants have conducted the door-to-door patients searching program at village level that also has indirect impact on people's attention. Health Assistants are given 10 days to complete the search program and submit their reports to the health complexes.

On the other hand, public education programs implemented by non-government organizations are comparatively well-planned and well-participated. Almost all NGOs working on arsenic and arsenicosis have particular awareness program and campaign against misinterpretation of arsenicosis-related physical symptoms. In the fields of the present study, contribution of NGOs in this regard has been found adequate. Through the interventions in health care, arsenic mitigation, or clinical trail, people have been sufficiently informed about arsenicosis. Moreover, NGOs

introduce different new initiatives in making people aware about arsenicosis. Posters, leaflets, banners, billboards, courtyard meeting, youth arsenic committee, village arsenic committee, local youth training on arsenicosis are included in their activities.

Though NGOs bring their services at the doorsteps of the people, their programs are not sustainable. Besides, NGOs' work area usually covers at best one or two upazillas. Time-bound projects, different operators sometimes generate people's annoyance and worry. Anyway, people of those villages where NGOs are involved in awareness activities are observed more aware compared to of the people only the Government agencies are involved.

The extent of misconceptions about arsenicosis depends on the duration of the prevalence of arsenicosis in a particular community. Believing arsenicosis as a contagious disease is the very primary misconception of every arsenic affected locality. But, this belief naturally disappears when people realize the truth over time. Separation between husband and wife becomes rare when people realize arsenicosis as not communicable.

Abhorrence toward arsenicosis-patients develops when arsenicosis patients develop cancer. Especially, patients with skin cancer, gangrene, and excessive exposure of skin lesions face different kinds of difficulty in relationships with others. This situation, in turn, leads to social exclusion of the arsenicosis patients. This negative attitude also has been changing in areas where awareness programs were conducted or are being implemented by different government and non-government organizations. In case of stigma for prospective marriage, the situation is observed almost the same in all fields of the study.

Politics and Arsenicosis

Local political influence has already been felt in the all processes associated with arsenicosis. The more arsenicosis cases appear in the fields, the more external influences on the crisis are being observed. Consequently, the sufferings of the patients increase in the fields. Socially and politically influential patients are always given priority in receiving services by both government and non-government organizations. In case of installing a community-based safe water source, the site is not selected according to demand of poor patients. Politically powerful families receive arsenic removal filters first whereas poor households with arsenicosis patients are at the bottom of the priority list. Queue jumping by the more affluent patients is very common in health centers. NGO operators have to manage local leaders to implement any clinical trail project with a commitment to install arsenic safe tube-wells in their prescribed households. In this way, poor patients are being excluded from proper care and service from both private and public organizations.

On the other hand, village grouping sometimes make this health issue as a matter of their pride and shame. According to their own perception, some groups want to hide the incidence of arsenicosis and some other groups want to expose the problem to attract NGO services. A chaotic situation has been observed in the fields where the symptoms of the disease have just begun to appear.

Cultural Practice and Arsenicosis

Ponds and pitchers are the two very common components of the cultural practice in rural Bangladesh. From the poetries of Jasim Uddin like 'Sojon Bodiar Ghat' to the paintings of Zainul Abedin, we get a clear picture of water culture in rural Bangladesh: a woman carrying an earthen pitcher to bring water from pond or river. Ponds are the thousand-year old water source for rural people. Households are normally built around the ponds in the villages. People built 'ghatla' to get easy access to the ponds. 'Ghatla' is a flight of stairs built by bricks, stones, or woods, at

the bank of the pond. Generally, a pond is surrounded by several houses with one 'ghatla' for each household. Ponds in the villages are dug for many household purposes. People in the villages used to take bath and wash cloths in the ponds. Housewives used to wash cut-fishes and vegetables, dishes and plates, etc. in the same ponds. Moreover, ponds supply fish to meet household demand. Fruit-trees are planted at the banks of the ponds. Before 20-30 years, people in the villages also used to collect drinking water from the same pond. Pitchers were used to bring water from the ponds and considered an essential household-item to carry and keep drinking water.

