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What You Need to Know About the World's Water Wars

Underground water is being pumped so aggressively around the globe that land is sinking, civil wars are being waged, and agriculture is being transformed.



A shepherd drinks water on the dry bed of Manjara Dam, which supplies water to Latur and nearby villages in the Indian state of Maharashtra. India has been enduring a severe drought, which has forced millions of farmers to rely more heavily on groundwater, which has been pumped out more rapidly than it can be naturally replenished.

PHOTOGRAPH BY MANISH SWARUP, AP



By **Laura Parker**

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Beijing is sinking.

In some neighborhoods, the ground is giving way at a rate of four inches a year as water in the giant aquifer below it is pumped.

The groundwater has been so depleted that China's capital city, home to more than 20 million people, could face serious disruptions in its rail system, roadways, and building foundations, an international team of scientists concluded earlier this year. Beijing, despite tapping into the gigantic North China Plain aquifer, is the world's fifth most water-stressed city and its water problems are likely to get even worse.

Beijing isn't the only place experiencing subsidence, or sinking, as soil collapses into space created as groundwater is depleted. Parts of Shanghai, Mexico City, and other cities are sinking, too. Sections of California's Central Valley have dropped by a foot, and in some localized areas, by as much as 28 feet.



FIG. 1 MAPS. SOURCES: UNIVERSITY OF CALIFORNIA, IRVINE, WYTHMAR, MARGAT, 2006; MARGAT AND VAN DER GUN, 2013. GROUNDWATER AROUND THE WORLD.

Around the world, alarms are being sounded about the depletion of underground water supplies. The United Nations predicts a global shortfall in water by 2030. About 30 percent of the planet's available freshwater is in the aquifers that underlie every continent.

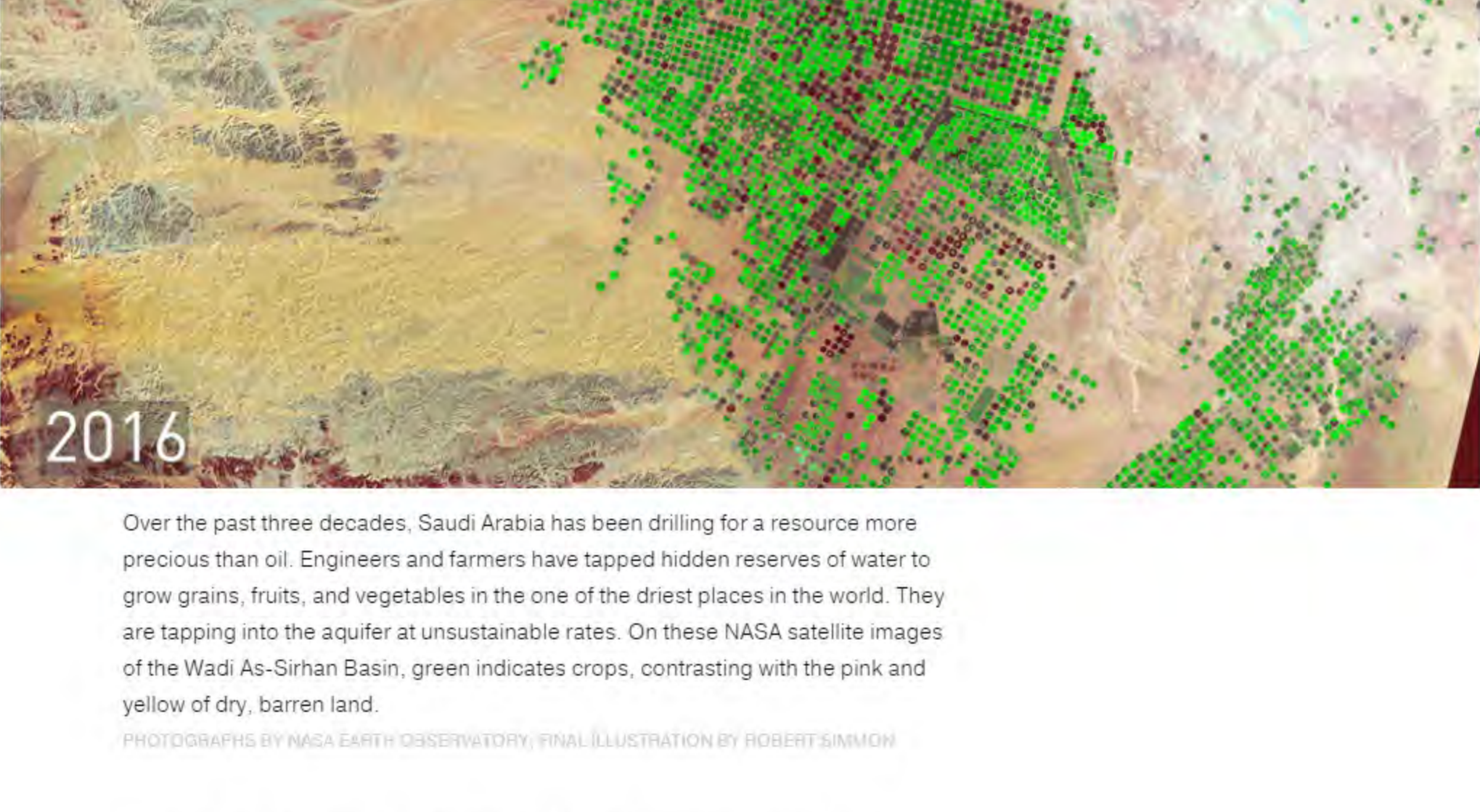
More than two-thirds of the groundwater consumed around the world irrigates agriculture, while the rest supplies drinking water to cities. These aquifers long have served as a backup to carry regions and countries through droughts and warm winters lacking enough snowmelt to replenish rivers and streams. Now, the world's largest underground water reserves in Africa, Eurasia, and the Americas are under stress. Many of them are being drawn down at unsustainable rates. Nearly two billion people rely on groundwater that is considered under threat.

