The search for smarter energy and water strategies

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Ashok Gadgil and postdoctoral researcher Chinmayee Subban are refining an affordable water treatment technology to produce fresh drinking water from brackish water, one of many projects supported by CERC-WET. Credit: Peg Skorpinski

As the changing climate disrupts familiar weather patterns, many countries face a dual threat: swamping along the coasts, but also unexpected shrinking freshwater supplies in many regions.

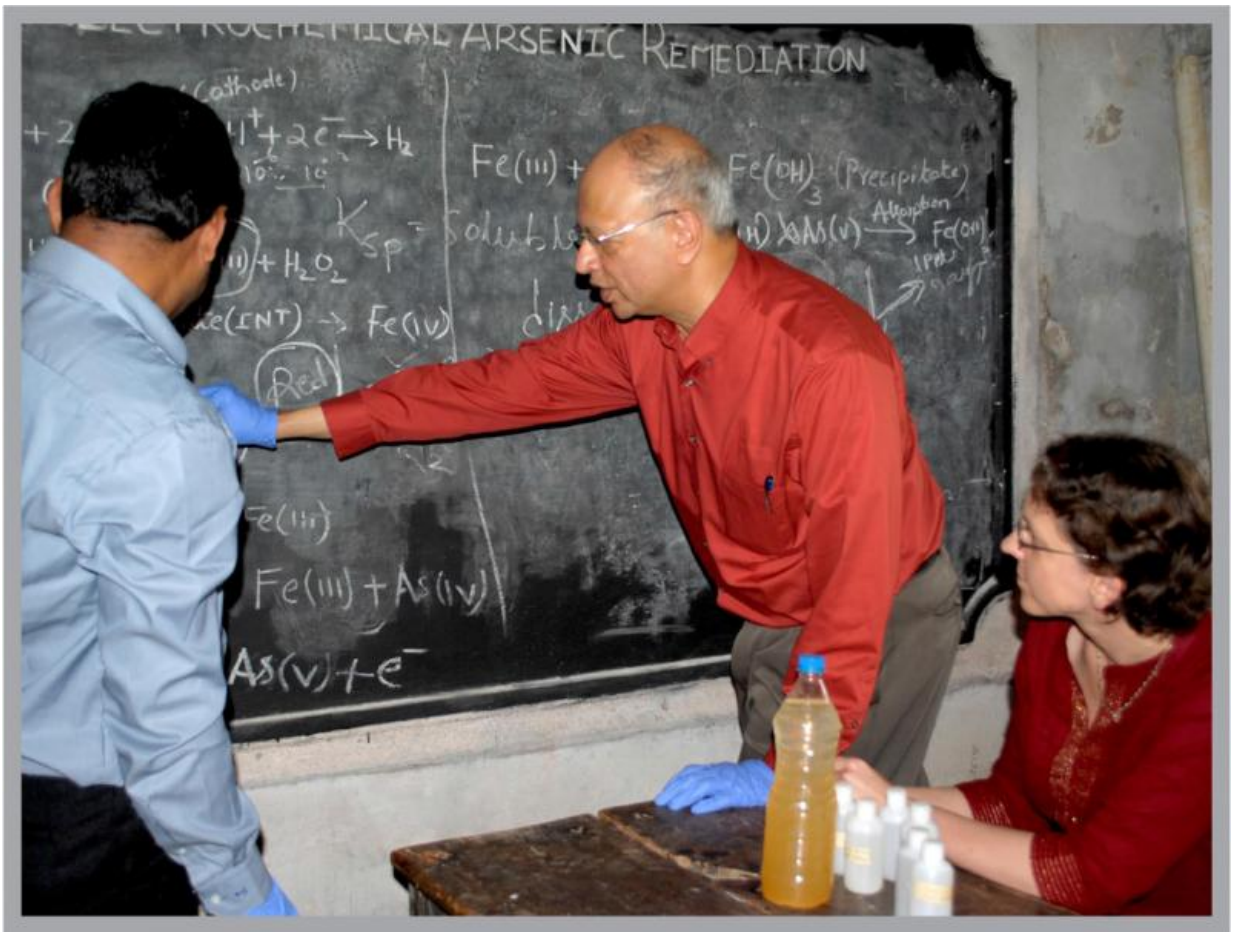
"Water has never been evenly distributed around the world, but droughts and an alarming decrease in groundwater create potentially catastrophic conditions," says Ashok Gadgil, Deputy for Science and Technology for the Energy Technologies Area at LBNL and professor of environmental engineering at UC Berkeley.

