

UNICEF - AusAID

Evaluation of Arsenic Mitigation in Four Countries of
the Greater Mekong Region

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Part One



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Disclaimer

The statements and opinions in this report are the views of the authors and do not necessarily reflect the policies or the views of the United Nations Children's Fund (UNICEF) or the Australian Agency for International Development (AusAID).

Executive Summary

Purpose of Evaluation

The consultants were engaged by UNICEF to undertake an evaluation of the UNICEF and AusAID jointly funded program 'Arsenic Mitigation in Four Countries of the Greater Mekong Region'. A consultancy team, comprising Dr Mhd Jakariya and Mr Simon Deeble, undertook the consultancy.

The purpose of the evaluation was 'to document and evaluate the UNICEF country offices' progress on the prevention and mitigation of arsenic in drinking water in Myanmar, Lao PDR, Viet Nam and Cambodia'.

Background

Access to safe drinking water is essential to health, a basic human right and a component of effective policy for health protection. Chronic arsenic poisoning results from drinking water with high levels of arsenic over a long period of time. The health effects are dependent on the susceptibility, dose and period of exposure. Today, tens of millions of people, mainly in developing countries, are affected by levels of arsenic in drinking water that exceeds the World Health Organization's (WHO) drinking water guideline value of 10 parts per billion (ppb). Proper identification of the arsenic contaminated tubewells is therefore needed to assess the health risks and initiate appropriate mitigation measures. Arsenic mitigation involves testing tubewell water for arsenic, raising community awareness about the health problems related to chronic arsenic exposure from drinking water, and finally, providing alternative safe water options for the exposed population.

High levels of arsenic in tubewell water were discovered relatively recently in the Greater Mekong region when compared to China and the Bengal Delta Plain. Installation of tubewells in the four studied Mekong countries commenced in the late 1990s, which may be one of the contributing factors why the arsenic exposure in these countries was found to be comparatively less. Furthermore, people in these regions traditionally collect rainwater for drinking during the rainy season. This drinking water habits assist in diluting the arsenic concentration in the human body, as a result, these people are less susceptible to arsenic poisoning.

Arsenic Mitigation activities in the Greater Mekong Region

Since 2000, UNICEF and AusAID have jointly supported arsenic mitigation activities in Myanmar, Lao PDR, Viet Nam and Cambodia. UNICEF was well placed to support arsenic mitigation activities in these countries because of their existing Water, Environment and Sanitation (WES) programs. AusAID also has experience in this field having previously supported arsenic mitigation programs in Bangladesh, which led to the publication of 'Managing arsenic in water supplies – Interim AusAID guidelines and operating procedure' in 2004.

The key components for UNICEF and AusAID's jointly funded program for arsenic mitigation in the Greater Mekong region are as follows:

- ▶ Testing and Database Development
- ▶ Awareness Raising
- ▶ Alternative Safe Water Options
- ▶ National Strategies

Testing and Database Development

Testing of tubewells is considered as one of the primary steps to mitigate and raise community awareness about the arsenic problem.

Through testing of water samples, each country has made considerable in-roads in developing an understanding of the scale of the problem in their respective countries. To date, each country has tested the following number of water samples:

- ▶ Myanmar – 230,000 tests
- ▶ Lao PDR – 3,500 tests
- ▶ Viet Nam – 187,000 tests
- ▶ Cambodia – 37,200 tests

The results of these samples have led to the development of risk maps identifying high risk areas where arsenic mitigation activities can be focused. The risk map prepared by Myanmar was found to be comprehensive. Myanmar was systematic in preparing the map and even installed test tubewells to get the necessary geological information. Cambodia and Viet Nam developed their risk maps based on the results of water quality testing and existing geological information. In Lao PDR, however, only UNICEF Lao PDR supported tubewells were considered during preparation of the risk maps.

A number of semi-quantitative test kits are available to detect the presence of arsenic within a water sample. Each test kit has advantages and disadvantages, both of which relate to the ease of use, sensitivity of the results and also the cost of the equipment. Myanmar and Viet Nam were the two countries where field test kits were standardized to test tubewell water at the field level. Lao PDR and Cambodia used a variety of kits to complete their water sampling testing.

Arsenic Field Testing Kits

It is important that arsenic affected communities are aware of the extent of arsenic contamination present in the water prior to consumption. A key factor in determining the arsenic concentration of a water source is the reliability of the assessment, which depends on the accuracy of measurement. The cost of the analysis increases considerably with the level of accuracy of measurement. For quick measurements of arsenic concentration in the field, a number of arsenic field testing kits were introduced by different manufacturers including Merck, HACH, and Wagtech. When compared to expensive laboratory testing, the use of field testing kits offers the best opportunity to assess arsenic contamination levels in most of the arsenic affected countries. It is important to determine the most appropriate field test kit both in terms of user friendliness and reliability close to laboratory assessment. A detailed description of the kits used by different countries is presented in Appendix A. Expensive but reliable arsenic field test kits are better than those that are inexpensive but give ambiguous results. Initially the four Mekong countries used a number of available arsenic field testing kits, however, later, Myanmar and Viet Nam finalized the use of test kit based on the practical experience. The table overleaf shows which test kits are being used by each of the countries:

Test Kit	Country of Origin	Used by Country	Sensitivity Range (ppb)
Merck	Germany	Lao PDR, Viet Nam, Cambodia	0 – 500
Wagtech Digital Arsenator	United Kingdom	Myanmar, Lao PDR	2 – 100
HACH (5 Stage)	USA	Cambodia	0 – 500
PeCo 75	Austria	Lao PDR	10 - 100

The use of multiple test kits is not recommended as this may lead to confusion for the testers and inconsistencies with the results. It was also revealed that the level of cross-verification of the results of the field tested samples varied between each country. Where available, countries were utilising sophisticated laboratory equipment to confirm the accuracy of test results conducted in the field.

As water samples were tested in the field, the results were logged and the water source was marked (with the exception of Lao PDR). Where the test results revealed that arsenic concentrations were below allowable limits for drinking and cooking, the water source was painted green. Where the result showed excessive arsenic concentrations, the water source was painted red.

For all countries except Viet Nam the present drinking water standard value for arsenic was set at 50ppb. In Viet Nam, there are two drinking water standards: 50ppb for water points used by less than 500 people and 10ppb for water points used by more than 500 people.

As the majority of the water samples were tested in the field, it was critical that each country established appropriate mechanisms to manage the result data so that the risk maps could be generated. Whilst the data collection and management systems of each country were found to be satisfactory, the system developed by Myanmar was comprehensive and impressive. In addition to an accurate database of results, Myanmar was also piloting the innovative idea of using personal digital assistants (PDA) to collect data in the field, which could then be easily transmitted to the central database.

Awareness Raising

A successful awareness raising campaign relies on a clear communication strategy that outlines key messages for community motivation, mechanisms for message dissemination and tools to monitor the effectiveness of the messages.

Whilst each country has implemented awareness raising activities at a national and local level, countries did not establish an arsenic specific communication strategy. It was noted however, that UNICEF Cambodia had developed a draft communication strategy that was under consideration at the time of the evaluation.

With regards to the messages that were developed, it was noted that each country had completed some form of pre-testing, which was commendable. Nonetheless, it is important to consider the socio-cultural context while developing tools to motivate a particular community or target group. Initially all four countries focussed on the negative health impacts of consuming arsenic contaminated water to motivate communities to follow arsenic related health messages. The risk in adopting this type of strategy is that it can lead to unnecessary fear within a community and the intent of the awareness raising message is overshadowed by panic. This was evident in Lao PDR where during the consultant's field visits communities were observed avoiding tubewell water that

contained arsenic less than 10ppb. Cambodia, however, revised its Information, Education and Communication (IEC) material, adopting a more moderate message to raise community awareness.

Conducting knowledge, attitude and practice (KAP) surveys is considered to be an important initiative to monitor and review progress of any development initiative. To date, Cambodia has been the only country to conduct an arsenic specific KAP survey to assess the effectiveness of their arsenic mitigation activities. Cambodia, however, needs to consider conducting a midterm evaluation of its arsenic mitigation activities rather than conducting an evaluation only at the end of the project, as currently planned. Use of media to sensitize people about the arsenic issue was found to be occurring in all countries except Myanmar. In Myanmar, the relevant Ministries considered the arsenic issue to be a localized problem and therefore only the people living in arsenic risk zones (*i.e.* people living only in the flood plain areas) should get motivated to change their current practice of drinking arsenic contaminated water.

Alternative Safe Water Options

A variety of alternative safe water options are available and being utilised, not only in the arsenic affected countries in the Greater Mekong region, but also in South Asia and China.

UNICEF's 'Arsenic Primer, Guidance for UNICEF Country Offices' reviews the options that are currently available and has separated the options into either Groundwater, Surface Water, Rainwater and Household Treatment. In the Arsenic Primer, 'Module No. 7 – Provision of Safe Water' provides an excellent summary of each of alternative safe water sources and systems used to collect and distribute water. Module No. 7 is provided in Appendix B.

With the exception of Viet Nam, each of the four UNICEF country offices supported affected communities through the provision of a variety of alternative safe water options. Viet Nam focussed its efforts on promotion of alternative options rather than provision.

The population that has gained access to safe water as a result of the program is shown below:

UNICEF Country Office	Estimated Exposed Population ¹	Population gained access to safe water
Myanmar	250,000	21,000
Lao PDR	400,000	5,000
Viet Nam	960,000	N/A
Cambodia	136,000	12,000

The table above shows that Myanmar and Cambodia have been the most active in providing alternative safe water options to affected communities. This reflects the large number of mitigation options that were offered to communities, including piped water systems. Lao PDR focussed on RWH as the main alternative safe water option offered to households whose water source was found to be contaminated with arsenic.

In determining which communities received assistance in the construction of alternative safe water options, each country prioritised households whose water source had been tested and results revealed excessively high levels of arsenic. The communities were expected to contribute to cost of the construction, which in some cases may have excluded poorer members of the communities. The contribution amounts varied for each mitigation option, and also for each country.

¹ Population consuming water with arsenic concentrations above the relevant National Standard

National Strategies and Co-ordination

Government endorsement and the subsequent development of national strategies are imperative in addressing the arsenic problem. In Viet Nam, the National Arsenic Action Plan was developed to address the arsenic issue and was endorsed by the Government in 2006. In Cambodia, a national Strategic Action Plan has been developed and is currently practiced by the relevant departments, however, it has not yet been approved by the Government.

Effective coordination among different stakeholders is considered to be an important issue to ensure sustainability of any development intervention. Although coordination was observed among the key government stakeholders, this coordination needs to be further strengthened in all countries.

Amongst the four countries, there was limited evidence to suggest that best practices and lessons learnt were being shared between the countries. This issue needs to be explored in a co-ordinated fashion so that countries can benefit from the experience of others. The UNICEF Regional Office could be an anchor point to organize such events.

Financial Comparison

UNICEF and AusAID have been the major financial contributors in supporting arsenic mitigation activities in the Greater Mekong region. Since 2000, UNICEF and AusAID have provided a combined total of approximately USD4.5 million to the four countries, with UNICEF providing USD2.3 million and AusAID providing USD2.2 million. The distribution of the funding between the UNICEF country offices varied as shown below:

UNICEF Country Office	UNICEF Contribution (USD)	AusAID Contribution (USD)	Total (USD)	%
Myanmar	1,195,910	725,410	1,921,320	42
Lao PDR	199,223	296,148	495,371	11
Viet Nam	200,000	767,326	967,326	21
Cambodia	755,000	414,152	1,169,152	26
Total	2,350,133	2,203,036	4,558,896	100

From the funding available, each country opted to focus on different activities. Myanmar has completed the largest amount of water sample tests and also established a number of large community piped water supply systems. As such the testing and database and alternative water supply components have utilised the majority of UNICEF Myanmar's available funds.

Lao PDR has conducted a considerably fewer number of water quality tests when compared to the other countries. For each water sample, however, Lao PDR have been collecting 11 other water quality parameters. The largest portion of the UNICEF Lao PDR's budget was spent on Awareness Raising activities, which was surprising as it appeared their awareness raising campaign culminated in a single poster that was distributed to affected communities.

UNICEF Viet Nam focussed its efforts on successfully developing national strategies and also promoting short term solutions to affected communities. As such a large proportion of UNICEF Viet Nam's budget was directed at National Strategies and also Awareness Raising activities.

UNICEF Cambodia has spent a large proportion of their arsenic mitigation budget on supporting National Strategies. This has resulted in the establishment of their impressive Strategic Action Plan. UNICEF Cambodia has also spent a considerable amount of money on the provision of alternative

safe water sources in affected communities. As a result of this, approximately 9% of the exposed population have gained access to alternative safe water sources.

Key Achievements and Recommendations

Each country has successfully implemented arsenic mitigation activities. The progress of each country's program, however, has varied between the countries. The following is a brief summary of each country's key achievements and the consultant's recommendations for future programs.

Myanmar

Key Achievements

- ▶ Conducted 230,000 water samples tested; the highest number of all four countries
- ▶ Developed a comprehensive database and produced impressive risk maps showing areas of high arsenic contamination
- ▶ 21,000 people in high risk areas have gained access to safe water making it the most successful alternative water supply options program compared to the other countries

Key Recommendations

- ▶ Review water sampling cross checking procedures to generate greater confidence in the field test results
- ▶ Undertake arsenic specific KAP survey and assess areas to improve the awareness raising activities accordingly
- ▶ Encourage stronger co-ordination amongst relevant stakeholders

Lao PDR

Key Achievements

- ▶ Nam Saat has admirably taken on the responsibility of acting as focus point to manage and co-ordinate all arsenic mitigation activities
- ▶ 3,500 water samples have been tested. Although low compared to the other countries, testing has also included 11 other water quality parameters, generating risk maps for not only arsenic but a number of other key water contaminants
- ▶ Through the Alternative Safe Water Options activities, a number of community members have acquired skills in constructing RWH tanks

Key Recommendations

- ▶ Expand the mitigation options that are offered to affected communities to include groundwater and surface water options
- ▶ Continue water quality sampling, although prioritising arsenic testing in high risk areas
- ▶ Conduct KAP surveys and re-visit IEC material, particularly posters, with the results of the surveys

Viet Nam

Key Achievements

- ▶ A strong enabling environment has been developed through successful awareness raising initiatives as the national level. This has led to the Government funding a number of arsenic mitigation activities
- ▶ Development of the National Arsenic Action Plan, which was endorsed by the Government in 2006
- ▶ Innovative use of a variety of media for raising affected communities' awareness on the arsenic issue
- ▶ Completed an impressive 187,000 water sample tests which have resulted in good quality risk maps which have identified specific areas for future mitigation activities

Key Recommendations

- ▶ Continue to conduct water quality tests in high risk areas
- ▶ Undertake KAP survey to assess effectiveness of awareness raising activities and also quantify the number of people who have actually been informed about the arsenic issue
- ▶ Establish clear timelines for short and long term mitigation activities

Cambodia

Key Achievements

- ▶ Developed the national arsenic Strategic Action plan to act as a reference and guide for mitigation activities
- ▶ Conducted arsenic specific KAP survey which provided valuable insight into the progress of the arsenic mitigation activities and assisted with designing future programs
- ▶ Establishment of the Arsenic Inter-ministerial Sub-Committee (AISC) to coordinate the Government's response
- ▶ 37,200 water samples have been tested and results inputted into the central database
- ▶ Approximately 50,000 people were informed on the arsenic problem through awareness raising activities
- ▶ 12,000 people have gained access to safe water

Key Recommendations

- ▶ Continue water sampling in high risk areas
- ▶ Improve co-ordination between key in-line ministries
- ▶ Finalise Communication Strategy and incorporate to future program activities
- ▶ Consolidate the two existing strategies for beneficiary selection and contribution amounts of the alternative safe water options

Future Support from UNICEF Regional Office

UNICEF's East Asia and Pacific Regional Office has been heavily involved in planning and implementation of activities to support each country's arsenic mitigation program of each country. The Regional Office has also been instrumental in identifying funding sources such as UNICEF and

AusAID. The de-briefing workshop held in Cambodia at the conclusion of the field visits, provided an excellent opportunity for representatives from each of the UNICEF country offices to nominate areas where further support from the Regional Office could be directed. A summary of the suggested activities are as follows:

- ▶ Facilitate the sharing of information between the countries on the various arsenic mitigation activities
- ▶ Share of results from evaluations on appropriateness/verification of alternative safe water mitigation options
- ▶ Explore opportunity for cost savings through mass procurement of equipment, such as water quality field test kits
- ▶ Create a clearer picture of what support, either external or internal, is available to the country offices
- ▶ Continue to track international workshops/seminars where the countries' experiences can be shared with others.

1. Background of Arsenic Mitigation Activities

Groundwater is considered an important natural resource for most parts of the world. It is often the primary source for domestic, industrial and agricultural water. With increasing exploitation of groundwater resources, a wide range of problems related to both quantity and quality have emerged during the past three decades. The presence of inorganic and organic contaminants from natural and anthropogenic sources threatens the suitability of groundwater for drinking purposes. This poses a significant threat to sustainable development. One such inorganic contaminant is arsenic. Elevated arsenic concentrations in drinking water from groundwater sources have been observed in many regions of the world. The problem is acute in China, the Bengal Delta Plain of Bangladesh and in the adjoining state of West Bengal in India, where it has emerged as one of the greatest environmental health disasters of the 20th century. Arsenic contaminated groundwater is also emerging as a new threat in Southeast Asia, in particular, certain parts of Myanmar, Lao PDR, Viet Nam and Cambodia.

Elevated arsenic concentrations in shallow, reducing groundwater constitutes a major public health hazard to those who use such water for drinking, cooking, or irrigation. A comparison of occurrences in the Ganges-Brahmaputra, Mekong, and Red River basins shows that common geological characteristics are responsible for arsenic mobilization in these aquifers (Charlet and Poly, 2006)

In the early 1990s, UNICEF and other international donor agencies campaigned to drill shallow tubewells in the Mekong Delta regions to provide the rural population with a pathogen-free source of drinking water. However, the quality of the extracted groundwater from the tubewells was not tested for arsenic prior to the implementation of the donor-driven projects. Following the diagnosis of arsenic related health disorders in neighbouring countries, the tubewell water was tested for arsenic. These tests revealed concentrations much above the World Health Organization's (WHO) drinking water guideline value for arsenic (10ppb). However, it is important to note that while tens of thousands of people in China, Bangladesh, and West Bengal have been diagnosed with arsenicosis, in the Mekong countries the problem is not as severe because groundwater exploitation through tubewells is a more recent phenomena.

The toxic properties of arsenic have been known for centuries (Nriagu et al., 2007). The presence of arsenic in drinking water is considered as one of the most significant environmental causes of cancer in the world. The consequences of chronic arsenic exposure depend on the susceptibility, the dose and the duration of exposure. The disease symptoms are termed arsenicosis. Long-term exposure to high levels of arsenic leads to public health problems including melanosis, leukomelanosis, hyperkeratosis, black foot disease, cardiovascular disease, hepatomegaly, neuropathy and also cancer or gangrene (UN, 2001; Kapaj et al., 2006).

UNICEF's water and sanitation programmes in Myanmar, Lao PDR, Viet Nam and Cambodia have been addressing the problems of arsenic in drinking water since 2000 with UNICEF's own resources supplemented with funding from AusAID. The main purpose of this evaluation study was to assess the arsenic mitigation activities of the four countries and subsequently to develop common understanding and strategies for implementation of future arsenic mitigation activities.

2. Evaluation Methodology

The adopted methodology for the evaluation was that which was proposed in the contract's Terms of Reference (TOR). The TOR was divided into four sections that were aligned with the evaluation's deliverables. The four methodology sections, including time periods, were recommended as follows:

- 1) Desk Review – 5 days
- 2) Country Visits – 1 week per country (total 3 weeks)
- 3) De-Brief Consultation – 1 day
- 4) Final Report – 10 days

2.1 Desk Review

Five days over a two-week period were allocated in the TOR for the desk review. During this time, the consultants reviewed documents provided by the participating UNICEF country offices relating to their arsenic activities.

In general, each country office provided examples proposals that had been submitted to AusAID, Progress Reports detailing mitigation activities, and specific guidelines and strategies.

The submitted documents provided background information on each country's program. They identified the scale of the risk areas, the works completed to date, and the strategies adopted by country offices.

Additional documents were made available during country visits, which supplemented the documents provided during the desk review.

At the end of the desk review period, the consultants were required to submit:

- ▶ Country visit itineraries for Lao PDR, Viet Nam, & Cambodia; and the
- ▶ Standard Information Checklist

The country visit itineraries were developed in collaboration with each country office visited and are available in Appendix C.

The Standard Information Checklist summarised the documents reviewed and established key reference questions so that a common, consistent review could take place for each country. The checklist expanded on a number of the questions that were included in the TOR, which can be found in Appendix D.

2.2 Country Visits

A total of three weeks was allocated for country visits. The consultants were unable to visit Myanmar as a result of visa restrictions. UNICEF Myanmar sent a team member to Bangkok to deliver detailed presentations on the arsenic mitigation program in Myanmar during one day of the Briefing Workshop in Bangkok. For Lao PDR, Viet Nam and Cambodia, the country visits provided an opportunity for UNICEF representatives to deliver presentations to the consultants on the arsenic mitigation activities in their country, introduce the consultants to key stakeholders and also conduct field visits in the arsenic affected areas.

2.3 De-brief Workshop

A one day debriefing workshop was held in Cambodia at the conclusion of the country visits. UNICEF officers from all of the participating countries were invited to attend and take part in the workshop. Key stakeholders, such as, AusAID, WHO, WSP, the Cambodian Government and Cambodian NGOs were also invited. The debriefing workshop provided an opportunity for the consultants to share their findings from the country visits and to present general recommendations. The de-briefing workshop is discussed further in Section 8 – De-briefing Workshop.

The consultants were required to submit the following documents to UNICEF's East Asia and Pacific Regional Office at the conclusion of the debriefing workshop:

- ▶ The consultant's presentations (refer Appendix E); and
- ▶ A draft version of the Country Visit Evaluation Report.

2.4 Final Report

Following on from the De-briefing Workshop, the consultants were required to consolidate the experiences gained from the desk review and country visits and to expand on the observations and recommendations delivered during the debriefing workshop.

In a minor modification to the TOR, a County Visit Evaluation Report draft was shared with the four UNICEF country offices for their review and comment prior to finalising the report.

The consultants' final evaluation deliverables were:

- ▶ Final version of the Country Visit Evaluation Report, in electronic format; and
- ▶ DVD with consolidated library of reference material. The list of the documents provided on the DVD are included in Appendix F.

