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Contamination Threatens One of the World's Biggest Freshwater Supplies

Scientists find high salt and arsenic concentrations in an aquifer that 750 million people rely on for drinking water and irrigation.

This dry-season rice crop in northwest Bangladesh's Barind region was irrigated using water pumped from wells that sink almost 250 feet deep into the Bengal Aquifer System, which is in South Asia's Indo-Gangetic Basin. (Photo: WG Burgess)

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Three-quarters of a billion people across four South Asian nations rely on one vast water basin for much of their irrigation and drinking water. Called the Indo-Gangetic Basin, it stretches east to west over 618 million acres, sitting like a cap over the Indian subcontinent, and contains about 7,200 cubic miles of groundwater, roughly 20 times the annual flow of the region's Brahmaputra, Ganges, and Indus rivers combined.

Satellite measurements collected since 2002 have led to worries that the region's aquifers were being severely depleted by overuse, increasing vulnerability to failed harvests, skyrocketing food prices, and civil unrest.

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But in a new study that includes on-the-ground measurements from 3,429 water wells across the basin over multiple years, an international team of scientists has found that water quality, not quantity, is a much bigger problem.

More than 60 percent of the Indo-Gangetic Basin is too contaminated with salt or arsenic to be safe for drinking or agriculture, according to research published Monday in the journal Nature Geoscience.

The basin provides communities and cities in Bangladesh, India, Nepal, and Pakistan with a quarter of all global groundwater that humans extract from underground. The region contains the world's fastest-growing megacities, including Dhaka and Delhi, as well as the world's largest aboveground irrigation system: more than 62,000 miles of canals that divert water from the Ganges and Indus rivers for agriculture.

"We worked with teams of scientists in Pakistan, Bangladesh, India, and Nepal—scientists working in the country who brought together data already being measured in these countries," said hydrogeologist Alan MacDonald of the British Geological Survey, who led the study. "This was the first time at this scale that these scientists had pooled data across the whole of the aquifer."

Salt concentrations have risen in Pakistan and more arid areas of northwest India, MacDonald said, in part because of the heavy use of the Ganges and Indus rivers for irrigation. "If you tap these rivers, which would naturally flow out to the sea with their natural salt content, [that] accumulates their salt content, which just gets flushed back into the groundwater," he said.

"Where we looked we found problems with nitrates and pesticides," MacDonald added, but "there wasn't enough data for us to map them out across the whole region."

Another problem is increased "pumping groundwater at depth, which can be drawing in saline water into higher depths of the aquifer," he said.

More reliance on groundwater as the region's population grows, and as monsoon rain patterns shift because of climate change, has contributed to the arsenic problem. "Arsenic has been very widely studied in this region," MacDonald said. "It's a problem in the Bengal basin, Bangladesh particularly. It's naturally occurring due to the geology. It's not really increasing. It's just there. But the more people use groundwater, the more they're finding it."

As for water depletion, the team found that despite the groundwater being heavily tapped, levels are stable or rising across 70 percent of the region. Levels are dropping near major population centers, however, including Lahore, Dhaka, and Delhi.

MacDonald hopes the research will help inform how the four nations use and protect the basin.

"The groundwater in this region is a great resource," he said. "It has been and will continue to buffer against climate variability. It just needs to be understood and managed. For salinity, trying to manage the water levels in the aquifer" would be one step toward a solution.

"The arsenic area is a lot more complex," MacDonald added. "It's [about] trying to protect and manage the good-quality water in arsenic-contaminated areas and protecting it for drinking water rather than irrigation."

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