Gadgil is the principal investigator on the U.S. side of a new $64 million collaboration between China and the United States to develop strategies and technologies to conserve water in energy production and use.

"Energy and water are coupled," he says. "We require energy to transport water and to desalinate water. At the same time, we require great volumes of water to produce energy, whether for hydroelectric power or cooling of thermal power plants.

"The challenges of meeting energy and water needs on the societal scale are two of the most critical problems of this century for both developing and industrial societies."

The Clean Energy Research Center for Water Energy Technologies (CERC-WET) brings the expertise of American and Chinese scientists, engineers, climate modelers and planners to take on the challenge. Researchers from both countries will be able to demonstrate new technologies on test beds in China, Gadgil says.



About 140 million people worldwide are affected by arsenic contamination in drinking water. Gadgil and his lab developed an inexpensive arsenic remediation technology, now being introduced in India and Bangladesh. Gadgil, PhD student Siva Bandaru and project scientist Susan Amrose discuss arsenic removal chemistry at a rural high school in India where they were setting up a field experiment.

"Let's say we develop the technology for running gas turbines using less water — say a huge gas turbine that requires a test rig the size of California Hall at UC Berkeley. We could run tests for the pilot turbine at a Chinese research institute. The Chinese are hungry for this. They need to build new plants no matter what. With a new turbine technology

demonstrated in China, the Chinese will be publishing the results. That gets the new technology a much more credible entry into the Chinese market."

Gadgil has learned first-hand—and many times—how institutional buy-in boosts the chances for adoption of even the simplest new technologies. After receiving a masters degree in physics from the Indian Institute of Technology Kanpur, and his physics Ph.D. from UC Berkeley, he spent five years back in India working for a non-profit. His work focused on energy efficiency and renewable energy technologies and policies for the energy-strapped India.

In the early 1990s, only about a third of India's 130 million households were electrified, and most of these households were so poor that the government subsidized their basic electricity use. Many families had only an incandescent bulb hanging on a wire.

Gadgil argued that the electric utility should rent highly efficient, but relatively costly Compact Fluorescent Lamps (CFLs) to these households. The utility could borrow money at four percent a year to buy the CFLs, while individuals would likely be charged as much as ten percent interest per month by moneylenders.

Even with the added rental cost, he concluded that the bulbs' efficiency would cut net household electric bills. He and his colleagues tested and proved the benefit of utility-sponsored energy-efficiency lighting programs in a few developing countries starting with Mexico.

Today, more than 100 million poor households in more than 20 developing countries deploy such programs, saving energy and saving about $ 5 billion per year on electric bills.

"Every time there is a wicked problem, we should look for what are the

wrong-headed incentives that keep it in place. It's not like you can simply give someone a new light bulb. You need to understand the feedback loops that are often complex and interacting that allow a wicked problem to persist. You need to find a way to cut the Gordian knot."

In the 1990s, Gadgil developed an inexpensive water disinfection process for rural areas of developing countries. The invention earned him Discover magazine's 1996 Discover Award for the most significant environmental invention of the year. Now it serves more than five million people daily, and Gadgil estimates that it saves about 1,000 children annually from diarrheal deaths.

More recently, he and his students devised a clean-burning stove for use in rural Africa. The stove uses only about half as much wood as traditional wood stoves, saving families time and money, and reducing exposure to toxic fumes. More than 45,000 of these stoves are now in use in Darfur, Sudan.

The CERC-WET effort, of course, aims to develop much larger-scale technologies. But whether it's needed for billions of light bulbs or thousands of factories, Gadgil says, energy must be produced more efficiently and the water used for societal purposes must be conserved, reused and recycled using less energy.

"There's no doubt that this is a challenge of international scope, and it's no overstatement to say that addressing it is essential for a prosperous and sustainable future."

Provided by University of California - Berkeley