

Arsenic Crisis Today- Strategy For Tomorrow





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Foreword



Awareness of the pollution of drinking water with arsenic and the significance of the crisis rose significantly among the international community during the 1990's. In the developing world, presence of arsenic in groundwater extracted from the alluvial aquifer underlying West Bengal and Bangladesh has highlighted the significance of this problem.

In fact, some of the estimates for the number of affected people in this region alone is of astonishing proportions. Naturally-occurring and human-induced arsenic pollution in drinking water has since been discovered in many parts of the world. It is now recognized as a problem of truly global dimensions. It also means that our earnest attention and collaborative efforts of researchers, practitioners and officials are required to combat this crisis.

This document presents ideas and concepts for ways to cope with the arsenic crisis. The focus is on Bangladesh, but the findings may be applied to any other part of the world. The information in this document is targeted to the general public, policy makers and practitioners in the field. The problems are indeed very complex and span a number of sectors and stakeholders; a simplified approach for describing these issues is taken here.

It is my hope that by working together with international agencies, bilateral donors and national governments, we can identify approaches best suited to deal with this complex problem. The people affected by this crisis need our urgent attention. Our collective efforts must be based on clear thinking and built around practical steps that can lead us to concrete solutions for the future.



Prof. Hans van Ginkel
Rector, UNU
UN Under-Secretary-General



Message from the speaker

I am happy to learn that United Nations University and NGO Earth Identity Project are going to hold a Roundtable Discussion on one of the more serious health hazards of today - arsenic contamination. I am distressed to hear that possibly twenty to thirty million people in Bangladesh are affected by Arsenic and out of 64 districts, people of 59 districts are affected by Arsenic. It is also horrifying to contemplate that another 80 million more people are under threat of dying of Arsenicosis within the next few years. To avoid such a catastrophe, immediate measure to combat the disease should be taken nationally and internationally.

Although some steps have been taken to mitigate the crisis facing our country today, I believe more effective and speedy measures should be undertaken before the disease takes more of our valuable lives. It is encouraging that Earth Identity Project and United Nations University have come forward with some ideas to overcome this horrifying disease today. I hope they succeed in their efforts and I wish them all the best.

Humayun Rasheed Choudhury MP
Speaker, Bangladesh Parliament



A Summary of Policy Alternatives

The arsenic pollution crisis in Bangladesh is a disaster of unprecedented proportions.

The number of people potentially impacted by this problem (some 28-35 million) is more than that for any of the individual crises facing the humanity today.

By the virtue of its sheer size, it is pushing the limits of our knowledge and the capacity to respond to it.

It is a complex problem that is multi-faceted and multi-sectoral. It requires clear thinking and a

comprehensive strategic response.

This strategy should be cohesive and cover all aspects of the problem.

The actions under such a strategy should be clearly divided into emergency measures that take effect right away and long-term tasks that work gradually over the next few years.



Emergency Measures

- Raising public awareness should be the starting point for any approach to deal with the arsenic problem
- Groundwater treatment technologies that are cheap, efficient and easy to use should be applied at a large scale as an interim or midterm solution
- Immediate measures must be taken to protect the health of those living in areas with arsenic-contaminated water
- Improving nutrition and fighting undernourishment has to be a central element of the fight against the arsenic crisis
- Participation of the civil society has to be a key element of designing, planning and implementing remediation strategies
- Intra-governmental coordination is a must for effective implementation
- Information dissemination and transparency play a key role in effectiveness of remedial strategies while building the confidence of stakeholders, particularly general public

Long-Term Policy Alternatives

- An overall health policy to deal with currently-identified patients as well as those potentially at risk
- Food security and improving nutritional quality of the food should be a high priority
- Alternative livelihoods should be provided for those who are directly impacted by arsenic contamination as well as their immediate families
- Water resource management on a regional or national scale is essential to fully exploit the abundant water resources available in Bangladesh
- Scientific research has to be emphasized to reduce uncertainty, with due consideration to local conditions
- Drinking water standard has to be re-evaluated based on scientific research
- Coordination, management and dissemination of information should be undertaken through well-defined mechanisms



The Arsenic Crisis - A Disaster of Unprecedented Proportions

The pollution of groundwater by arsenic in West Bengal, India and Bangladesh has led to a human disaster of unprecedented proportions. Some recent estimates show that more than 35 million people are potentially at risk from drinking arsenic-contaminated water (Smith et al., 2000). This indeed brings the problem to a catastrophic scale in a limited region never before experienced. In comparison, the current estimate of people possibly infected by the HIV virus all over the world is around 34 million. (UN AIDS, 2001) The sheer magnitude of this disaster means that we are faced with new challenges and tasks that have likely been never undertaken before. It also provides an opportunity for various actors to join hands and improve the situation for those affected by this problem.