3. Myanmar

3.1 Program Background

Myanmar is one of the Southeast Asia's largest nations, with a population of approximately 48 million. Approximately 69% of Myanmar's people live in rural areas (UNICEF and WHO, 2008). Myanmar is among the world's Least Developed Countries (LDCs) with a per capita yearly income of USD220. An estimated 80% of the population has access to improved drinking water and 82% has access to sanitary means of excreta disposal (UNICEF and WHO, 2008). Although these figures are high compared to those of other LDCs, significant disparities between and within States/Divisions remain.

Tubewells with hand pumps have proven to be effective in providing bacterially safe water at a low cost and have therefore been widely accepted in Myanmar. Currently there are about 200,000 tubewells in Myanmar, where more than 70% of the existing tubewells were installed after 1991. Although installation of tubewells has reduced the number of diarrhoeal incidence in Myanmar, it is still an emerging priority for the UNICEF Myanmar's Water, Sanitation and Hygiene (WASH) program to reduce the risk of people drinking biologically contaminated water and more recently arsenic contaminated tubewell water. In Myanmar, especially in the delta region, arsenic is part of a larger water quality issue. Many surface water sources are bacterially contaminated and the groundwater often has iron and fluoride concentrations in excess of the recommended WHO guideline values. It is difficult to estimate how many people use unsafe water from shallow tubewells, ponds and streams for drinking.

In Myanmar arsenic contamination was discovered in 2001 during a reconnaissance water quality survey that was conducted by the Water Resources Utilization Department and the Department of Development Affairs with support from Save the Children Fund, UK (SCF) and UNICEF Myanmar. More extensive arsenic mitigation activities were subsequently initiated by the Department of Health with support from AusAID, focusing on villages that were suspected to be at varying levels of risk in different parts of the country.

3.2 Water Quality Testing

3.2.1 Extent of Arsenic Contamination

Until now testing of all the water sources (both groundwater and surface water) were completed in fifteen townships out of the total 325 townships of Myanmar. The results of the tests has led to the development of an arsenic risk map for Myanmar, as shown in Figure 3-1 overleaf, which highlights the high risk areas:

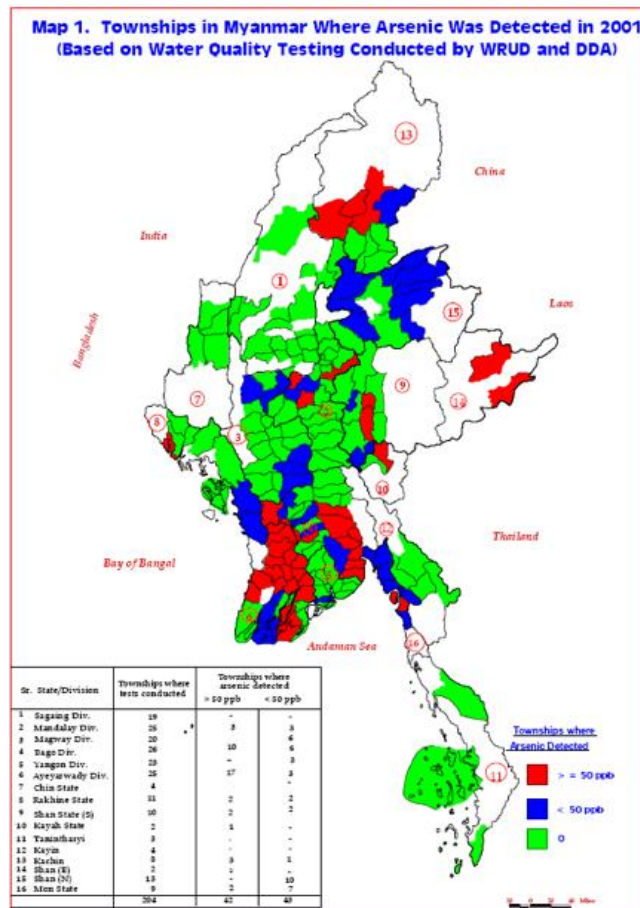


Figure 3-1 Myanmar Arsenic Risk Map

Initially, all the water points that were installed by UNICEF Myanmar during 2002 were tested for arsenic to ensure that the UNICEF Myanmar provided options were safe. The countrywide arsenic testing programme in only 58 townships (18% of the total townships) by UNICEF Myanmar identified the need to test all the country's tubewells particularly those tubewells installed in the alluvial plains. As per the test results, surveys were completed only in 10% (7,016 villages) of the total exposed villages in Myanmar. Water with elevated arsenic concentration was found to be mainly confined to the alluvial flood plain areas.

The population exposed to arsenic concentrations above 50ppb is estimated to be 250,000 people, out of whom approximately 50,000 people are currently using water containing arsenic above 200ppb. Apart from identifying the total exposed population, the percentage of townships with arsenic concentrations above the national standard was also identified (66.7%). Therefore, there is an urgent need to test all the tubewell water in the highly contaminated areas. Proper planning is required to complete testing in those areas, however, the required resources are not yet available.

3.2.2 Testing Procedures and Results

A total of 228,324 tubewell water samples from 11 out of 17 States and Divisions were tested for arsenic contamination with the Wagtech digital field testing kit. In Myanmar a total of 58 townships out of the total 325 fell under the national survey. Out of the total tubewell water samples tested, approximately 32% were found to have arsenic concentration above the WHO's guideline value of 10ppb and only 8% above the national standard value of 50ppb. Of the samples which showed concentrations above 50ppb, there was an even distribution of samples from both shallow and deep tubewells. This was a surprising result, as it is more likely that there would be fewer deep tubewells

with arsenic concentrations greater than 50ppb, compared to shallow tubewells. It was not possible to gain an understanding why a similar percentage of deep tubewells were found to be contaminated as the definition of shallow and deep tubewells was not available, nor was information on lithology and sediment types at various depths.

Another surprising result was that arsenic concentrations greater than the national standard were detected in one percent of the pond and river/stream water samples. No further information, however, was available to identify the causes for such contamination.

Two types of sampling methods were used to test tubewell water:

- (i) approximately 10% of the UNICEF Myanmar supported tubewells were selected in order to gain understanding of the national extent of arsenic contamination; and
- (ii) All tubewells of two townships were tested in order to gain in-depth understanding about the arsenic contamination at the local level and thus enable better management of the problem.

Under the blanket type of testing all tubewells of two provinces were tested. 75% of the water samples were taken from the boreholes and the remaining 25% water samples were taken from surface water sources.

Basic health staff and volunteers, especially women were selected to conduct tubewell water sampling tests by the Township Health Authority. Each testing team comprises one supervisor and three team members. Teams were formed according to the number of Rural Centres. A four day training workshop was organized for the testing teams to teach them how to test tubewell water, collect GPS data, raise community awareness levels, collect and send water samples to the laboratory for cross verification, etc.

3.2.3 Government Regulations for Tubewell Installation

It is important to develop standard regulations for the installation of tubewells considering a large proportion of the population continue to use tubewells, both in arsenic affected and arsenic free areas. To date, however, no such regulation has been developed in Myanmar to facilitate the safe installation of tubewells.

3.3 National Database

Computer data entry and subsequent analysis of data and data management at the central level is the responsibility of the Groundwater Division, Water Resources Utilization Department, Ministry of Agriculture and Irrigation.

In the surveyed areas, Global Positioning Systems (GPS) records of all water points and alternative safe water options were collected for the preparation of Geographic Information System (GIS) maps. Satellite imagery was also used to identify possible locations of arsenic contamination (e.g. old meandering river beds, oxbow lakes). All other necessary data related to the water use was collected and entered into Personal Digital Assistants (PDAs). The collected data was later downloaded to computers and the database was maintained centrally.

The national database was developed based on the arsenic test results of 228,324 tubewells. In addition, more than 10,000 tubewell water samples were selected randomly and tested for 11 different parameters² to generate an understanding of other possible contaminants in the drinking water.

² pH, Conductivity, Turbidity, Fluoride, Nitrate, Iron, Manganese, Total Coliform, Faecal Coliform, Chloride, Hardness

3.4 Awareness Raising

3.4.1 Objectives and Implementation Strategies

The overall objective of Myanmar's awareness raising activities is to increase the 'proportion of the population that are aware of the arsenic issue' with an expected outcome of 'changing water usage patterns' of affected communities.

Although not identified as a key outcome, increasing the Myanmar Government's Ministries' awareness on the scope and scale of the arsenic issue was also recognised as an important outcome to be achieved.

At the national level, the presence of the Inter-Ministerial Action Group provided an excellent opportunity for broad campaigning at the national level. Through the Inter-Ministerial Action Group representatives from the relevant ministries were informed of the problem and were also tasked with the responsibility of developing strategies to achieve the program's objective.

At the community level the Ministry of Health's Central Health Education Bureau (CHEB) was assigned with the responsibility of planning and implementing community based activities.

To achieve the output of 'changing water usage patterns', the CHEB developed a strategy that focused on warning communities of the health implications resulting from consuming arsenic contaminated water. As the motivating message chosen for the awareness raising campaign was health related, basic health staff from the affected areas were selected to be the focal points for the community awareness activities.

The CHEB conducted training workshops for the basic health staff on arsenic related issues. Each training session was intended to develop staff capacity to assist with water quality sampling, diagnosis of arsenic related diseases and to educate the community on alternative safe water sources.

Communities were first introduced to the risk of arsenic contamination by the basic health staff during the initial water quality testing phase. As the water samples were being tested, basic health staff informed households of the purpose of the testing. Where the samples were above acceptable limits, safe alternative water sources were discussed.

Basic health staff also led 'Health Education Sessions' at community meetings. In a participatory manner, basic health staff used Information, Education and Communication (IEC) material to discuss the health implications of consuming arsenic contaminated water. The IEC materials, which typically included posters and leaflets, were designed by CHEB. The posters and leaflets contained key messages on the acceptable contamination level, alternative safe water sources and the health implications of consuming arsenic contaminated water. The IEC materials were approved at Ministerial level and distributed via Health Centres to the affected communities.

3.4.2 Evaluation of Progress

The considerable reach of UNICEF Myanmar's awareness raising activities has undoubtedly increased affected communities' awareness of the arsenic problem. In this respect, the objective of increasing the 'proportion of the population that are aware of the arsenic issue' has been achieved – which is a positive result. Unfortunately this result cannot be quantified because figures to determine the increase in community awareness were not recorded. UNICEF Myanmar has estimated that 35,000 households were 'provided with health information'. Providing information, however, does not necessarily translate to people's awareness levels increasing.

It was recognised that the proxy indicator of ‘changed water usage patterns’ was adopted to represent improvement in communities awareness levels, however, the extent of changes to water usage patterns were not recorded either.

3.4.3 Discussion on key activities

KAP Surveys

Knowledge Attitude Practice (KAP) surveys are an essential aspect of monitoring progress, in particular the progress of awareness raising activities. The KAP survey is also a critical tool to evaluate a program’s effectiveness. Unfortunately no arsenic specific KAP surveys have been conducted for Myanmar’s awareness raising activities to date. To assist future evaluations, it is strongly recommended that KAP surveys are undertaken to track the progress of community awareness on the arsenic issue and to assess the effectiveness of the messages. In addition to conducting KAP surveys, it would be beneficial to establish specific measurable targets with which achievements can be quantified.

Communication Strategy

A key component of any awareness raising campaign is to develop an effective communication strategy. A well-developed communication strategy will act as a guide and reference point for the overall program and should include, as a minimum, the following points;

- ▶ Identification of the activities that should be undertaken;
- ▶ Allocation of responsibilities to the various stakeholders to implement the activities; and
- ▶ Establishment of measurable targets for each activity, with timelines.

Whilst the CHEB has employed a number of strategies to progress the awareness raising campaign to date, a formal communication strategy has not been developed. By implementing communication activities without an over-arching guiding strategy, there is the risk that program inefficiencies will develop, followed by confusion amongst stakeholders. For this reason, it is strongly recommended that such a strategy is developed and endorsed by the Myanmar Government’s Ministries for its awareness raising activities.

IEC Material

A number of colourful posters and pamphlets were developed as part of Myanmar’s community awareness raising activities. The posters were pre-tested by the CHEB at both national and community levels prior to mass distribution, which was a positive initiative on their behalf. They portray a number of key messages, including the acceptable level of arsenic in contaminated water. The posters, however, rely on high literacy rates within the community and an understanding and appreciation of the arsenic concentration units (safe water source options are recommended depending on whether arsenic contamination levels are above or below 50ppb). The following images are an example of two posters which demonstrates the substantial use of text.



Figure 3-2 Myanmar IEC Poster

Since these posters have been in use their effectiveness in raising affected communities' awareness levels has not been determined.

Utilising KAP surveys would assist UNICEF Myanmar to quantify the number of people who have been able to understand and retain the messages in the posters. If community awareness is determined to be low, further testing could be done to determine whether the level of text in the messages was too high and if more visual aids would be more effective in villages with low literacy levels.

3.5 Alternative Safe Water Options

3.5.1 Objective and Implementation Strategy

The objective of Myanmar's Alternative Safe Water Options activities is to increase the availability of 'safe-water options/sources in communities affected by arsenic'. The key outcome is to increase the number of safe water sources available as a result of this program (UNICEF Yangon, 2008).

Institutional Framework

The Myanmar Government's Department of Development Affairs (DDA) is ultimately responsible for providing alternative safe water options in arsenic affected areas. With support from other agencies, the DDA established procedures for the selection of alternative safe water options and was the key player in motivating and facilitating community choice.

Community Mobilisation

One of the successes of Myanmar's Alternative Safe Water Options activities was the establishment of the procedure used by government and local communities to select mitigation options. The procedure that was established follows a similar structure to AusAID's Water Quality Management Plans which encourages communities to play an active role in all aspects of the implementation process. A summary of the mitigation option procedure that was established, is as follows:

- ▶ Identify 'high risk' townships for support through water quality testing and database mapping
- ▶ Conduct township level co-ordination meetings in high risk areas
- ▶ Conduct 'Informed Choice Meetings' with communities where safe water options are chosen by key local stakeholders including PTA, Health officers, government officials and affected community members
- ▶ Action plans collectively drawn by all stakeholders

Myanmar's Alternative Safe Water Options activities recognised the importance of gender equality in decision making and during the implementation process. The campaign encouraged women to actively participate in activities related to alternative water supplies.

Community Contributions

The communities made financial and physical contributions as part of the Alternative Safe Water Options activities. Communities were required to meet the cost of material transportation and also the cost of constructing the elevated storage tank used with pumped systems. Communities were also required to assist with manual labour including trench digging and concrete mixing. With the exception of the elevated storage tank, the program met all other costs.

Where programs rely on community contributions to encourage ownership and sustainability, there is potential for vulnerable members or whole communities to be disadvantaged. Vulnerable individuals or poor communities that cannot afford to make financial contributions may be denied access to the water source. In Myanmar, however, this is less likely to occur because Myanmarese people have an interesting cultural belief. They believe that by making donations to secure water they will receive ten blessings³. This was demonstrated in 2006 for a village that was not able to make the contributions for an alternative safe water source. In this case, neighbouring villages collectively met the contribution amounts so that the poorer village's water source could be constructed. In this way, they believed they would receive the ten blessings.

Introduction of Water Safety Plans (WSP)

Water Safety Plans (WSP) have been successfully introduced to Myanmar's Alternative Safe Water Options activities. Considerable efforts were made by DDA staff to educate communities on how to identify potential causes of contamination and the methods that could be employed to make the source safer. Examples of existing sources, which have been successfully improved, include ponds and dugwells.

3 1) Long life/longevity, 2) Beauty, 3) Supreme wealth, 4) Supreme strength, 5) Supreme intellect, 6) A sparkling and charismatic personality, 7) Fame, 8) Having a retinue attendants, 9) Never suffering thirst and 10) Be ever sprightly and active

3.5.2 Achievements to date

Table 3.1 Myanmar – Installed Safe Water Systems⁴

Type of System	Numbers Installed
<u>Community</u>	
‘New’ Safe Water Options	
Tubewells with Afridev Handpumps	320
Tubewells with Solar panels & pumps	14
Dugwells with Rope pumps	119
Improved Water Options	
Improved Dugwells	73
Improved Ponds	38
<u>Household</u>	
WaterGuard (chlorine solution)	Promotion only
Ceramic Water Filters	200
RWH	Promotion only

3.5.3 Evaluation of Progress

As a result of Myanmar’s Alternative Safe Water Options activities, approximately 21,000 people (UNICEF Yangon, 2008) have gained access to safe water, which is approximately 9%⁵ of the total exposed population. This is an admirable achievement and undoubtedly meets the objective of increasing the availability of safe water options. To assist with future evaluations, it is recommended to establish targets and timelines so that the program’s stages of progress can be monitored.

3.5.4 Discussion on Mitigation Options

Ground Water and Surface Water Options

UNICEF Myanmar has stated that communities in arsenic affected areas prefer to use surface water and rainwater rather than groundwater options. Table 3.1 above, however, does not necessarily support this theory, with considerably more groundwater systems installed compared to surface water options. It is understood the reason for this is that time is required to develop an enabling environment so that a water usage shift from groundwater to surface water can be supported. As an immediate response to the arsenic problem, UNICEF Myanmar supported the installation of a large number of boreholes where arsenic free aquifers could be utilised, hence the reason for the high number of ‘new’ tubewells installed shown in Table 3.1. Although not the first choice of options, the drilling of deep tubewells into arsenic free aquifers remains an option as long as the proper sealing of the borehole can be guaranteed.

⁴ Figures provided from presentation made by UNICEF Myanmar representative during Evaluation Briefing Workshop in Bangkok

⁵ Estimated exposed population – 250,000 (above 50ppb) (UNICEF Yangon, 2008)

Where communities are shifting to surface water, the Alternative Safe Water Options campaign is promoting household treatment options such as chlorine solutions and filters to treat the surface water prior to consumption.

Rain Water Harvesting

Rain Water Harvesting (RWH) in Myanmar is a well practised form of water collection, yet, it has not been chosen by participating communities as an option to be constructed on a larger scale. It is understood that the cost of the RWH jars that are currently being used may be the driving factor for the lack of up-take. The jars are not constructed locally, are limited in size, and cost approximately USD20 each. The Safe Water Options component of UNICEF Myanmar's WASH program, however, has constructed RWH tanks in schools where groundwater exploitation was not available.

It is understood that locally made RWH tanks were trialled in Myanmar, however, communities did not like the 'cement' taste from the tanks, and preferred to continue using the traditional clay jar.

Household Treatment Technologies

Two household treatment options are being promoted as part of the alternative safe water options program:

1. Chlorination of surface water by using sodium hypo-chloride solution manufactured by an NGO the commercial name of the sodium hypo-chloride solution is 'WaterGuard'; and
2. Ceramic Water Filters to treat surface water.

Ceramic Water Filters have only been recently introduced to Myanmar yet are already under strong demand from communities. The Ceramic Water Filters that are being offered as an alternative safe water option are locally manufactured by two factories. Both factories have undergone quality control checks to assure the Myanmar Government that the filters remove bacteria and protozoa.

Solar Panels

Solar panels have been successfully introduced to Myanmar's Alternative Safe Water Options activities. To date, 14 systems have been installed, and each system continues to operate well.

Solar panels are known to be an attractive option for power where electricity supply is intermittent. What must be remembered, however, is that these systems, like all others, require ongoing maintenance and replacement of parts. If the community cannot afford to maintain the system or purchase the necessary replacement parts, there is the very real risk that the system will fail. Whilst not discrediting the use of solar panels, the long term costs including maintenance requirements and availability and costs of replacement of parts must be reviewed and accepted by the communities prior to implementation.

3.6 National Strategies and Co-ordination

3.6.1 Responsible Organization

Myanmar was found to be well ahead of the other countries in many areas of arsenic mitigation activities. The national policy on arsenic mitigation, however, has not yet been developed and endorsed by the relevant government Ministries. Nevertheless, there is a task force for arsenic mitigation that oversees the arsenic mitigation activities taking place in the country. The problem of elevated arsenic in water in Myanmar appears to be random in nature, and currently does not constitute a significant emergency.

The main government partners for implementation of the arsenic mitigation activities includes the Department of Health, Department of Development Affairs, Department of Medical Research and Water Resources Utilization Department.

3.6.2 Capacity Building of Government Officials

Senior officials involved with the arsenic mitigation activities (e.g. DoH, CHEB, DMR, and DDA) attended different workshops and seminars both locally and internationally. Later they imparted their experiences and knowledge with others who were participating in arsenic mitigation activities at grass root levels. One Medical Professor from China visited Myanmar as a key resource person to train medical doctors on identification of the arsenicosis patients.

3.7 Detection and Management of Arsenicosis

Since 2004, two surveys have been conducted to develop strategies to identify arsenicosis cases. A total of 12,897 people from 3,348 households located in the vicinity of arsenic contaminated tubewells which contained arsenic greater than 50ppb were surveyed and hair nail samples were also collected for analysis. As per the test results, only five probable cases of arsenicosis were identified. All of the identified cases showed high levels of arsenic content in nail samples with minimal skin pigmentary changes. The low prevalence of arsenicosis disease in Myanmar might be due to the recent mass scale installation of tubewells (less than 10 years) and traditional dependency of rain and surface water, particularly during rainy season of its rural population.

4. Lao PDR

4.1 Program background

Lao People's Democratic Republic (PDR) is located in Southeast Asia and is bordered by Thailand, Cambodia, Viet Nam, China, and Myanmar. With an approximate population of 5.8 million people (UNICEF and WHO, 2008) and a population density of 18 person per square km, Lao PDR has one of the lowest population densities in Asia. The largest population centres, the capital Vientiane and Savannakhet, are both in the Mekong River Valley while 80% of the population lives in rural areas. Almost a quarter of all Laotians have no access to basic health services and approximately half have no access to safe drinking water facilities.

The domestic water supply in Lao PDR was traditionally sourced from surface water and hand-dug wells, however, there was a shift to groundwater from 1990's when UNICEF Lao PDR commenced programs to install tubewells to reduce diarrhoeal incidence due to drinking untreated surface water. In Lao PDR, the deterioration of the water quality in rivers and streams is posing a major public health risk and is jeopardising the public health improvement initiatives of the Government. The recent discovery of arsenic and other heavy metal contaminants in groundwater aggravates the situation and further reduces the safe water coverage in Lao PDR.

Arsenic contamination in Lao PDR was discovered in 2003 when a reconnaissance water quality survey was carried out in seven southern provinces. Arsenic risk mapping based on the water quality test results of approximately 3,500 tubewells, mostly supported by UNICEF Lao PDR, identified approximately 1,400 villages located within the high arsenic contaminated areas. About 40% of the population in these areas collect their drinking water from tubewells. Approximately 20 percent of these wells were found to be contaminated with arsenic concentrations greater than the national drinking water standard of 50ppb.

