



More Irrigation, Less Rainfall

Researchers in India find evidence of a correlation between irrigation and rainfall amounts.

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Courtesy PlaneMad

Research shows that irrigation use in India is more widespread while the amount of rainfall from monsoons has decreased.

Man-made changes to landscape in India have affected the area's monsoon rains, suggesting that land-use decisions play an important role in climate change, according to a study by a Purdue University scientist.

Monsoon rainfall has decreased over the last 50 years in rural areas where irrigation has been used to increase agriculture in northern India, says Dev Niyogi, an associate professor of agronomy and Earth and atmospheric sciences. At the same time, dense urban areas are seeing an increase in heavy rainfall.

Niyogi used rainfall data spanning back to 1951 that was collected by 1,803 recording stations monitored by the India Meteorological Department to determine different regions' average yearly monsoon rain totals. While the mean monsoon rainfall for the entire country remained stable, Niyogi found that rainfall averages in India's northwest region decreased by 35 percent—from 75 to 40 percent—from the historical mean during the past 50 years.

Analysis of soil moisture showed that before monsoon rains came, the northwest region had become as much as 300 percent wetter in recent years relative to the past 30 years, which has been attributed to irrigation from groundwater to sustain intensified agricultural production. This wetter surface causes cooling that weakens the strength of low pressure necessary for monsoons to progress into northern India.

Satellite data showed that northern India is greening sooner than it had in the past. That greening is creating a barrier for monsoons, which provide much-needed rain to replenish groundwater reserves being used for irrigation.

"In this case, you need a warm, dry surface to advance the monsoon," says Niyogi. "Because of increased irrigation, you now have a wet, green area, which does not allow the monsoon to reach far enough north."

Because that rain isn't reaching the region, more irrigation is needed to sustain agriculture.

"Unless this is checked and controlled, the problem is going to become more and more severe," Niyogi says. "With more irrigation, we will have less monsoon rain. With less monsoon rain, you will need more irrigation, and the cycle will continue."

Urban areas, on the other hand, are being pounded with rain when it comes. Niyogi says there have been storms in some urban areas that drop as much as 37 inches of rainfall in a single day.

"You only see these types of heavy rainfall events in those areas with heavy urbanization," says Niyogi. "The more urbanization spreads in those areas, the more of these heavy rain issues we'll see and the more flooding will become a problem."

Niyogi says there are two theories on why that's happening. The first says that urban landscapes create heat, which extends into the atmosphere and energizes storms. The second theory is that pollution created in urban settings interacts with passing clouds and increases rainfall.

He says the results of his study could have land-use implications elsewhere.

"If urbanization is affecting the Indian monsoon season, it has the ability to affect patterns here in the United States," he says. "This likely isn't localized in India."

He adds that India is hotter than the United States, and that may be exacerbating the issues. The next step in this research is to examine landscapes in the United States to see if development has affected weather patterns historically.