The crisis has its roots in another worthy effort to

More than 35 million people are potentially at risk from drinking arsenic-contaminated water

fight water-borne diseases that had impacted this tropical region for a long time.

Acute health problems, such as gastrointestinal diseases and infant mortality, were attributed to drinking bacteria-contaminated surface water. It was, therefore, believed that using groundwater would easily circumvent the problem because groundwater at certain depths is not exposed to bacterial contamination. Presence of arsenic in groundwater was not considered a concern during the 1970's when a campaign of switching

to groundwater as a source of drinking water was undertaken.

Over a period of about 20-25 years since then about four million wells have been installed to utilize the groundwater from shallower aquifer layers, typically less than 200m deep (UNICEF, 1999).

The alluvial aquifer that underlies the Ganges-Brahmaputra river basin contains arsenic in mineral form.

Exploitation of groundwater from these wells for drinking water and irrigation purposes has resulted in mobilizing the arsenic (Rahman et al., 2001). Presence of arsenic from natural and anthropogenic sources in the groundwater is not unusual and has been documented in other parts of the world, including Brazil, Thailand, Taiwan, and Vietnam.

Box 1 - Bangladesh

Bangladesh is a tropical country with a total surface area of about 144,000 km² and an estimated population of 129 million as of July 2000.

Of the surface area available, about 70% is arable and about 10-15% comprises forests and woodlands. It is estimated that the contribution of the agricultural sector to national GDP at about 25%. A vast majority (~76%) of the population lives in rural setting. Incidentally, it this rural population that is most impacted by the arsenic contamination, largely because of lack of access to safe drinking water. Even in the cities only about half the population has access to safe water.

Source: UN, 2000 and World Bank, 2000





Areas Affected by Arsenic Pollution

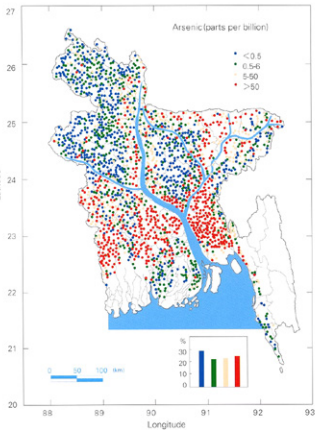
The British Geological Survey (BGS), in cooperation with the Department of Public Health Engineering (DPHE) of the Government of Bangladesh (GoB), has conducted the most systematic nation-wide survey of the water quality in wells (GoB, 2000). The aim of that study was to establish the extent of arsenic contamination and to understand the basic hydrochemistry. The final data set for that study comprised samples from 3534 tube wells in 61 of the 64 districts and 433 of the 496 thanas in Bangladesh.

Box 2 - What is Arsenic ?

Arsenic - a metalloid element - is a natural part of the earth's crust in some parts of the world and may be found in water that has flowed through arsenic-rich rocks. Arsenic is also emitted into the atmosphere by high-temperature processes such as coal-fired power generation plants, burning vegetation and volcanic action. High concentrations of arsenic in drinking-water are found in various parts of the world including Argentina, Bangladesh, Chile, Taiwan, Hungary, India (West Bengal), Mexico, and the USA. A variety of instrumental techniques available for the determination of arsenic in water and air.

Source: WHO Environmental Health Criteria, No. 224:

Arsenic



Groundwater Studies of Arsenic Contamination in Bangladesh DPHE/BGS/DFID (2000)





Although almost all the pertinent areas of potential arsenic contamination were sampled, the sample size is approximately 0.1% of the total number of wells in Bangladesh.

As a result of this survey, the spatial extent of the arsenic pollution is well-defined in general, although much more detailed localized information is still needed.

The DPHE/BGS survey has also helped estimate the population exposed to drinking water in which arsenic exceeds the Bangladesh drinking water standard of 50 parts per billion (or microgram per liter). These estimates range between 28 and 35 million, and are also significantly higher than those provided earlier (e.g., an estimate of 20 million provided by WHO). Even more importantly, size of the problem is also related to how the "arsenic-clean" water is defined. If, for example, the WHO guideline for arsenic in drinking water is used the number of people affected jumps to the 46-57 million range - an increase of more than 60%!