UNICEF Lao PDR is working closely with the Centre for Environmental Health and Water Supply (Nam Saat) and Ministry of Health (MoH) to implement arsenic mitigation activities. In implementing the activities, Nam Saat has been supported by multi-lateral agencies including UNICEF and WHO, and also departments in the other key Ministries.

In Lao PDR, arsenic contamination is part of a larger water quality issue. The national arsenic survey and other water quality testing initiatives showed that the alluvial plains in the south of the country are not only at risk of having elevated arsenic concentrations but often having very poor water quality, in terms of biological and heavy metal contamination.

4.2 Water Quality Testing

4.2.1 Extent of Arsenic Contamination

Naturally occurring arsenic contamination in shallow groundwater was first detected in Lao PDR in 2003 when part of a national water quality survey was conducted in the southern provinces of the country. The national survey was conducted in two phases (2002 and 2005) and tested all the tubewells provided by UNICEF Lao PDR. A total of 2,244 tubewells from all 14 provinces were tested for 12 water quality parameters⁶ as part of the survey. Adventist Development and Relief Agency (ADRA), an International NGO, also tested a total of 690 water sources and added the collected information to the central database.

⁶ Arsenic, pH, Conductivity, Turbidity, Fluoride, Nitrate, Iron, Manganese, Coliform, Chloride, Hardness, Odour

The population that are consuming water with arsenic concentrations greater than 50ppb has been estimated at 400,000. This figure was estimated from the results of the national survey, which covered only a part of the at-risk areas. There are many tubewells that still need to be tested for arsenic to develop a more accurate estimate of the exposed population.

4.2.2 Testing Procedures and Results

The national survey involved testing of all boreholes and gravity flow systems that had been previously provided by UNICEF Lao PDR. The total number of samples tested was about 3,500. Approximately 100 test samples were found to be contaminated with arsenic greater than the national standard of 50ppb. The results of the water sampling tests led to the development of the Lao PDR arsenic risk map as shown in Figure 4-1 below:

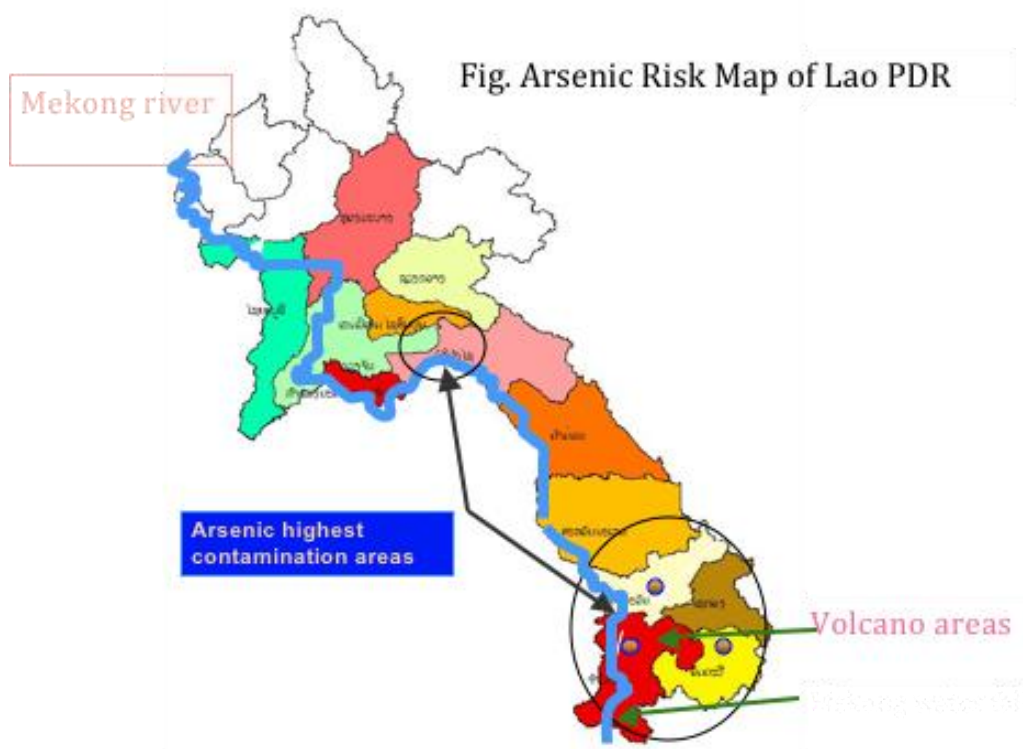


Figure 4-1 Lao PDR Arsenic Risk Map

Since the national survey did not consider taking samples from private wells and the number of private wells seems to be much higher than the public wells, it is recommended that the method used for delineating the risk areas be reconsidered. Different field testing kits were used to test the tubewell water, e.g. PeCO 75, Wagtech digital arsenator, HACH. No marking of the tubewells, either red or green, based on the test results was observed which is considered an important initiative to raise community awareness levels.

Nam Saat developed a standard monitoring procedure to revisit the tested tubewells by involving provincial level Nam Saat staff. The monitoring plan was developed by Nam Saat with assistance from experts and is presented in Table 4.1 overleaf. No initiative, however, has been taken to validate the field data in the laboratory with standard procedure.

Table 4.1 Lao PDR's Guideline for monitoring of water quality

Arsenic Concentration Range	Policy Recommendation for Action
0 – 10ppb	Good to drink Regular monitoring of water quality one time in a year
10 – 50ppb	Recommended to drink Regular monitoring of water quality two times a year
50 –100ppb	Higher than national standard Not for drinking, cooking, washing, and cleaning Regular monitoring of water quality four times a year
> 100ppb	Closing of water point

4.2.3 Government Regulations for Tubewell Installation

Tubewell water is still the preferred option for the majority of the Lao PDR people. Installation of new tubewells is continuing in the villages visited. Two new tubewells were installed in the first village about two months prior to the consultants' visit in July 2008. Neither the owner nor the contractor, however, had managed to test the water for arsenic as they had no access to testing facilities at the local level. Most of the private tubewells are installed at shallow depth (about 50m) and in most cases the owners did not follow the standard procedure (e.g. proper casing with 4 inch diameter pipe) of installing tubewells as this is usually more expensive than installing the normal tubewells. According to Nam Saat most of the private tubewells are not only contaminated with arsenic but also biologically unsafe to drink as the private tubewell installation did not follow the standard procedure of sealing the pipes. In order to avoid unplanned and unsafe installation of tubewells, Nam Saat developed a guideline for the installation of tubewells. As per these guidelines, it is the contractor's responsibility to test tubewell water for twelve water quality parameters, including arsenic which costs about USD35. In addition, the tubewells must be installed properly and permission from provincial Nam Saat office must be given.

4.3 National Database

4.3.1 Responsible Department

A national database has been developed and is managed by the central Nam Saat office. Although the initial database was managed by the central Nam Saat office, they are currently considering provincial offices take the lead in regular monitoring of water quality as well as entering water test results into the database. Logistical support and training to the provincial staff members has been provided for database management. In Kampasak province, for example, two Nam Saat staff members received training from the central Nam Saat office on the database management system and since May 2008 they have been using the database for entering their regular water quality testing results.

4.3.2 Method of Data Collection and Storage

This database includes water test results for 12 parameters of all 3,500 tested tubewells. Although GPS data of all the tested wells was collected no GIS maps have been prepared based on the arsenic test results.

Establishment of a separate water quality monitoring and maintenance system needs to be developed at Nam Saat to ensure sustainable use of the provided mitigation options as well as encouraging people to drink safe water. This is also reflected in the National Water Quality Strategy 2004. Accordingly, UNICEF Lao PDR started water quality surveillance system in some selected villages as a pilot case. The surveillance system has already proved effective. The people in Nampa village of Bolokamsai province were found to be aware of water quality issues including both arsenic and bacterial contamination and no one in that village was observed drinking unsafe water. The provincial Nam Saat staff have successfully trained and motivated villagers to understand why they need to treat surface water by demonstrating the H₂S kit. The villagers also mentioned that before starting the UNICEF Lao PDR project in 2006, incidence of diarrhoeal disease was common, yet now diarrhoea is rare.

4.4 Awareness Raising

4.4.1 Objectives and Implementation Strategies

The overall goal of UNICEF Lao PDR's arsenic mitigation program is to 'significantly reduce the risk to children drinking water contaminated with arsenic' with the objective 'to assist governments to develop or strengthen appropriate mitigation strategies and action plans'. While neither the program's goal nor objective are specific to awareness raising activities, two of the identified outcomes are specific:

1. Increased government awareness on scope and scale of arsenic problem; and
2. Changed water use patterns through heightened community awareness about water quality issues in general and arsenic contamination in particular (UNICEF Lao PDR, 2006).

Since activities began in 2003, Nam Saat has played a key role in raising the profile of the arsenic issue at both the national and community levels.

At the national level, Nam Saat focussed on establishing nation-wide guidelines and procedures to raise the awareness level on the arsenic issue. Key achievements in this regard include the development of Water Quality Testing guidelines and also the establishment of the Lao PDR National Water Quality Standards and Regulations, in which arsenic is included.

At the community level, Nam Saat aimed to raise affected communities awareness levels through household and community education sessions. The key messages to be imparted warned affected communities on the health impacts of consuming contaminated water, and also discussed alternative safe water options.

Nam Saat utilised a large proportion of staff based at district and provincial levels to act as community educators for awareness raising activities. A number of training workshops were held to build the capacity of Nam Saat's provincial staff on water quality sampling techniques and also key awareness raising messages.

Nam Saat also aimed to raise community awareness on the arsenic problem through the development and distribution of IEC material. With support from other key stakeholders, including WHO, Nam Saat developed an arsenic awareness raising poster which was distributed to affected communities. The poster, which shows a number of examples of skin diseases, was adapted from other countries awareness raising material and adapted specifically to be used in Lao PDR.

4.4.2 Evaluation of Progress

Two key outputs for Lao PDR's arsenic awareness raising activities were established, along with their indicators:

Output No. 1 - 'Increased awareness at government level on the scope and scale of the arsenic problem'

Indicator:

- ▶ Field testing of arsenic;
- ▶ Arsenic contamination mapping; and
- ▶ Risk and Public Health Impact Assessment.

Undoubtedly, the Lao PDR Government has increased its awareness on the scope and scale of the arsenic problem, and this is demonstrated by the steady progress of all 3 of the key indicators.

An additional indicator of the Government's increased awareness on the arsenic issue was the establishment of the Lao PDR National Water Quality Standards and Regulations. The inclusion of arsenic within these regulations was a considerable result as it confirmed that the Lao PDR Government recognised and was committed to mitigating the negative effects of arsenic contaminated water.

Output No. 2 - Changed water use patterns by raising community awareness about water quality issues in general and arsenic contamination in particular

Indicator:

- ▶ Conduct baseline KAP survey

A KAP survey was undertaken in 2004 on broader water quality issues, however, the survey did not include questions relating to arsenic. It is understood that UNICEF Lao PDR does intend to undertake a mid-term KAP survey to assess the effectiveness of the awareness raising activities, however, this is funding dependent. At the time of writing the report, no funding had been allocated to conduct further surveys.

- ▶ Develop Nation-wide Communication Strategy

A Nation-wide communication strategy was developed to raise awareness on broader water quality issues, part of which included arsenic related strategies.

- ▶ Prepare and Distribute Information Material

Posters and leaflets with key arsenic awareness raising messages were developed and distributed to the affected communities via Health Centres.

The above demonstrates that considerable efforts have been made to raise affected communities awareness on arsenic. With the exception of an arsenic specific KAP survey, the indicators that were established have either been completed or are in progress. Whilst this is commendable, it is difficult to evaluate the success of the activities without an arsenic related KAP survey. This is particularly important to assess change in community water use patterns as a result of the activities.

4.4.3 Discussion on Key Activities

KAP Survey

The importance of utilising a KAP survey to evaluate the activities' effectiveness was recognised at the start of the campaign, and thus, was identified as a key indicator. Without the results of an

arsenic focussed KAP survey, however, it is difficult to evaluate the effectiveness of the community awareness raising activities to date. It is therefore strongly recommended that a KAP survey is conducted to assess the effectiveness of the IEC material, to quantify the changed water usage pattern and to identify appropriate change agents to focus on awareness raising messages. Ideally the results of the KAP survey would highlight the successes of the activities to date and identify areas for review. It is also recommended that measurable targets are established with which progress can be quantified.

Communication Strategy

The establishment of the Nation-wide communication strategy for broader water quality issues was an excellent achievement for UNICEF Lao PDR and Nam Saat. Whilst it was recognised that arsenic was included within the strategy, it is recommended that an arsenic specific communication strategy is also developed. This document would act as a stand-alone reference document and would establish clear roles of responsibility, measurable targets and also strategies to be implemented.

Community Educators

The efforts of the Nam Saat provincial team to raise affected communities awareness levels on the arsenic problem are commendable. There was some concern, however, that some of the messages being imparted by the provincial team were inconsistent and sometimes incorrect. For example, during the consultants' field visit basic questions, such as, 'where does arsenic come from?', could not be answered correctly by community members or the Nam Saat provincial team. This indicated that it would be most beneficial to hold refresher courses for the educators so that a clear, consistent, and correct message is being imparted to communities.

An additional recommendation would be to explore the opportunity to include the village health staff as a community educator on arsenic issues. Health staff are traditionally well respected members of the community and are often focus points for health related activities. Involving health staff in the arsenic awareness raising campaign also creates the critical link in the referral chain for patient identification and management.

IEC Material

The poster that was developed by Nam Saat was adapted from similar campaigns in other countries, an example is shown in Figure 4-2 overleaf:

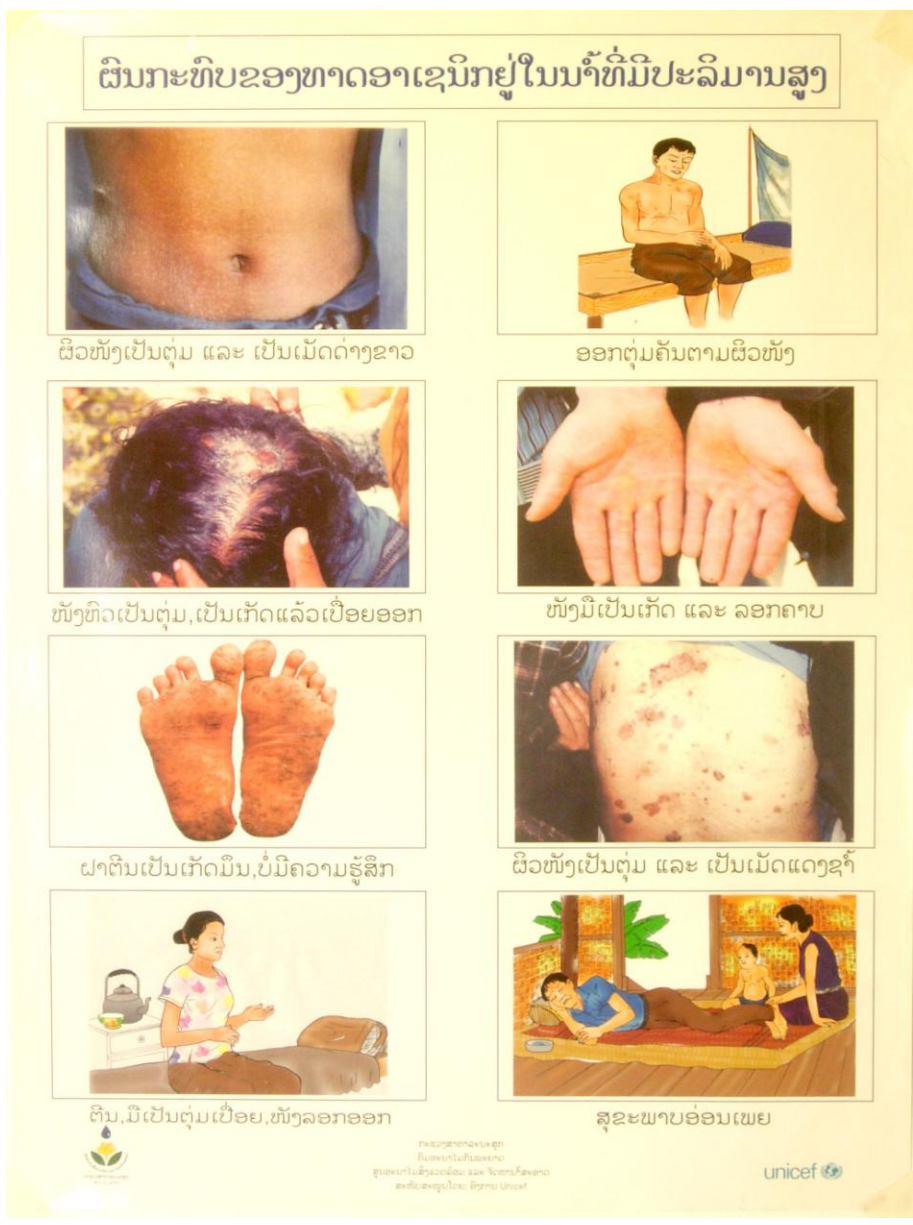


Figure 4-2 Lao PDR IEC Poster

There were two main concerns regarding the poster in Figure 4-2 above:

- 1) Clarity of the message
- 2) Appropriateness of the message

Clarity of message

The text on the poster describes the likely health implications of drinking arsenic contaminated water with a concentration above 50ppb consumed over a prolonged period. For community members to understand this message, it relies on the community being:

- literate & educated on the units of contamination (parts per billion);
- aware of contamination levels of their existing water sources; and
- able to make a reasonable estimate of what is a 'prolonged period'.

Appropriateness of message

The message in the poster clearly focuses on the negative health impacts of consuming water with high arsenic concentrations. The poster is helpful in educating people to recognise the signs and symptoms of arsenic related disease. There is concern, however, that where 'scare' tactics are used as the main motivator to modify water usage, other aspects of the campaign are missed. During the field visits, the consultants encountered households who had abandoned their water source completely, despite arsenic contamination levels being below the national guideline. When asked why, the household leader explained that they were fearful of the health impacts of continuing to use the water.

In the development of future visual aids, it would be beneficial to include instructions on how to differentiate between contaminated and non-contaminated water sources. Furthermore, information on alternative water source options would also be very useful.

For a true evaluation on whether the communities understand the messages, a KAP survey is required. It is recommended that in the KAP survey, questions regarding the clarity, understanding and appropriateness of the messages are included.

4.5 Alternative Safe Water Options

4.5.1 Objectives and Implementation Strategy

The objective of Lao PDR's Alternative Safe Water Options activities is to increase 'the availability of safe water options in the at-risk areas', with the key indicator being the number of alternative water supplies constructed (UNICEF Lao PDR, 2006). The following strategies have been implemented to achieve this objective:

Institutional Framework

Nam Saat is the key agency dedicated to implementing Lao PDR's Alternative Safe Water Options activities. In close co-operation with the communities' Watsan committees, Nam Saat is responsible for mobilising community activities and creating interest in alternative safe water options.

Community Mobilisation

Nam Saat provincial staff and the communities' Watsan committees led community meetings to discuss alternative safe water options and the required contributions. For Lao PDR's Alternative Safe Water Options activities, Rain Water Harvesting (RWH) was the main mitigation option that was offered to communities. Generally the number of RWH tanks that could be offered to affected communities was dependent on the funding available. With funding being limited, first priority was therefore offered to households whose water source had been tested and was found to have unacceptable levels of arsenic.

Once the beneficiary households had been determined, the Watsan committee was responsible for sourcing the required materials and for arranging trained local volunteers to commence construction. The Watsan committee was also responsible for collecting the contributions from the beneficiary households.

Community Contributions

To construct a household RWH tank, the beneficiary household is required to meet the cost of the labour, which is approximately USD15. The program meets the remaining amount of USD30 which covers the supply and transportation of materials. The period in which the amount is to be paid to the Watsan committee is dependent on the financial capacity of individual households.

Poorer households are permitted to pay the contribution amounts back over an extended period. The contribution amount, however, is not reduced.

Introduction of Water Safety Plans (WSP)

Water Safety Plans (WSPs) have not been introduced to Lao PDR's arsenic affected areas. It was noted, however, that WSP have been successfully piloted in other villages that are not within the arsenic affected areas.

4.5.2 Achievements to Date

Table 4.2 Lao PDR – Installed Safe Water Systems

Type of System	Numbers Installed
<u>Community</u>	0
<u>Household</u>	
Chlorination	0
Ceramic Water Filters	0
RWH	1,200

4.5.3 Evaluation of Progress

As a result of the construction of 1,200 RWH tanks, the objective of increasing the availability of safe water options in the at-risk areas has been met. The RWH tanks have provided approximately 5,000 people with access to safe water, which results in 1% of the overall exposed population⁷.

Whilst progress is being made, it is difficult to determine whether this progress is on schedule as no targets or timelines were established. For future campaigns, it is therefore recommended that measurable targets are set to assist with monitoring and evaluation.

4.5.4 Discussion of Mitigation Options

Rain Water Harvesting

Under certain circumstances Rainwater Harvesting (RWH) has been proven to be a successful alternative safe water option. The main limitation of RWH, however, is the security of the supply. Household RWH tanks rely on regular rainfall to recharge their storage tanks. A key aspect of a successful system is therefore determining the appropriate storage tank size such that demand can be met during dry periods. Whilst UNICEF Lao PDR believes that their 2,000L RWH tank can supply water during the 3 – 4 month dry period, this claim needs to be followed closely. Assuming a household of 4 persons, each consuming 15L/day⁸ then the 2,000L tank has sufficient capacity to meet demand for approximately 1 month without rain. It is noted that multiple RWH tanks can be combined to create sufficient storage, however, this practice was not observed during the consultants' visit in Lao PDR. If an alternative safe water source cannot meet the constant daily demand, and the household is forced to return to un-safe water sources, then the option cannot be considered as an appropriate alternative.

⁷ Exposed population is estimated at 400,000

⁸ Key Indicator from the Sphere Handbook (2004)

Contribution Amounts

Approximately two-thirds of the cost of the RWH tank (supply and transportation of materials) is met by the program. This appears to be a particularly high subsidisation amount, considering there appears to be strong up-take of the option and also a willingness and capacity from communities to pay for the tank.

For future programs, it would be beneficial to review the amount that is subsidised by the program, with the aim of reducing the subsidy. More support could be focussed on building the skills of local tradesman to construct the RWH tanks. This support may entail further training, or simply donating more tank moulds. Demand for the tanks amongst community members appears strong, and during the field visits the trained local volunteers told the consultants that the progress of the construction could be improved if more moulds were available.

