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ARSENIC CONTAMINATION IN GROUNDWATER AFFECTING SOME COUNTRIES IN THE SOUTH-EAST ASIA REGION
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1. SITUATIONAL ANALYSIS

1.1 Introduction

Arsenic is a chemical that is widely distributed in nature and principally occurs in the form of inorganic or organic compounds. Inorganic compounds consist of arsenite, the most toxic forms and arsenate the less toxic forms. Exposure to inorganic compounds may occur in a variety of ways through certain industrial effluents, chemical alloys, pesticides, wood preservative agents, combustion of fossil fuels, occupational hazards in mining and dissolution in drinking water. The most commonly found arsenic compounds in drinking water are trivalent arsenite or pentavalent arsenate. Organic forms of arsenic compounds occur primarily in seafood obtained from several marine organisms that extract arsenic from water and methylate it to an organic compound.

1.2 Geological Process of Arsenic Contamination and Removal of Arsenic from Water

For Bangladesh and India, it is generally held that rocks containing arsenic eroded from the Himalayas and deposited in the Gangetic plains later got buried in the sediments over thousand of years. These arsenic-bearing sediments form parts of the aquifers that are presently being tapped for water resources. Arsenic may be released in the groundwater by oxidation of the arsenopyrites or pyrites from the subsoil due to air leaking through wells or sand-pipes; reduction of the oxy-hydroxides of iron or manganese by reducing microorganisms or reduction of ionic oxygen due to aging; and desorption of arsenic by phosphate from fertilizers or other sources.

The available treatment technologies for arsenic removal give varying results depending on the concentration of arsenic in water, the chemical composition of water including interfering particles and the amount of water to be treated. Other important considerations include the feasibility and cost of the treatment process. The most commonly used biophysical methods are: coagulation, softening, iron and manganese oxidation, anion exchange, activated alumina membrane processes and elcedristolysis. The prohibitive cost of these technologies has prompted the search for alternative sources such as rainwater harvesting for obtaining arsenic-free water.

1.3 Global Situation

Groundwater is a significant source of drinking water in many parts of the world. Well-protected groundwater is safer in terms of microbiological quality than water from open dug wells and ponds. However, groundwater is notoriously prone to chemical and other types of contamination from natural sources or by anthropogenic activities.

Reliable data on exposure and health effects are rarely available, but it is clear that there are many countries in the world where arsenic in drinking water has been detected at concentrations greater than the WHO Guideline Value, 0.01 mg/L or the prevailing national standards. These include Argentina, Australia, Bangladesh, Chile, China, Hungary, Mexico, Peru, the United States of America and some countries in the South-East Asia Region. Countries where adverse health effects have been documented include Bangladesh, China, India, and the United States of America.
1.4 The Situation in South-East Asia Region

To date, in the South-East Asia Region, arsenic contamination of groundwater has been reported in Bangladesh, India, and Thailand and to a limited extent in Nepal and Myanmar. In India and Bangladesh, and possibly Nepal and Thailand, arsenic is of geological nature originating from the natural aquifers. However, in Thailand, the contamination is anthropogenic in nature, being due to mining activities. Irrespective of the origin of arsenic, in Bangladesh, India and Thailand, the concentrations in several groundwater samples range from 0.06 mg/L to 1.86 mg/L, a value that is in excess of the WHO Drinking Water Guideline Value of 0.01 mg/L.

Studies from West Bengal in India show that approximately 5 million persons are consuming groundwater containing arsenic exceeding 0.05 mg/L that is their national standard. Recent unconfirmed reports point to the presence of arsenic in Tamil Nadu and other states of India, implying industrial contamination of groundwater. In India, it is estimated that 220 000 of the 5 million exposed subjects are showing signs of arsenicosis.

The arsenic crisis in Bangladesh has been described as one of the worst cases of mass poisoning in world history. Exposure to arsenic in Bangladesh is through consumption of water obtained from some 8-12 million tube wells distributed throughout the country. The precise number of affected persons in Bangladesh is not known, but most estimates put the number of people being exposed to arsenic concentration at around 25 million, exceeding the Bangladesh national standard of 0.05 mg/L. Furthermore, about 10 000 subjects have developed signs of arsenicosis. These recent estimates are higher than the initial ones obtained in the year 1997. However, they must be interpreted with caution in trying to establish any increasing trends, as the apparent increase may equally be due to increase in arsenic testing, case recognition and case reporting. Continuous testing by many parties is going on. The National Arsenic Mitigation Information Centre (NAMIC), DPHE, DANIDA and others collect data according to an agreed format. Collation of the data is very time-consuming and as it also requires quality control, updating of maps is going slow. At the sub-district level, gradually better information is becoming available.