Size of the problem is also related to how the "arsenic-clean" water is defined

These numbers clearly indicate that the magnitude of the problem is immense. Consequently, the response to the problem has to be accordingly scaled-up.

It also means that the response has to be undertaken at a much faster pace than has been the case.

This, undoubtedly, will require concerted and cohesive action by various players active in this field.

Box 3 - Why is Arsenic Bad for Health ?

Arsenic dissolved in water is acutely toxic and can lead to a number of health problems.

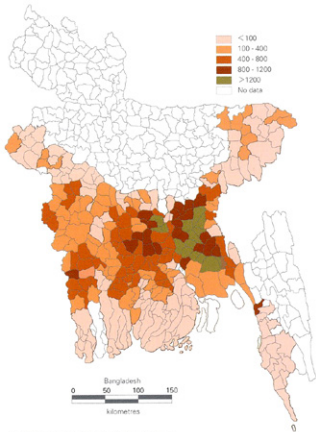
Long-term exposure to arsenic in drinking-water causes increased risks of cancer in the skin, lungs, bladder and kidney. It also leads to other skin-related problems such as hyperkeratosis and changes in pigmentation.

Consumption of arsenic also leads to disturbance of the cardiovascular and nervous system functions and eventually leads to death. These health effects - sometimes collectively referred to as arsenicosis - have been demonstrated in many studies.

Increased risks of lung and bladder cancer and of arsenic-associated skin lesions have been reported for consuming drinking-water with arsenic concentrations equal to or greater than 50 microgram per liter.

Source: WHO Environmental Health Criteria, No. 224. Arsenic





Population per km² exposed to arsenic greater than 50 parts per billion. (Source:GOB,2000)



A Public Health Catastrophe

It is important to appreciate the suffering of the large population impacted by arsenic poisoning through drinking contaminated water.

A large number of patients with visible or measurable health impacts are anticipated - although such precise estimates for Bangladesh have not even been developed as yet.

In neighboring West Bengal, about 200,000 patients are estimated by WHO for an exposed population of about 1.5 million.

The exposed population in Bangladesh is at least 20 times that in West Bengal!

An additional complicating factor in underestimating the impact of arsenic exposure exists.

It takes several years of drinking arsenic-contaminated water to develop visible symptoms - although they may appear earlier in some patients.

This hints towards a "surprise factor" where a much larger than anticipated number of people may be impacted.

It takes several years of drinking arsenic-contaminated water to develop visible symptoms

Box 4. Arsenic-Related Health Effects

- Skin lesions
- Skin cancer
- Internal cancers (bladder, kidney, lungs)
- Hypertension and heart diseases
- Diabetes mellitus

Source: Smith et al., 2000



Societal Problems and Lack of Knowledge

Several studies on the arsenic crisis indicate the lack of knowledge about the arsenicosis, its causes and possible remedies.

This is particularly true because the vast majority of the population lives in rural areas and is not well-educated.

Pre-existing notions and superstitions about the diseases triggered by arsenic exposure further worsen the situation, this is despite the concerted

Pre-existing notions and superstitions about the diseases triggered by arsenic exposure further worsen the situation

efforts made by many players to educate the general public and raise the level of awareness. Given the magnitude of the problem and the level of education amongst the villagers, this is a particularly challenging undertaking.

Additionally, the arsenic contamination problem has triggered a number of social and societal problems that could not have been foreseen and are still not fully recognized or understood. Recent studies confirm that worst arsenic problems are encountered by the poorest fraction of the society (WHO, 2000) - particularly those who are already undernourished.

Significant gains can be made in educating the people about improving the level of nutrition in

their diet and supporting them in the endeavor, as and when necessary.

By adopting a policy of improved nutrition, the vulnerability of the exposed population to health effects can be minimized.

There is also a certain social stigma associated

Significant gains can be made in educating the people about improving the level of nutrition in their diet

with people affected by arsenicosis, with the disease wrongly attributed to sins in the current or past lifetimes.

Clearly, this indicates that ignorance about causes and remedies for the arsenic-related problems.

Yet another societal impact is that on livelihoods of families that lose head of the household or "bread-earners" to the disease.

There is a need for serious consideration of alternative livelihoods for people who may be affected by arsenicosis as well as for the orphans and widows of those who pass away.

It needs to be re-emphasized the raising public awareness on the arsenic pollution and related health problems is largely a societal problem.

One has to overcome the obstacles mentioned earlier to make a public awareness campaign successful.

Therefore, it is critical to fully engage the civil society in developing and implementing such campaigns. Numerous NGOs active in this area could be an invaluable asset in this respect.