Groundwater Exploitation

It was not clear to the consultants why only RWH was offered to communities and other options, such as, groundwater or surface water were not explored. Groundwater exploration is a common and popular practice in Lao PDR. This is demonstrated by private tubewell contractors continuing to install boreholes in affected areas, with the approval of Nam Saat, subject to the water source meeting the relevant water quality guidelines. Furthermore, in certain Nam Saat Provincial offices, Nam Saat has access to borehole drilling equipment that was donated from other projects. For future programs, it is recommended that the number of mitigation options that are offered is extended to include groundwater and surface water options.

Household Water Treatment

Boiling of water is a common technique that is widely used amongst community members and continues to be the recommended method for surface water treatment. There is evidence that suggests, however, that water is boiled as part of the 'tea making' process and is reserved for adults, whilst children continue to drink water that has not been boiled. For this reason, it is recommended that UNICEF Lao PDR and Nam Saat consider additional water treatment options for potential inclusion into the Alternative Safe Water Options activities.

It was noted that chlorine dosage has been successfully piloted as part of the broader water quality program in villages that have not been affected by arsenic. Nam Saat Provincial teams have been trained on correct handling methods of the chlorine and also on training community members on the appropriate dosage amounts.

An additional water treatment option that has not yet been developed in Lao PDR is the Ceramic Water Filter. Given the successes of the ceramic water filters in neighbouring countries, there would be merit in UNICEF Lao PDR and Nam Saat exploring the option of supporting the manufacturing of local ceramic water filters with the aim of introducing the filter as a viable and sustainable water treatment technology.

Water Safety Plans

Water Safety Plans (WSP) have not been introduced as part of the arsenic mitigation Alternative Safe Water Options activities. It is assumed this is because RWH is the only mitigation option offered. Nonetheless, there is still merit in introducing WSPs to the affected communities as it raises the communities' awareness of potential contamination paths and also discusses methods to improve water quality. It is recommended that for future programs, WSPs are introduced to affected communities.

4.6 National Strategies and Co-ordination

4.6.1 Responsible Organization

An overall guiding strategy for the Rural Water Supply and Sanitation sector, based on proven international principals, was developed and approved by the Government of Lao PDR in 1997. The establishment of the National Water and Sanitation Strategy (NWSS), and the adoption of the new Hygiene Law by the National Assembly in April 2001, is a clear indication of political commitment towards the water and environmental sanitation (WES) sector. The Government has now provided both the legal framework and the tools for institutional reforms and sustainable sector development. Furthermore, improvements in Water Supply and Sanitation have been recognized by the Government as a fundamental requirement for poverty eradication and this is adequately reflected in their poverty eradication strategy. Although the NWSS was launched in 1997, in June 2001 the Sector Forum undertook a process to simplify the implementation procedure and adopted a 7-Step process to implement the WES activities. Lao PDR's 7-steps are presented in Appendix G.

The Centre for Environmental Health and Water Supply (Nam Saat) and the Centre for Information and Educational Health, both under the Ministry of Health, are the main counterparts to manage and supervise the arsenic activities in Lao PDR. WHO is an effective advocate for the development of a national water quality control system and supports the Ministry of Health in areas such as policy development and the setting of water quality standards. UNICEF Lao PDR will continue to work closely with international NGOs active in the water supply sector who works directly with provincial government offices and communities. These international NGOs include ADRA, CARE UK, PADEC and the Red Cross.

Until now, a well structured national arsenic mitigation strategy was not developed by Lao PDR except for the development of water quality standard and regulation, which was approved in October 2005. The Government also approved the national drinking water standard value of 50ppb with an intention of reviewing the guideline value after three years.

4.6.2 Capacity Building of Government Officials

In Lao PDR, with the exception of providing training to the provincial staff on how to measure arsenic and other 11 parameters in drinking water and how to raise community awareness levels using different IEC materials, no other initiative was taken by UNICEF Lao PDR for capacity building of the government stakeholders who are involved with the arsenic mitigation activities.

4.7 Detection and Management of Arsenicosis

Although no arsenicosis cases have been reported in Lao PDR, the awareness of arsenicosis among health professionals and decision makers is imperative. During the first inter-ministerial water quality meeting it was decided that necessary steps should be taken to train provincial and district health staff in the identification of early signs and symptoms of arsenic poisoning.

It is anticipated that many cases of arsenicosis patient may exist in the three highly arsenic contaminated provinces in Lao PDR. However, due to lack of assistance and expert support, no action has been taken to identify and develop appropriate mitigation plan.

5. Viet Nam

5.1 Program Background

The Socialist Republic of Viet Nam stretches 1,600 km along the eastern coast of the Indochina Peninsula and borders the neighbouring countries of Cambodia, Lao PDR, and China. With a population exceeding 86 million, 72% of who live in a predominantly rural agrarian society (UNICEF and WHO, 2008), Viet Nam is one of the most densely populated agriculture based counties in the world. Topographically Viet Nam can be divided into the highlands and Red River delta to the north, the Central Mountains, the coastal lowlands, and the Mekong River delta to the south. Surface water is the main source of water supply for the country, supplying two thirds of the country's demand with the bulk of the remainder supplied from groundwater. Construction of tubewells commenced in the late 1990s. UNICEF Viet Nam has so far supported the implementation of over 150,000 tubewells and local communities and individuals have constructed an even greater number since this time. It is estimated that around 20% of Viet Nam's population consume water from tubewells in the Red River delta and Mekong River delta regions of the country.

Arsenic in groundwater is an emerging problem in Viet Nam. The Red River delta in the north has geology similar to that found in Bangladesh. It lies in an alluvial delta where groundwater is highly reducing and contains high concentrations of iron and manganese.

The risk of arsenic contamination in Viet Nam was first encountered in 1998 and since 2001 UNICEF Viet Nam has been a 'pioneer' in initiating arsenic mitigation activities in Viet Nam. As part of the nation wide sampling program, approximately 187,000 water quality samples have been tested from each of Viet Nam's provinces. Approximately 12% of these samples recorded arsenic concentrations above the acceptable limit of 50ppb.⁹ The results of the national wide sampling program resulted in 'risk maps' being developed enabling planned and strategic mitigation activities to be programmed for specific areas. The high risk areas have been identified within the Mekong River delta and Red River regions.

The Ministry of Agriculture and Rural Development (MARD) has the overall responsibility for legislation, policies, and strategies for the management of drinking water quality and safety for the whole country. The Department of Preventive Medicine & Environmental Health under the Ministry of Health (MoH) is responsible for monitoring water quality at the local level along with the Environmental Health Division of the Provincial Preventative Medicine Centres.

In addition to the arsenic mitigation activities, UNICEF Viet Nam provides extensive support to the MoH to improve patient identification and management. To date approximately 30 cases of arsenicosis have been identified from 1,000 samples tested. Potential reasons for the comparatively low number of cases identified may be because tubewells have only recently been introduced in Viet Nam. Furthermore water from wells is often stored in sand filters for prolonged periods to remove the unpalatable taste of iron, and this may also serve to remove arsenic.

5.2 Water Quality Testing

5.2.1 Extent of the Arsenic Contamination

Extensive arsenic contamination exists in and around Hanoi, in the Red River and Ma River basins in the north and in the Mekong River delta in the south of the country. In order to assess the extent

⁹ In Viet Nam, for water sources supplying more than 500 people, the acceptable arsenic contamination level is 10ppb. Less than 500 people, the acceptable contamination level is 50ppb

of the arsenic problem in Viet Nam, MONRE initially tested a total of 77,000 tubewells taking samples from different probable arsenic prone areas of the country with financial support from UNICEF Viet Nam in 2005. Later, MONRE continued the testing programme with financial support from the Government and completed testing of an additional 110,000 tubewell water samples in the subsequent year. This served as a basis for prioritizing the testing areas with regards to the arsenic concentration in tubewell water and also assisted in developing the arsenic risk map for the country, as shown in Figure 5-1 below:

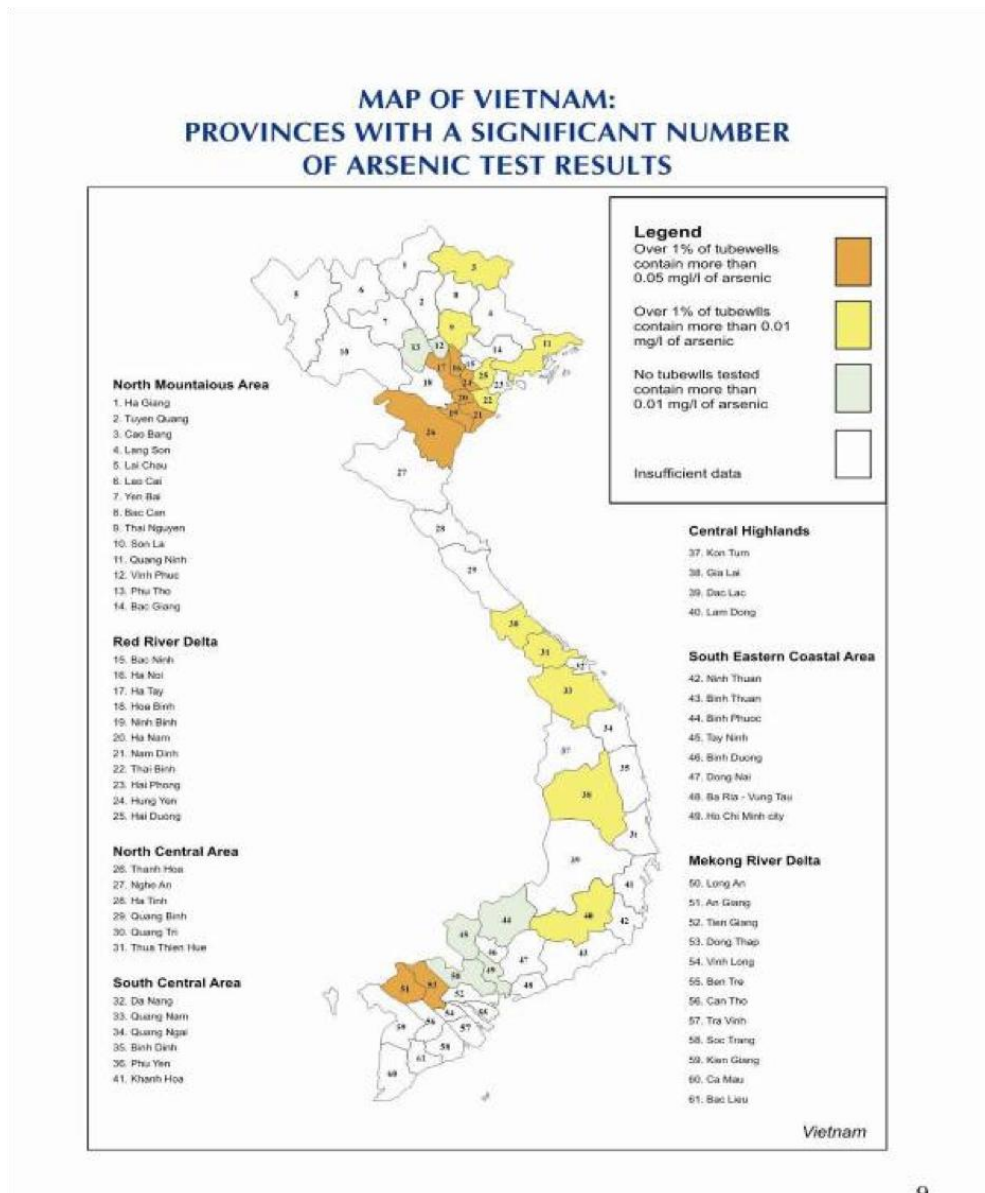


Figure 5-1 Viet Nam Arsenic Risk Map

The total population who live in the arsenic affected areas is 6.6 million while the population who are at risk of exposure is approximately 1.0 million.

5.2.2 Testing Procedures and Results

To gain an in-depth understanding on the arsenic problem, MONRE, the Government designated coordination agency, developed a two-phase initiative. Different field kits (e.g. Merck, HACH, etc.) were used for the testing.

1. Until now, MONRE completed testing of 187,000 tubewell water samples for arsenic concentration. This involved taking 24 samples from a total of 6,900 communes distributed from each of Viet Nam's provinces. The survey was carried out with financial support from the Government. The Merck field testing kit was used for this testing. A total of 1,368 water samples were cross-checked in the laboratory with Atomic Absorption Spectrophotometer (AAS) equipment. It should be noted that after testing the UNICEF Viet Nam supported wells with different field testing kits, the Merck kit was found to be the most convenient and user friendly. It was therefore decided to use the Merck field testing kit to test the remaining tubewells in Viet Nam.
2. In order to gather more information on the levels of groundwater contamination, MONRE initiated the second phase of testing. The methodology adopted is as follows:

A total of 150 tubewells will be tested randomly in communes where at least one tubewell was found to be contaminated with arsenic >50ppb. According to MONRE, by the end of 2008 testing of at least 70% tubewells in such communes will be completed. GPS data will also be collected for all the tested tubewells. After completion of the survey, district and provincial level arsenic exposure maps will also be prepared. MONRE also planned to test at least 5% of the water samples in the laboratory for cross-verification of the field kit data in two university laboratories. One laboratory is located in the south and another is in the north. MONRE, however, does not have any future plan to complete testing of all TW water in the arsenic contaminated areas of the country.

Regarding field test results, no cross-checking mechanism was developed to validate field testers' results in the field. A certain percentage of cross-checking at field by the testing supervisors will increase confidence levels with the field kit data and this ultimately will help to reduce the number of water samples that need to be sent to the laboratories. Since identification of test results is difficult just below and above 10ppb and 50ppb, it is recommended that 5% of water samples should be selected from both below and above 50ppb.

Field testing is currently conducted by the district and provincial level staff of MONRE, however, MONRE has the authority to request additional staff from other departments, if required, to carry out the testing activity. The field testers, however, receive little incentive for conducting the tests. In addition, MONRE feels that they should get more remuneration for conducting the tests at the commune levels.

5.2.3 Government Regulations

MOH developed two national drinking water standards for arsenic in groundwater. These standards are based on the number of people using a system:

- 10ppb for water options using by more than 500 people (mostly urban piped water facilities). In Hanoi, however, it is understood one urban piped water supply contains arsenic more than three times higher than the national standard, yet no government initiative has been taken by the authority to reduce this arsenic level.
- 50ppb for water options used by less than 500 people. These are mostly rural individual boreholes and also rural small scale water supply projects.

During the consultant's field visits it was observed that people are confused by the two standard values. Even staff in the province and district levels seemed confused. For example, in the south it was observed that the tester painted a red mark on boreholes that contained arsenic less than 10ppb. Though installation of new tubewells was continuing in the arsenic affected areas, no standard regulation was developed by MONRE to facilitate the safe installation of new tubewells.

5.3 National Database

5.3.1 Responsible Department

An Arsenic Database Monitoring System (ADMsys) has been developed and reviewed with revision of the system structure and monitoring parameters continuing. MONRE is the responsible department to manage the database centrally and has started providing training to different relevant government officials and provincial staffs on the ADMsys. Training on arsenic sampling procedures, survey methodology, data computerization and reporting procedures has also been conducted by MONRE for technical staff of different provinces in the Red River delta, Central area and Mekong River delta. MONRE is also planning to provide logistical and training support to the district and province level staff so that they can take responsibility of primary data collection and enter the data into the computer before sending the soft copy to the central database.

5.3.2 Method of Data Collection and Storage

Until now only arsenic and GPS data have been entered into the database from the national survey and the information is kept with MONRE. The database system was developed based on the findings of the arsenic risk classification study. Although the data entry format was found to be comprehensive, additional information (e.g. tubewell installation year, O&M records) and also some disaster related information could be included. This information can then be used to improve the outputs of other agencies, including both government and other development partners. As per the developed system, only the provincial and central levels staff can enter data into computer.

5.4 Awareness Raising

5.4.1 Objectives and Implementation Strategies

The overall goal of UNICEF Viet Nam's arsenic mitigation activities is to 'significantly reduce the risk to children of drinking water contaminated with arsenic'. The objective is to 'assist governments in developing appropriate arsenic mitigation strategies and comprehensive action plans'.

For Awareness Raising activities, the anticipated outcome was for 'the target populations (to) have increased awareness of the consequences of arsenic contamination on health and know how to avoid arsenic contaminated water sources or how to treat water to reduce arsenic levels' (UNICEF Viet Nam, 2008).

At the national level, the National Arsenic Steering Committee (NASC) was responsible for raising awareness levels amongst the Ministerial sector. To do this the NASC focussed on developing and obtaining government approval on national and regional policies and guidelines. Examples of the documents which have been successfully endorsed by government and distributed include the National Arsenic Action Plan and the Arsenic Diagnosis Guideline.

Members of the Viet Nam Government also participated in study tours to learn from the achievements of other countries and to apply the lessons to Viet Nam's arsenic mitigation program.

At the community level, awareness raising activities were supported through the Department of Preventive Medicine and Environmental Health (DPMEH) and the National Centre of Rural Water Supply and Sanitation (NCERWASS). The strategy involved the implementation of Comprehensive Arsenic Mitigation Plans in the three high risk provinces.

A key aspect of the community awareness raising activities is the involvement of the Provincial Centre of Preventive Medicine (DPM) in the high risk provinces. The DPM offices are responsible for planning, implementing and monitoring the Comprehensive Arsenic Mitigation Plans.

The Comprehensive Arsenic Mitigation Plan utilised media and community mobilization 'to build awareness and encourage households and communities to avoid drinking from contaminated wells and instead use alternative safe water sources'.

Following a participatory assessment, nine key arsenic mitigation messages were developed into IEC materials, which included posters, leaflets and flipcharts as shown below in Figure 5-2:



Figure 5-2 Viet Nam IEC Poster

The material was distributed to affected communities through the community motivators, health staff and other project collaborators during village meetings and household visits. In addition to the IEC material, a TV documentary on the arsenic issue was also developed and shown to local community members during village meetings.

5.4.2 Evaluation of Progress

There were two components of the Awareness Raising activities' expected outcome;

1. The target populations have increased awareness of the consequences of arsenic contamination on health; and
2. The target population know how to avoid arsenic contaminated water sources or how to treat water to reduce arsenic levels'.

For the first component, the extensive awareness raising activities has definitely increased the affected communities awareness on the health impacts of consuming arsenic contaminated water. The level of increase, however, is unknown. UNICEF Viet Nam has provided estimates in the number of people who have been made aware of the arsenic issue, however, there has been limited monitoring during implementation to assess any improvements to the target population's awareness levels.

The lack of monitoring also makes it difficult to evaluate whether the second component has been achieved. For future Awareness Raising activities, it is strongly recommended that KAP surveys are conducted so that achievements can be verified and quantified.

It is also recommended that specific measurable indicators are used and an additional indicator developed that focuses on behavioural change as it relates to an increase in community awareness.

5.4.3 Discussion on Key Activities

KAP Survey

UNICEF Viet Nam and the Viet Nam Government have invested a considerable amount of effort into awareness raising activities. For this reason, it was surprising that a KAP survey had not been conducted to evaluate the success of the activities and the mechanisms with which it is being implemented.

As discussed above, it is strongly recommended that a KAP survey is conducted to assess the effectiveness of the current awareness raising strategy and assist with identifying components of the program which could be improved.

IEC Material

It was noted that the IEC material was developed from group workshops in a consultative manner and the material was also pre-tested, which is a worthy initiative. Again, it would be worthwhile to follow this up with KAP surveys to obtain 'real' data from the community which will enable any revisions of the IEC material as may be required.

DVD

An information DVD was commissioned by UNICEF Viet Nam to be used as a tool for awareness raising. Feedback from the community motivators during the consultants' field visit revealed that the DVD had been well received by communities and is one of the preferred methods for awareness raising. One comment on the DVD, however, was that the only alternative safe water option discussed was arsenic removal. Care needs to be taken if this DVD is going to be shown to a wider

audience as the removal technique that was promoted is only appropriate under certain geological conditions.

5.5 Alternative Safe Water Options

5.5.1 Objectives and Implementation Strategy

The key strategy for the Alternative Safe Water Options activities is to introduce and promote 'low-cost alternative water supply options such as rainwater harvesting and household treatment through community level action'.

This strategy is in line with the short term and long term solutions that were identified within the Government's National Arsenic Action Plan (NAAP) to address the arsenic problem in Viet Nam. As per the NAAP, short term solutions included awareness raising and arsenic removal techniques. Long term solutions included rainwater, 'safe tubewells' and treated surface water. The following sections describe the strategies which have been implemented to achieve the objectives of the Alternative Safe Water Options activities.

Institutional Framework

The UNICEF Viet Nam's Alternative Safe Water Options activities focussed on promoting safe water options rather than actual construction of alternative options. As such, the promotion was closely linked to awareness raising activities that were facilitated by the Provincial Centres of Preventative Medicine (DPM) and community motivators.

Community Mobilisation

Rainwater Harvesting (RWH) was promoted as a safe water alternative, however, UNICEF Viet Nam focussed its efforts on promoting arsenic removal techniques to affected communities. Referring to the NAAP, this strategy was considered part of the 'short-term' solution program.

In the northern high-risk provinces, the majority of households were already using sand filters to remove iron from extracted groundwater. Community motivators encouraged the communities in these areas to modify their existing sand filters so that arsenic could also be removed. The IEC material which was developed as part of the awareness raising campaign included instructions on what modifications were required to achieve this, and in what situations the technique could be used.

Community Contributions

The affected communities were encouraged to adopt the alternative safe water options and they were also expected to meet any construction costs. UNICEF Viet Nam's Alternative Safe Water Options activities did not provide any subsidies to affected communities for construction of the mitigation options.

Introduction of Water Safety Plans

Water Safety Plans (WSP) were piloted as part of the Alternative Safe Water Options activities. Five existing piped water supply systems in one of the high risk provinces were selected for the pilot program. The model was developed using WHO guidelines, and followed the necessary steps for establishing a water safety model.

5.5.2 Achievements to Date

Table 5.1 Viet Nam – Installed Safe Water Systems

Type of System	Numbers Installed
<u>Community</u>	0
<u>Household</u>	
Arsenic Removal	Promotion only
RWH	Promotion only

5.5.3 Evaluation of Progress

Considerable efforts were made in promoting the arsenic removal techniques in affected communities. It is not clear, however, to what extent this promotion has progressed to meeting the overall goal of reducing the risk to children drinking arsenic contaminated water. It was noted that Provincial Arsenic Mitigation Plans set targets for each of the high risk provinces, however, there did not appear to be a set mechanism to assess and record the numbers of affected communities who had changed their water usage behaviour as a result of the arsenic mitigation activities.