The arsenic problem in the amphoe of Ronphibun, Thailand originates from tin mining containing arsenite and arsenate. Tin ore mining activities were practised for over 50 years. At present these mining sites have become water ponds and with natural rainfall, they sediment downstream, contaminating shallow wells used by villages for their water supply.

The water monitoring section of PCD conducted a survey in 1993 to establish the extent of arsenic contamination in groundwater in Ronpiboon district of Nakorn Si Thammarat province. During the survey, it was established that arsenic concentration in excess of Thailand standard (0.05mg/L) was detected in more than 90% of shallow wells and there were “hot spots” in the soil with arsenic concentration exceeding 1 000 mg/Kg of soil. A recent survey done in collaboration with JICA has identified that six hot spot areas still remain for targeting pollution control measures. A health survey funded by SEARO in August 2000 estimates that approximately 6 120 of potentially 24 566 exposed subjects were showing symptoms of arsenicosis.

Arsenic testing was undertaken in Nepal, since it shares some geological features with the Gangetic plains of India and Bangladesh. The Department of Water Supply and Sewerage (DWSS) of Nepal, with assistance from WHO, conducted a systematic study in 1999 on possible arsenic contamination of groundwater in Jhapa, Morang and Sunsari districts. The study revealed that most of the contaminated samples were found around the active flood plains of River Koshi. The Nepal Red Cross Society (NRCS), with Japan Red
Cross Society (JRCS), jointly tested groundwater samples at their project sites in 17 Terai districts. This study showed that the concentration of arsenic in groundwater is found to be high in the districts of Nawalparasi, Rautahat, Bara and Bardia. The Rural Water Supply & Sanitation Support Project (RWSSSP), FINNIDA has also tested some of the tubewells at their scheme areas. Approximately 3% of the wells tested were found to be positive with arsenic concentration up to 0.17 mg/L. Another survey has found that about 3% of the 1,142 subjects surveyed were showing signs of arsenic diseases in the form of dermal lesions.

The Water Resources Utilization Department (WRUD) in the Ministry of Agriculture and Irrigation of Myanmar conducted arsenic testing in mid-1999. Samples drawn from Lower Myanmar showed traces of arsenic. A survey conducted by the Save the Children Fund, (UK) in Thabaung, Laymyethan and Hethada townships during March-May 2000 found that 35% of 125 sunken tubewells that were tested showed arsenic concentration in excess of 0.05 mg/L. Currently, the WRUD has conducted a thorough water quality monitoring programme in five selected townships, namely Magway, Sittway, Kawmu, Kyaungkone and Henthada. In these townships, localized random distribution arsenic concentration of varying magnitude was observed. The evidence so far reveals that sunken tubewells in delta and coastal areas are generally prone to arsenic contamination.

2. HEALTH IMPACT OF CHRONIC ARSENIC POISONING

2.1 Clinical Consequences and Management

The health outcomes of exposure to arsenic depend on the modality and duration of exposure as well as the source and type of arsenic. In our Region, the principal health outcomes are due to consumption of arsenic from groundwater, resulting in chronic effects. The symptoms of chronic arsenic poisoning manifest themselves with accumulating doses of consumed arsenic concentration. The hallmarks of chronic arsenic poisoning are dermal changes including melanosis, increased pigmentation or blackening of the skin around lips, hyperkeratosis or hardening of the skin especially of palms and soles and furfuraceous desquamation, or shedding of epithelial elements of the skin in brain-like scales. These lesions are susceptible to super infection by fungi and bacteria. Some patients may show severe complications, such as solid oedema of the feet, first characterized as black-feet in Taiwan; hepatomegaly and splenomegaly. Long-term exposure to arsenic, with a mean latency period of 10 years, has also been considered as a cofactor in the development of skin cancer called squamous cell carcinomas.

Up to now, there is no universally agreed case-definition of arsenic diseases and this makes comparison of the clinical pictures across the Region an impractical exercise. Invariably, underlying dietary factors, age and the presence of other debilitating conditions will modulate the clinical manifestations.