Richard Damania, a lead economist at the World Bank, predicts that without adequate water supplies, economic growth in the most stressed parts of the world could decline by six percent of GDP. His findings conclude that the most severe impacts of climate change will deplete water supplies.

"If you are in a dry area, you are going to get a lot less rainfall. Run-off is declining," he says. "People are turning to groundwater in a very, very big way."

But few things are more difficult to control than groundwater pumping, Damania says. In the United States, farmers are withdrawing water at unsustainable rates from the High Plains, or Ogallala Aquifer, even though they have been aware of the threat for six decades.

"What you have in developing countries is a large number of small farmers pumping. Given that these guys are earning so little, there is very little you can do to control it," Damania says. "And you are, literally, in a race to the bottom."



Over the past three decades, Saudi Arabia has been drilling for a resource more precious than oil. Engineers and farmers have tapped hidden reserves of water to grow grains, fruits, and vegetables in the one of the driest places in the world. They are tapping into the aquifer at unsustainable rates. On these NASA satellite images of the Wadi As-Sirhan Basin, green indicates crops, contrasting with the pink and yellow of dry, barren land.

PHOTOGRAPHS BY NASA EARTH OBSERVATORY; FINAL ILLUSTRATION BY ROBERT SAMOH

As regions and nations run short of water, Damania says, economic growth will decline and food prices will spike, raising the risk of violent conflict and waves of large migrations. Unrest in Yemen, which heavily taps into groundwater and which experienced water riots in 2009, is rooted in a water crisis. Experts say water scarcity also helped destabilize Syria and launch its civil war. Jordan, which relies on aquifers as its only source of water, is even more water-stressed now that more than a half-million Syrian refugees arrived.

Jay Famiglietti, lead scientist on a 2015 study using NASA satellites to record changes in the world's 37 largest aquifers, says that the ones under the greatest threat are in the most heavily populated areas.

"Without sustainable groundwater reserves, global security is at far greater risk," he says. "As the dry parts are getting drier, we will rely on groundwater even more heavily. The implications are just staggering and really need to be discussed at the international level."

