Science & Technology

Washing the Water

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It is a tragedy of good intentions that 40 million Bangladeshis are slowly being poisoned. In the 1970s, international health workers, alarmed by high rates of infectious disease caused by the drinking of surface water, dug millions of pump wells in Bangladesh. But they failed to test for arsenic, a mineral that leads to skin cancer and other serious health problems. One-third of the country's wells now are contaminated.

Since 2000, a multidisciplinary team of Columbia scientists have been trying to determine where the arsenic comes from, how dangerous it is, and how best to prevent illness. Their research in Bangladesh, which has produced several landmark findings, received a boost recently with a five-year, $16.9 million grant extension from the National Institute of Environmental Health Sciences (NIEHS). The award continues a longitudinal study tracking arsenic levels in 12,000 Bangladeshi adults and children, with the aim of determining the long-term effects of exposure. It also expands efforts to develop new water-treatment methods, to dig deeper wells, to determine the biochemical processes involved in arsenic poisoning, and to teach local communities how to avoid exposure.

In addition, the NIEHS grant expands several studies on the health effects and geochemistry of arsenic exposure at sites in New York, New Jersey, and New England. The umbrella program involves 15 faculty at the Mailman School of Public Health, the Lamont-Doherty Earth Observatory, and the Center for International Earth Science Information Network. It is directed by Joseph Graziano, a professor of environmental health sciences and associate dean at Mailman, and Alexander Van Geen, a senior research scientist at Lamont-Doherty.

A key challenge in Bangladesh, says Graziano, is determining why arsenic levels are high in groundwater yet relatively normal in soil. "One working hypothesis is that it involves Bangladesh being in a delta where flooding rivers deposit a lot of sediment onto the fields," he says. As the organic material decays, bacteria absorbs oxygen

from water in the soil, which kick-starts a chemical process whereby arsenic becomes more water soluble.

The scientists already have predicted that Bangladeshis who drink contaminated water more than double their likelihood of dying from liver, bladder, or lung cancer, in addition to being at high risk for skin cancer. They've also discovered that babies are exposed to arsenic in utero, and that the poison impairs children's cognitive development. "The dogma had always been that a person needed to drink contaminated water for 20 years before showing any effects," says Graziano. "But we're seeing children five and six years old with the precancerous skin lesions that are a telltale sign of exposure."

To help prevent disease, the researchers have identified genetic factors that predispose people to illness from arsenic exposure, and they've determined that deficiency in folic acid leads to difficulty in breaking down the mineral. "The best news is that our education and prevention efforts have led to a 28 percent reduction in the arsenic blood levels of our subjects," says Graziano. "That's a tremendous public-health achievement."

Also as part of the NIEHS grant, the Columbia scientists plan to screen 500 third- and fourth-graders in several New Hampshire towns identified by the US Geological Survey as having high levels of groundwater arsenic.

Graziano's research team, which has studied arsenic contamination at several industrial sites and landfills in the US, is also focused on helping the Environmental Protection Agency develop new technologies for cleaning up the ecosystem around Vineland, in southern New Jersey. There, hundreds of tons of arsenic were dumped into lakes and streams by the Vineland Chemical Company over the past five decades.

"The arsenic in Vineland is so bad you can detect its presence off the Atlantic coast," says Graziano. "The EPA is pumping water out from beneath the ground, cleaning it, and pumping it back in, but they're not capturing all the plumes. We're going to study the underground hydrology to develop a better system."



Guide to school abbreviations