There is no universal medical treatment for chronic arsenicosis, although a number of clinical treatments have been advocated. The chelating agent, dimercaprol which is effective in acute poisoning, may give a positive result in some patient with chronic poisoning. Patients should be removed from the source of exposure and symptomatic management undertaken.

2.2 Possible Burden Of Disease due to Arsenic Contamination

A review of studies conducted in other parts of the world shows that between 16% and 21% of the exposed subjects develop the disease. Hence for our purpose, we can assume that approximately 20% of exposed subjects eventually develop signs of arsenic poisoning. Based on this conversion factor, a number of scenarios can be formulated, but the following
assumptions will have to be made. These include validity of arsenic test, accuracy of clinical case recognition and generalizability of survey results, all of which are prone to error as discussed under Section 4 below. Therefore, the estimates in the table below, have no reliable statistical confidence intervals ascribed to them.

<table>
<thead>
<tr>
<th>Country</th>
<th>Presumed exposed population</th>
<th>Number of cases</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Observed to date</td>
</tr>
<tr>
<td>Bangladesh</td>
<td>25 million</td>
<td>10 000</td>
</tr>
<tr>
<td>India</td>
<td>5 million</td>
<td>220 000</td>
</tr>
<tr>
<td>Thailand</td>
<td>24 665</td>
<td>6 120</td>
</tr>
<tr>
<td>Nepal</td>
<td>No current estimate</td>
<td></td>
</tr>
<tr>
<td>Myanmar</td>
<td>No current estimate</td>
<td></td>
</tr>
</tbody>
</table>

The wide range of the estimates clearly shows that a proper assessment of the burden of disease associated with arsenic contamination is required. As part of WHO's activities on the global burden of disease, an estimate of the disease burden associated with arsenic in drinking water is under preparation. A report entitled “Towards an assessment of the socioeconomic impact of arsenic poisoning in Bangladesh” was released in 2000.

3. REVIEW OF MITIGATION ACTIONS TAKEN SO FAR

3.1 Actions Taken by the Countries

Significant initiatives to mitigate the effects of arsenic contamination of water undertaken by the state and central governments in India include: constitution of a working group by the Government of West Bengal (GOWB) in December 1983, a follow-up project sponsored by the Government of India (GOI) in 1988, constitution of expert committees by the GOI in 1988 and an expert committee constituted by the GOWB in April 1992. The Central Ground Water Board, the All India Institute of Public Health and Hygiene, Calcutta, the Department of Environmental Science of Jadavpur University and the National Bureau of Soil Sample and Land Use Planning are working in the West Bengal districts of Murshidabad, Malda, Nadia, 24 Parganas North, 24 Parganas South, Hughli and Burdwan. A variety of activities, including geological surveys for monitoring levels of arsenic concentration in groundwater and epidemiological surveys for monitoring the extent of arsenic disease are being carried out by these organizations alone or in collaboration with development partners such as CIDA and DFID.

In Bangladesh, the Government convened a special interministerial meeting in 1996 and constituted a National Steering Committee with the Minister of Health as chairman. Several international and donor agencies offered assistance in this field. In 1997, the World Bank assisted the Government of Bangladesh in the formulation of an Arsenic Mitigation and Water Supply Project and provided a loan of US$ 35 million; so far US$ 2 million have been utilized for the project based with the local government. A National Conference on Coordinated Action for Arsenic Mitigation was convened by the Steering Committee in Dhaka in February 1999 and a number of health-related recommendations were made. The Government of Bangladesh has one project of about US$ 13 million focusing on drinking water supply from ponds in arsenic-affected areas and the saline belt.
The Pollution Control Department (PCD) in the Ministry of Science and Technology of Thailand formulated an action plan in 1998 for remedying arsenic contamination in Ronpiboon district. Action programme number 8 is aimed at health surveillance and treatment of arsenic-related symptoms to be implemented jointly by the Nakorn Sri Thammarat province and the Office of the Permanent Secretary, Ministry of Public Health for the period 1998-2002. No current information is available on the implementation status of the project.

On the basis of preliminary arsenic findings, the Water Resources Utilization Department (WRUD) in the Ministry of Agriculture and Irrigation of Myanmar, with the assistance of UNICEF, decided to do a nationwide water quality monitoring programme. In this context, as the first stage of this intervention, WRUD has targeted 96 townships for this fiscal year (2000-2001).

