Breakthrough Technology or Breakthrough Solution: What Are We Really After?

Arup K. SenGupta,*† Michael German,‡ Prasun Chatterjee,§ Anil Shaw,∥ Sudipta Sarkar,¶ Todd A. Watkins,*† Mizan Rahman,⊥ and Minhaj Chowdhury⊥

*†Lehigh University, 1 W. Packer Ave, Bethlehem, Pennsylvania 18015, United States
‡Technology with a Human Face (NGO), Kolkata 700061, India
§WIST Water Solutions Pvt. Ltd., Kolkata 700039, India
¶India Institute of Technology-Roorkee, Roorkee PIN 247667, India
⊥Drinkwell Bangladesh Ltd., Motijheel, Dhaka, Bangladesh

Of all the basic needs to sustain human life, access to drinking water, or more specifically the quality of drinking water, is the single most unifying element globally. In contrast to other basic needs of life (size of dwelling per family, sanitation, quality of air, calories of food intake per day, source and availability of energy supply, and access to education and healthcare), none binds every life in both the developed and the developing world with nearly the same rigid standard as drinking water. That is why the recommended drinking water standard of World Health Organization (WHO) for people making less than two dollars a day is about the same as the SDWA (Safe Drinking Water Act) standards routinely enforced by the United States Environmental Protection Agency for U.S. citizens. Understandably, for both the Millennium Development Goals (MDGs) and the Sustainable Development Goals (SDGs), poverty elimination and access to clean water are top priorities.

Per UN-Water, approximately 3.5 million people die every year due to inappropriate water supply, sanitation and hygiene. Most of the victims are from families around the world that make less than $2 per day and that are routinely confronted with abject poverty. Poverty and lack of access to safe drinking water are closely intertwined. A critical question thus arises: Can access to safe drinking water be simultaneously engineered toward both poverty elimination and wealth generation?

Groundbreaking advanced technology does not guarantee its adoption and concomitant economic growth in affected communities. For example, home filters impregnated with silver nanoparticles, an outcome of nanotechnology initiatives, are recommended for use to eliminate microbial contamination of drinking water in underdeveloped countries.1 Interestingly enough, there is to date no commercial deployment or even field trials of silver impregnated filters in the U.S., even though, according to the National Groundwater Association (www.ngwa.org), over 13 million private well-owning single homes exist in the U.S. and are ideally suited for in situ silver impregnated filters. Why is there such a haste for intercontinental transport of a technology that remains untested at the field level in the developed world? Along the same vein, a unique class of magnetically active nanoparticles were synthesized with arsenic sorption properties.2 These nanoparticles, which can be conveniently separated by applying a weak magnetic field, were presented as a revolutionary solution to mitigate the arsenic crisis in Bangladesh and other arsenic-affected countries in South and Southeast Asia.3 But this breakthrough technology did not lead to any breakthrough solution. Unlike the U.S., every arsenic-contaminated groundwater in Bangladesh and Southeast Asia invariably contains relatively high levels of dissolved iron, often exceeding 2.0 mg/L. The magnetic nanoparticles are unable to remove iron, present as a major cocontaminant, and cannot comply with WHO standards. Such examples abound and, very often, more thrust is attached to the promotion of technology than to the final delivery of the beneficial solution.

The November 10, 1998 issue of New York Times, in an article titled “New Bangladesh Disaster: Wells that Pump Poison”, called the arsenic crisis the worst natural calamity of recent times. For nearly two decades since then, geologists, chemists, policy specialists, engineers and epidemiologists from the U.S. and the Western world have been heavily engaged in investigating various aspects of the crisis. In the end, the number of people drinking arsenic-safe, treated water through such efforts has barely increased, but a large body of research

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Additionally, for treatment of toxic contaminants like arsenic quality monitoring for every household system is expensive. Technology is very effective for its ease in deployment. However, water quality monitoring for every household system is expensive. Additionally, for treatment of toxic contaminants like arsenic and fluoride, safe disposal and containment of contaminated sludge resulting from every individual household is nearly impossible to coordinate. Field-scale failures of PoU systems have been well-known and photographed, but barely disseminated in the peer-reviewed literature.

To overcome such limitations of PoU systems, community based systems that serve 100–200 families (400 to 800 people) in arsenic-affected regions in India gradually evolved. Collective oversight of the community in conforming to the prescribed treatment protocol, use of a reusable arsenic-selective sorbent to minimize waste generation and safe disposal of hazardous sludge consistently delivered treated water with arsenic and iron below the maximum contaminant level. Employment opportunities were created using a monthly tariff from every participating family. One critical inquiry is can such models be transplanted and adapted in other communities and countries?

Let us take the specific example of Betila Village in Manikganj, Bangladesh, where people have been threatened for over two decades with unsafe levels of both arsenic and iron in the groundwater. This village truly serves as a museum of Bangladesh’s prior mitigation efforts with defunct PoU systems strewn across many households. In March 2015, DrinkWell (www.drinkwellsystems.com) in concert with Technology with a Human Face (www.techhumanface.org) and Lehigh University installed Bangladesh’s first community based system in Betila using a reusable arsenic-selective sorbent. As of November 2016, over 112 households purchase safe water daily at the price of 25 paisa per liter for pick up (20 households) and 50 paisa per liter for home delivery (92 households). A deliveryman and the plant caretaker are kept on staff and an additional 4000 ‘Taka (Bangladesh currency) is kept as a monthly net profit for future upgrades, Figure 1.

The success or Breakthrough Solution in Betila resulted from the attributes of the technology to support and sustain economic growth within the affected community while providing safe drinking water in accordance with WHO standards.

**AUTHOR INFORMATION**

**Corresponding Author**

*E-mail: arup.sengupta@lehigh.edu.*

**ORCID**

Arup K. SenGupta: 0000-0003-3399-9431

**Notes**

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**REFERENCES**


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**Figure 1.** (Top) A community-scale arsenic treatment system and rickshaw delivery service in West Bengal; (Bottom) Women waiting in line at the arsenic treatment system in Manikganj, Bangladesh.