Ponds and pitchers are still in use in the villagers. But, the nature and purposes of use have changed a lot. Maximum ponds are now used as commercial fishery either by the pond owner or by lease-owner businessman. Pond-sides are filled with plants that have timber value in place of fruit-trees. Therefore, people are loosing their daily family nutrition supply from their own households. They have to buy fruits and fishes from markets.

Among all other household activities, collecting and carrying water for household use is the responsibility of the housewives and girls of the families. Pitchers, jugs or jars are now used to carry water from arsenic-free tube-wells or arsenic removal units. People have already abandoned pond water for drinking.

Tube-wells are also on the way disappearing at the village level. Arsenicosis has been forcing people to bring change in their practice of water usages. Because tube-wells are found arsenic contaminated, people are advised to avoid them for drinking and cooking. Instead of saving people's life, tube-wells have appeared as silent killer. As a result, a highly chaotic situation has been created in the traditional practice of water use. People are now trying to adapt with community based arsenic-free water units as the safe source of drinking water.

Increasing number of arsenicosis cases are pressing people to introduce alternative practices of water use. Some people in the fields were observed using rainwater for drinking and some returned to the ponds and dugs. Provided by different Government and Non-government filtration technology, people are changing their previous habit of drinking water. Women or young girl children are still the ones who carry water-pitcher and collect water from any community safe water source. A deep tube-well or a community based arsenic removal unit or a pond sand filter is now meeting the demand of safe water for the majority of the population.

CHAPTER - 6

RECOMMENDATIONS AND CONCLUSIONS

Recommendations with Social Work Interventions

Arsenicosis is not simply a disease like typhoid. Rather, it is a disease with strong public and community concern. No specific medication has yet been introduced for this disease. The only practical prevention is to stop consumption of arsenic contaminated water. Therefore, people's perception, habit, behavior and practice of water use are closely related to this disease. As a modern human service profession, 'social work' has different scientific methods, approaches, strategies and tools to address any social crisis. It is equipped with a number of methodologies to be acquainted with any social situation. Through proper social diagnosis, social work professionals try to recover all social damages and to accelerate social development.

As identified in the present study, to attain an improved social situation for arsenicosis patients, social work by its very nature as an enabling profession is potentially able to play a key role in terms of supporting and preventing. Therefore, determination of appropriate social work approaches that can best be addressed to combat this problem was the main purpose of the present study. Based on several empirical findings, field experiences and many more observations in the fields, the emergence of social work intervention in this regard has been an issue of social workers and policy planners. By being an applied social science, social work can play a significant role in **public education, community mobilization, and community development** programs to reduce social difficulties of arsenicosis patients, their families and other community people as a whole. Recommendations set by World Health Organization to face social consequences of arsenicosis have specifically extracted the role of social work in this regard. WHO has suggested for

standard Intervention Education and Communication (IEC) strategies in its regional consultation report 2002.

Since we are far behind for medication, prevention of arsenicosis has been considered the only option by all stockholders. Therefore, the measures of **social medicine** are to be applied in patients' management. The government's arsenic policy has also recognized the importance of social medicine (National Policy for Arsenic Mitigation, 2004). For proper application of preventive and social medicine, the role of social work is also imperative. Effective motivation must be conducted to wean people from using tube-well water and to consume microbiologically and chemically safe water for drinking and cooking. It is therefore can be a vital role of the social workers to provide appropriate **counseling** for safe water options and health consequences of consuming arsenic contaminated water to the patients and their family members. In arsenic affected villages, safe water options have been centralized with limited community based water sources. New forms of village cooperation are required to have successful and effective use of those water sources. This issue must be brought under **public education** program. Moreover, misconceptions about arsenicosis usually lead to stigmatization, family and occupational disruption and other social hardships of patients can also be dissolved with a successful public education program. Arsenicosis survivors with surgically removed limbs, and who are diagnosed with cancer or gangrene, and who lost their social and occupational status need **physical** and **social rehabilitation**. Social workers are the scholars having the professional training and skills to rehabilitate those patients. This pivotal role of social workers has been documented in the National Policy for Arsenic Mitigation 2004, as it emphasized on, "capacity building of health workers as well as social service workers in rehabilitation of arsenicosis patients" (National Policy for Arsenic Mitigation, 2004, p. 4).

