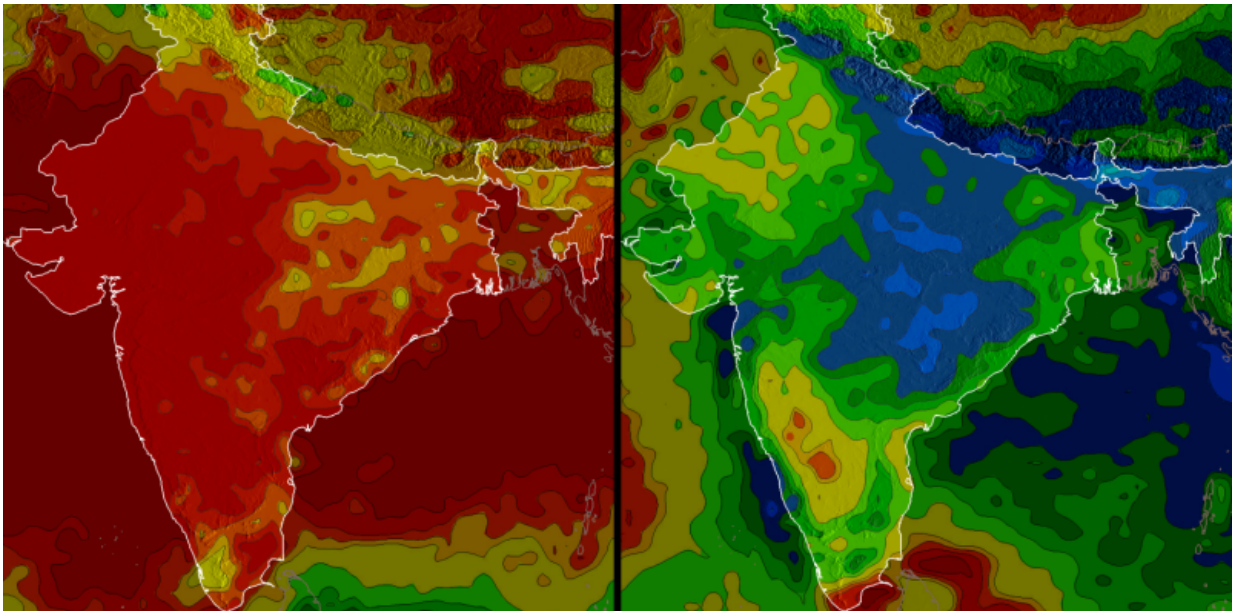


Using NASA data to show how raindrops could save rupees

June 25 2015, by Ashley Morrow



Precipitation in India varies significantly from season to season. The red in the image above indicates low rainfall, which is evident in the winter. Blue indicates high rainfall, which is abundant in the image of monsoon season. The left image shows December 2002 through March 2003, and the right image shows July 2003 through September 2003. Credit: NASA/Hal Pierce

Rainwater could save people in India a bucket of money, according to a new study by scientists looking at NASA satellite data.

The study, partially funded by NASA's Precipitation Measurement

Missions, found that collecting rainwater for vegetable irrigation could reduce water bills, increase caloric intake and even provide a second source of income for people in India.

The study, published in the June issue of *Urban Water Journal*, is based on precipitation data from the Tropical Rainfall Measuring Mission (TRMM), a joint mission between NASA and the Japan Aerospace Exploration Agency, which provided observations of rainfall over the tropics and subtropics from 1997 to 2015.

"India has severe problems getting potable water to all of its residents," said Dan Stout, research assistant in the Department of Civil Engineering at the University of Utah and one of three authors of the study. "We considered collecting water in a relatively small tank, and it's amazing the effect that doing something that small and simple can have on the Indian people."

Rainwater harvesting is not a new concept, but the team said it is currently a largely untapped resource in India. Other researchers have studied rainwater harvesting as a potential solution for the country's water problems, but they mostly focused on its use to replenish groundwater levels, which does not provide any direct benefit for immediate water supply. The water must run off into the ground before being pumped again for use aboveground.

Here, the team examined the possibilities if Indians collected precipitation in cheap 200-gallon tanks that they could easily engineer to fit in densely populated urban areas, such as many of India's growing cities. The team analyzed satellite data of precipitation in different areas to evaluate the availability of rainwater for direct harvesting—information that would have been nearly impossible to obtain if not for TRMM.

"I spent a decent amount of time trying to find precipitation data in India," Stout said. "For the most part, it didn't exist or was kept under lock and key, aside from annual accrued averages across large regions of the country. That was not at all sufficient. Before I found TRMM's data, I was thinking we would have to drop the project."



A woman in India pumps groundwater for drinking. Credit: Joel Bassuk/Oxfam

TRMM precipitation estimates show the variation in rainfall at 3.1-mile resolution, even in areas where ground measurements are non-existent.

"In the U.S., we benefit from a really good radar network along with a lot of rain gauges, but in many parts of the world, satellites are the best way to get this precipitation data," TRMM project scientist Scott Braun said.

The team used data sets provided every three hours from 1997 to 2011 to determine how much precipitation, on average, was available for collection and supplementation in each of the six test cities: Bangalore, Delhi, Hyderabad, Kolkata, Mumbai and Srinagar. The team input TRMM data into algorithms that Stout developed to determine the benefit to each of two scenarios: indoor use and outdoor vegetable irrigation.

For indoor use, they estimated each person would require an average of about 35 gallons of water per day, or about the amount needed to fill a standard bathtub. For an average household of five people, demand would be about 178 gallons daily.

Outdoor vegetable irrigation would require less water. The team calculated irrigation demands for a roughly 215-square-foot garden planted half with tomatoes and half with lettuce. Irrigation demands varied seasonally, and the team calculated them for each season.

The team found that rainwater harvesting provided for nearly 20 percent of the average indoor demand overall, though some seasons, such as southern monsoon season, provided more.

Rainwater harvesting provided a sufficient water source for vegetable irrigation, which demands less water than indoor use. The team ultimately judged that this use of rainwater provided the most benefit. While rainwater collection for irrigation resulted in fewer water bill savings, it did provide vitamin-rich food, profit from selling excess vegetables and a significantly shorter payback period for infrastructure,

operation and maintenance required for the endeavor. This can help boost cost savings and increase quality of life in India.

After a one-year payback period, rainwater harvesting for vegetable irrigation would provide a profit of between 1,548 and 3,261 rupees per year and a total cost savings of between 2,605 and 4,522 rupees per year. The savings could pay for up to about half a year's rent in an average 1-bedroom apartment in an Indian city, according to online cost-of-living database Numbeo.

The team said their data shows a conservative estimate of rainwater harvesting benefits. Stout designed the algorithms to assume at least 10 percent of the precipitation that reached the ground would be lost in evaporation, leaks and spills.

"When you're in a highly seasonal environment where you're getting rain constantly, the algorithm is going to underestimate the actual benefits," said Thomas Walsh, an engineer who worked on and co-wrote the study.

The team couldn't include many systems they looked at in the study, such as hydroponics, or the system of growing plants in water without soil, which would use water more efficiently. Walsh said the area could be explored further through global partnerships and using global data.

"Being able to pull out from the data the potential economic and social benefit you could get from something as simple as [rainwater harvesting](#) really brings to life the importance of [water](#)," Walsh said.

Provided by NASA's Goddard Space Flight Center

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