# UN University compares technologies that remove arsenic from groundwater

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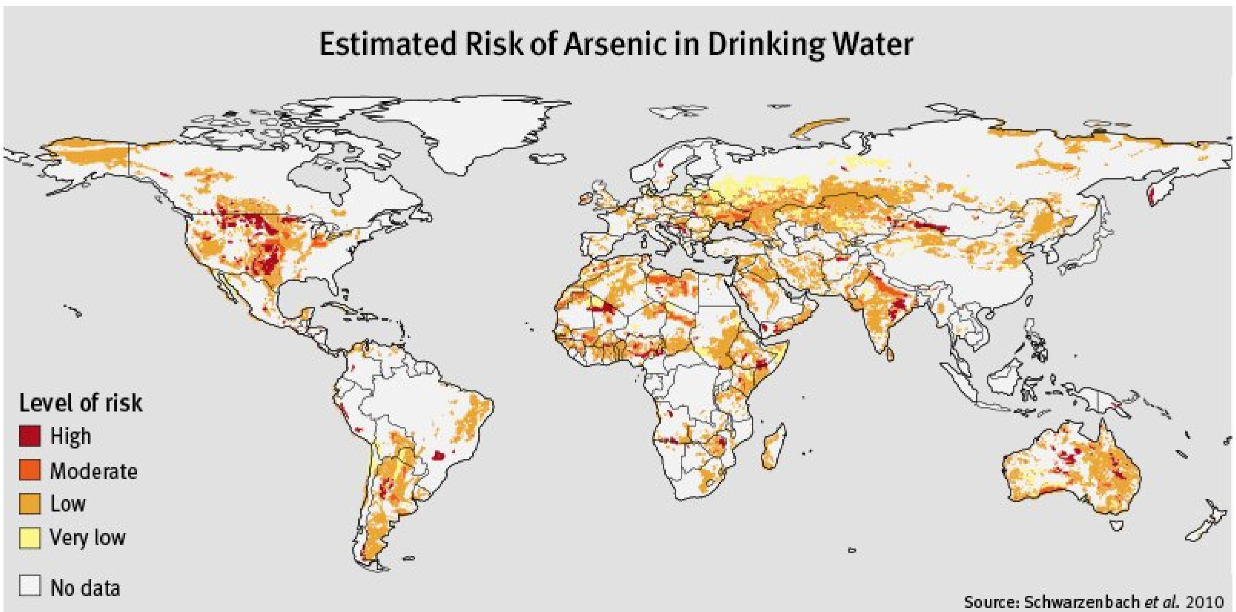


Estimated risks for arsenic contamination in drinking water based on hydrogeological conditions. Credit: Schwarzenbach *et al*., 2010

A United Nations University study compares for the first time the effectiveness and costs of many different technologies designed to remove arsenic from groundwater—a health threat to at least 140 million people in 50 countries.

Released today by UNU's Canadian-based Institute for Water, Environment and Health, the report draws on 31 peer-reviewed, comparable research papers published between 1996 and 2018, each describing new technologies tested in laboratories and / or in field studies.

And while no single technology offers a universal solution, the research helps point to remedies likely to prove most economical and efficient given the many variables present in different locations worldwide.

Serious health, social and economic losses are caused worldwide by arsenic-contaminated water and a wide range of technologies exists to remove it but "their widespread application remains limited," according to the report.

From 2014 to 2018, over 17,400 arsenic-related publications were published and "there is a myriad of reportedly 'low-cost' technologies for treating arsenic-contaminated water. But the specific costs associated with these technologies are rarely documented," says Duminda Perera, a Senior Researcher at UNU-INWEH and report co-author.

The summary of costs and effectiveness of the few dozen arsenic remediation technologies that are directly comparable in those respects can serve as a preliminary guideline for selecting the most cost-effective option, he says. It may also serve as an initial guideline (minimum standard) for summarising the results of future studies describing arsenic remediation approaches.