In Nepal, the Department of Water Supply & Sewage (DWSS), in collaboration with UNICEF, has started "Terai Tube Arsenic Testing Programme" to conduct assessment of arsenic in all 20 terai districts to find out the severity of the problem and provide required mitigation measures. DWSS has already trained key engineering staff in each of the 20 Terai districts.

3.2 Actions Taken by the Regional Office

Recognizing the gravity of the situation, the Regional Office provided policy and technical support to the governments of Bangladesh and India. Thus, in May 1997, a bilateral consultation of experts from Bangladesh and India as well as interested donors was organized. An action plan, incorporating both immediate and long-term relief measures, based on the recommendation of a WHO short-term consultant (STC), was finalized at this meeting and has been accepted as guidelines by many development partners in their implementation projects.

WHO continues to play an important role in assisting the governments of both the countries with specialized advice of a variety of experts on the subject. WHO supported the visit of a special mission to assist the Government of India in August 1996, and subsequently, the visit of Prof. J.M. Dave in 1996 and 1997, and of Dr. Allan Smith in 1997 to Bangladesh. WHO sent a consultant again in 1998 to Bangladesh to review the earlier recommendations and to further assist in the implementation of GOB emergency relief programme.

Assistance has also been provided for organization of training of Bangladeshi nationals on the treatment of arsenicosis at the Jadavpur University in Calcutta. The visit of Bangladeshi water supply engineers to West Bengal (India) was also supported. Several courses were funded by WHO at the All India Institute of Hygiene and Public Health, Calcutta, for participation both from India and Bangladesh. In addition, the National Environmental Engineering Research Institute (NEERI), Nagpur, India, which is a WHO collaborating centre, was commissioned in 1997 to evaluate the arsenic testing kits used in both countries.

As a result of the flurry of activities generated while responding to the arsenic hazards in the Region, the Regional Office has developed a concept plan consisting of three goals namely, intensified response to arsenic hazards, strengthening infrastructure and capacity-building. As detailed in Section 5 below, these are being implemented in collaboration with development partners both at the regional and country levels in Bangladesh. In addition, a UN report on arsenic in drinking water has been prepared in cooperation with other UN agencies under the auspices of an interagency coordinating body (Sub-committee on Water Resources of the Administrative Committee on Coordination) which provides available information on chemical, toxicological, medical, epidemiological, nutritional and public health
issues; develops a basic strategy to cope with the problem and advises on removal
technologies and water quality management.

Globally, information on arsenic in drinking water on a country-by-country basis is being
collected and will be added to the UN report and made available on the WHO website. WHO
is periodically publishing fact sheets on “Arsenic in Drinking Water”. An updated version
giving a global overview was published on 23 May 2001.

3.3 Partnership of WHO with Other Agencies

The WHO consultation held in New Delhi in May 1997 generated tremendous interest among
UN and bilateral agencies such as UNDP, WB, UNICEF, JICA and Arsenic Asia Network.

The second half of 1998 saw an increasing involvement of several UN agencies in the
effort in Bangladesh. The future roles for multi-agency efforts were discussed by the UN
Administrative Committee on Coordination (ACC) during the meeting of its Inter-agency
Steering Committee on Sustainable Development for Water Supply and Sanitation which was
held in Beirut from 29 September to 1 October 1998 and attended by representatives of
UN/DESA, UNDP, UNEP, UNICEF, UNIDO, IDNDR, ESCAP, ESCWA, UNESCO, WHO,
CBD, and WSSCC. Agreements at this meeting for agency roles were as follows.

<table>
<thead>
<tr>
<th>Agency</th>
<th>Roles</th>
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</thead>
<tbody>
<tr>
<td>WHO</td>
<td>1. Health impacts and epidemiology</td>
</tr>
<tr>
<td></td>
<td>2. Patient treatment through nutrition</td>
</tr>
<tr>
<td>UNICEF</td>
<td>1. Public information campaigns</td>
</tr>
<tr>
<td></td>
<td>2. Mitigation through use of alternative supply sources</td>
</tr>
<tr>
<td>UNESCO and IAEA</td>
<td>Hydro-geology and geochemistry</td>
</tr>
<tr>
<td>UNIDO</td>
<td>Treatment for arsenic removal</td>
</tr>
<tr>
<td>UNIDO and FAO</td>
<td>Food security and agricultural aspects</td>
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Subsequent to the ACC recommendations, a United Nations Foundation grant for US$ 2.5
million approved in July 2000, will enable UNICEF and WHO to support a project for providing
clean drinking-water alternatives to 1.1 million people in three of the worst affected sub-districts
of Bangladesh. The project utilizes an integrated approach involving communication, capacity-
building for arsenic mitigation of all stakeholders at sub-district level and below, tubewells
testing, patient management, and provision of alternative water supply options.