5.5.4 Discussion of Mitigation Options

Long & Short Term Solutions

The Viet Nam Government's approach of recommending long and short term solutions showed good initiative in addressing the risk of arsenic contamination. It demonstrated the Government's commitment to initiate mitigation efforts whilst the scale of the problem was being determined. One aspect of the strategy that could be improved would be to establish target dates or milestones to act as a trigger for transition between short-term and long-term strategies. This would assist in creating a clearer vision of the implementation program and determining acceptable strategies.

This is also applicable to UNICEF Viet Nam's Alternative Safe Water Options activities. Whilst the short term solution of promoting household treatment options is progressing, it was not clear when long-term solutions, such as piped water systems, or new 'safe' tubewells would also be offered to communities as alternative water sources. For future campaigns, it is crucial that UNICEF Viet Nam continues to provide both financial and technical support for the Viet Nam arsenic mitigation efforts so that long-term solutions can also be offered to affected communities.

Arsenic Removal Techniques

It was acknowledged that considerable investigation has been conducted by UNICEF Viet Nam, the Government and also a number of research institutions in assessing the appropriateness of the promoted arsenic removal techniques. It was also noted that the option that is being promoted by communities has received full support from the Government.

One of the main risks of promoting such a system, however, is that it must be robust enough so that it continues to work as effectively in the field, as in the laboratory. Follow up testing of field samples is the most appropriate way to assess whether the filter is removing arsenic to an expected level. From the consultant's field visits, it was not clear whether the households' water was being tested once it had passed through the filter. As with any other treatment technique, it is recommended that on-going testing is conducted to ensure that the filter is working effectively. This is particularly crucial where the household is responsible for adapting their existing filter so it can remove arsenic.

It should be noted that at a regional level, UNICEF recommend that arsenic removal techniques are implemented only when all other alternative safe water options, community and household, have been considered and deemed inappropriate.

5.6 National Strategies and Co-ordination

5.6.1 Responsible Department

UNICEF Viet Nam in conjunction with the relevant government departments (i.e MARD and MoH) placed significant emphasis on implementing different arsenic mitigation activities. All arsenic mitigation activities have been integrated into Annual Work Plan of 2008 of the programme. In addition, UNICEF Viet Nam, MoH and MARD have been working closely with the Ministry of Natural Resource and Environment (MONRE), the coordinating agency of the NAAP, to provide the latest information and lessons learned from the project to support implementation of the NAAP.

UNICEF Viet Nam developed a strategy to maintain liaison with its central government stakeholders through conducting training and workshops. The Centre for Rural Water Supply and Environmental Sanitation under the Ministry of Agriculture and Rural Development and the Viet Nam Administration of Preventive Medicine under the MoH were the two main stakeholders in the arsenic mitigation activities in Viet Nam. Different arsenic mitigation activities at the field levels also strengthened the co-operation between UNICEF Viet Nam and various government research institutes, including the Institute of Environmental Technology, the National Institute of Occupational and Environmental Health, the National Institute of Hygiene and Public Health, and the Centre for Environmental Technology and Sustainable Development (under the Ha Noi National University). At the provincial level, UNICEF Viet Nam developed close relationships with provincial centres for rural water supply and environmental sanitation (PCERWASSs) and Provincial Departments of Preventive Medicine for sustainable implementation of the arsenic mitigation activities in Viet Nam.

5.6.2 Capacity Building of Government Officials

In Viet Nam, capacity building of the government officials both at the central and provincial levels was being improved through a range of activities such as:

Training on use of arsenic test kit and equipment for field survey (such as GPS equipment) for the field technicians, IEC skill training, IEC mitigation planning training at the provincial, district and commune level, training on the use of ADMsys database to computerize the field data for the provincial level, training on water quality treatment and the sand filter construction for arsenic removal. Training for the provincial medical doctors was also organized to identify arsenicosis patients with the use of their own guideline for arsenicosis patient diagnosis management. Limited initiatives were also taken for exposure visits of the key government officials to China, India, and Bangladesh to gain an in-depth understanding about the arsenic problem.

5.7 Detection and Management of Arsenicosis

The MOH developed the 'Guidelines on Diagnosis, surveillance and prevention of Arsenicosis due to using arsenic contaminated water sources' with the assistance from Chinese experts in 2006. Later on, two national workshops on the diagnosis of arsenicosis patients was organized with assistance from experts of the NIOEH for all the provincial level medical professionals. In 2005 UNICEF Viet Nam supported the NIOEH to conduct an extensive study in four communes in Ha Nam to identify the extent of the arsenicosis problem. Following this initiative in four communes the professional doctors of NIOEH identified 16 suspected patients and later experts from China confirmed only eight patients. Two of the identified cases showed skin cancer but the doctors were

not sure whether the suspected cases were exclusively due to arsenicosis disease. However, a systematic identification of the arsenicosis patients with the active involvement of MoH at the central level and the health centre staff at the local level is needed immediately and to take remedial measures if further arsenic exposure is to be stopped.

UNICEF - AusAID

Evaluation of Arsenic Mitigation in Four Countries of the Greater Mekong Region

Final Report – December 2008

Dr. Mhd Jakariya and Mr Simon Deeble

Part Two



Supported by the Australian
Government, AusAID

6. Cambodia

6.1 Program Background

Cambodia is a developing country with a constitutional monarchy and an elected government. Situated on the Indochinese peninsula, Cambodia lies on continental Southeast Asia. Geographically the country is mainly flat in the central regions with these areas prone to flooding. Cambodia is bordered by Thailand and Lao PDR to the West and North, by Viet Nam on the East and South, and the Gulf of Thailand on the Southwest. Cambodia covers an area of 181,035 km² with a total population of 14.2 million of which 80% live in rural areas (UNICEF and WHO, 2008). Administratively the country divided into 20 provinces and four municipalities.

The major water supply issue for the rural population is the provision of safe water. Since the early 1990s, the Cambodia Government, UNICEF Cambodia, International donors and NGOs have had ongoing programs aimed at supplying safe water to rural communities. These programs were largely based on the provision of community wells, in particular tubewells, to provide biologically uncontaminated water. Approximately 43%¹⁰ of the rural population currently rely on groundwater, with hand dug and open wells widespread. As a result of such initiatives approximately 40,000 community wells (on average each well shared is by 10-25 families) were constructed mostly by UNICEF Cambodia since early 1980s. Following the precedence it is anticipated that the number of private wells in Cambodia would be much higher than UNICEF constructed wells. The discovery of arsenic contamination in tubewell water, however, significantly reduced the safe water coverage when it was detected through the joint National Drinking Water Quality Assessment in 2001. The Government has responded by initiating an Arsenic Mitigation Program involving all the key ministries related to the water supply sector; the Arsenic Inter-Ministerial Sub-Committee (AISC) consists of five ministries and chaired by Ministry of Rural Development (MRD). Under the AISC, the Arsenic Secretariat was established with direct supervision of MRD to co-ordinate all of the arsenic mitigation activities in Cambodia.

Since it was first detected in 2001, arsenic contaminated groundwater has become a significant health threat in Cambodia, especially in certain rural areas where people rely heavily on groundwater for their drinking water needs. UNICEF Cambodia supported water quality testing to identify the areas most at risk of arsenic contamination through mapping and screening of wells. An estimated 320,000 people in 1,600 villages in 7 central provinces bordering the Mekong and the Bassac rivers were found to be at risk after 16,000 tubewells tested positive for arsenic. Alarmingly, arsenic concentrations as high as 1,300ppb were measured in the Mekong delta south of the capital, Phnom Penh, far in excess of the national standard of 50ppb.

Although the quality of water resources is generally good, some chemical pollution of surface water sources does occur (e.g. nitrite, nitrate, barium, chromium, fluoride, lead, manganese, molybdenum, selenium, etc.), and in a recent groundwater survey naturally occurring arsenic above the WHO guideline level of 10ppb was found in five of the 13 provinces surveyed. As a result, an emergency Arsenic Mitigation Program was initiated involving all the key ministries related to the water supply sector.

¹⁰ Cambodia Demographic and Health Survey 2005

6.2 Water Quality Testing

6.2.1 Extent of Arsenic Contamination

Arsenic was first detected in Cambodia in 2001 and this came as part of the National Drinking Water Quality Assessment where at least 11% of water samples from 13 provinces along the major rivers of the country were taken. The results from the testing led to the production of the Cambodia arsenic risk map shown in Figure 6-1 below:

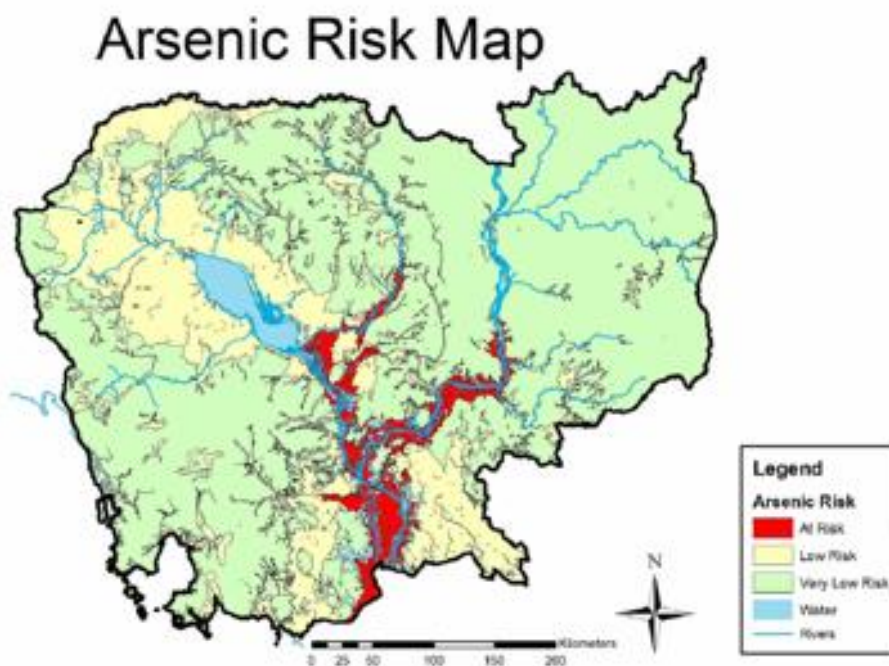


Figure 6-1 Cambodia Arsenic Risk Map

MRD is responsible to coordinate testing of tube well water, which was carried out by Provincial Rural Development (PDRD) staff and NGO partners. Geological mapping and testing of tubewell water for arsenic has identified the risk of arsenic contamination in approximately 1,600 villages located in 49 Districts of seven provinces, including Kandal, Prey Veng, Kampong Cham, Kampong Chhnang and Kampong Thom. With the testing information, countrywide arsenic risk mapping was completed using GIS software.

The total population in the above mentioned seven provinces is approximately 2.25 million. Of this population about 25% use or previously used tubewell water as a source of drinking and cooking water. About 38% of tubewells within this area were found to be contaminated with arsenic above the current Cambodian National Standard (50ppb) with approximately 136,000 people drinking water from these contaminated tube wells. As per CDHS 2005, 45% of rural Cambodian population utilize unimproved source of drinking water. Approximately 36% do not practice any type of water treatment for drinking water. Combining the arsenic and bacteriological exposed population, it is estimated that approximately 610,000 people living within the arsenic affected areas are regularly consuming unsafe, bacterially contaminated surface water.

6.2.2 Testing Procedures and Results

The national assessment created huge demand for blanket type testing and currently testing of 37,200 tubewells has been completed. This includes testing of all tubewells in approximately 1,600 villages considered to be the highly affected by arsenic. Out of the total tested tubewells, 24,792 samples were collected from the arsenic high risk areas. Of these samples only 35% showed arsenic concentrations above the national drinking water standard (i.e 50ppb). The testing was supervised by the provincial level staff of the Ministry of Rural Development (MRD) and was carried out by the local level staff both from the Government and NGOs.

A variety of field testing kits, were used to test the tubewell water, e.g., HACH, Wagetch digital arsenator, and PeCo 75. The Wagtech digital arsenator was also used but only for limited monitoring by educational institutions for research purposes. UNICEF Cambodia, however, also supported the development of a testing protocol in 2004 with feedback from the countrywide situation analysis survey that took place in early 2004.

To check field testing data by the local level testers at least 20% of samples were re-tested by the provincial level supervisors. Provincial level supervisors typically only supervised the quality of the field tests once in every one to two months. However, about 25-30% cases the results of the testers and the supervisors did not match. Usually no further initiative was taken to validate the field test results in the absence of any reference laboratory. Although educational institutions such as the . The Institute Technology of Cambodia (ITC) have access to Atomic Absorption Spectrophotometer (AAS) testing facilities, use of these facilities has not yet been explored by the MRD. A system of cross-checking monitoring the field test data could easily be implemented by getting assistance from either of these organizations.

In line with the national strategy, blanket testing in the high risk areas has been completed. MRD was optimistic to achieve the target of the Strategic Action Plan, i.e., to ensure clean water for at least 75% of the exposed population by the year 2011. Although the Strategic Action Plan has not yet been approved by the Government, it is considered as the guiding document for all the arsenic mitigation activities in Cambodia.

6.2.3 Government Regulations for Tubewell Installation

The occurrence of tubewell installation has reduced due to the identification of arsenic in tubewell water, nevertheless, installation of tubewells is continuing. It is therefore, important to develop appropriate government regulations for safe installation of tubewell in arsenic exposed areas of Cambodia.

6.3 National Database

6.3.1 Responsible Department

An arsenic information centre has already been set up at MRD, the secretariat for the Inter-Ministerial Sub-Committee on Arsenic, with active involvement of the five related Ministries. The database is centrally managed by the MRD and it is now stationed at the Arsenic Information Centre. Those interested in the database for conducting arsenic related studies may apply to the National Action for Arsenic Mitigation Project for access to this database.

6.3.2 Method of data collection and storage

With regards to entering testing related information in a systematic way, MRD developed a standard data collection format for the field testing teams to use and send back to the national database for

data entry. MRD has already modified the format so that it can be expanded to include monitoring of water quality parameters in addition to arsenic.

According to the current practice, MRD enters data in two stages. Firstly the necessary data regarding tubewell and arsenic concentration is entered at the provincial level by provincial testing team using an excel spreadsheet. Here, however, they do not enter all data into computer but rather they enter only the basic information about the tubewell. It should be noted that some of the provinces have both computer and trainer manpower to transfer the data from the forms to the spreadsheet. Some provinces, however, hired this service locally. Once the provincial staff have entered the required data into computer hard copies of the collection forms are sent to the central MRD office for re-entering into the national database system.

Initially, the MRD did not have sufficient experience for developing the data entry software nor the trained human resources to take care of the collected information. Through the involvement of a private company, MRD has developed its own capacity and now they are capable of managing their database. Use of database as per the coordinating organization i.e. MRD are as follows:

- ▶ To get information about the safe depth for people who want to install new tubewells;
- ▶ To plan for mitigation activities; and
- ▶ To advise organizations and private contractors planning to install new tubewells of possible contamination and possible consequence of having to abandon the tubewells.

Based on the collected data, an arsenic risk map has been produced for all the exposed provinces of the country. With the support of UNICEF Cambodia, MRD started the community based water quality testing and awareness raising in two provinces and the pilot project started in early 2008. Resource Development International (RDI), an international NGO active in rural water supply improvement in Cambodia, has spearheaded the establishment of a water quality index system in two selected provinces which is accessible through the internet. It would be useful for the Government to systematically utilize the results of these types of NGOs initiatives in its continuing efforts to promote water quality surveillance.

6.4 Awareness Raising

6.4.1 Objectives and Implementation Strategies

As part of the overall program, the following awareness raising targets were agreed between the Royal Government of Cambodia and UNICEF Cambodia. The aim is to achieve these targets by 2010:

1. At least 50 percent of the population living in the arsenic high risk provinces are informed of arsenic issues and their implications; and
2. At least 30 percent of them use alternative safe water.

To achieve these objectives, a number of strategies have been implemented at both the national and community levels. The MRD has been appointed as the Secretariat of the AISC and has been tasked with raising awareness levels both at the national and community levels.

At a national level, the key document with which all arsenic mitigation strategies are referenced is the Strategic Action Plan. Not only does the document serve as a common reference point for strategies and key partners, it is also an excellent tool for advocacy at national and sub-national levels. In addition to the Strategic Action Plan, other important documents which have been developed to support the awareness raising program at the institutional level include the Cambodia Arsenic Situation Analysis and the Interim National Drinking Water Standards.

At the community level, awareness raising activities were focussed through education sessions at community meetings, household visits and school activities. The MRD's provincial teams were responsible for educating communities on the arsenic issue, with the support of community volunteers and school staff.

Affected communities were first introduced to the risk of arsenic contamination during the initial water quality testing stage by the MRD's provincial staff. Where the test results showed contamination levels above 50ppb, the households using the wells were encouraged to stop using the water for drinking and cooking. They were also informed that the contaminated water could still be used for other purposes, such as, washing and gardening. Follow up education sessions to the affected communities were also led by the MRD teams through community meetings and distribution of leaflets and posters.

Arsenic education was also provided to students, teachers and parents of the schools that have contaminated wells. Provincial MRD staff and Provincial Office of Education (PoE) staff from high risk provinces, were trained to be master trainers, and subsequently trained teachers from the affected schools.

Communities in selected villages have been supported with provision of alternative arsenic free water supply. Priorities have been given to villages with the highest proportion of wells contaminated with arsenic. A number of schools and community health centres have also been provided with support to replace their contaminated wells with alternative water supply facilities particularly rain water tanks.

6.4.2 Key Activities Completed

Strategic Action Plan

A five year Strategic Action Plan was developed in 2006 by the Royal Government of Cambodia. The Strategic Action Plan provides a clear vision for the future and outlines strategies, objectives and activities so that all stakeholders can strategically work towards a successful outcome. The document is well developed and provides the overall arsenic mitigation program with a solid framework with which the proposed implementation activities can be initiated and monitored.

It should be noted, however, that the Strategic Action Plan is still to be formally endorsed by the Royal Government of Cambodia.

KAP Survey

A KAP survey was conducted by the MRD in mid-2006 'to gain a better understanding on the current knowledge, attitudes and practices of households in the seven high risk provinces in relation to arsenic.' (MRD, [ca 2006])

The efforts and commitment by the MRD to conduct the survey are to be applauded. It demonstrates an understanding of the importance of monitoring and a desire to manage the program's activities effectively. An end-program KAP survey is proposed for 2010 to assess the effectiveness of the program, and quantify the achievements made.

From the 2006 KAP survey, key information was obtained on the affected communities and their habits, which included;

- ▶ Characteristics of respondents;
- ▶ Water usage patterns;
- ▶ Arsenic awareness; and

- ▶ Knowledge, Attitude and Practice in relation to arsenic.

6.4.3 Communication Strategy

UNICEF Cambodia, in partnership with the Royal Government of Cambodia has developed the framework of a communication strategy for the arsenic mitigation efforts. Although still in draft format, the document identifies communication channels and target groups for IEC material dissemination. The creation of the strategy is in-line with the activities identified within the Strategic Action Plan. The strategy that is being developed uses UNICEF's Behavioural Change Communication Strategy.

6.4.4 Evaluation of Progress

Objectives and Outcomes

Two key indicators were identified to evaluate the success of the Awareness Raising activities:

Indicator No. 1

At least 50 percent of the population living in the arsenic high risk provinces are informed of arsenic issues and their implications

KAP Survey Result - 12.1%

Indicator No. 2

At least 30 percent of them use alternative safe water

KAP Survey Result - 10.3%

The aim is to achieve the set targets by 2010. Although a lot of work is required to meet the targets, steady progress is being made. The most impressive aspect of the UNICEF Cambodia awareness raising campaign is that the activities as outlined in the Strategic Action Plan are being implemented and that the progress of the activities is being monitored.

6.4.5 Discussion on Key Aspects

IEC Material

Posters and leaflets are the main forms of material used to disseminate information to affected communities. The material is being distributed during community meetings and is also provided to schools and health centres.

Key messages focus on the differences between 'green' and 'red' tubewells. The messages are clear, they make mention of acceptable uses of 'red' tubewell water and also discuss alternative safe water options.

One particularly encouraging aspect of the development of the IEC material was that the original posters had been reviewed and revised to avoid creating panic within the community with the use of over-zealous examples of the health impacts. Examples of the revised IEC posters are shown in Figure 6-2 overleaf:



Figure 6-2 Cambodia IEC Poster

KAP Survey Results

The results of the 2006 KAP survey confirmed that there are still a considerable number of community members in affected areas who are not aware of the arsenic problem. Given the extensive work done to date on community awareness raising activities, it was surprising to see the result that only 12% of communities in affected areas were aware of the arsenic issue. The low KAP survey results also conflicted with information received during the consultants' field visits, were MRD Provincial Officers informed the consultants that for one commune, the level of awareness amongst the community members was as high at 87%.

It is likely the low result from the KAP survey is not a true reflection of the awareness levels among affected communities. A potential reason for this relates to the respondents of the KAP Survey. Of the 4,448 respondents who took part in the KAP survey it is likely only a portion of these people live in the areas where testing and education activities have been conducted. An additional reason for the difference in figures may have been due to how the awareness levels were determined in the survey. It is understood that 3 basic questions were asked in the survey to determine awareness levels. If the respondent could not answer the first question, the remaining questions were not asked and the respondent was marked as 'un-aware'. Determining levels of awareness is a difficult process, however, for future KAP surveys it is recommended that more flexibility is designed into the questionnaire so that a more realistic result in awareness levels is obtained.

6.5 Alternative Safe Water Options

6.5.1 Objectives

The key objective of UNICEF Cambodia's Alternative Safe Water Options activities is to increase the availability of safe water sources in "at-risk" areas' (UNICEF Cambodia, 2004). Two key outputs were identified to achieve this objective:

- ▶ Promoting alternative safe-water sources so that they can be adopted by the affected community; and
- ▶ Verifying through independent assessments that alternative safe water sources are indeed safer than the arsenic-contaminated tube-wells.

6.5.2 Implementation Strategy

Institutional Framework

In addition to its role of chairing the AISC's Secretariat, the Ministry of Rural Development (MRD) also has the responsibility for rural water community supply. As such, UNICEF Cambodia focussed its support for the Alternative Safe Water Options activities through the MRD and its provincial offices. In addition to the mitigation options offered through the MRD, UNICEF Cambodia also collaborated with local NGOs to implement a number of the alternative safe water options, as follows:

- ▶ Resource Development International (RDI) implemented ceramic water purifiers, shallow rope pump & rainwater tanks
- ▶ Group de Recherche et d'Echanges Technologiques (GRET) implemented piped water systems through public/private partnerships and rainwater harvesting
- ▶ Rainwater Cambodia implemented household rainwater tanks

Although not directly supported by UNICEF Cambodia, other members of the AISC were also involved in the Alternative Safe Water Options activities, in particular the Ministry of Industry, Mining and Electricity (MIME) who are responsible for the regulation of private sector involvement in piped water systems.