To pose the big challenges of gaining a sustainable public health in arsenicosis affected communities, application of the concept of **'self-help'** can be considered as a key issue. Formation of **self-help groups** by arsenicosis patients in affected

communities will enable them to use available community resources more effectively through sharing their knowledge, and experience regarding arsenicosis and other public health issues. Social workers can organize and motivate the arsenicosis patients and other people of the affected community to introduce self-help among them. It is also equally important to utilize the available **social capital** to enhance the well-being of arsenicosis patients in the rural areas of Bangladesh. Socially and economically stable dwellers of the affected communities can be influential to bring about change in people's perception, behavior as well as their practices in daily life. For example, teachers and religious leaders at local level usually guide their community people on different local issues. Besides, businesspeople generally donate money in various development purposes of their locality. To get assistance from these resource systems and for proper utilization of 'social capital', participation of socially influential persons in all activities must be ensured. These locally important persons must be well informed about arsenic and arsenicosis. In combination of self-help and social capital, social workers approach to **mobilize** the society and bring expected **social change**.

Ensuring equal opportunity for all in terms of access to safe water and healthcare are big challenges for development. Once again, it has been realized from the outcome of the present study. The study findings have revealed that the social-fallouts caused by arsenicosis cannot be prevented without sustainable access to safe drinking water. By all counts, it is discernibly demonstrated from the above discussion that, making a line is very difficult between the issues of arsenicosis patients and the developmental aspects of rural communities in Bangladesh. It is the role of social workers to support, educate, and enable the community people in achieving greater **social development** goals, through effective **community participation** and **planning.**

Conclusions

If we can empirically measure all aspects of arsenicosis, this disease must be viewed as a symbol of the biggest disaster for the mass people of Bangladesh. The environmental aspects, public health issues and their social perspectives have posed the greatest threats and challenges to Bangladesh ever faced. Drinking from groundwater, contamination of arsenic, use of hand pumped tube-wells, chronic poisoning on human body and their social consequences are embedded into this crisis. A comprehensive and holistic approach can only help to overcome this worst situation. However, achieving the ultimate solution of this complex situation, the fundamental intervention must be the identification and provision of arsenic safe drinking water. Dependence on groundwater must be reduced and the use of surface water and rainwater can be increased with complete precautions. People's perception and awareness on arsenicosis must be enhanced to decrease social sufferings. Moreover, to ensure the success of all interventions taken to combat the situation, community education and participation are essential. Furthermore, all of the above activities should be tied with effective follow-up monitoring to verify that the sufferings of the people have been decreased.

APPENDICES

APPENDIX - A

National Policy for Arsenic Mitigation 2004

Department of Public Health Engineering

Government of Bangladesh

1. Preamble

1.1 In Bangladesh surface water is abundantly available during monsoon but it is scarce during the dry season. Ninety seven percent of the population relies on ground water for drinking purpose. Ground water used for drinking in many areas of Bangladesh has been reported to have contamination by arsenic above the Bangladesh National Standard of 50 parts per billion (ppb). The percentage of contaminated tubewells in villages varies from more than ninety percent to less than five percent. Geographically, the tube wells in the delta and the flood plains regions, which comprise 72% of the land area, are more or less affected by arsenic contamination.

1.2 Arsenic contaminated aquifers have no regular pattern, varies both horizontally and vertically within short distances.

1.3 Population exposed to arsenic in Bangladesh runs into millions, thousands of people are suffering from arsenicosis and many among them have developed cancer and other complications.

1.4 Arsenic contamination is geological and there is no known control at source and also there is no proven treatment for arsenicosis. Hence the primary option is alternate supply of arsenic safe drinking water. Therefore, it is simultaneously a water supply and a health issue.

