Helping Households Protect Themselves from Arsenic Contamination: A Water Supply Study from Vietnam

Strengthening local capacity in the economic analysis of environmental issues

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One of the main environmental challenges facing Vietnam is supplying households with clean, safe water. The contamination of water by arsenic is a particularly pressing problem in a number of the country's regions. To help policy makers to come up with an effective strategy to tackle this issue, a new EEPSEA study has looked at the level of awareness that households in the Vietnamese Mekong Delta (VMD) have about arsenic contamination. It also assessed the choices that households in this region make about their sources of drinking water and the water treatment technologies they employ.

The study is the work of a team led by Vo Thanh Danh from Can Tho University. It found that unsafe groundwater is still being used for drinking water in the VMD, and that household knowledge about arsenic contamination is generally poor. The study showed that, although the ineffective borax method is the most popular means of water decontamination, alternative sand filter and safe water treatment equipment are cost-effective solutions that should be promoted. The study proposes a number of other policy initiatives that should be put in place, including public information and awareness campaigns and speeding up of the government's existing rural piped water program.

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"Drinking Water Options in the Context of Arsenic Contamination in the Vietnamese Mekong Delta," by Vo Thanh Danh, Huynh Viet Khai, Nguyen My Hoa, and Nguyen Van Cong, School of Economic and Business Administration, Can Tho University, Can Tho City, Vietnam.
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The arsenic challenge

The Vietnamese Mekong Delta (VMD) is home to about 18 million people. However, nearly 70% of the people in this region live in rural areas where access to clean, unpolluted water is a problem. This issue is set to get worse due to Vietnam's high economic growth rate and its growing population.

One of the key water pollution challenges in the VMD is the contamination of groundwater by arsenic. Since 2003, the United Nations Children's Fund (UNICEF) has examined groundwater from tube wells in the VMD and has found serious arsenic contamination in Long An, Kien Giang, An Giang, and Dong Thap provinces.

The consumption of arsenic in water has been linked to various clinical symptoms including hyperpigmentation, symptoms of keratosis, and a variety of other illnesses, including cancer of the skin, internal organs, and lungs.

Looking at household knowledge and choices

The main objective of the study was to look at the choices that households make about the water sources they use and the actions they take to deal with arsenic contamination. Households in the VMD make use of three main sources of water for drinking, washing, and other domestic uses. These are rainwater, river water, and groundwater.

The study was conducted in Dong Thap and An Giang provinces. Both provinces border Cambodia.

Since the 2000s, survey testings have indicated that groundwater in Dong Thap and An Giang contains high levels of arsenic. For example, in An Giang, 40% of the 2,966 tube wells tested were found to be contaminated with arsenic.

In the study, households in arsenic-contaminated areas were selected for interview, and a total of 404 households were interviewed using a questionnaire. Households were selected from the Thanh Binh and Tam Nong districts of Dong Thap province and from the Phu Tan and Cho Moi districts of An Giang province. All these districts are located along the Mekong River.

What factors affect household choices?

The respondents were asked various questions to gauge their understanding and knowledge of arsenic contamination. The Protection Motivation Theory (PMT) approach was used to assess how households acted (or did not act) to protect themselves from arsenic contamination and to see what issues affected their behavior.

These issues included the extent to which respondents thought they were vulnerable to the threat of arsenic contamination, how severe they perceived the threat to be, and how much they feared it. The issues also included the degree to which a person thought they could deal with the pollution problem, their belief in the effectiveness of their chosen coping mechanism, and the costs involved in dealing with arsenic pollution.

The cost-effectiveness analysis method was used to rank the efficiency of arsenic treatment technologies. Meanwhile, the multi-criteria analysis method was used to assess the impact of a household's preference for arsenic mitigation technologies. The impact of arsenic pollution was measured in terms of disability-adjusted life years (DALY). A DALY was defined as a lost year of "healthy" life due to the contamination of water with arsenic.

Sources of water in the VMD

The proportion of people who use safe water in the VMD was found to be quite low (approximately 37%). Besides piped water, tube wells are the main source for domestic water in rural areas. In areas where serious levels of arsenic contamination have been detected, majority of the residents use bottled water for drinking and piped water for cooking purposes.

In households where the cost of water provision is considered to be important, the most favored water supply choices are piped water, bottled water, groundwater, rainwater, and surface water. However, in households where health issues are the top priority, bottled water and piped water are the preferred choices.

Household knowledge of arsenic contamination

Household knowledge of arsenic contamination is very poor. When the respondents were asked about the issue, they achieved a mean score

of 1.76, compared to the best total score of 27. Some 10% of the sampled households used tube wells. Among these households, 29% did not know whether their tube well was arsenic contaminated, and 39% were not sure about arsenic contamination.

This lack of knowledge is partly becayse information on arsenic-contaminated groundwater and arsenic-related diseases has not been given to the public in the study sites by the relevant local government agencies. This is despite the fact that the UNICEF and the Institute of Hygiene and Public Health have recommended that there is a high risk that groundwater is contaminated with arsenic in these areas.

Households' concern about arsenic contamination

The survey found that those who were more educated were more than twice as concerned about arsenic contamination as those who were less educated. Not surprisingly, households with more knowledge about arsenic pollution had more concerns about arsenic contamination.

Those who owned safe water treatment equipment were 50% more concerned about arsenic contamination than those who did not own this equipment. Those who lived in an area with easy access to water were 46% more concerned about arsenic contamination than those who lived in areas with a constrained water supply.