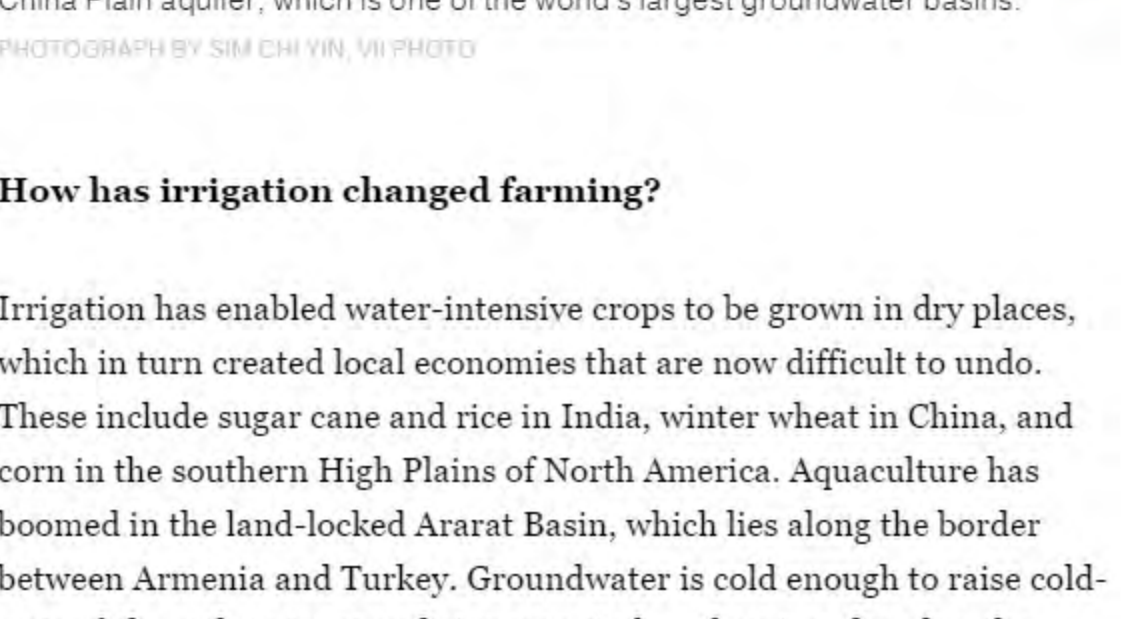
Below are answers to your key questions.

Where is groundwater the most threatened?

The most over-stressed is the Arabian Aquifer System, which supplies water to 60 million people in Saudi Arabia and Yemen. The Indus Basin aquifer in northwest India and Pakistan is the second-most threatened, and the Murzuk-Djado Basin in northern Africa the third.

How did these giant basins become so depleted?

Drought, bad management of pumping, leaky pipes in big-city municipal water systems, aging infrastructure, inadequate technology, population growth, and the demand for more food production all put increasing demand on pumping more groundwater. Flood irrigation, which is inefficient, remains the dominant irrigation method worldwide. In India, the world's largest consumer of groundwater, the government subsidizes electricity – an incentive to farmers to keep pumping.



The 20 million people of Beijing get about two-thirds of their water from the North China Plain aquifer, which is one of the world's largest groundwater basins.

PHOTOGRAPH BY SIM CHYI YIN, VIA PHOTO

How has irrigation changed farming?

Irrigation has enabled water-intensive crops to be grown in dry places, which in turn created local economies that are now difficult to undo. These include sugar cane and rice in India, winter wheat in China, and corn in the southern High Plains of North America. Aquaculture has boomed in the land-locked Ararat Basin, which lies along the border between Armenia and Turkey. Groundwater is cold enough to raise cold-water fish, such as trout and sturgeon. In less than two decades, the aquifer there has been drawn down so severely for fish ponds that municipal water supplies in more than two dozen communities are now threatened.

How much water remains?

More is known about oil reserves than water. Calculating what remains in aquifers is extraordinarily difficult. In 2015, scientists at the University of Victoria in British Columbia, Canada concluded that less than six percent of groundwater above one-and-a-half miles (two kilometers) in the Earth's landmass is renewable within a human lifetime. But other hydrologists caution that measurements of stores can mislead. More important is how the water is distributed throughout the aquifer. When water levels drop below 50 feet or less, it is often not economically practical to pump water to the surface, and much of that water is brackish or contains so many minerals that it is unusable.

Is there any good news?

Depleted groundwater is a slow-speed crisis, scientists say, so there's time to develop new technologies and water efficiencies. In Western Australia, desalinated water has been injected to recharge the large aquifer that Perth, Australia's driest city, taps for drinking water. China is working to regulate pumping. In west Texas, the city of Abilene is drilling into a deeper aquifer that lies beneath the High Plains aquifer and mixing the two to supplement the municipal water supply.

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