1.5 Water supply brings with it the issue of appropriate and affordable technology options to the community. The shallow tube wells, cornerstone of the water supply miracle in Bangladesh, can no longer provide safe water for drinking and cooking in arsenic affected areas.

1.6 Symptoms of arsenic poisoning bring in the social dimensions. People with arsenic induced symptoms face social sanctions with apparent but no real justification.

1.7 Arsenic in ground water used for irrigation may also have affect on agriculture and food chain.

1.8 The variety of ways arsenic affects life and people have attracted the attention of a diverse group of stakeholders. Different ministries and government agencies, academics, NGOs and bilateral/multi-national development partner agencies are pursuing separate programmes without any co-ordination. This is resulting in duplication of activities and conflicting strategies that inhibit synergy and optimal use of scarce resources.

1.9 A policy guideline for arsenic mitigation programmes for arsenic affected areas to guide and co-ordinate all activities has therefore, become imperative.

2. Objectives

2.1 The policy provides a guideline for mitigating the affect of arsenic on people and environment in a holistic and sustainable way.

2.2 This will also supplement the National Water Policy 1998, National Policy for Safe Water Supply and Sanitation 1998 in fulfilling the national goals of poverty alleviation, public health and food security.

3.0 Policy Statements

Access to safe water for drinking and cooking shall be ensured through implementation of alternative water supply options in all arsenic affected areas. All arsenicosis cases shall be diagnosed and brought under an effective management system. Impact of arsenic on agricultural environment shall be assessed and addressed.

4.0 Identification of the nature and extent of the problem

Considering the pattern of distribution of arsenic contaminated tube wells and prevalence of patients, the national programme shall include the following:

4.1 Screening and regular monitoring of all tube wells including irrigation wells to identify the wells that have arsenic above the levels permissible in Bangladesh. The purpose of monitoring will be twofold, first to identify priority areas and groups for assistance and second to assess the effectiveness of the Policy and the Implementation Plan in reducing the arsenic risk and he number of patients.

4.2 Identification of all arsenic affected patients and population at risk;

4.3 The water quality of all new water supply sources is tested prior to commissioning; and

4.4 Assessment of the level of arsenic in soil and agriculture products including livestock.

5.0 Arsenic Mitigation

The arsenic mitigation activities under the Policy will focus on the following:

5.1 Public Awareness

5.1.1 Raising awareness regarding the impact of ingestion of arsenic contaminated water;

5.1.2 Raising awareness about alternative arsenic free safe water sources and mitigation options;

5.1.3 Raising awareness regarding remedial measures against arsenic poisoning; and

5.1.4 Raising awareness that arsenicosis is not contagious and that social exclusion is not justified.

5.2 Alternative Arsenic Safe Water Supply

Technology options for water supply are area dependent and no single option can serve the purpose of the people having diverse socio-economic background. Arsenic mitigation programme for water supply must promote a range of technology options approved for arsenic affected areas. All mitigation programme shall adhere to the following:

5.2.1 Follow the Bangladesh Standards for drinking water as defined in 'Environmental Conservation Act 1995 and Rules 1997, Schedule - 3';

5.2.2 Give preference to surface water over groundwater as source for water supply;

5.2.3 Follow approved guidelines/protocols for installation of water supply technology options;

5.2.4 Ensure on an emergency basis, safe source of drinking water at a reasonable distance;

5.2.5 Assess the needs for water supply intervention based on the status of contamination at village level; and

5.2.6 Endeavor to promote piped water systems wherever feasible and such schemes must ensure that the poorest members of the community have access to safe water that meets the minimum service levels established by the Government. In case of piped water supply in the rural areas where the supply will be mainly for drinking and cooking, 8 litres of water per capita per day will be ensured and the service level in municipal areas will be determined by the respective municipal council/city corporations.