The Need for Urgent Measures

It is obvious that the scale of the problem has caught everyone by surprise.

Historically, disasters of much lesser magnitude (such as major floods, earthquakes or even the AIDS epidemic) have required a response on 'emergency' footings. In this case, the additional incentive is that significant time has been spent in fully understanding the magnitude of the problem. This increases the level of urgency in developing and implementing a comprehensive response.

The Bangladesh government, with support from international agencies and local and international NGO groups, has initiated a number of programmes to determine the extent of the problem. It is also undertaking a complete evaluation of arsenic levels in all the wells in Bangladesh; please see the graphic below outlining the well screening process being coordinated by BAMWSP.

Considering the unprecedented scale of this disaster, it has been a major challenge to come up with a cohesive strategy to tackle the problem. This is particularly difficult because the problem is multi-dimensional and involves a number of sectors.

Another confounding factor is the scientific uncertainty in a number of aspects, including the exact mechanism of arsenic mobilization, exact delineation of arsenic contamination (with concentration levels and estimated water volume) and effective medical remedies for arsenicosis. A number of measures are proposed in this document that draw upon previous experiences in disaster management but are specific to this problem.

Such measures would include extensive awareness raising programmes, public health protection initiatives, measures to improve the level of nutrition in villages, and provision means to treat water at either household or community level. Successful implementation of these activities requires close cooperation and joint implementation with civil society actors. Involvement of NGOs in design and implementation of activities is critical.

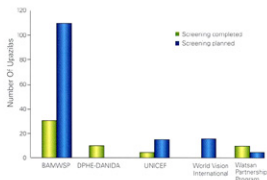
The government has to provide guidance and leadership in the emergency initiative while also serving as a coordinator and facilitator between various agencies

The most important element in these emergency responses is the role of Government of Bangladesh.

It has to provide guidance and leadership in the emergency initiative while also serving as a coordinator and facilitator between various agencies.

Obviously, this is no easy task! In other emergency situations, intervention at the highest level of government is often required to elicit an appropriate response.

A similar approach in Bangladesh should be encouraged.



Comprehensive well screening program
(Source: communication with BAMWSP, 2001)

Emergency Measure Needed



The unprecedented scale of the arsenic crisis means that much rapid action is necessary to minimize its impact.

The population that has been impacted can be offered facilities for getting hygienically-clean water, improved access to improved nutrition, and educating the affected population about nature of the problem and ways to cope with it. Natural disasters - which typically occur at a much smaller scale - require action on emergency footings to minimize adverse effects.

Well-established codes of conduct - such as those developed by the International Red Cross - should provide overall guidelines for the humanitarian relief efforts.

The arsenic crisis also demands setting up of similar emergency management institutions and involvement of the GoB and other stakeholders at the highest level.

Box 5: The Code of Conduct

For the International Red Cross and Red Crescent Movement and NGOs in Disaster Relief. The principle commitments:

- The Humanitarian imperative comes first.
- Aid is given regardless of the race, creed or nationality of the recipients and without adverse distinction of any kind. Aid priorities are calculated on the basis of need alone.
- Aid will not be used to further a particular political or religious standpoint.
- We shall endeavour not to act as instruments of government foreign policy.
- We shall respect culture and custom.
- We shall attempt to build disaster response on local capacities.
- Ways shall be found to involve programme beneficiaries in the management of relief aid.
- Relief aid must strive to reduce future vulnerabilities to disaster as well as meeting basic needs.
- We hold ourselves accountable to both those we seek to assist and those from whom we accept resources.
- In our information, publicity and advertising activities, we shall recognise disaster victims as dignified human beings, not hopeless objects.



Raising Everyone's Awareness

It is of utmost importance to make the general public, practitioners and policymakers aware of the full range of issues relevant to the arsenic crisis. The most essential element of this activity has to be informing people that consuming water containing arsenic has serious health consequences. Obviously, this approach can only work if alternative sources of drinking water are also available simultaneously.

These can include methodologies for treatment of contaminated water at household and community level, rainwater harvesting, utilization of groundwater from deeper aquifers and bottled water supply. In response to the urgent need for awareness raising, GoB and UNICEF launched in December 1999 a Nationwide Communication Strategy for Arsenic. This strategy has been implemented fairly successfully and its impacts should be fully evaluated.

The existing strategy must be further strengthened through involvement of various international agencies and civil society actors. This strategy constitutes an integral part of the arsenic mitigation activities, and will seek to raise public awareness to change water use patterns.

