SURFACE WATER NOT ALWAYS THE ANSWER 
TO BANGLADESH ARSENIC POLLUTION PROBLEM

BOSTON -- In a preliminary study of arsenic pollution in Bangladesh drinking water sources, Duke University hydrologists have found evidence that surface waters can also be contaminated with the substance. Thus, say the scientists, abandoning polluted wells in favor of ponds and surface reservoirs, as is advocated by the World Health Organization (WHO) and the Bangladeshi government, will not always solve the problem.

“Our analyses found that surface waters as well as ground waters have arsenic in excess of WHO standards, especially in areas of significant irrigation,” said associate professor Stuart Rojstaczer, who led the study. “This finding means that groups advocating surface water over ground water must be very cautious. They should not assume a priori that arsenic levels in the surface waters will be negligible.”

The scientists’ early data also suggested that soil arsenic levels may vary greatly between nearby sites, suggesting that re-siting new wells even close to contaminated wells may be a useful strategy to reduce arsenic levels. The scientists’ studies were supported by funds from a National Science Foundation Presidential Young Investigator award to Rojstaczer.
Arsenic contamination in Bangladesh ground water has been called perhaps the most widespread mass poisoning in history, exposing at least 10 million people to arsenic levels that cause eye disorders, skin lesions such as gangrene, and cancer. Ironically, the population’s massive exposure to arsenic resulted from efforts begun in the 1960s by international aid organizations to reduce exposure to pathogens in drinking water by sponsoring the sinking of millions of shallow tube wells into underground aquifers.

However, not until 1993 did health experts realize that the sediments found throughout the country contain high levels of natural arsenic that leach into ground water.

In a paper delivered Thursday at the American Geophysical Union meeting in Boston, postdoctoral fellow Mohammed Riajul Islam and Rojstaczer described the results of their analyses of samples of ground water, surface water and soil in five locations throughout Bangladesh.

The two scientists -- from the Center for Hydrologic Science and the Division of Earth & Ocean Sciences in the Duke Nicholas School of the Environment -- also obtained separate core samples in areas of eastern Bangladesh to compare deep earth layers with soil levels, to begin to understand how much arsenic has been leached from soils over time.

The scientists’ objectives were both to measure surface water arsenic levels and to explore possible geologic and geochemical reasons for varying arsenic levels in order to guide possible re-siting of wells to reduce arsenic levels.

“We had reason to believe that surface waters might have high arsenic levels,” said Rojstaczer. “Some surface waters come from ground water that has leached through soils highly laden with arsenic. And some surface waters received drained irrigation return water that originally came from pumped ground water.

“We wanted to get a first snapshot analysis of where exposure is the greatest, whether surface waters are a significant source, and whether we can identify the mechanism behind high arsenic levels in ground water,” said Rojstaczer.

The scientists found surface water arsenic levels greater than WHO drinking water standards at most of the sites, the highest being176 micrograms per liter in surface water in Rajarampur, near the Indian border. WHO guidelines specify arsenic levels no higher than 10 micrograms per liter. Ground water arsenic levels were highly variable in the scientists’ samples, ranging from less than one microgram per liter to greater than 2,000 micrograms per liter.

The Duke hydrologists also tested for the presence of other metals, and found aluminum levels in one area that was 10 times higher than WHO guidelines.

In comparing arsenic in soil and core samples in different regions of Bangladesh, the
scientist found early evidence that climate strongly affected arsenic levels in soil -- with soils in wetter climates more heavily depleted of arsenic and other metals as compared to deep core samples. Their analysis also gave some hints about the long-term climatic history of Bangladesh.

“This leaching -- which is heavier in the monsoon-prone east than in the drier west -- is long-lived,” concluded Rojstaczer. “It indicates that rainfall has been higher in the east for perhaps thousands of years, which offers a significant insight into the history of global climate.”

Importantly, the scientists also found hints of a possible solution to the problem that Bangladesh will not likely travel long distances to carry water from new wells. The two wells that showed arsenic levels of one microgram per liter and 1,000 micrograms per liter were only about 100 meters apart, noted Rojstaczer.

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“Perhaps there are geologic and geochemical reasons why one well had low arsenic levels, and if we can exploit those reasons, perhaps we can learn to re-site wells that don’t have high arsenic levels near contaminated wells, eliminating the need to travel long distances for non-polluted water.”

Much more research, however, remains to be done, even at the most basic scientific level, emphasized Rojstaczer.

“For example, no one really understands yet what causes the arsenic to come into solution and make the ground waters have intensely high dissolved levels of arsenic,” he said. According to Rojstaczer, a great many questions remain about the influence of such factors as soil type, acidity and other factors on leaching of metals from the soil.

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