SWAPNO: Safe Water - Advances in Purification Options

Project type

☐ interdisciplinary pilot project ☒ cross-sector project ☐ global health postdoc fellowship

Research areas involved (check all that apply)

☒ Biomedical sciences ☒ Public health
☒ Social sciences and humanities ☒ Engineering and other sciences

Project duration

May 2022 – June 2024

Project team

Name	Organization	Discipline(s)
Dr. Martin Maier	Institute of Earth Sciences, Heidelberg University (GEOW)	Hydrogeology, Geochemistry
Dr. Amanda Wendt	Potsdam Institute for Climate Impact Research (PIK)	Epidemiology, Nutrition
Dr. Jillian L. Waid	Potsdam Institute for Climate Impact Research (PIK)	Epidemiology, Surveillance
M.Sc. Mofizur Rahman	Potsdam Institute for Climate Impact Research (PIK)	Sustainable Development
Dr. Charlotte Stirn	AGAPE e.V. Germany	Geography, Technical implementation
Shafinaz Sobhan	Charité University Hospital	Implementation science

Case study

Water is one of our planet's most vital resources, making United Nations Sustainable Development Goal 6 – clean water and sanitation for all – a global priority. Despite this, clean water clean water for drinking and hygiene remains inaccessible in many rural regions. In Bangladesh, large-scale construction of hand-pumped tubewells during the 1970s and 1980s aimed to reduce microbial contamination and as a consequence diarrheal disease. However, this effort inadvertently led to widespread access and use of arsenic-contaminated water, becoming a significant public health issue. Chronic arsenic exposure has been linked to various cancers, neurologic disorders, cardiovascular disease, diabetes mellitus, among others. In Bangladesh over 20 million people rely on drinking water exceeding the national arsenic limit of 50µg/L and around 30 million use sources surpassing the World Health Organization's (WHO) safe limit of 10µ/L.

While conducting the Food and Agricultural Approaches to Reducing Malnutrition (FAARM) trial in Nabiganj, Sylhet District, Bangladesh we found 89% of the households with drinking water arsenic concentrations above the 10 µg/L WHO threshold.

The Safe Water Advances in Purification Options (SWAPNO or “dream” in Bangla) trial, sought to measure the impact of an improved household-level water hardware solution in rural Bangladesh. The water treatment systems are locally produced and maintained, with most parts already available on the market. As the commercially available filters do not remove arsenic, we added a titanium based arsenic adsorber (Titansorb®) which can be recycled and reused to avoid waste.

During the trial we undertook quantitative and qualitative assessments of water use systems to assess their impact on health in the study community both before and after the introduction of improved handwashing and water filtration systems. This assessment, along with the rigorous testing of the use and effectiveness of these devices, enabled further revision of these systems across the project cycle.

SWAPNO’s intervention centered on Drinkit water filters, which were modified with Titansorb® (WatchWater, Mannheim) for arsenic removal. These filters were chosen for their durability, quality, and locally available spare parts, supporting the project's sustainability goals. Data collection was structured in multiple phases, beginning with a baseline survey from November 2022 to January 2023, which successfully enrolled 337 women (87% of the eligible list) and 189 children under six years. The project maintained impressive retention rates throughout its duration, with over 95% participation in all subsequent surveys. Two monitoring surveys were conducted at four months (March-June 2023) and eight months (July-September 2023) post-intervention. The endline data collection, occurring between December 2023 and April 2024, was split into two surveys: one following the structure of previous surveys and another focusing on households' ability and willingness to pay for improved water systems. The project also included a component measuring urinary arsenic levels in 100 women, with high compliance rates across multiple sampling periods. We tested the quality of drinking water stored in the household using a field lab (TRAWAS, Wiegand Labs) for microbiology and collected samples for later water composition analysis in Germany (ICP-OES and Dionex, Institute for Earth Sciences, Heidelberg University).

Throughout the project, adjustments were made to address challenges and improve effectiveness, such as modifying handwashing station designs and providing additional materials like jute bags for splash water collection, soap bags, and nets for filter cleaning. These adaptations demonstrate the project's commitment to practical, sustainable solutions for water quality improvement in rural Bangladesh. At the end of the project, the control group also received filters and training to improve their water quality.

Overall, filter use increased. At baseline and in control households, less than 20% of households filtered their water, while this was over 98% among intervention households after distribution. Filters led to a sizable reduction in arsenic although 38% of intervention households remained above the Bangladesh threshold of 50 µg/L vs. 68% at baseline. Microbial contamination was similar between intervention and control groups.

At baseline there were very low levels of the most common indicators of acute arsenicosis and we found no measurable impact of the water filter on urinary arsenic. Both groups received a

handwashing station and training and reported more frequent handwashing at key moments. Increased odds of children reporting no illnesses (189 children, 731 obs., OR=1.8, p=0.018) were found along with a borderline reduction in reported illness among women (338 women, 1,316 obs., OR=1.5, p=0.06).

Photo: Water filter involved in SWAPNO Project
Credit: SWAPNO

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Contact

For more information please visit the following links from the Potsdam Institute for Climate Impact Research (PIK), Heidelberg University, and news from AGAPE e.V.

Dr. Martin Maier, Institute of Earth Sciences, Heidelberg University: martin.maier@geow.

uni-heidelberg.de

Dr. Charlotte Stirn, AGAPE e.V.: stirn@agape-ev.de

Dr. Jillian Waid, PIK: waid@pik-potsdam.de

Dr. Amanda Wendt, PIK: wendt@pik-potsdam.de

Contact

German Alliance for Global Health Research (GLOHRA)

Secretariat c/o Charité – Universitätsmedizin Berlin
Charitéplatz 1, 10117 Berlin, Germany
e: secretariat@globalhealth.de
t: +49 30 450 572 100

www.globalhealth.de
linkedin.com/company/globalhealth-de

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