5.3 Diagnoses and Management of Patients

In proper diagnosis and management of patients the arsenic mitigation programme shall include the followings:

5.3.1 Provisions for protocols for diagnosis and management of arsenicosis patients;

5.3.2 Provision of training to health service providers at different levels;

5.3.3 Formulation and maintenance of an effective referral chain for complicated case management of arsenicosis patients;

5.3.4 An appropriate mix of preventive and social medicine;

5.3.5 Provision of medical and healthcare in health centers and hospitals for seriously affected patients; and

5.3.6 Provision for rehabilitation of arsenicosis patients;

5.4 Capacity Building

Programme to address the problem of arsenic in ground water in the country shall include building appropriate capacity at all levels. Capacity building shall include the following:

5.4.1 Providing government support for test kit manufacturing within the country, through both public and private initiatives;

5.4.2 Capacity at local and community levels for installation, operation and maintenance of mitigation options including monitoring, information management and reporting;

5.4.3 Capacity of the relevant government departments will be increased for hydrogeological investigation and analysis;

5.4.4 Capacity for water quality monitoring and surveillance of existing safe tube wells and the proposed interventions;

5.4.5 Establishment of a network of well-equipped laboratories with arsenic measurement capacity at appropriate levels;

5.4.6 Capacity of relevant government agencies to provide technical guidance and monitoring for supply of safe water should be strengthened;

5.4.7 Capacity of relevant government agencies for assessment of arsenic in soil and agricultural products.

5.4.8 Provision shall be made to tap international expertise in areas where necessary local expertise is yet to be developed. The government shall identify, with assistance from the national level expert committee, the specific areas where inputs from international experts will be beneficial.

5.4.9 Capacity building of local level doctors and health workers to diagnose and management of cases of arsenicosis patients and diagnosis and management of arsenicosis patients will be included in the curricula of all medical colleges as well as of all training institutes for health workers of all levels;

5.4.10 Capacity building of health workers as well as social service workers in rehabilitation of arsenicosis patients; and

5.4.11 All government hospitals in arsenic affected areas shall have trained medical personal for identification and management of arsenicosis patients and district

and the national level hospitals shall have different types of specialist medical professionals for treatment and management of different varieties of arsenicosis patients.

6.0 Institutional Arrangement

The policy emphasizes effective coordination of the activities of government ministries and agencies, greater role of local government institutions, the involvement of the user communities in planning and delivery of services. NGOs and the private sector may also be involved in service deliveries. The institutional arrangement for implementation of the policy shall include the following:

6.1 The Government shall form a high level committee or designate any such existing committee to oversee all activities, implementation programmes in accordance to this policy;

6.2 The Government shall form a national level expert committee or designate any such existing committee to provide technical advice and support in the field of arsenic mitigation;

6.3 National level government agencies shall focus and co-ordinate their activities in their mandated field in a more effective way;

6.4 Move towards decentralised planning and delivery of safe water options and health services through the grass root level local government institutions (LGIs) with technical support from relevant government agencies;

6.5 Greater involvement of LGIs in mobilizing resources, monitoring and information management; more specifically registration and monitoring of tube wells and patients;

6.6 Groundwater being a natural resource, a suitable regulatory mechanism shall be in place to regulate all activities in relation to groundwater such as exploration, exploitation and management.

7.0 Research and Development

The national programme shall encourage and promote research and development to seek a clear understanding of the impact of arsenic on water supply, health, food and agriculture. To promote co-ordinated research and development the government shall:

7.1 Prepare with the help of the National Committee of Experts, among others, a prioritised list of study and research activities needed in different fields of arsenic mitigation; and

7.2 Shall formulate appropriate regulatory measures to ensure that all research on arsenic in the country whether by local or expatriate organisations or individual researchers are undertaken in a co-ordinated way and the results are shared with the government of Bangladesh or its designated agency; and

8.0 Information, Applied Research and Reference Laboratory

8.1 Knowledge and information shall be managed centrally to ensure transparency of the implementation process. Ready accessibility of information to all stakeholders is essential. A government institution shall undertake this sustained role of functioning as an information warehouse at the national level;

8.2 Centres of excellence on relevant research shall be developed. These centres shall focus on existing information and knowledge leading to identifying and conducting research on key areas; and

8.3 A reference laboratory shall be designated for analytical validation of arsenic related laboratory activities.

9.0 Collaboration and Co-operation

To ensure effective collaboration and cooperation among various stakeholders the government shall emphasize on the following:

9.1 Co-operation and co-ordination among the Government organisations and ministries involved in arsenic mitigation;

9.2 Identification by the government, with the assistance of the national level expert committee, the areas where international collaboration is required for program implementation, arsenic mitigation and research and specifying the nature of required support.