The materials designed for this programme will

The existing strategy must be further strengthened through involvement of various international agencies and civil society actors

promote changes in lifestyle behavior - particularly water usage - in communities impacted by arsenic contamination.

Those efforts will be reinforced by messages disseminated through mass media.

Any awareness-raising campaign has to involve various members of the civil society, including health workers, doctors, engineers, technicians, agricultural extension workers, imams, students, and NGO groups.

In general, the awareness raising campaign must comprise the following elements:

- *Health Issues about Arsenic Poisoning* - how does it occur, what are the symptoms, what to expect
- *Alternatives for Health Protection* - use of clean water, improving nutritional quality, seeking medical help for arsenic victims
- *Safe water options* - providing information about arsenic treatment options and alternative water supplies
- *Testing for Arsenic* - methods to ascertain whether arsenic contamination is a problem for household wells
- *Dispelling Myths* - providing basic information that targets prevailing myths about arsenic poisoning in villages
- *Involvement of Women* - awareness of gender-based issues and the role women can play in fighting the problem



UNICEF brochures for raising public awareness





Public Health Protection

The impacts of arsenic pollution on human health - keratosis, melanosis and others - are typically gradual. Some researchers have divided them into four categories or levels ranging from mild to severe (Oshikawa et al., 2001).

The transition from one level to another occurs due to continued long-term exposure to arsenic contaminated water.

Provision of clean and affordable supply of freshwater is absolutely essential to halting the further impacts of the problem

Some of the research work done by Oshikawa et al. (2001) in Thailand clearly indicates either improvement in health or halting further worsening when use of contaminated water is discontinued in the early stages of the disease. This has important implications for formulating health protection alternatives.

It goes without saying that provision of clean and affordable supply of freshwater is absolutely essential to halting the further impacts of the problem.

Developing and implementing a health policy for arsenicosis patients poses several challenges for government agencies, civil society groups and international organizations.

Firstly, convincing the general public that the

simple step of using clean freshwater will help with the emerging epidemic is a difficult task. This difficulty has to be viewed in the context of similar publicity campaigns carried out in the 1970's and 1980's to promote that groundwater is the safest source of water. The credibility barrier so-created can be overcome through involvement of local communities in the development of health protection programmes. Secondly, providing clean freshwater at low cost or free of charge would require considerable investment in developing, managing and operating a reliable water supply system. Interim measures such as supplying bottled water may not be sustainable in the long-term. Needless to say, international funding agencies as well as bilateral donors can and have stepped in to assist in the process.

Another important public health issue is setting the standard for what is "clean" water. Currently, Bangladesh employs a drinking water standard of 50 parts per billion (or micrograms per liter) which is based on some earlier guidelines.

Existing scientific evidence should be weighed carefully and the drinking water standard for arsenic should be reviewed for Bangladesh's own conditions

established by the World Health Organization (WHO, 1993).

Many countries including Bangladesh have either kept this as the national standard or as an interim target, with the realization that significant impacts may also exist at lower concentrations in the 10-50 part per billion range.

Existing scientific evidence should be weighed carefully and the drinking water standard for arsenic should be reviewed for Bangladesh's o



conditions. Obviously, this will have significant impacts in identifying and delineating the regions impacted by the arsenic groundwater pollution.

In order to undertake an emergency-based response to protect the public health, a number of steps must be taken on immediate basis.

These should include the following.

- *Minimize or Eliminate Exposure to Arsenic* - by providing alternative sources of drinking water and making people aware of the consequences of drinking arsenic - contaminated water
- *Provide an Alternative Drinking Water Source* - numerous options for treatment: at household and community level are available; it may be possible to identify "safe" tube-wells in a community; treatment of surface water and rainwater harvesting are also options

- *Improvement of Nutrition* - by improving the nutrition level the impacts of arsenic poisoning can be minimized in both existing and potential patients
- *Diagnosis of Arsenicosis Patients* - the most common signs of arsenicosis are hyperpigmentation, especially on the upper chest and arms, and keratoses on the palms and soles of the feet
- *Provide Health Care to Arsenicosis Patients* - although effective cures for arsenicosis patients in advanced stages is not yet known, providing basic health support is essential. Some studies suggest appropriate doses of *vitamin A* can be beneficial.