Community Mobilisation

The MRD's provincial offices; Provincial Department of Rural Development (PDRD) are responsible for mobilising communities through an 'informed choice approach'. Through community meetings, PDRD officers facilitated discussions on the alternative safe water options that were available for the communities and the associated costs, both initial and ongoing.

The financial limitations of the program restricted the number of alternative safe water options that could be offered. As such, priority for the options was provided initially to households whose water source was shown to have excessive levels of arsenic contamination.

Community Contributions

The AISC developed a National Guideline to be used by PDRD officers to determine community contributions. For the Alternative Safe Water Options activities, MRD has set up a guideline for the PDRD officers in each province, establishing the contribution amounts for the various safe water options. As a minimum, communities are expected to contribute at least 30% of the cost of the safe water system, however, there is flexibility in the payment options for more vulnerable community members.

Typically the PDRD officers follow the National Guideline for determining contribution amounts. During the field visits, however, the consultants encountered one district which was using PRDC/Excom Guidelines (Provincial Rural Development Committee/ Executive Committee), which sets considerably lower community contribution amounts. This type of discrepancy still prevails in Cambodia due to the current on-going decentralization process. The ExCom rules and regulations which were established for decentralized development activities have yet to be fully adopted by all Ministries.

For consistency, it is recommended that a single guideline is used for determining contribution amounts. It is understood that the AISC intends to integrate the two documents into one reference guide. Once the integration is completed and the document has been formalised, there would be merit in conducting workshops on the use of the document with the relevant PDRD offices so that there is a clear and consistent understanding on what should be the contribution amounts for each of the alternative safe water options.

Introduction of Water Safety Plans (WSP)

There has been limited use of Water Safety Plans (WSP) within UNICEF Cambodia's Alternative Safe Water Options activities. There are two major reasons for the limited use:

1. Ceramic Water Filters have been successfully introduced to communities to treat surface water. As such, community members now appear less motivated to improve water sources as they believe the filter is a sufficient mechanism to remove contaminants.
2. For larger piped water systems, it is the water owner's responsibility to treat water so that water quality is to an acceptable level. Households pay the required tariff to the water owner, and have little to no other involvement in the process.

Despite these two factors, it is still advisable to introduce WSPs to the affected communities, regardless of whether household or community water systems are installed. WSPs will assist in educating community members on health issues associated with contaminated water supply, which could be used as a mechanism to discuss other health related topics.

6.5.3 Achievements to Date

Table 6.1 Cambodia – Installed Safe Water Systems

Type of System	Numbers Installed
<u>Community</u>	
Dugwell with Rope Pump	10
Improved Dugwells	50
<u>Household</u>	
Ceramic Water Filters	15,000
RWH	400

6.5.4 Evaluation of Progress

The combined efforts of UNICEF Cambodia, MRD and the local NGOs have resulted in approximately 3,000 families gaining access to safe water through either community piped systems,

rainwater harvesting or ceramic water filters. This equates to approximately 9% of the exposed population¹¹.

This is an impressive result, particularly as UNICEF Cambodia recognised that its financial and technical capacity was limited. The construction of the options undoubtedly meets the program's objective of increasing 'the availability of safe water sources in "at-risk" areas'.

To evaluate the progress of the Alternative Safe Water Options activities, the Strategic Action Plan established measurable targets with which the program's achievements could be validated. By 2011, the Strategic Action Plan set a target of at least 75% reduction in the number of people consuming arsenic contaminated water in the high risk areas. Whilst there is still much work to be done, the progress to date is a commendable step in the right direction. In addition to the overall target, the Strategic Action Plan went further and established targets for various contamination levels:

- ▶ All villages using wells with arsenic > 500ppb supplied with alternative water by end of 2009
To date, 30 of the 172 villages with arsenic > 500ppb have access to safe water
- ▶ All villages using wells with arsenic > 200ppb supplied with alternative safe water by 2011 (Note remaining villages will be provided with arsenic safe water in next 5 year plan).
281 villages are using wells with arsenic > 200ppb. To date, no safe water alternatives have been provided to these villages as priority has focussed on villages with arsenic > 500ppb.
- ▶ All villages with arsenicosis patients supplied with alternative safe water.
9 villages have arsenicosis patients, each of which has been provided alternative safe water options.

6.5.5 Discussion of Mitigation Options

Appropriateness of Alternative Safe Water Options

A key aspect of promoting and providing alternative safe water options is ensuring the options that are offered to communities are indeed 'safe'. This is a responsible initiative as there is the constant risk of contamination transfer when alternative water sources are being considered. This is especially true when surface water options are being recommended as the alternative water source.

Ceramic Water Filters are a successful example of the investigation process leading to a valuable treatment option being offered to communities. UNICEF Cambodia supported the use of Ceramic Water Filters and also a study to assess the effectiveness of the filters. With WSP and RDI, the results of the study have now been published into an award winning document titled 'Use of Ceramic Water Filters in Cambodia'.

In addition to supporting NGOs to investigate alternative treatment options, local education institutions have also been engaged. Cambodia's Alternative Safe Water Options activities also supports the investigation of arsenic removal technologies. The Institute Technology of Cambodia (ITC) has developed a number of techniques which are producing promising results for arsenic removal. It is noted that considerable care needs to be taken to validate the efficiency and robustness of the techniques, in preparation for their roll-out to the affected communities. This has already been considered and set out in the Strategic Action Plan which specifies that 'the adoption and promotion of arsenic removal technologies will require careful analysis and government approval'.

¹¹ Exposed population is estimated to be 136,000

Public Private Partnerships

Public Private Partnerships have been piloted successfully as part of the Alternative Safe Water Options activities. At this stage, the partnerships have been limited to community piped water systems with partnerships forming between local private entrepreneurs and the Government for the supply of water to communities to an acceptable water quality standard. The entrepreneur, or 'water owner', charges rates for water users per cubic metre to cover their costs with a profit margin.

Each of the public private piped water systems that were trialled were implemented with the assistance of an international NGO, GRET. GRET was critical in mobilising communities and local governments, selecting local entrepreneurs and working with relevant government ministries during construction. Each system utilised an existing surface water source and included a basic treatment plant prior to reticulation to the communities. The average number of households connected to the piped water system was 400 – 500 families. As each of the pilot systems is reticulated, the Ministry of Industry, Mining and Energy (MIME) is the governing Ministry, rather than the MRD.

A critical aspect of reticulated systems is the control of the treatment process. The serious impacts of distributing contaminated water to large numbers of community members are often seen when the treatment process is managed poorly. During the field visit, the consultants visited a piped water system, where river water was treated at a simple treatment plant prior to distribution. The consultants met with the local 'water owner' and discussed the frequency of water quality testing. The consultants were surprised to learn that the water owner did not believe it was his responsibility to test the water, and that the MIME conducted water quality testing approximately every 3 months. Testing the water with such a low frequency is not appropriate for a relatively large reticulated system. It was not feasible to review the contractual agreements between MIME and the water owner. If, however, the responsibility to conduct regular water quality testing is not included in the current contract, it is recommended that it is added to future contracts. The contract should also provide clear definitions of what the acceptable water standards should be, necessary testing frequencies, and also establish any penalties to be enforced where the water quality does not meet acceptable standards.

Rain Water Harvesting

Rainwater Harvesting (RWH) is a well practiced water collection technique in Cambodia. The major challenge of RWH is constructing a RWH tank that has sufficient capacity to meet water demands during long, dry periods, whilst still remaining affordable for community members.

RWH is considered a 'long term' solution as part of the Strategic Action Plan, however, feedback from local NGO, Rainwater Cambodia, suggests that communities continue to be reluctant to invest in the large initial outlays required for the construction of a sufficiently large tank, preferring to wait until a piped water system becomes available. This challenge had been recognised by Rainwater Cambodia who continues to encourage communities to invest in RWH, highlighting that investing early will eventually be more financially beneficial over time.

Ceramic Water Filters

The manufacturing and distribution of ceramic water filters in Cambodia is one of the major success stories of Cambodia's efforts to improve water quality. Considerable efforts have been made by UNICEF Cambodia, WSP and local NGO, RDI, to confirm the appropriateness of the locally manufactured filtered. These efforts culminated in the production of the award winning field note 'Improving Household Water Quality – Use of Ceramic Water Filters in Cambodia'. The study reviewed the microbiological effectiveness and health impacts of the water filter and also investigated the successes and potential challenges that are faced with the scale-up and implementation of the technology.

Although considered a 'short-term' solution from the Strategic Action Plan, the success of the program to date, and the acceptance levels from communities suggest that future programs should continue to offer the technology as a viable treatment method. During the field visits, the consultants witnessed numerous households using the ceramic water filter successfully. Households who were consulted were pleased to have the filter and stated they would purchase another filter when required to replace it.

6.6 National Strategies and Co-ordination

6.6.1 Responsible Organization

Arsenic mitigation activities in Cambodia are being implemented by the Ministry of Rural Development (MRD) and its Provincial Department of Rural Development (PDRD). The overall coordination is the responsibility of the Arsenic Inter-ministerial Sub-Committee (AISC). UNICEF Cambodia plays a key role in providing technical support to MRD during the preparation of the annual work plans, ensuring appropriate and timely submission and subsequent reporting of funding and supply requests, provision of technical support and monitoring of the arsenic related activities.

To mitigate the arsenic problem in Cambodia, the national arsenic Strategic Action Plan has already been developed by the responsible Ministry (i.e. MRD). This plan however has not yet been endorsed by the Government. As mentioned in the Strategic Action Plan, the Government has responded to the arsenic issue in a number of ways including:

- ▶ Development of Interim National Drinking Water Standard of 50ppb arsenic in drinking water;
- ▶ Formation of Arsenic Inter-ministerial Sub Committee (AISC) to coordinate the government response;
- ▶ Mass screening of wells in arsenic affected areas by MRD, PDRD and NGOs coordinated by the AISC;
- ▶ IEC campaigns by MRD/PDRD, MoEYS, and NGOs to inform the population of the arsenic contamination issue, alternative water sources etc;
- ▶ Provision of various alternative safe water sources; and
- ▶ Identification of arsenicosis patients.

There are two goals mentioned in the Strategic Action Plan and they are as follows:

Goal One

Every person exposed to arsenic through the consumption of water from contaminated wells shall have sustained access to alternative safe water source so that the occurrence of arsenicosis and arsenic related diseases in Cambodia are minimised.

Goal Two

Every person affected by arsenicosis can be swiftly diagnosed, receive treatment for the signs and symptoms of the disease, and not be discriminated against or excluded from their community.

In order to achieve the above mentioned goals, several specific objectives (e.g. testing of tubewell water, provision of alternative safe water options, conduct awareness raising activities, identification of arsenicosis patients, etc.) were identified and when, how, and who will carry out the tasks was specified. Monitoring of the planned activities, however, needs to be revisited on regular intervals for sustainable implementation of the planned activities.

6.6.2 Capacity Building of Government Officials

Adequate support was provided to strengthen capacity of the concerned government counterparts by way of training four staff of MRD to act as core trainers for water quality testing and arsenic awareness-raising activities. Two key MRD officials gained exposure to international experience through participation in an International Learning Exchange on arsenic issues held in India. Additional to this, the Director and other officers of the Endemic Diseases received training in China in 2003 to diagnose arsenicosis patients during a regional training workshop conducted by the Chinese arsenicosis experts.

Thirty four testing teams from seven high-risk provinces were provided with refresher training in the capital Phnom Penh. The training included the use of the arsenic test kit, the use of GPS and the assignment of well code numbers to each tested well as well as the procedure for marking tubewells. Training was also provided on delivering educational messages on the use of safe drinking water and the dangers of drinking arsenic contaminated water. Two of the seven affected provinces (Prey Veng and Kampong Thom) have adopted a decentralized arsenic mitigation response, starting from 2008 with anticipation that the other high-risk provinces will gradually follow the same procedure.

6.7 Detection and Management of Arsenicosis

In 2003, the Ministry of Health undertook a cross-sectional survey in Kien Svay (Kandal Province). Under the survey, a total of 1,470 randomly selected households from 12 villages were surveyed and a total of 7,817 people examined for skin lesions. However, no clinical manifestations were observed despite 29% of the tested tubewells showing arsenic contamination levels greater than 500ppb.

Later, in 2006, through a KAP survey conducted by MRD, a number of people with suspected arsenicosis were coincidentally identified in Kandal Province. Subsequently, PDRD from Prey Veng Province also reported findings of similar cases during the testing and education program. 139 families with a total of 311 people in nine villages of seven communes in Kandal and Prey Veng exhibited arsenicosis symptoms. Of the 311 people, 135 were women and 56 were children. The most common symptoms observed were Leukomelanosis (rain-drop pigmentation on skin) and Nodular Keratosis. The KAP survey indicated the increased disease burden in future and that majority of the identified patients were at the initial stage of disease manifestation. The immediate provision for safe drinking water for the patients as well as the exposed population would reduce further exposure to the disease.

UNICEF - AusAID

Evaluation of Arsenic Mitigation in Four Countries of the Greater Mekong Region

Final Report – December 2008

Dr. Mhd Jakariya and Mr Simon Deeble

Part Three



Supported by the Australian
Government, AusAID

7. Financial Assessment of Works

7.1 Overall Program Funding

UNICEF and AusAID have been the main financial contributors to the arsenic mitigation works in Myanmar, Lao PDR, Viet Nam, and Cambodia. As part of this overall program evaluation, each of the UNICEF country offices were requested to provide details of the funding amounts provided since activities commenced in 2000. Table 7.1 and Figure 7-1 show the total amounts provided by UNICEF and AusAID from 2000 – 2008 in relation to the arsenic mitigation efforts for Myanmar, Lao PDR, Viet Nam and Cambodia:

Table 7.1 Overall Program Funding

Donor	Contribution (USD)	%
UNICEF	2,350,133	52
AusAID	2,208,763	48
Total	4,558,896	100

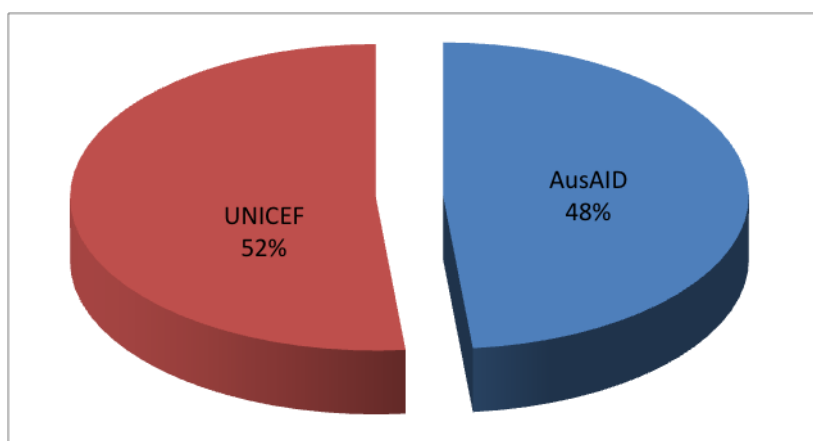


Figure 7-1 Overall Program Funding Pie Chart

Since activities began in 2000, the total funding provided across the four countries, over approximately eight years has been approximately USD4.6M, with an almost even split of contributions between UNICEF and AusAID. During this time, each of the UNICEF country offices have made substantial achievements with this amount of donor funding; significant in-roads have been made to raise awareness levels of the arsenic problem at national levels and governments have been well supported to initiate activities to mitigate the risks in affected areas. For each of the four countries, the foundations from which future programs can be launched appear to be well established.

7.2 Country Funding

The funding amounts varied for each country, with the amounts being typically linked to the size of the exposed populations. The Table 7.2 and Figure 7-2 overleaf itemise the total funding (UNICEF and AusAID) amounts for each country from 2000 to 2008:

Table 7.2 UNICEF Office Country Funding

UNICEF Country Office	UNICEF Contribution (USD)	AusAID Contribution (USD)	Total (USD)	%
Myanmar	1,195,910	725,410	1,921,320	42
Lao PDR	199,223	296,148	495,371	11
Viet Nam	200,000	767,326	967,326	21
Cambodia	755,000	414,152	1,169,152	26
Total	2,350,133	2,203,036	4,558,896	100

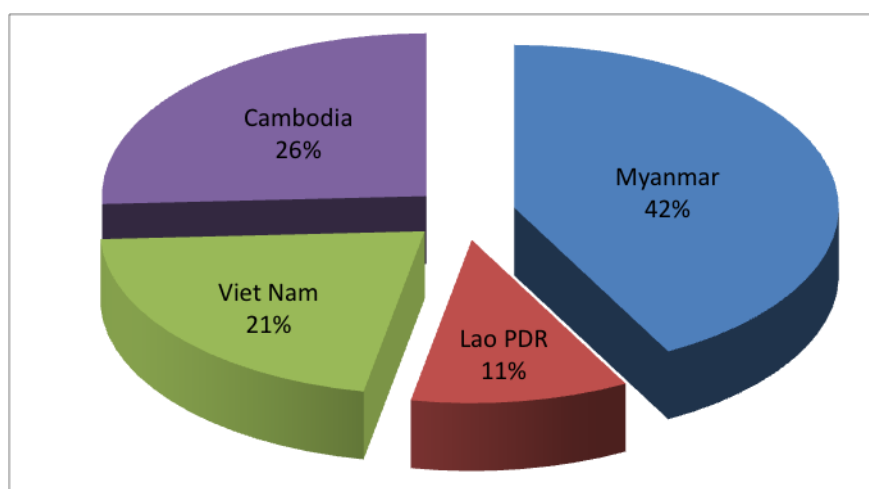


Figure 7-2 UNICEF Office Country Funding Pie Chart

7.3 Country Expenditure

As part of the evaluation, UNICEF country offices provided details on the expenditure amounts for each of the mitigation programs. The figures provided from each country office enabled country comparisons to be made¹². Each country office provided the amounts spent on each of the following key arsenic mitigation activities:

1. Testing and Database Development
2. Awareness Raising
3. Alternative Safe Water Options
4. National Strategies

The following sections summarise the expenditures of each country since activities commenced in 2000. The figures provided by the country offices are included in table and pie chart formats. For comparison purposes, the average expenditure (%) of the four countries for each activity also appears on the charts, and is shown in parenthesis. It is noted that in most cases the UNICEF country office funding amounts as shown in Table 7.2 does not match the countries' total

¹² Care should be taken when making direct comparisons between country expenditure per program. Although guidance was provided to country offices to assist them with attributing costs to each program, there are likely to be inconsistencies on how the data was attributed to each of the four programs. For example, one country office may have attributed the cost of community workshops to the Awareness Raising activities, whereas another country office may have attributed the costs to the Alternative Safe Water Options campaign.

expenditure amounts (refer Table 7.3, Table 7.4, Table 7.5 and Table 7.6). A reason for is that the expenditure amount tables separates the costs for each of the program’s activities. Program incidentals such as program staff’s wages are not necessarily included in these costs.

7.3.1 UNICEF Myanmar

UNICEF Myanmar has received the largest amount of funding when compared to the other countries, accounting for 42% of the overall budget. Table 7.3 and Figure 7-3 below demonstrates that UNICEF Myanmar also exceeded the average expenditure for their Testing & Database and Alternative Safe Water Options activities. The higher than average expenditure for these two mitigation activities suggests that Myanmar’s Arsenic Mitigation program is well developed and has a strong foundation with community based capital works being well underway and opportunities to expand further.

Table 7.3 UNICEF Myanmar Activity Expenditure

Activity	Myanmar Expenditure (USD)	% (Myanmar)	Average Expenditure (USD)	% (Ave)
Testing & Database	644,642	40	355,433	34
Awareness Raising	52,067	3	135,480	13
Alternative Safe Water Options	922,239	56	453,800	44
National Strategy	5,802	1	97,943	9
Total	1,642,749	100	1,042,669	100

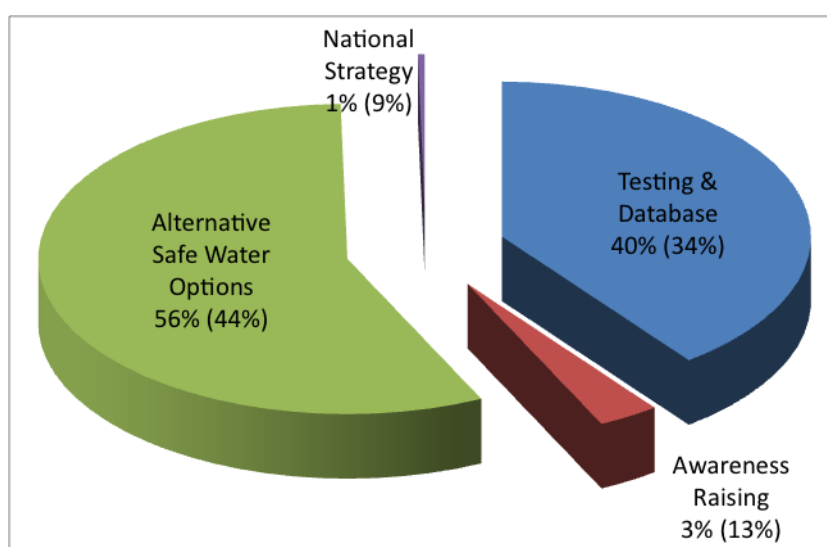


Figure 7-3 UNICEF Myanmar Activity Expenditure Pie Chart

7.3.2 UNICEF Lao PDR

UNICEF Lao PDR’s funding was the lowest of the four countries, comprising of 11% of the overall budget. UNICEF Lao PDR’s higher than average expenditure on Awareness Raising activities indicates that the program is progressing from its initial stages to an intermediate phase. The development of the provincial risk maps has assisted key stakeholders to gain a better

understanding of the scale of the arsenic problem in Lao PDR. This in turn has provided for more constructive discussions at a national level leading to a more enabling environment for the formulation of policies and procedures. The higher than average Awareness Raising expenditure demonstrates that considerable efforts are being made to inform affected communities on the arsenic issue. Whilst some work has begun on offering mitigation options to the communities, the next phase of works should focus more intensely on promoting and implementing alternative safe water options.