Households from the Kinh ethnic group were 48% more concerned than households from the Khmer ethnic group.

The fear of arsenic contamination was a key factor that made people plan to carry out arsenic testing in the future.

Use of arsenic treatment technology

Among the 404 sampled households, 44% used some form of water treatment methods. These water treatment methods included the borax method, using safe water treatment equipment, using chemical materials, boiling or heating water, and using sand filtering. The borax method and safe water treatment equipment were the most popular approaches, and were used by 77% and 27% of households, respectively.

The borax method was popular because it incurs the lowest cost and is easy to use. The survey revealed that the higher a household's income, the more treatment equipment it had. For example, 24% of households with an annual income higher than VND 100 million owned treatment equipment, but only 8% of households with an annual income lower than VND 100 million owned any equipment.

Why households don't treat their water

The study found a number of reasons why households were not willing to use arsenic treatment technology. Some 46% of households did not believe that arsenic treatment technology is reliable, and 18% of households thought that water treatment equipment is difficult to use. Around 19% of households said that there were financial constraints to owning arsenic treatment technology. A few households said that they did not know about arsenic treatment technology.

Technically, only the sand filter and treatment equipment methods are effective in eliminating arsenic. Using calculations based on the risk that people faced from arsenic poisoning and the effectiveness of sand filter and safe water treatment equipment, the study estimated the number of deaths that these arsenic treatment methods could avert.

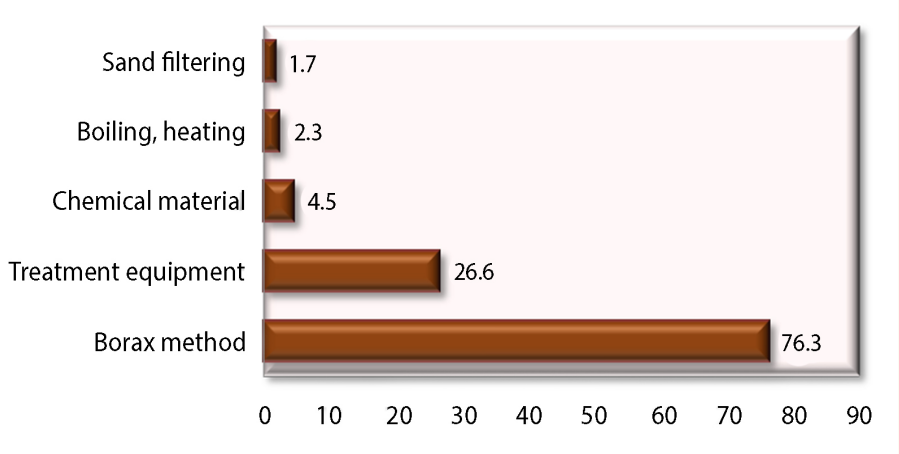

Figure 1. Household safe water treatment methods (in percent)

Table 1. Calculations of costs per DALY saved with different arsenic treatment methods

Item	Water Treatment Method	
	Sand filter	Treatment Equipment
Rate of effectiveness of arsenic treatment	0.20	0.98
Rate of arsenic-related disease infection	0.02017	0.02017
Number of people in the sampled area	1,750	1,750
DALY	7.60	37.22
Total DALYs (t = 10 years, r = 3%)	64.79	317.45
Investment ('000 VND)	1,866.67	1,572.08
Treatment materials per year ('000 VND)	–	756.00
Present value of costs (t = 10 years, r = 3%)	1,866.67	8,020.76
Cost per DALY saved ('000 VND)	28.81	25.27

Factoring in the costs of these approaches, it found that ensuring a year of "healthy" life using sand filter and safe water treatment equipment would cost USD 1.29 and USD 1.13, respectively. This suggests that the safe water treatment equipment method is a particularly cost-effective intervention for preventing arsenic-related diseases.

Awareness-raising and improving supply

To improve safe water use and provision in the VMD's rural areas, the study recommends a number of potential actions. First, a campaign to raise awareness of safe water use should be implemented in rural areas. Under such a campaign, people should be advised to stop using unsafe water sources for drinking or cooking because of the possible health impacts.

Currently, people have very little knowledge about arsenic contamination. Raising public awareness of the arsenic issues and of ways to deal with it should therefore be placed front and center in all future safe-water-use campaigns. Improving knowledge will motivate people to adopt protective behavior such as switching to a safer water source or using an effective arsenic treatment method.

Currently, the proportion of rural households using piped water is low. The study therefore recommends accelerating the implementation of the current rural piped water program.

In addition to groundwater supply investments, the privatization of piped water investment is needed to accelerate the rate of rural safe water provision. Private investment in piped water should be combined with the current rural safe water supply program (this is part of the VMD's rural development strategy and masterplan).

Providing information about arsenic pollution and treatment

To protect people from arsenic poisoning, the study recommends that households should be made aware that the borax method cannot effectively eliminate arsenic in water, and that it does not make contaminated water safe for domestic consumption. Safe and effective water treatment equipment should be recommended to water users.

In arsenic-polluted areas, local authorities should announce the arsenic contamination levels to the public, and encourage tube well users to participate in regional arsenic testing programs. Rural safe water centers should periodically examine the status of arsenic contamination near people's homes, and accordingly report the results to residents in a timely manner.

In the long term, additional safe water sources such as rainwater and treated groundwater should be utilized. The availability and reliability of rainwater and groundwater make them possible additional water supplies, as long as they are properly treated in a way that is economically viable.

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