Safe Water Options

The most important emergency measure needed is to prevent further exposure by providing them with arsenic-free safe drinking water. People in Bangladesh, particularly in the rural areas, are accustomed to using groundwater from hand-operated tubewells. In principle, it was considered safe from bacteriological pollution, unlike surface water. In view of the overwhelming dependence of the population on groundwater, point-of-use treatment of arsenic-contaminated groundwater appears to be a promising option for providing safe water to the rural population. Socio-economic conditions of Bangladesh demand a low cost for setting up and operation, particularly when dealing with treatment units that would operate at the household level.



A number of promising commercial and non-commercial technologies are available that suit Bangladesh's local conditions, particularly in the rural settings.

Another option is to treat the surface water, in which the contamination is mostly biological in nature.

Yet another option is to capture rainwater and utilize it for drinking purposes.

Rainwater harvesting can potentially suffer from biological contamination and thus may require some form of treatment to ensure its safety.

Various technologies have been used successfully for removing arsenic from groundwater.

The most commonly used technologies include co-precipitation with alum or iron; adsorptive filtration (e.g., using activated alumina); ion exchange; and membrane processes such as reverse osmosis.

A number of comparative evaluation programmes provide the necessary information about the effectiveness and efficiency of these treatment processes, including the environmental technology verification-arsenic mitigation (ETV-AM) studies being undertaken by Ontario Centre for Environmental Technology Advancement (OCETA), with the support of the Canadian International Development Agency (CIDA).



Coordination of Efforts

Integrated response is a must for the emergency measures to be successful.

In many countries, political involvement at the highest level is required to marshal an effective and timely governmental response to an environmental disaster.

At the same time, various government ministries need to be involved in the emergency response, in part because no individual ministry is capable of coping with the wide range of issues related to the arsenic crisis.

Different ministries and international agencies have different experience and expertise that would likely be required at various times throughout the emergency response.

Only one agency should be responsible for coordination of the overall implementation, so that lines of authority and responsibility are clearly identified.

Only one agency should be responsible for coordination of the overall implementation

There must also be an effort to directly engage the civil society.

Policymakers must realize that dealing with the arsenic crisis on the short term as well as long-term strategy will have other effects on the country.

These may include economic impacts - whether positive or negative, direct or indirect - on a number of sectors including agriculture and related industry, water management, public health and the overall national economy. The urgency for designing an emergency management paradigm is, therefore, at the highest level.

Transparency means that there will be openness and honesty in information about the arsenic crisis and its potential impacts

This emergency management paradigm should also deal with a number of indirect issues.

There should be transparency in the agencies dealing with those impacts.

Transparency means that there should be openness and honesty in information about the arsenic crisis and its potential impacts. At-risk regions, populations and sectors should be identified and notified in a timely manner.





Emergency measures need to be backed by adequate expertise and funding. National expertise should be maintained and strengthened over time so that government agencies can fall back to it for long-term implementation. Funding from donor agencies can be used to help to build national expertise. This would show commitment of donors and enhance the prospects for long-term planning instead of fostering a reliance on ad hoc responses.



A Partnership with the Civil Society

The affected communities and the stakeholders all have to work together towards the success of the emergency measures.

This partnership has to be developed and cultured at the earliest stages of the short-term responses. It should extend to involvement of the stakeholders in design and implementation of various measures.

This is particularly necessary when existing social practices and customs are counter to the desired response - such as changing the habit of drinking untreated well water to the one that requires extra effort to treat the water. As an example, it is difficult to convince people that they can store

Partnership with the civil society has to be developed and cultured at the earliest stages of the short-term responses

water safely and use it for drinking purposes. For success of this partnership, several of the existing NGO's must be fully engaged in various activities.

Long-Term Policy Options

A long-term strategy is essential and central to the success of any measures against the arsenic crisis.

Such a long-term strategy or policy should adequately identify the scope of the problem, the range of solutions available and the resources necessary for its implementation.

Implementing a long-term policy will greatly help in the fight against arsenic crisis and can also reap benefits for the sustainable development of the country

To mobilize the necessary resources, the government agencies have to work closely with international agencies and bilateral donor agencies.

It is also important to realize that implementing the long-term policy will greatly help in the fight against arsenic crisis and can also reap benefits for the sustainable development of the country.

There are five sectors that will likely be impacted in the long-term and must, therefore, be addressed in the policy: public health care, food supply, water resources, scientific research and information management.



Health Policy for Arsenic Patients

The existing estimates of people affected by drinking arsenic-contaminated groundwater range from 28 to 57 million.

It is not unreasonable to argue that significant fraction of these people will likely develop symptoms of arsenicosis; a similar trend is observed in the neighboring West Bengal. It is also clear that these symptoms manifest themselves after a prolonged exposure of several years to arsenic contamination.