9.3 Collaboration and co-operation among professional groups involved in various activities related to arsenic contamination; and

9.4 Close co-operation among Government, Non-Government Organisations, Civil societies, Development partners and Research & Training Institutions within and outside Bangladesh.

10.0 Policy Implementation

10.1 All stakeholders shall work within the framework of this policy. The government shall administer this policy through relevant ministries and government agencies.

10.2 An implementation plan shall be prepared which will provide the operational framework for arsenic mitigation activities in the country.

10.3 The policy shall be reviewed and updated depending on the implementation feed back, if and when such need arises.

APPENDIX - B

Extracts of the National Water Policy

Ministry of Water Resources

Government of Bangladesh

The policies set forth herein are considered essential for addressing the objectives of improved water resources management and protection of the environment. Every public agency, every community, village and each individual has an important role to play in ensuring that the water and associated natural resources of Bangladesh are used judiciously so that the future generations can be assured of at least the same, if not better, availability and quality of those resources.

.. . .

4.3 Water Rights and Allocation

The ownership of water does not vest in an individual but in the state. The Government reserves the right to allocate water to ensure equitable distribution, efficient development and use, and to address poverty. The Government can redirect its use during periods of droughts, floods, cyclones, and other natural and man-made disasters, such as contamination of groundwater aquifers that threaten public health and the ecological integrity. Allocation rules will be the formal mechanism for deciding who gets water, for what purpose(s), how much, at what time, for how long, and under what circumstances water use may be curtailed. Rules for water allocation will be developed for in-stream needs (ecological, water quality, salinity control, fisheries and navigation) during low-flow periods; for off-stream withdrawal (irrigation, municipal and industrial, power), and for groundwater recharge and abstraction. Allocation for non-consumptive use (e.g. navigation) would imply ensuring minimum levels in water bodies used for that purpose.

Henceforth, the policy of the Government to regulate the use of water, where required, will be exercised in the following manner:

a. The Government will exercise its water allocation power in identified scarcity zones on the basis of specified priorities.

b. In general, the priority for allocating water during critical periods in the water shortage zones will be in the following order: domestic and municipal uses, non-consumptive uses (e.g. navigation, fisheries and wild-life), sustenance of the river regime, and other consumptive and non-consumptive uses such as irrigation, industry, environment, salinity management, and recreation. The above order of priority could however be changed on specific socio-economic criteria of an area by local bodies through local consensus.

c. For sustaining rechargeable shallow groundwater aquifers, the Government will regulate the extraction of water in the identified scarcity zones with full public knowledge.

d. Specific drought monitoring and contingency plans will be prepared for each region experiencing recurrent seasonal shortages of water with due consideration to conjunctive use of rainwater, surface water and ground water and alternative ways of satisfying demand. The contingency plan will include action to limit the use of groundwater according to priorities. Appropriate provisions of law should be made to protect specific users' rights in these extreme cases.

e. The Government may empower the local government or any local body it deems fit, to exercise its right to allocate water in scarcity zones during periods of severe drought, and it will monitor the water regime and enforcement of the regulations through specifically designed mechanisms.

f. The Government may confer water rights on private and community bodies to provide secure, defensible and enforceable ownership/usufructuary rights to ground water and surface water for attracting private investment.

g. In specifying surface water rights, the minimum requirement of stream-flow for maintaining the conveyance channel will be ensured.