Table 7.4 UNICEF Lao PDR Activity Expenditure

Activity	Lao PDR Expenditure (USD)	% (Lao PDR)	Average Expenditure (USD)	% (Ave)
Testing & Database	98,087	33	355,433	34
Awareness Raising	109,409	36	135,480	13
Alternative Safe Water Options	65,571	22	453,800	44
National Strategy	26,751	9	97,943	9
Total	299,828	100	1,042,669	100

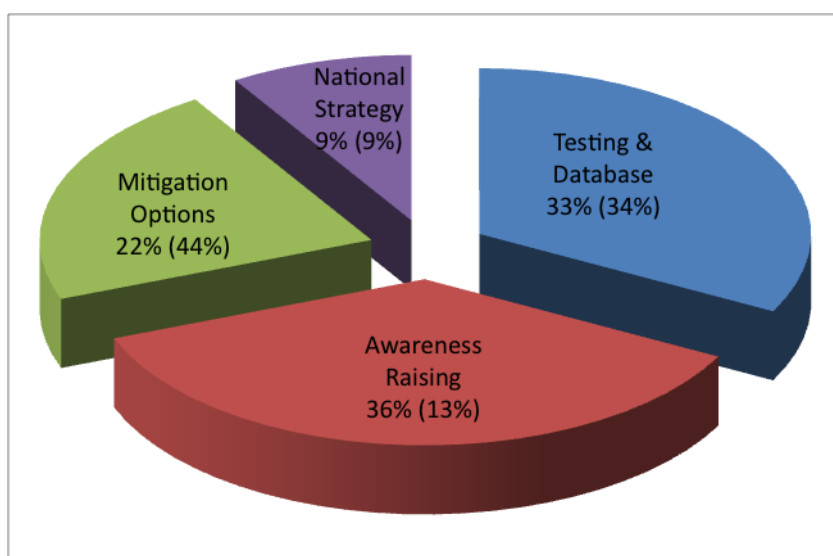


Figure 7-4 UNICEF Lao PDR Activity Expenditure Pie Chart

7.3.3 UNICEF Viet Nam

UNICEF Viet Nam's expenditure comprised approximately 21% of the overall funding amount. As shown in Table 7.5 and Figure 7-5 below, a considerable amount of effort has been placed into Testing and Database development and Awareness Raising activities. This is in line with Viet Nam's 'short-term' strategy; to understand the scale of the problem and promote household treatment options. The relatively high expenditure amount attributed to Alternative Safe Water Options was unexpected as activities were limited to promotion only. It is also the consultants' understanding that subsidies were not provided to communities to assist with construction of options. As part of the evaluation exercise UNICEF Viet Nam may have attributed the costs associated with community mobilisation, and also development of IEC material to the Alternative Safe Water Options which would account for the higher than expected expenditure amount. As Viet Nam's arsenic mitigation

program progresses and Viet Nam begins to implement their long term mitigation strategy, which includes large scale piped water systems, it is expected that more funding will be spent on alternative safe water options.

Table 7.5 UNICEF Viet Nam Activity Expenditure

Activity	Viet Nam Expenditure (USD)	% (Viet Nam)	Average Expenditure (USD)	% (Ave)
Testing & Database	307,547	40	355,433	34
Awareness Raising	244,141	31	135,480	13
Alternative Safe Water Options	157,053	20	453,800	44
National Strategy	66,842	9	97,943	9
Total	775,582	100	1,042,669	100

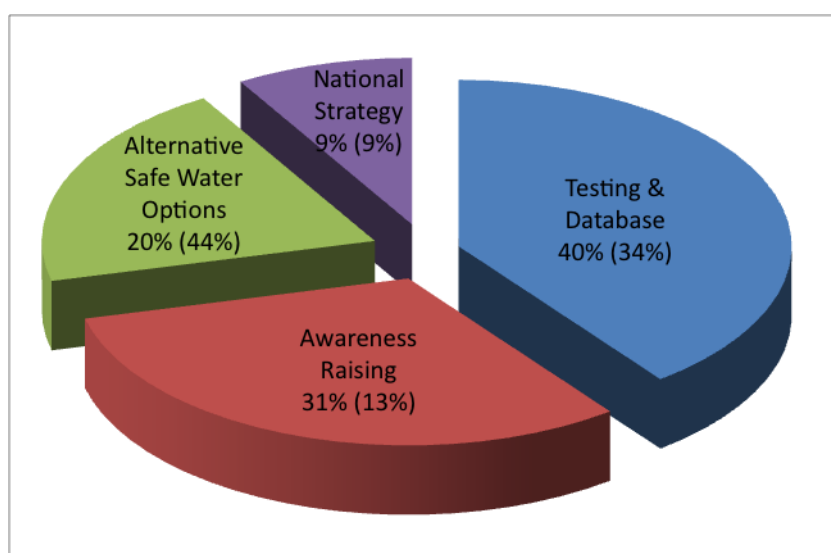


Figure 7-5 UNICEF Viet Nam Activity Expenditure Pie Chart

7.3.4 UNICEF Cambodia

UNICEF Cambodia's funding accounted for approximately 26% of the overall funding budget. As observed in Table 7.6 and Figure 7-6 the Testing and Database expenditure is considerably lower than the average, despite approximately 30,000 water quality samples being tested. A potential reason for this difference is that during the initial phases of testing there were numerous agencies involved in conducting random testing. Water quality test results from other agencies were included in the national database, however, it is likely that the costs associated with these tests were provided from alternative funding sources and have therefore not been attributed to the overall program costs.

The higher than average National Strategy expenditure was expected as Cambodia has made considerable achievements in this area. A number of policies and guidelines, including the Strategic Action Plan and also the Situation Analysis, have been developed representing important steps to establishing a framework for the program.

Table 7.6 UNICEF Cambodia Activity Expenditure

Activity	Cambodia Expenditure (USD)	% (Cambodia)	Average Expenditure (USD)	% (Ave)
Testing & Database	371,487	25	355,433	34
Awareness Raising	136,307	9	135,480	13
Alternative Safe Water Options	670,341	46	453,800	44
National Strategy	292,381	20	97,943	9
Total	1,470,516	100	1,042,669	100

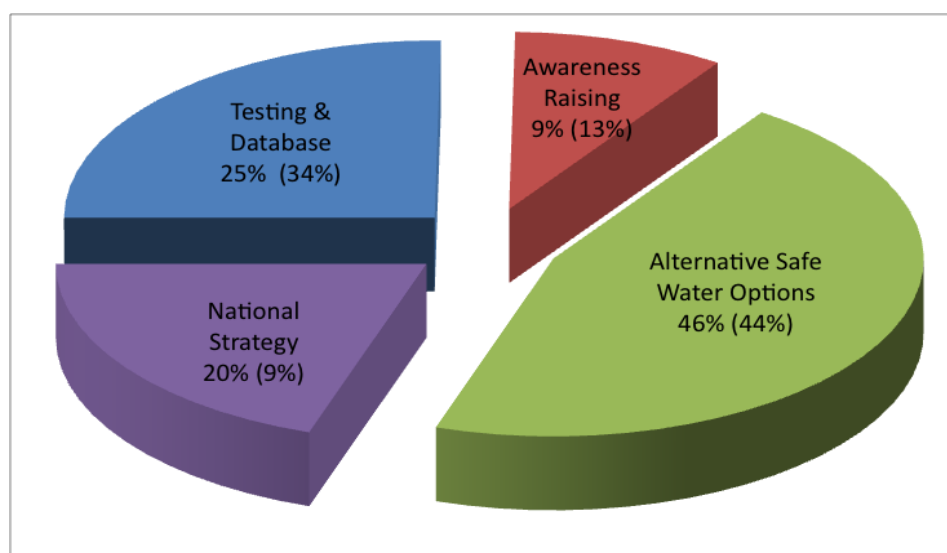


Figure 7-6 UNICEF Cambodia Activity Expenditure Pie Chart

7.4 Testing & Database

Figure 7-7 overleaf demonstrates clearly that UNICEF Myanmar has spent the most on Testing and Database development when compared to the other countries. The money spent coincides with the high number of water quality tests that Myanmar has conducted. This has also led to the establishment of an extensive and impressive database of tests results in Myanmar. Figure 7-7 also shows the impressive number of water quality tests completed by Viet Nam, despite a much lower expenditure. This is due to the Viet Nam Government funding the majority of the 187,000 water quality tests that have been completed, however, it is likely that the costs for these tests were not been attributed to the UNICEF Viet Nam program.

UNICEF Lao PDR has spent the least on Testing and Database development and has also conducted a considerably smaller number of tests when compared to the other countries. It is noted, however, that Lao PDR has also tested for 11 other water quality parameters, in addition to arsenic, which has undoubtedly increased their expenditure amounts in this area.

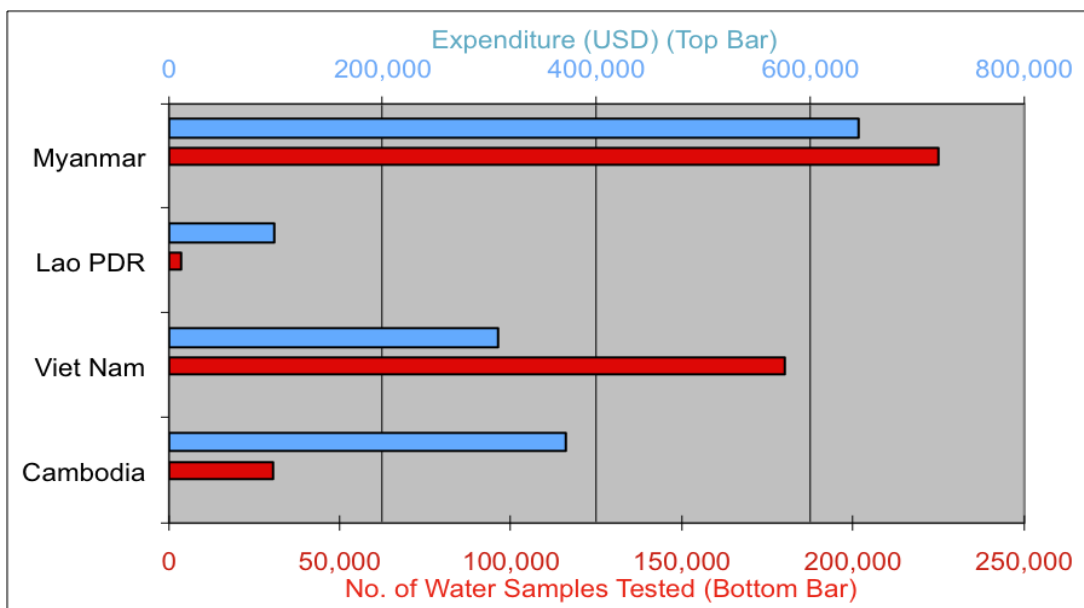


Figure 7-7 Testing & Database: Expenditure versus No. of Water Samples Tested

7.5 Awareness Raising

Awareness Raising activities have been the main focus of UNICEF Viet Nam’s Arsenic Mitigation Project. Figure 7-8 confirms that UNICEF Viet Nam has spent the most money on Awareness Raising activities when compared to the other countries.

Figure 7-8 shows the relationship between expenditure on Awareness Raising activities and the number of people within an affected community who have been informed on the arsenic problem. As mentioned previously, it is difficult to quantify the people whose awareness levels have improved as result of program efforts, particularly as few KAP surveys were conducted by the UNICEF country offices. Nonetheless, as part of this evaluation, each UNICEF country office was requested to estimate the number of people who have been informed as a result of the program’s efforts. Figure 7-8 shows that an enormous number of Viet Nam’s community members have been informed on the arsenic issue. This numbers, however, need to be verified, as it appears UNICEF Viet Nam has reported that the entire population of each of the high risk areas has been informed.

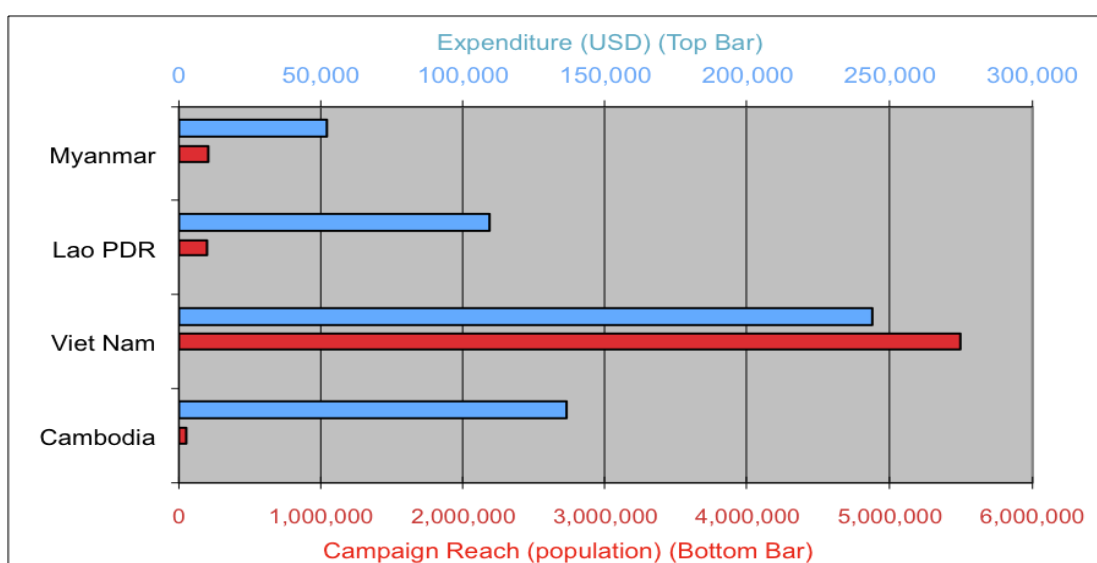


Figure 7-8 Awareness Raising: Expenditure versus Campaign Reach

7.6 Alternative Safe Water Options

UNICEF Myanmar and UNICEF Cambodia have clearly been the most active in offering alternative safe water options to affected communities. This is reflected in the both the expenditure amounts and also the number of people gaining access to safe water as a result of the program as shown in Figure 7-9. It was expected that UNICEF Myanmar's expenditure on alternative safe water options would be higher when compared to the other countries. UNICEF Myanmar has introduced a number of solar powered reticulated systems as part of their Alternative Safe Water Options activities. The infrastructure required for these systems are typically more expensive than conventional pumping systems.

The numbers of people using alternative safe water options in Viet Nam were not available as UNICEF Viet Nam focussed on promotion rather than implementation, although expenditure was attributed to Alternative Safe Water Options activities.

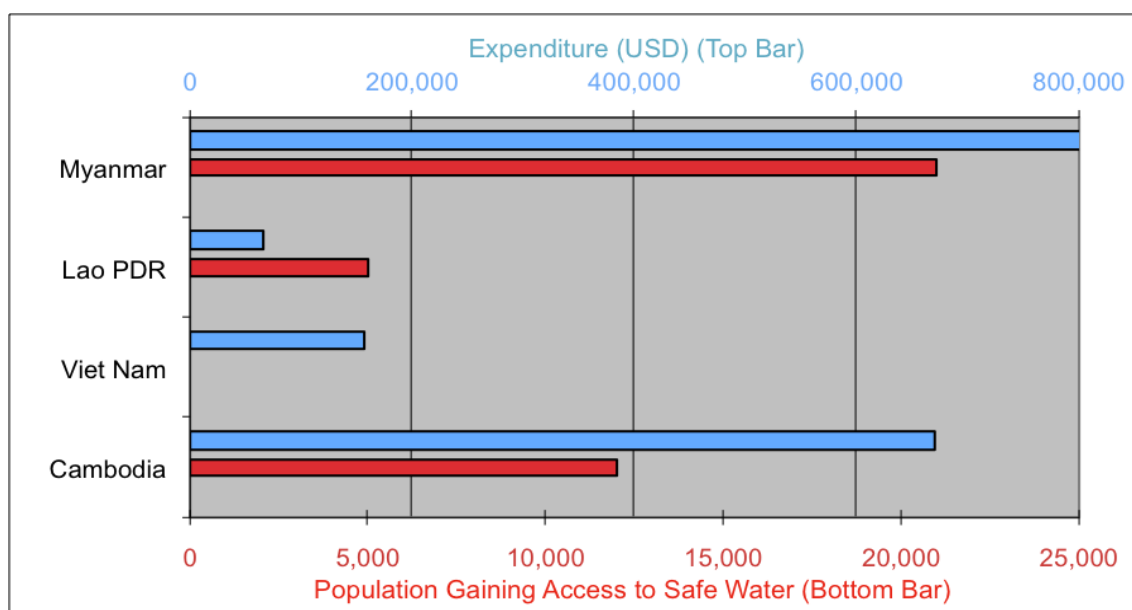


Figure 7-9 Alternative Safe Water Options: Expenditure versus Population gaining access to safe water

7.7 National Strategies

Figure 7-10 overleaf clearly shows that UNICEF Cambodia has spent a considerable amount more on National Strategy development when compared to the other countries. UNICEF Cambodia has utilised these funds well through the development of a number of policies and guidelines for the arsenic mitigation works. A similar level of achievement was made in Viet Nam, although UNICEF Viet Nam's expenditure is considerably lower than UNICEF Cambodia. It was noted, however, that the UNICEF Viet Nam arsenic mitigation program was also supported by other agencies such as the WHO, who assisted in the development of health related guidelines.

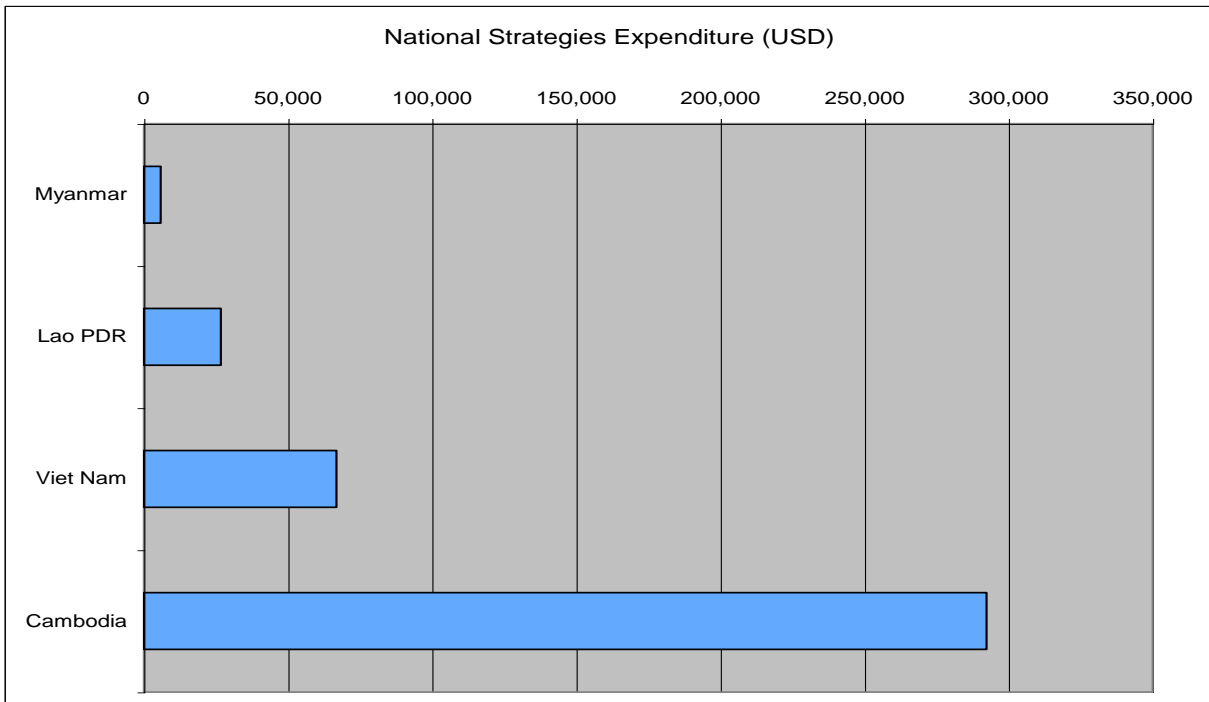


Figure 7-10 National Strategies – Expenditure

7.8 Unit Costs

Unit costs for a variety of arsenic mitigation activities were requested from each of the UNICEF country offices. The aim was to compare activity costs between the countries to act as a useful reference point and to assist with budgeting for future program activities. A key aspect of this comparison was to ensure that there was consistency with the units that were used to determine each cost.

As each country office submitted their unit costs, it became evident that the qualifications that were provided from each office made a true comparison too difficult. The units for each activity were all different, and any attempts to manipulate the data to create consistency would undermine the validity of the responses.

The difficulty in establishing a standard unit cost of each of the activities highlighted that there are considerable differences in the activities that are being conducted by the country offices. It appears that each office is working independently with only limited evidence suggesting that lessons learned and successes from neighbouring countries are being utilised by the UNICEF country offices. An example of this is the variations in the types of testing equipment that is used and also the water quality parameters that are being tested. This has a major impact to the cost of testing; in Cambodia and Viet Nam water samples are testing for arsenic only, whereas in Lao PDR, 12 water quality parameters, including arsenic are being tested.

It was hoped that a worthwhile comparison of each of the country offices' alternative safe water options could be made so that cost differences could be highlighted and opportunities for cost savings could be explored. Whilst some information could be extrapolated from the data, the qualifications made by the country offices again made it too difficult for a true cost comparison.

One worthwhile comparison that was noted was that the cost of installing bores in Myanmar appeared higher than the other countries. One reason for this difference could be the diameter of the bore that is used which is typically larger than what is required. UNICEF Myanmar explained that

one of the reasons for installing an oversized bore was to allow for future population growth of the area. Whilst the procedure appears reasonable where population growth is expected and it is unlikely other water sources will be constructed, UNICEF's Regional Office suggested that in many cases, the population using the water source does not increase and the spare capacity of the bore is not utilised. To assist with such situations, it is understood UNICEF's Head Quarters is preparing guidelines on designing a variety of safe water options for country offices.

Although Unit Cost comparisons could not be made for each country, the information that was provided should act as useful reference point for other countries which are involved in arsenic mitigation activities. Each country's Unit Cost data is provided in Appendix H.

8. De-briefing Workshop

As per the TOR, a de-briefing workshop was held at the conclusion of the country visits. Conducted in Cambodia, representatives from each of the four UNICEF country offices attended, along with key personnel from AusAID, World Bank, and WHO. Royal Government of Cambodia representatives also participated in the workshop, along with local NGOs who are working within the arsenic mitigation sector.