A long-term health policy must take into account this pattern of delayed appearance of patients. This means that there is some time available to fully build the capacity of existing health care services to cope with an increased flow of arsenic patients.

A long-term health policy must take into account this pattern of delayed appearance of patients





There are no known cures for arsenicosis at the moment, the best treatment is to drink arsenic-free water. Some researchers claim that increased levels of vitamin A, vitamin C, vitamin E and proteins assist the body in fighting arsenicosis symptoms. Similarly, increased level of other micro-nutrients is essential. Some symptoms of arsenicosis, such as skin lesions can be relieved temporarily; for example treatment with medicated lotions that soften the skin.

A long-term health policy should include the following basic elements:

- *Estimation of the total number of arsenicosis patients* - this has important implications for the range of capacity building required
- *Mechanisms for identification of arsenicosis patients* - the health care system should be geared towards properly and correctly identifying patients suffering from arsenicosis symptoms
- *Training of medical staff* - building the human resource capacity is most important in success of a long-term health policy

- *Identification of potential treatments* - research efforts must be concentrated to identify what medical treatments can work for arsenicosis patients

Research efforts must be concentrated to identify what medical treatments can work for arsenicosis patients

- *Provision of medical support in villages* - as most of the affected population lives in villages, appropriate measures must be developed to provide support in rural settings
- *Improving nutritional quality* - to achieve success of the long-term policy, it is essential to provide access to a nutritionally-balanced diet to all those potentially affected by arsenic poisoning



Food Security

Bangladesh currently faces a food security challenge.

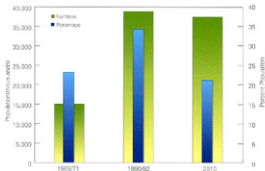
A recent report on State of the Environment in Asia and the Pacific (UN, 2000) projects approximately 37 million people will still be undernourished in the year 2010.

The impacts of the arsenic pollution on this worsening food security have not been considered explicitly. It is also not clear whether arsenic in irrigation water is taken up by the plants or if a fraction of such uptake ends up in food.

Approximately 37 million people will still be undernourished in the year 2010.

These issues of food security, both science- and policy-oriented, have to be considered in developing the overall long-term policy to fight arsenic crisis.

Undernourished population in Bangladesh
(Source: UN, 2000)



Undernourished population in Bangladesh (Source: UN, 2000)

Water Resource Management

Bangladesh has abundant water resources - both in terms of surface water and groundwater, as shown in Table 1.

An estimate of the exact volume of groundwater contaminated with arsenic above WHO guidelines standards is not readily available.

The figure below shows the sectoral distribution of freshwater and groundwater, respectively.

It is obvious that a vast majority of groundwater is utilized by the agricultural sector.

The abundance of available surface water, if managed appropriately, would obviate the need for utilization of groundwater in the first place.

However, installing an infrastructure on a nation-wide basis for treatment and delivery of freshwater is a major undertaking.

The overall approaches for remediating arsenic contamination problem, however, cannot be

successful if they do not account for water availability as a broader resource management issue. In this respect, rainwater harvesting can be an important resource for drinking water - successful implementation has been undertaken in Bangladesh and Thailand (UNICEF, 2000; Oshikawa, 2001).

Installing an infrastructure on a nation-wide basis for treatment and delivery of freshwater is a major undertaking



	<i>Average annual internal renewable water resources 2000</i>	<i>Annual with draws 1990</i>	<i>Average annual ground water recharge 1990</i>	<i>Annual groundwater with draws 1990</i>
Total km ³	105.0	14.6	21.0	10.7
Per capita (m ³)	813	134	163	19.6

Table 1. Water resources in Bangladesh (Source: WRI, 2000)



It is also important to utilize groundwater as a freshwater resource.

It is possible that a number of "safe" non-domestic uses of arsenic-contaminated water may be found.

More significantly, the potential for treating the groundwater for domestic purposes is quite large.

By treating the groundwater for arsenic contamination, it attains hygienically superior quality than readily-available surface water.

A number of technologies are available for removing arsenic from groundwater to below the drinking water standards; these have been described in some detail in other publications (e.g., WHO, 2000 and BUET-UNU, 2001).

It is also important to utilize groundwater as a freshwater resource

To be fully applicable, these technologies must be acceptable for users, easy to operate, efficient under local climate conditions and cheap.