In May 2001, WHO participated in a joint meeting with UNICEF, and ESCAP (Economic
and Social Commission for Asia and the Pacific) in Bangkok on “Solving the arsenic crisis in
the Asia-Pacific Region” and supported, among others, the recommendation to create a
regional centre for collation and exchange of information on arsenic.

WHO has and will continue to work in partnership with development and bilateral
agencies as well as national governments in the area of risk assessment and burden of
disease reduction, setting norms and standards in health and providing technical and policy
support to the arsenic problem in the South-East Asia Region.

4. GAPS IN EXISTING KNOWLEDGE ON ARSENIC TOXICITY AND
NEEDS FOR ADDRESSING FURTHER ISSUES
A review of the current epidemiological data shows that the following gaps exist in our knowledge of arsenic mitigation: due to uncertainty in the measurement of exposure to arsenic caused by lack of validity of testing kits; in measuring the outcome of exposure to arsenic due to lack of objective criteria for defining a clinical case; in estimating the prevalence of arsenicosis because of uncertainty in measuring the exposure and the outcome variables; about the health outcomes of low-dose exposure to arsenic as well as the role of nutritional and other cofactors in modifying the onset and prognosis of arsenicosis, and about arsenic removal technologies.

All these uncertainties are inter-linked and will propagate together to compound the errors in measurement. If a case is not clearly defined, it will be misclassified, leading to erroneous counts. By the same token, if exposure to arsenic is not accurately measured, the exposure status will be misclassified. Both these errors will lead to biased estimates of true prevalence, making it difficult to assess the true impact of any intervention measures.

5. REGIONAL STRATEGIC GOALS FOR ARSENIC MITIGATION

Realizing the serious health impacts of arsenic contamination, SEARO has adopted a strategic plan focussing on three main areas: responding to arsenic hazards through exposure assessment, risk determination and risk management; strengthening infrastructure for arsenic mitigation and, capacity-building through human resource development.

The main activities implemented or planned so far have been: defining assays for exposure assessment; setting the norms and standards for risk management in the formulation of standard case-definition, reporting and management; establishing the role of nutritional or other cofactors for risk determination in the onset and prognosis of arsenic diseases and assisting the evaluation of technologies for the provision of arsenic-free water.

5.1 Responding to Arsenic Hazards

The Regional Office’s goal of responding to arsenic hazards is a collective effort comprising three objectives namely, exposure assessment, and risk determination and risk management.

5.1.1 Exposure assessment

The sub-objectives of exposure assessment comprise defining and validating laboratory assays and estimating the true prevalence of arsenic in groundwater. The Regional Office will work with other agencies such as the International Atomic Energy Commission on defining regional policy and guidelines for arsenic testing and validation of test kits.

The validity of any prevalence estimate is contingent on accurate laboratory measurement of arsenic in groundwater. Currently, there are many test kits that are used in our Region, but the results do not show a high degree of concordance among various assays in the field. The Regional Office has supported the initial laboratory assessment of some of these kits, and will continue to support epidemiological evaluation of these kits for validating their true sensitivity and specificity under field conditions.

5.1.2 Risk determination

The sub-objectives of risk determination are to establish: (1) the magnitude of the risk for
developing arsenicosis after exposure to arsenic-contaminated water by a case-control design; (2) the population attributable risk and, (3) dose-response relationship, particularly for long-term exposure to low doses of arsenic.

The bulk of the evidence linking arsenical dermatitis to arsenic exposure is derived from cross-sectional studies. While such studies provide the first line of evidence, the interpretation of the conclusion is limited by confounding due to other exposure. Thus, the extent to which unexposed or exposed persons develop clinical dermatological conditions mimicking chronic arsenical dermatitis is not known; similarly, the extent to which exposed persons do not develop chronic arsenical dermatitis is not known. These limitations can only be overcome by a case-control study in which both exposed and non-exposed subjects are investigated for arsenic-related diseases. By proper manipulation, the case-control study can also establish if the onset of arsenicosis is modified by prevailing local conditions such as climate, dietary intake and occupation.