4.6 Water Supply and Sanitation

The rural areas of Bangladesh suffer from lack of quality drinking water. Surface water supplies are generally polluted and groundwater, which till now had been the best source of safe drinking water, is contaminated with arsenic in many parts of the country. Heavy withdrawals of groundwater for irrigation have also lowered the water table in many areas below the effective reach of hand tube-wells. Seepage of agro chemicals into shallow aquifers may also pollute water for human and animal consumption. Salinity intrusions from seawater deep into the land in the southwest are rendering groundwater unfit for consumption. Cities and urban areas too are facing the problem of receding water table due to heavy groundwater extraction. These water supply and sanitation problems have obvious implications for public health. Diarrheal diseases, arising largely from drinking unsafe water, are a leading cause of death in the rural areas. Lack of proper sanitation and drainage facilities, inadequate water supply, and insufficient health and hygiene education are the primary causes of diseases in the urban areas. Lack of access to safe water supply in the rural areas is a special hardship for women who have to carry water over long distances, with significant impact on their health and productivity.

To address these problems, it is the policy of the Government to:

a. Facilitate availability of safe and affordable drinking water supplies through various means, including rainwater harvesting and conservation.
b. Preserve natural depressions and water bodies in major urban areas for recharge of underground aquifers and rainwater management.
c. Mandate relevant public water and sewerage institutions to provide necessary drainage and sanitation, including treatment of domestic wastewater and sewage and replacement of open drains and construction of sewers, in the interest of public health.
d. Empower, and hold responsible, municipalities and urban water and sewerage institutions to regulate the use of water for preventing wastage and pollution by human action.

e. Mandate local governments to create awareness among the people in checking water pollution and wastage.

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4.12 Water for the Environment

Protection and preservation of the natural environment is essential for sustainable development. Given that most of the country's environmental resources are linked to water resources, it is vital that the continued development and management of the nation's water resources should include the protection, restoration, and preservation of the environment and its bio-diversity including wetlands, mangrove and other national forests, endangered species, and the water quality. Accordingly, water resource management actions will take care to avoid or minimize environmental damages. Water quantity and water quality issues are uniquely linked. Poor water quality affects the availability of fresh water for different uses. Contamination of surface water bodies and groundwater aquifers by agricultural pollutants, industrial discharge, domestic pollution, and non-point source urban runoff exacerbate water quality problems and endanger both natural ecosystem integrity and public health. Other environmental problems include: excessive soil erosion and sedimentation, waterlogging and salinisation of agricultural land, groundwater depletion, watershed degradation and deforestation, reduction of biodiversity, wetland loss, saltwater intrusion, and coastal zone habitat loss.

Henceforth, all agencies and departments entrusted with water resource management responsibilities (regulation, planning, construction, operation, and maintenance) will have to enhance environmental amenities and ensure that environmental resources are protected and restored in executing their tasks. Environmental needs and objectives will be treated equally with the resources management needs. It is, therefore, the policy of the government that all water management agencies and related natural resources departments will:

a. Give full consideration to environmental protection, restoration and enhancement measures consistent with the National Environmental

Management Action Plan (NEMAP) and the National Water Management Plan (NWMP).

b. Adhere to a formal environmental impact assessment (EIA) process, as set out in EIA guidelines and manuals for water sector projects, in each water resources development project or rehabilitation programme of size and scope specified by the Government from time to time.
c. Ensure adequate upland flow in water channels to preserve the coastal estuary eco-system threatened by intrusion of salinity from the sea.
d. Protect against degradation and resuscitate natural water-bodies such as lakes, ponds, beels, khals, tanks, etc. affected by man-made interventions or other causes.
e. Completely stop the filling of publicly-owned water bodies and depressions in urban areas for preservation of the natural aquifers and environment.
f. Take necessary steps to remove all existing unauthorised encroachments on rivers and watercourses and to check further encroachments that cause obstructions to water flows and create environmental hazards.
g. Stop unplanned construction on riverbanks and indiscriminate clearance of vegetation on newly accreted land.
h. Encourage massive afforestation and tree coverage specifically in areas with declining water table.
i. Enforce the "polluter pay" principle in the development of regulatory guidelines for all regulatory actions designed to protect public health and the environment.
j. Provide education and information to the industrial and farming communities on self-administered pollution control mechanisms and their individual and collective responsibilities for maintaining clean water sources.

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APPENDIX – C

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