Nevertheless, scaling up the implementation of these technologies at national or district level is a daunting task, both

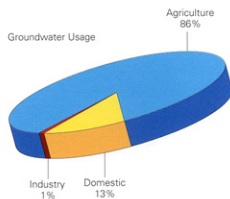
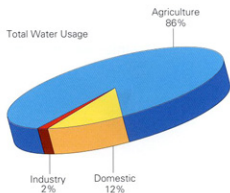
from technical and financial points of view.

It can only be implemented if the international agencies, NGO groups and relevant government institutions join their resources.

A major factor that will govern the range of alternatives for long-term water resource management is availability of human and financial resources.

This has to include capital investment in infrastructure as well as cost of maintenance.

In order to make this possible, a broad cooperation between various stakeholders is necessary. Most importantly, the government has to initiate a dialogue with international agencies and bilateral donor agencies for its implementation.



Water Usage in Bangladesh (Source: WRI, 2000)



Scientific Research on Key Issues

A number of gaps in the scientific knowledge exist at the moment.

These must be tackled keeping in mind the particular conditions prevailing in Bangladesh. Information from scientific research should be directly fed into the policy development process, as some of the research findings may have far-reaching consequences.

Some of the more critical research needs are discussed in this section.

Information from scientific research should be directly fed into the policy development process,

- *Evaluating arsenic drinking water standard* - the current water quality standard for permissible level of arsenic in drinking water is 50 parts per billion or micrograms per liter. This should be carefully evaluated considering factors appropriate for Bangladesh (such as average body weight, daily water consumption, etc.)
- *Finding treatments for arsenicosis* - this presents a great challenge to the global medical research community to find effective treatments for arsenic poisoning related medical problems
- *Evaluating presence of other pollutants* - health impact of arsenic in the presence of other pollutants and iron must be fully studied and understood
- *Ingestion of arsenic through other routes* -

once arsenic in groundwater is brought to the surface, it can enter the human body through routes other than just drinking contaminated water; the significance of these other routes - such as eating contaminated foods or inhaling dust particles - should be established scientifically

- *Retention of arsenic in soils and plants* - uptake of arsenic into plants and foods from the irrigation water, its retention in soils and leaching back to shallower aquifers needs to be fully investigated



Information Management and Dissemination

One major aspect of strategies to tackle the arsenic pollution problem is management and dissemination of information to various stakeholders, including researchers, policymakers, politicians, international donor agencies and the general public. The information can come in various forms including, but not limited to, the following:

- Data from groundwater monitoring
- Geographical distribution of arsenic contamination
- Medical facts about diseases triggered by drinking arsenic-contaminated water
- Resources available for remediation activities
- Statistics of the impacted population

A comprehensive information management approach must be adopted to centralize and organize the vast volumes of information being generated currently as well as those to be generated in the near future.

The information management paradigm should include the following:

A comprehensive information management approach must be adopted to centralize and organize the vast volumes of information being generated

- *Validation and/or ground truth verification* - to ensure that the information is correct and reliable; this should also include documentation of information sources
- *Development of analytical processes* - the process of analyzing information is a well-established science and several "tools" for this purpose are available; use of geographical information systems (GIS) is essential because most of the information is spatial in nature
- *Information dissemination* - there should be mechanisms for both active and passive dissemination of information to targeted audience; use of Internet must be built into the system
- *Stewardship of information* - to sustain the information management system, stewardship of the information management system - perhaps by GoB - is quite essential

Openness and transparency can increase trust among government agencies, scientists and the public

Transparency in information management is also critical for fully understanding the problems and for developing a cohesive strategy.

Openness and transparency can increase trust among government agencies, scientists and the public.

At a minimum, it can create awareness as well as educate, alert, and prepare people about the risks they may face.

Transparency between the government agencies and donors is also necessary, so that the needs and expectations of both are well understood.



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Disclaimer

All the statements provided in the document are those of the author. The views expressed in this document do not constitute endorsement of technologies or commercial products by UNU or EIP.



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I acknowledge that the crisis of Arsenic in Bangladesh today is not just a problem of Bangladesh, but the problem of entire Earth. Therefore, urgent policy measures must be sought. From this point of view, it was prime time for both the United Nations University and NGO Earth Identity Project to hold such roundtable by collaboration. I would like to thank the Parliament of Bangladesh for its support, and also to those people who have helped us make this policy brief. Lastly, we could not have organized this roundtable without the effortless work of Ms. Nasrine R. Karim, Director General of NGO Earth Identity Project Bangladesh Branch and Dr. Zafar Adeel of United Nations University.

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