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Arsenic contamination of water sources in rural Myanmar

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ARSENIC CONTAMINATION OF drinking water sources is an emerging public health issue in Myanmar. In early 2000, Save the Children UK's (SC UK) Water and Sanitation Programme identified arsenic contamination of groundwater in rural Ayeyerwady River Delta project communities. Since that time, there has been growing interest, concern and action related to arsenic testing, communication and mitigation in Myanmar. The magnitude of arsenic contamination of groundwater sources in Myanmar is unknown, as no comprehensive studies have been conducted. This paper describes SC UK's experience conducting an extensive water quality survey of drinking water sources in project communities and implementation of a community-based pilot arsenic action project.

Background

After the severe flooding of 1997 in Myanmar, SC UK initiated a water and sanitation rehabilitation project in 12 flood-affected rural Townships. The project facilitated the construction of 50,000 household latrines and constructed/rehabilitated village drinking water sources including 957 sludger-drilled shallow tube wells (STW). More than 60% of project achievements – 30,000 household sanitary latrines and 615 water supply projects were located in four Ayeyarwady Division Townships.

Based upon geographical similarities between Myanmar and Bangladesh delta-regions, SC UK expressed suspicions of arsenic contamination of groundwater, especially in those communities located in the Ayeyarwady River Delta. A preliminary water quality survey was carried out by SC UK in 63 project communities during March-May 2000. The findings showed that arsenic contamination in excess of the proposed Myanmar national standard of 0.05 mg/l was present in 35% of the 145 inspected STWs, thus confirming initial concerns.

Extensive water quality survey

In early 2001, SC UK conducted a comprehensive water quality survey in 327 villages and wards, covering an area of approximately 550 square kilometers in four Ayeyarwady Division Townships (Thabaung, Laymyathna, Hinthada, and Kyonpyaw Townships). The survey covered 1,969 drinking water sources including 1,912 STWs. The purpose of the survey was to: 1) assess the bacteriological safety of STWs for drinking water purposes; 2) check for the presence of arsenic in STWs in order to determine the extent and severity of the problem and if possible to help explain the pattern of occurrence; 3) measure five other water quality parameters considered particularly relevant: iron, manganese, pH, electrical conductivity and temperature; 4) rapidly assess the physical condition and use of SC UK water and sanitation instillations two years after implementation; and to 5) provide supplementary data for the newly initiated country-wide Myanmar National Water Quality Surveillance and Monitoring Programme.

Survey methodology

The survey was conducted in 327 villages and wards in the four Ayeyarwady River Delta Townships mentioned above. The survey covered all 548 functioning STWs constructed during SC UK's previous rehabilitation project. In addition, 98 Unicef –assisted STWs and 1,266 private STWs were tested. The private STW samples were selected based on village input and with the consent of the owners. Sources used most for drinking water were selected for survey inclusion.

Three survey teams, consisting of three trained surveyors each, carried out two distinct survey components simultaneously. Two surveyors performed in-situ water quality testing and the third member conducted a rapid assessment of the physical condition and operations and maintenance (O&M) of water and sanitation facilities constructed/rehabilitated two years earlier. Upon arrival in the scheduled village, the survey teams facilitated meetings with village leaders and community members to discuss the testing process and to identify primary drinking water resources. Testing results were not immediately shared with communities, but were communicated during the implementation of the pilot arsenic action plan described later in this paper.

The equipment used for the survey included: *Oxfam DelAgua* portable water testing kit for assessing faecal coliform counts, *Palintest* comparator kit for testing iron, manganese, and pH, *Palintest* Electro Conductivity meter, and *Merck* arsenic field test kit. Two types of *Merck* arsenic tests were used during the survey. In the first half, the less sensitive *Merck* arsenic test kit (1.10026.0001) was used. The new more sensitive product (1.17926.0001) was only available in the second half of the survey. Results were recorded and entered into an MSExel database. Confirmatory testing using the Gutzeit method were conducted by Myanmar Scientific and Technological Research Department (MSTRD) on 25 random water samples collected.

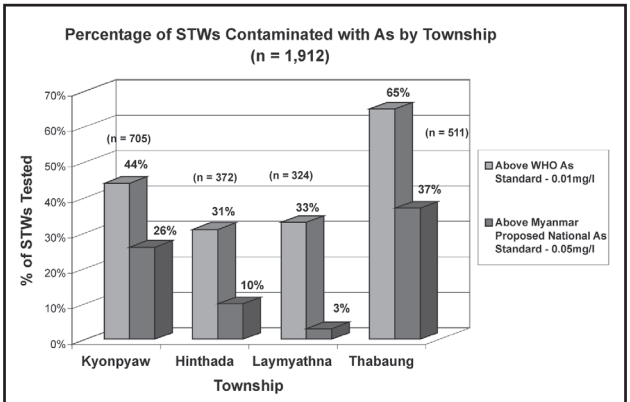

Figure 1.

Results and findings

Overall, water samples containing arsenic levels in excess of 0.01mg/l (WHO Standard) were detected in 45% of the STWs examined: Kyonpyaw 44% (n=705); Hinthada 31% (n=372); Laymyathna 33% (n=324); and Thabaung 65% (n=511). The highest concentration of arsenic detected was 0.50 mg/l in 9 STWs (0.5% of the total sample). A total of 21% of the sample exceeded 0.05mg/l, the proposed Myanmar National Standard (see Figure 1). Overall, 55% of the samples showed no measurable level of arsenic.

Tube well depth and arsenic levels were analyzed (see Table 1). All the STWs investigated in the survey were constructed by the traditional sludger drilling technique or improved sludger method. Mainly for alluvial formations, this method provides a low-cost way of obtaining good quality water of sufficient yield for human consumption. Although the method is usually limited to depths of up to 200ft and a maximum bore-hole diameter of 2 inches, under certain conditions, improved sludger methods - adding a motorized capstan winch for lifting the drill-pipes or applying air lift for aiding removal of cutting chips and larger gravels - can help overcome these limitations.