There is a wide range of the projected number of arsenic-affected patients in Bangladesh, India and Thailand. This is partly due to an active case search being conducted in the proximity of a contaminated well and generalizing the results to the whole population. Another factor accounting for this wide discrepancy of the figures is due to the lack of a consistent case definition. An unbiased estimate of occurrences of arsenicosis, and therefore the population who are at risk, can only be made by using standard working case definition and sound epidemiological design such as cluster sampling to minimize the selection bias.

The subjects identified in the case control studies may be followed up prospectively to assess the long-term health effects of exposure to low doses of arsenic.

5.1.3 Risk management

The sub-objectives of risk management are to set the norm for case definition; formulate guidelines for case management and provide arsenic-safe water.

The accurate detection of arsenic cases is the cornerstone of good case management and reporting. Until now, no uniform case definition of arsenicosis has been developed or validated regionally or internationally. Formulation of criteria for classifying cases into the categories of suspected, probable, and confirmed need to be developed. These uniform case definitions will be used to estimate the prevalence and management of arsenicosis.

The lack of currently available proven therapy for clinical management of chronic arsenic poisoning has led to a number of unsubstantiated therapeutic measures being used for treating arsenicosis. If the case-control study, described under risk determination section above, will identify particular dietary habits as cofactors, then appropriate intervention measures could be targeted at those factors for the prevention of arsenicosis onset. An expert committee will then critically review the state-of-the-art therapy for chronic arsenicosis and evidence-based recommendations for the proper management of patients suffering from arsenicosis.

The prohibitive cost of arsenic removal technologies on a large scale has prompted the search for alternative sources. These include: confirmation and use of “green” tubewells, use of deeper aquifers in areas where there is a well-developed aquiclude separating the upper and deeper parts of the aquifers, promotion of rain-water, consideration of piped schemes based on central supply of surface water treatment or higher yielding deeper, arsenic-free tubewells, and using a packet of chemicals for household treatment. Some
examples include the so-called “tea bag” treatment developed by NEERI and the Pan American Center of Sanitary Engineering and Environmental Sciences in Peru, Lima.

Since the efficacy of these technologies varies, a number of different protocols exist. Therefore, it is necessary to develop protocols for the independent verification of arsenic-safe water technologies and to train national experts in at least two national centres of excellence in their. As a result, the countries themselves may evaluate technologies that are proposed for implementation in arsenic mitigation projects in future. Increasing consumers’ access to arsenic-safe drinking water can only reduce health risks due to arsenic in drinking water, whether at the community or household-level. Researchers, NGOs, and private sector have developed numerous community and point-of-use arsenic removal technologies concerns and many have been applied in Bangladesh, West Bengal and Thailand. These technologies and others may be considered in future for application in Nepal and other SEAR countries where arsenic-contaminated drinking water may be found. A limited number of arsenic removal technologies in use in Bangladesh have been evaluated in separate initiatives by CIDA and DFID, but neither has focused on strengthening national capacity to independently evaluate such technologies.

5.2 Strengthening Infrastructure for Arsenic Mitigation
Realizing the role of infrastructure for arsenic mitigation, the Regional Office is strengthening key existing infrastructures in India, Bangladesh, Thailand and Nepal. Two aspects are being addressed: strengthening of reference laboratory and setting up of an arsenic mitigation network. In order to monitor and validate arsenic testing and arsenic removal technologies, centers are being supplied with equipment and reagents as well as training in the use of the protocols. A regional network will be created by cross-linking available national and international centres of excellence and collaborating centres.

5.3 Capacity-building through Human Resource
A concerted response to arsenic mitigation can only occur if a critical number of human resources is developed in the field of arsenic diseases. The Regional Office is supporting human resource development by providing international experts to assist scientists in arsenic-affected countries, such as Bangladesh, India, Nepal and Thailand and developing standard training curriculum and materials. Similarly, WHO has supported several study tours or short courses at the All India Institute of Hygiene and Public Health, Calcutta, for participants from Bangladesh, India and Thailand. WHO is funding the production of standard training modules that will be used for training trainers throughout the arsenic-affected countries of the Region.

6. TIME-FRAME FOR IMPLEMENTATION OF REGIONAL STRATEGIC GOALS
The strategic goals of the Regional Office have already been implemented in parts and will be intensified in the next biennium. The initial phase which covers the period up to the year 2001 will focus on norms and standard-setting in test validation, case detection and case management. The next phase starting in 2001 will focus on developing standard training modules and building capacity, as well as undertaking epidemiological assessment.
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