The report notes that "arsenic-removal technology should only be seen as efficient if it can bring the water to the WHO standard" (in 2010, WHO's recommended a drinking water limit of 10 µg/L—micrograms per litre), but countries with resource constraints or certain environmental circumstances (e.g. typically high arsenic concentrations in groundwater) have much higher, easier-to-reach concentration targets.

"While this may help national policymakers report better results for their national arsenic reduction efforts, it may have the opposite effect on public health," the report says. "Higher thresholds will not help solve this public health crisis. On the contrary, if a country has a feeling that the arsenic situation is coming under control, this may reduce the sense of urgency in policy circles to eradicate the problem, while the population continues to suffer from arsenic poisoning."

"This policy approach is not well-conceived as it does not effectively resolve the issue."

It is estimated that in Bangladesh, for example, where the nationally-acceptable arsenic limit in water is set to 50 µg/L, more than 20 million people consume water with arsenic levels even higher than the national standard.

And globally, despite international efforts, millions of people globally continue to be exposed to concentrations reaching 100 µg/L or more.

## Key findings:

UNU studied 23 technologies independently tested in laboratory settings using groundwater from nine countries—Argentina, Bangladesh, Cambodia, China, Guatemala, India, Thailand, the United States, and Vietnam—and demonstrated efficiencies ranging from 50% to ~100%, with a majority reaching >90%. About half achieved the WHO standard of 10 µg/L.

14 technologies tested in the field (at the household or community level, in Argentina, Bangladesh, Chile, China, India, and Nicaragua) achieved removal efficiency levels ranging from 60% to ~99%, with 10 removing more than 90%. Only five reached established the WHO standard.

Technologies that demonstrate high removal efficiencies when treating moderately arsenic-contaminated water may not be as efficient when treating highly contaminated water. Also, the lifetime of the removal agents is a significant factor in determining their efficiency.

For lab tested technologies, the cost of treating one cubic meter ($m^3$) of water ranged from near-zero to ~US$93, except for one technology which cost US$299 per $m^3$. For field tested technologies, the cost of treating $1m^3$ of water ranged from near-zero to ~US$70.

## Key factors influencing removal efficiencies and costs:

- the arsenic concentration of the influent water
- pH of the influent water
- materials used
- the energy required
- absorption capacity
- labour used
- regeneration period and
- geographical location

Remediation technologies that demonstrate high arsenic removal efficiencies in a laboratory setting need to be further assessed for their suitability for larger-scale application, considering their high production and operational costs.

Costs can be reduced by using locally available materials and natural adsorbents, which provide near zero-cost options and can have high arsenic removal efficiencies.

Leading authors Yina Shan and Praem Mehta, who worked at UNU-

INWEH and are now at McMaster University, noted that exposure to arsenic can lead to severe health, social and economic consequences, including arsenicosis (e.g. muscular weakness, mild psychological effects), skin lesions and cancers (lung, liver, kidney, bladder, and skin).

Social implications of these health impacts include stigmatization, isolation, and social instability, they added. Arsenic-related health complications and mortality also lead to significant economic losses due to lost productivity. The economic burden in Bangladesh is projected to reach US$13.8 billion by around 2030.

Looking ahead, the study identifies priority areas to assist in commercializing wide-scale implementation of arsenic removal technologies.

"The main objective of the report is to help accelerate the wide-scale implementation of remediation solutions to alleviate, and ultimately eradicate, the problem of arsenic-contaminated water consumption over the next decade and meet the world's Sustainable Development Goals," says UNU-INWEH Director Vladimir Smakhtin.

"This report aims to inform decision-makers who face an arsenic public health challenge, of the specific costs and effectiveness of technologies tested in laboratory or field settings. It also urges researchers to present cost and effectiveness data cohesively to better inform planners' and policymakers' choice of the best arsenic remediation technologies."

"Today, the current science and knowledge on arsenic remediation technologies may be mature enough to help significantly reduce the numbers of people affected by this public health problem. However, the effective translation of research evidence and laboratory-level successes into quantifiable and sustainable impacts on the ground requires a concerted and sustained effort from policymakers, engineers, healthcare providers, donors, and community leaders."

Provided by United Nations University

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