The majority of arsenic affected tube wells lie within the depth range of 80-200ft.

The relationship between iron and arsenic was also examined (see Table 2). Among the set of STWs with arsenic contamination exceeding 0.05mg/l, 47% had iron content in the high range of 7.5 ~ >10mg/l, 48% in the medium range of 2 ~ 5mg/l and 5% in the low range of £1mg/l.

Pilot Arsenic Action Plan

Based on the survey outcomes, SC UK implemented a pilot arsenic action project with 131 arsenic-affected villages in the four Townships. Communities with water sources with at least one STW with arsenic concentrations ³ 0.10mg/l were prioritized for project inclusion. The project had four major components:

1. Retesting and confirmation of arsenic levels of water sources
2. Arsenic education/awareness raising
3. Community mobilization and immediate protection measures
4. Identification and implementation of alternative drinking water sources

Table 1. STWs by depth and arsenic level

	Kyonpyaw						
	As mg/l						
Depth ft	0	£0.05	0.1	0.2	0.3	0.4	0.5
0~50ft	156	15	11	0	0	0	0
51~80	36	23	13	0	0	0	1
81~150	71	36	34	8	3	2	5
151~200	113	53	66	4	2	0	2
201~250	18	12	10	0	1	0	0
251~300	4	1	2	0	0	0	0
> 300	0	0	0	0	0	0	0

	Thabaung						
	As mg/l						
Depth ft	0	£0.05	0.1	0.2	0.3	0.4	0.5
0~50ft	8	0	0	0	0	0	0
51~80	10	5	1	1	0	0	0
81~150	93	81	55	38	20	7	1
151~200	65	60	33	22	8	0	0
201~250	3	1	0	0	0	0	0
251~300	0	0	0	0	0	0	0
> 300	0	0	0	0	0	0	0

	Hinthada						
	As mg/l						
Depth ft	0	£0.05	0.1	0.2	0.3	0.4	0.5
0~50ft	91	8	1	0	0	0	0
51~80	49	18	5	2	3	0	0
81~150	54	21	7	7	2	2	0
151~200	25	23	7	1	0	0	0
201~250	27	6	1	0	1	0	0
251~300	9	1	0	0	0	0	0
> 300	0	0	0	0	0	0	0

	Laymyathna						
	As mg/l						
Depth ft	0	£0.05	0.1	0.2	0.3	0.4	0.5
0~50ft	48	4	1	0	0	0	0
51~80	24	11	1	1	0	0	0
81~150	73	35	7	0	0	1	0
151~200	32	26	3	0	0	0	0
201~250	26	9	1	0	0	0	0
251~300	10	9	0	0	0	0	0
> 300	2	0	0	0	0	0	0

Table 2. Number of STWs corresponding to different combinations of As and Fe contamination

	As (mg/l)						
Fe (mg/l)	0	£0.05	0.1	0.2	0.3	0.4	0.5
£1	596	42	17	0	1	0	1
2~3	119	26	17	0	4	2	1
4~5	167	155	114	9	12	2	3
7.5	61	92	54	7	14	3	2
10	91	82	55	1	9	3	0
>10	29	55	10	0	2	2	0

The pilot project used a participatory approach to conduct testing, arsenic communication/education and community water supply intervention planning. Social mapping was used to identify water sources to be tested. Village volunteers assisted project staff in testing and communication. Information, Education, and Communication (IEC) materials for arsenic awareness raising and arsenic testing promotion were developed as part of the project communication strategy. Alternative drinking water sources implemented varied across the project area, depending on geophysical conditions and community preference.

Major findings

- Seasonal variation in arsenic levels of groundwater sources is pronounced in the project communities (maximum variation is found to have +0.3mg/l to -0.2mg/l). There was no observable pattern to this variation however.
- Arsenic contamination was present in handdug wells (11% and 3% of n=175 were exceeding the WHO and the proposed Myanmar National Standard respectively.)
- Based on group discussions with community members, it is estimated that less than 20% of pilot project communities currently use contaminated sources for drinking and cooking.
- Prior to the project, knowledge of naturally occurring arsenic contamination of water sources was negligible. After awareness raising campaign in project villages, knowledge had significantly improved.
- Prevalence of arsenocosis is thought to be low in project communities. Although case identification was not an objective of the project, no cases have yet been detected by project staff. To date, only three confirmed cases have been reported by Myanmar health officials.
- Currently, there is little demand or interest in rainwater harvesting as an alternative drinking water source to arsenic contaminated STWs.

Lessons learned

- Community participation is key to successful implementation and sustainability of arsenic mitigation activities.
- Communication strategies need to be well planned, clear and balanced to avoid alarming people unnecessarily.
- Inadequate coordination of testing and communication efforts between agencies can result in confusion at the community level and duplication of services.
- The emphasis on communication with affected communities is of primary importance.
- The identification and training of community-based arsenic testers was seen as a positive step towards decentralization and better sustainability.

Recommendations

- "Blanket" testing and the training and use of community-based testers are essential future modifications based on our experience.
- Applying PRA tools in community mapping is recommended because it provides not only for the identification of sources but also useful in arsenic awareness raising.
- GPS coordinates should be recorded to better understand arsenic distribution patterns.
- Priority needs to be given to coordination and communication between stakeholder organizations and government departments in order to improve community-based arsenic mitigation efforts.
- Community-level and household-level treatment of water to remove arsenic is not recommended at this stage due to cost, operation and maintenance issues and the availability of As-free sources in most communities.

References

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