The key purpose of the de-briefing workshop was to allow the consultants to present the findings from the field visits and also discuss future programs for the countries and the region. The consultants presented 3 presentations:

- ▶ Discussion of Country Programs and Recommendations;
- ▶ Financial Comparison of Country Programs; and
- ▶ Comparison of Country Activities.

Each of the presentations are provided in Appendix E.

The de-briefing workshop also included participatory activities where attendees were invited to separate into groups which had been split into the 4 major elements. Each group was asked to consider the consultants presentations and propose key areas for future programs where regional support can be provided.

The general recommendations from the group discussions involved improving knowledge sharing between countries and also learning from the successes from the other countries activities. It was also recommended that future regional support focus on supporting National Strategy Development and development of guidelines and frameworks. The notes from the group discussions, as recorded by UNICEF Cambodia are also provided in Appendix E.

9. Comparison of Countries' Activities

9.1 Testing and Database Development

9.1.1 Identification of High Risk Areas

When compared to the other countries, Myanmar achieved significantly more progress in the number of samples tested and the development of a comprehensive database system. Identification of the high risk areas through the development of risk maps is also considered to be a key initiative in planning arsenic mitigation activities. In all countries except Lao PDR, risk maps were prepared based on the existing water testing results and geological information. In Lao PDR, risk maps were prepared from the test results of UNICEF Lao PDR's supported tubewells only.

9.1.2 Blanket Testing

Since arsenic concentrations vary widely based on the geological formation it is important to conduct blanket testing in the entire risk area. Cambodia was the only country where blanket testing had been completed in all high risk villages. Although identified as a task to complete, the other countries had not commenced blanket testing.

Each country developed their own strategy to perform testing of tubewell water. For example, in Lao PDR, appropriate mechanisms for blanket testing have not yet been developed. In Kammasak province of Lao PDR, the provincial authority identified the total number of tubewells and estimated that testing of all the 6,000 tubewells that might exist in that province may take over two years to complete.

9.1.3 Water Quality Testing Criteria

There were differences between the countries on what additional water quality parameters should be tested, in addition to arsenic. Myanmar and Lao PDR considered testing other parameters in addition to arsenic. In Lao PDR, 12 different parameters were tested for all the 3,500 tested tubewell samples tested as part of the national survey. This was done in order to get an idea about other possible contaminants in the drinking water.

9.1.4 Field Test Kits

The use of appropriate and user friendly kits to test tubewell water in the field is extremely important to ensure accurate and reliable marking of tubewells. It was revealed that a variety of field test kits were used by the countries for water quality sampling. In some instances, countries were using a number of test kits. It is important one type of field kit is used consistently as different kits have different sensitivity and specificity. Furthermore, to a large extent the performance of the kit depends on the field testers and on testing procedure. Among the four countries Viet Nam initially started using different types of field kits but later decided to use the Merck field test kit since they found this kit to be the most accurate and user friendly.

9.1.5 Verification of Test Results

Cross-checking of the field test results both in the field and at the laboratory is important to produce accurate results. Cross-checking at field level by supervisors was practiced only in Cambodia. It is similarly important that a certain number of samples are sent to the laboratory for further verification by more sophisticated methods, eg. Atomic Absorption Spectrophotometer (AAS). Viet Nam and Myanmar were following a process of sending samples to the laboratory for cross-verification,

although each country developed a different criteria for sending samples. In Viet Nam samples containing arsenic greater than 50ppb are sent to the laboratory whereas in Myanmar samples with arsenic contamination results greater than 200ppb are sent to the laboratory. It is important, however, to also send samples with less than 50ppb concentration level to the laboratory for analysis since field kits often do not provide accurate results at low concentration levels (i.e. < 50ppb).

9.2 Awareness Raising

9.2.1 Communication Strategy

A clear and concise arsenic mitigation Communication Strategy was missing for each country. Whilst various awareness raising activities were being conducted by each of the countries, there was a lack of an over-arching guiding framework. It was noted that UNICEF Cambodia had developed a 'draft' communication strategy, although at the time of the evaluation the document had not been finalised.

9.2.2 KAP Surveys

Another key aspect of the awareness raising activities is the use of KAP surveys to assess the effectiveness of the IEC material that was being distributed to communities. UNICEF Cambodia was the only country to complete a KAP survey specific to arsenic mitigation activities. It was noted, however, that each country had pre-tested its IEC material prior to mass distribution.

9.2.3 IEC Material

Development of appropriate techniques to raise community awareness level depends on the socio-cultural aspect as well as severity of the problem. For example, in Lao PDR, people were so scared they did not even drink water from tubewells that contain arsenic less than the 10ppb, while the other hand, in Song Kroush village of Kampasak province some people are still drinking from arsenic contaminated tubewells. Therefore it is important to develop IEC materials based on the country context. It is similarly important to make provision of alternative options so that people can easily switch between these options.

Initially all the four countries focused on the negative health impacts associated with consuming arsenic contaminated water to raise community awareness about the arsenic problem. Later Cambodia modified its IEC materials and adopted a more moderate message to raise community awareness levels.

9.2.4 Painting of Water Sources

Painting of water sources after water samples had been tested can be an effective method to raise awareness in communities about the presence of arsenic in groundwater. Painting is often linked to the IEC material where 'safe' and 'unsafe' water sources are shown as 'green' and 'red' respectively. Lao PDR was the only country that chose not to paint their water sources. It was understood this was because most water sources are housed in an enclosed area. As the water source typically cannot be accessed to community members, few people would be aware if the water source had been painted. This however, would not be true if the tap at the point of collection was painted. Although, it is noted these taps are often located inside the family's home.

9.3 Alternative Safe Water Options

9.3.1 Options Offered

The provision of alternative safe drinking water options is considered to be the best way of reducing the arsenicosis burden in the absence of any proper medical support. Myanmar and Cambodia offered communities in the affected areas a variety of mitigation options for implementation, which include:

- ▶ Rain water harvesting jars of various sizes;
- ▶ Different filter including ceramic filters;
- ▶ Deep and shallow tubewells; and
- ▶ Piped waters systems.

In Lao PDR, the mitigation options offered to communities were limited to RWH tanks only. In Viet Nam, mitigation options were promoted to affected communities, however, no financial assistance was offered for construction. In the north of Viet Nam almost all households were using sand filters initially to remove iron but later when arsenic was discovered, people came to understand that the sand filter can take also remove arsenic from the raw water to some extent. In these areas, UNICEF Viet Nam arranged for demonstration of a new and improved version of sand filter with a higher arsenic removal efficiency.

Preference for tubewells was found to be still high in Lao PDR and in the northern parts of Viet Nam. Preference was found to be less in the other two countries, however, to some extent tubewell installation was still going on in the other countries. Lao PDR and Viet Nam have established government regulations for the installation of new tubewells, however, proper enforcement of the regulation was found to be reluctant in both countries.

Collection of rainwater in traditional jars was found to be common in all four countries. In most cases it was observed that people drink such water after boiling. Poor families, however, who lack access to adequate fuel resources were seen drinking directly from collected traditional tanks and also from untreated rivers. As such, diarrhoea continues to be a major threat in ensuring safe water is provided to affected communities in each of the four countries. Introduction of water safety plans (WSP) is an initiative to make drinking water free from pathogen and heavy metal contamination. Although the WSP initiatives were relatively new in all the four countries, villages that were visited during the country visits were enthusiastic about the initiative and displayed ownership over addressing water quality issues within their communities. This initiative needs to be expanded in each country as biological contamination of water was found to be more severe than arsenic and other heavy metal contaminants in all the four countries.

Both in Cambodia and Myanmar people in the arsenic affected areas were found to be using household ceramic filters to treat surface water. Ceramic filters appear to be an extremely important option in the provision of alternative safe water, as the majority of people in all four countries traditionally drink surface water and this has been increased in recent years due to arsenic contamination in tubewell water.

9.3.2 Public Private Partnerships

Cambodia was the only country that had implemented public-private partnerships in arsenic affected communities. Whilst it is recognised that the Government's requirement to ensure safe water is reduced when private entrepreneurs are involved in the safe water business, stronger government regulations are required to make this initiative sustainable.

9.3.3 Distribution Regulations

It is important to develop regulations for distribution of the project subsidized options so that the disadvantaged exposed groups are prioritised. Comprehensive and clear distribution guidelines have not prepared by any of the countries. Priority was provided to households whose water source was found to be contaminated. It did not appear, however, that the financial status of the household was considered when selecting beneficiary households. An example of this was in Cambodia where separate guidelines were developed for central and provincial levels. In Song Kroush village only 10% of the total ceramic filters were distributed among the poor villagers as a result of an understanding gap between the central and provincial arsenic mitigation guidelines.

9.4 National Strategy and Co-ordination

9.4.1 National Strategy

Development of a national strategy reflects Government's commitment to address an issue. More or less all of the four countries had developed national strategies to address the arsenic problem, however, Viet Nam and Cambodia were the only countries where the strategy was documented. Cambodia's Strategic Action Plan established goals and targets for arsenic mitigation activities and also a clear division of responsibility. Although still awaiting Government approval, the document can be cited as an example to be followed by other Mekong countries. Viet Nam's National Arsenic Action Plan is a comprehensive document that sets program targets and also provides guidelines for activity implementation. Viet Nam's National Arsenic Action Plan was endorsed by the Viet Nam Government in 2006.

9.4.2 Co-ordination

Co-ordination among different stakeholders, including government agencies is extremely important for achieving sustainability. With the exception of Lao PDR, coordination among different stakeholders, both government and non-government, needs to be enhanced. In Lao PDR all activities related to arsenic mitigation are being controlled by the government agency Nam Saat.

9.4.3 NGO Involvement

International NGOs are actively participating in arsenic mitigation activities, in each of the four countries, however, there was no involvement of national NGOs. There appeared to be limited co-ordination amongst NGOs and it is recommended that the international NGOs should co-ordinate more and follow the national strategies to implement program activities.

10. Key Achievements and Key Recommendations

Each country has successfully implemented arsenic related activities. The level of achievement, however, varied widely amongst each country. The following sections present the key achievements of each country and also the consultants' key recommendations.

10.1 Myanmar

10.1.1 Key Achievements

- ▶ An impressive 230,000 water samples have been tested; the largest number of water sample tests completed compared to the other countries
- ▶ Arsenic risk maps were developed from results of the water sample tests and also available geological information. Myanmar also installed approximately 36 new tubewells to gather additional geological information in order to assist in generating a country arsenic risk map
- ▶ The comprehensive database that was developed was an excellent achievement. The introduction of PDA machines to enter field data directly into the database was an innovative initiative. It is noted that this technologically advanced GPS controlled data entry system may only be possible for Myanmar because of its high literacy rate¹³
- ▶ The establishment of the Inter-Ministerial Action Group was a clear demonstration of the Government's commitment to addressing the arsenic issue in Myanmar
- ▶ Awareness Raising activities have informed approximately 35,000 households on the arsenic issue
- ▶ Through the Alternative Safe Water Options activities, approximately 21,000 people have gained access to safe water, which is approximately 9% of the total estimated exposed population

10.1.2 Key Recommendations

Testing & Database Development

- ▶ Expand testing of all tubewell water in the arsenic exposed areas, starting from the high to low risk areas
- ▶ Explore the possibility of using a single, suitable field kit to test the remaining water points in the exposed areas
- ▶ Review the existing cross checking procedures to include verification of samples in the field by supervisors and also conducting laboratory testing of water samples where field test results showed contamination levels below 50ppb
- ▶ Identification of arsenic should be given priority; testing of other parameters could be a separate initiative based on the lessons learned from the initial testing results of other water quality parameters
- ▶ Review existing database for wider application (e.g. safe depth, O&M records, emergency responses) and consistency with UN/Government agencies.

¹³ In rural areas, 97% of Myanmar people are literate

Awareness Raising

- ▶ Develop an arsenic specific Communication Strategy outlining key messages, responsible parties and establishing measurable targets
- ▶ Undertake arsenic specific KAP surveys to assess effectiveness of awareness raising activities and review campaign messages accordingly

Alternative Safe Water Options

- ▶ Develop guidelines for tubewell installation including procedures for recording lithological information
- ▶ Develop guidelines for distribution of alternative safe water options, including standardisation of contribution amounts for the various mitigation options
- ▶ Ensure that the ongoing operation and maintenance costs of each mitigation option are identified and committed to by the communities prior to implementation

National Strategy and Co-ordination

- ▶ Encourage improved co-ordination amongst different key stakeholders including government ministries, NGOs and donors through regular meetings to share and exchange ideas on water and sanitation issues

10.2 Lao PDR

10.2.1 Key Achievements

- ▶ Establishment of the National Water Quality Standards and Regulations, which included allowable limits for arsenic contamination
- ▶ Monitoring guidelines have been established, however, these guidelines need to be revised based on practical evidence and precedence from neighbouring countries
- ▶ 3,500 water samples have been tested, identifying high risk areas for future mitigation activities
- ▶ Under the national survey, information was collected on 12 water quality parameters which identified risk maps for other possible water contaminations
- ▶ Community Awareness Raising activities have informed approximately 200,000 people of the arsenic issue
- ▶ Through the Alternative Safe Water Options activities, approximately 5,000 people have gained access to safe water

10.2.2 Key Recommendations

Testing and Database Development

- ▶ Based on the national survey data, select specific water quality parameter(s) to test the remaining tubewells water of the country
- ▶ Explore the possibility of using a single suitable field kit to test the remaining tubewells
- ▶ Make provision for cross checking the field kit data both in the field by supervisors and a laboratory with sophisticated methods (e.g. AAS).
- ▶ Tested tubewells should be marked either red or green based on the test results

- ▶ Review existing database for broader application (e.g. safe depth, O&M records, emergency responses) and consistency with UN/Government agencies

Awareness Raising

- ▶ Develop stand-alone arsenic nation-wide Communication Strategy that identifies key messages, parties responsible and establishes measurable targets
- ▶ Conduct arsenic specific KAP surveys and review effectiveness of messages accordingly
- ▶ Explore opportunity to include community health staff in awareness raising activities

Alternative Safe Water Options

- ▶ Include groundwater and surface water as alternative safe water options
- ▶ Review subsidy amounts provided for each safe water option
- ▶ Explore opportunity to support local manufacturing of Ceramic Water Filters
- ▶ Introduce water safety plans to arsenic affected areas

National Strategy and Co-ordination

- ▶ Enhance the National policy for easier implementation of the programme
- ▶ Coordination among different stakeholders should be further supported

10.3 Viet Nam

10.3.1 Key Achievement

- ▶ The National Arsenic Action Plan was endorsed by the Government. Accordingly the MARD and other key stakeholders are taking action to maintain the arsenic issue as a priority in addition to allocating funding to provincial budgets
- ▶ The National Arsenic Steering Committee (NASC) was established to act as a focus point for arsenic mitigation activities
- ▶ Formulation and dissemination of Arsenicosis Diagnosis Guideline
- ▶ Standardization of the field kit; Merck testing kit was selected as the single test kit to be used for arsenic testing in the field by all stakeholders involved with arsenic mitigation activities in Viet Nam
- ▶ Risk maps were developed based on the test results of 187,000 water samples and existing geological information
- ▶ District and provincial risk maps will be prepared by the end of 2008
- ▶ A comprehensive database system has been developed and is in operation

10.3.2 Key Recommendations

Testing & Database Development

- ▶ Test all tubewell water in the high risk areas (i.e. blanket testing)
- ▶ Consider testing of other water quality parameters (e.g. Mn) while expanding the countrywide testing program

- ▶ Review the appropriateness of the two drinking water standards (e.g. 10ppb and 50ppb). It is unconventional and appears to cause confusion amongst provincial staff
- ▶ Cross checking of the field test data (at least 5%) by the supervisors in the field
- ▶ Conduct cross-referencing tests in laboratories where field test results showed arsenic contamination above and below the national standard
- ▶ Explore the opportunity to decentralize the arsenic data inputting responsibility to provincial offices with the possibility to expand for broader water quality data collection
- ▶ Review existing database for broader application (e.g. safe depth, O&M records, and emergency responses) and consistency with UN/Government agencies

Awareness Raising

- ▶ Conduct arsenic specific KAP surveys to assess the effectiveness of the awareness raising activities
- ▶ Review DVD message so that limitations of the promoted arsenic removal techniques are discussed

Alternative Safe Water Options

- ▶ Develop a clear framework and timelines for short term and long term mitigation activities
- ▶ Continue to test water samples from household arsenic removal plants ensuring that the removal plants consistently produce water that meets the relevant standards for arsenic contamination
- ▶ Review effectiveness of pilot WSP program for potential for roll-out to more communities

National Strategy and Co-ordination

- ▶ Explore the possibility of separating the awareness raising activities from the mitigation components
- ▶ Train Health Centre staff for primary identification of arsenicosis patients
- ▶ Co-ordination among different stakeholders should be further supported

10.4 Cambodia

10.4.1 Key Achievements

- ▶ The formation of the Arsenic Inter-ministerial Sub-Committee (AISC) to coordinate the Government's response
- ▶ Development of the national Strategic Action Plan for arsenic mitigation activities established clear lines of responsibility and set goals and targets to effectively monitor the program's progress
- ▶ A KAP survey was conducted to evaluate the progress and effectiveness of the arsenic mitigation activities
- ▶ 37,200 water samples have been tested
- ▶ Blanket testing has been completed in 1,607 high risk villages
- ▶ IEC material was revised and a moderate message has been adopted instead of the focussing on negative health impacts of consuming arsenic contaminated water

- ▶ Good involvement of research institutions to carry out different studies to make arsenic mitigation activities sustainable
- ▶ The arsenicosis patient management guideline was adopted from the existing WHO guideline for use in Cambodia and accordingly the patient management initiative was started in Cambodia
- ▶ Public-private partnerships have been initiated to ensure more rapid safe water coverage
- ▶ Through Awareness Raising activities, approximately 50,000 people were informed on the arsenic problem
- ▶ As a result of the Alternative Safe Water Options activities, 12,000 people have gained access to safe water
- ▶ Identified arsenicosis patients have been provided alternative safe water options and are no longer consuming arsenic contaminated water
- ▶ A National Arsenic Centre has been established for better coordination of arsenic mitigation activities

10.4.2 Key Recommendations

Testing and Database Development

- ▶ Expand the blanket testing of tubewell water in the entire flood plain areas of the country
- ▶ Consider testing of other water quality parameters for risk identification (e.g. Mn, fluoride, etc)
- ▶ Explore the possibility of using a single suitable field kit to test the remaining tubewell water of the country
- ▶ Explore the possibility of collaborating with research institutions (e.g. ITC) to use their laboratory facility for cross validation of the field kit results
- ▶ Explore opportunity to decentralize the arsenic data inputting responsibility to provincial offices with the possibility to expand for broader water quality data collection
- ▶ Review the existing database for wider application (e.g. safe depth, O&M records, emergency responses) and consistency with UN/Government agencies
- ▶ In the case of public-private partnerships, clearer definition is required on water quality testing protocols. It is preferable that the water seller tests water quality regularly and Government take responsibility of cross-checking
- ▶ Involve health volunteers with PDRD testing teams for regular monitoring of water quality

Awareness Raising

- ▶ Finalise draft Communication Strategy and roll out for future program activities
- ▶ Undertake mid program review on effectiveness of IEC material
- ▶ Review questions for future KAP surveys so that more realistic results on awareness levels can be obtained

Alternative Safe Water Options

- ▶ Consolidate the two existing strategies for beneficiary selection and contribution amounts (National and Excom). Conduct refresher training for PDRD staff involved in safe water option implementation

- ▶ Stronger government regulations should be enforced to facilitate the involvement of private companies in water business in a sustainable way
- ▶ Continue to encourage communities to purchase large RWH tanks

National Strategy and Co-ordination

- ▶ Government to approve the national Strategic Action Plan
- ▶ Improve co-ordination between key in-line ministries, in particular between MRD and MOH

11. Future support from UNICEF Regional Office

UNICEF's East Asia & Pacific Regional Office, which is based in Bangkok, has played a key role in supporting each of the four countries' arsenic mitigation programs. In addition to its role of sourcing and allocation of funds, UNICEF's Head Quarters has also supported the countries through the development of technical guidelines for referencing, such as the 'UNICEF Arsenic Primer', and the 'Communication Strategy Handbook'. The Regional Office has also made technical specialists available to country offices on an 'as required' or 'as requested' basis.

The support to date has been commendable, however, during the consultants country visits, and also during the de-briefing workshop, there were a number of areas where each of the UNICEF country offices felt further support from the Regional Office would be beneficial to their respective programs. These areas include:

- ▶ Facilitating exchange programmes and visits for the key stakeholders both from government and non-government organizations
- ▶ Supporting additional workshops at a certain intervals for each of the four country offices to share successes and constraints of program activities for possible adoption by other countries
- ▶ Creating clearer communication on what technical support may be required by each of the country offices and also what assistance can be offered from the Regional Office through either internal or external consultants
- ▶ Exploring opportunities to save costs through mass procurement of equipment, eg water quality testing equipment and PDAs for data collection
- ▶ Ensuring UNICEF country offices' web portals are up to date with latest information and material on arsenic mitigation activities
- ▶ Continuing to track international workshops/seminars where presentations on countries' arsenic mitigation activities can be shared
- ▶ Remaining abreast of alternative safe water options that are being trialled and sharing results of evaluations on appropriateness/verifications that have been completed
- ▶ Providing guidance to country offices on subsidy/user fees for arsenic mitigation options
- ▶ Disseminating water and sanitation related information among the four Mekong countries on a regular basis through publishing e-newsletter.

12. Conclusion

Overall, each country's progress to mitigate the arsenic problem with the active involvement and financial support from UNICEF, and particularly with recent financial support from AusAID, is commendable.

A key achievement for each of the four countries was the establishment of an institutional environment where future arsenic mitigation programs can be launched from a strong foundation. Governments' awareness levels have been increased, the determination of the risk areas is progressing well and each country has assisted in providing safe water alternatives to affected communities.

Nonetheless, there is considerable amount of work still required by each country to secure safe water to communities in affected areas. Testing of water samples in high risk areas needs to continue, greater efforts are required to raise affected communities' awareness levels on the arsenic issue, and more funding is needed for the provision of alternative safe water options.

Through continued financial and technical support from UNICEF and donors such as AusAID, the momentum that has been created by the four countries can be carried through to future phases of the arsenic mitigation program.

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Appendix A

Arsenic Field Test Kit Description

Appendix B

UNICEF Arsenic Primer – Module 7, Provision of Safe Water

Appendix C

Country Visit Itineraries

Appendix D
Evaluation TOR

Appendix E

Workshop Presentations

Appendix F

List of Documents on DVD

Appendix G

Lao PDR's 7 Step Implementation Process

Appendix H

Unit Cost Information from Country Offices