In Tucson, Subsidies for Rainwater Harvesting Produce Big Payoff

The Arizona city has spent more than $2 million subsidizing rainwater harvesting systems. Consultant Gary Woodard explains that results from a new study he is leading show such systems don't just collect water, they also change behavior.

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Rainwater runoff from a summer monsoon storm floods a normally dry desert streambed, an arroyo, near Tucson, Arizona. The city has spent more than $2 million subsidizing rainwater harvesting systems, which help manage stormwater runoff during monsoons and also reduce potable water demand.*Wild Horizons/UIG via Getty Images*

The city of Tucson, Arizona, officially got serious about rainwater harvesting five years ago, viewing it as a cost-effective tool to reduce demand for potable water.

In 2012, the city's water utility, Tucson Water, began offering rebates to its residential customers to subsidize installation of rainwater catchment systems, both to divert water onto landscaping and store it in cisterns. Later, it expanded the program to include grants and loans to help low-income households harvest rainwater.

Now it is one year into a three-year study to find out how effective those subsidies have been, and the results look good. Gary Woodard, a consultant with Montgomery & Associates in Tucson, is leading the study. He says the first year of data gathering confirms that residential rainwater harvesting has reduced the city's overall potable water demand.

And it hasn't merely reduced demand equal to the size of the rainwater harvesting systems, but significantly more.

To learn more about the results so far, Water Deeply recently spoke with Woodard, a longtime Tucson resident who previously served as deputy director of the Water Resources Research Center at the University of Arizona.

Water Deeply: What's the history of rainwater harvesting in Tucson?

Gary Woodard: It's been going on since people have been living here. It became much more popular probably a decade ago. The city started to support it five years ago in different ways. They have a larger program where they offer rebates to people who put in rainwater harvesting. They also may have been the first in the country to say all new commercial properties must be designed so the landscaping receives a minimum of 80 percent of its water through rainwater harvesting.

A lot of it is pretty simple. For example, there's a Target store down the street, and it used to have its parking lot trees in planters 8 inches above the ground, isolated by concrete curbs. What the city's rainwater harvesting ordinance has caused is, now those trees are in the ground that's a few inches *below* the level of the parking lot, and the parking lot is very gently sloped to channel the water toward the trees, and there are notches or curb cuts around the planting areas. And it doesn't raise the cost at all. In fact, it lowers the cost because you don't use as much potable water irrigating those trees.

Water Deeply: How common is rainwater harvesting in the area?

Woodard: As of this summer, the city has spent over $2 million in rebates to encourage people to put in rainwater harvesting systems. It started in the summer of 2012.

 Gary Woodard, standing next to a cistern, teaches a course in Tucson, Arizona, on rainwater harvesting. Working as a consultant for the city of Tucson, Woodard has found that rainwater harvesting reduces potable water consumption beyond the capacity of the harvesting systems themselves, because it also changes consumer behavior. (Photo Courtesy Gary Woodard)

The community has really embraced it. For example, the food bank has a very large garden, and they put in a very large rainwater harvesting system to irrigate their garden. It's sort of become a common thing around town. It doesn't rain often here, but when it does it can rain very hard. And the ground doesn't soak up water very well. So rainwater harvesting is a way to deal with stormwater runoff. A little over half of our annual rainfall comes in the summer monsoons.

Water Deeply: And what has your work for the city on rainwater harvesting been about?

Woodard: I have a contract with the city to answer the question, If you want to figure out what's going on with rainwater harvesting, how would you do it? You need three things. You need a rain gauge on site, because the precipitation is very different across short distances during the monsoon. You need a pressure transducer at the bottom of the cistern, which correlates to height of water and volume. If you read that frequently, you can see over time when it rains, how much the captured water is used. Those two are hooked up to a data logger with a built-in cell phone to upload data every night. So we can measure inflows, overflows and outflows.

We also got a follow-up contract to seek out 15 volunteer sites where we installed the instruments. The plan is to monitor them for three years, and we're just now coming up on the end of the first year. So we're just starting to figure out what's going on with these systems.

In our third angle of research, over three or four years we built dynamic simulator models for residential demand for a number of water providers, including Tucson Water. And we just got

some funding from Tucson Water and from the state Department of Water Resources to update and enhance the model. We've added rainwater harvesting to the model. In order to do that, we had to understand what happens to potable demand when people put in these rainwater harvesting systems.

Tucson Water has run various types of rebate programs going back to the early 1970s, and they keep meticulous records. We have these great records on what kinds of systems have been put in. So we're able to do an econometric analysis on what happens to water demand when these systems begin operating. The city has spent a lot of money on this, so they need to know, What are we getting from this expenditure?

Water Deeply: How do rainwater harvesting systems influence behavior?

Woodard: We know people don't just put in a rainwater harvesting system. They also put in a different landscaping system and change the way they irrigate. Most drip irrigation systems operate at 20-25 lb per square in (psi). But with a cistern, you get very low pressure – around 0.4 psi per foot of height in the tank. So even if you have a big cistern and it's full – say 7ft of water – that's 2.8 psi. So people either have to switch the way they irrigate, or some people buy a pump.

And clearly people become a lot more aware of how they irrigate and how much water they're using.

Another question is, If you subsidize the cost of these systems, and essentially you're lowering the cost of rainwater harvesting, are people typically oversizing their system because of the subsidy? We also had a very strange monsoon pattern this year. This last January, everybody's tanks were overflowing, and by mid- to late July everybody's tanks were overflowing again.

To answer some of these questions, we clearly are going to have to go three years with the study. We need to experience multiple monsoons with different rainfall patterns.

Water Deeply: What have you learned so far about how rainwater harvesting affects demand for potable water?

Woodard: We looked at two different types of rebates. You can get up to $500 for a passive system, which means you're not storing water for a later point in time; you're just taking water from your roof or the surface of the land and diverting it through earthworks, usually, and storing water in the ground. This reduces the amount that flows off your property and maximizes the amount that soaks into the ground at the right places for irrigation on your property. That's about 20 percent of rebates. About 80 percent of rebates are for active storage and allow up to $2,000 to store water in things like a cistern.

It turns out we were unable to reach any conclusions about the passive systems, in part because there aren't as many of them. But we found statistically significant reductions in potable demand for the active systems. And in fact we determined the savings were larger than we expected. If you just look at the rainfall pattern and the size of the systems you might say, well, if they capture as much water as they could, then maybe demand will go down that much. Well, on average, demand went down by more than that.

At first this was a big mystery. Then you talk to people who have put in systems and you realize, Oh, they're making major changes to their landscapes. And once they got that rainwater harvesting system, the way they're irrigating is completely different, and they're paying a lot more attention to how they irrigate. It really changes behavior. Definitely people are more careful with how they use that rainwater than how they were using the potable water to irrigate beforehand.

Another finding was that it actually reduced demand in every month of the year. As expected, it reduced demand in summer, but it also did reduce it throughout the year. Averaged across the year, these systems reduced demand about 748 gallons per month. It's more than you can easily explain by just looking at the amount of rain and the size of the cisterns. So there was clearly something else going on besides having this additional water supply. They're clearly also using less water than they used before.

Water Deeply: What lessons can you offer other communities that want to support rainwater harvesting?

Woodard: For it to make sense from a cost-benefit analysis, your local climate can't be too wet or too dry. It would not work in Yuma, Arizona, for example, where they only get four inches of rain a year. The payback period would be decades. I'm guessing it also doesn't make sense in Seattle. You need places where the demand of the landscape greatly exceeds the rainfall, and does so at a time of year that comes shortly after it may have rained. You really have to compare the evapotranspiration of a typical landscape species, and its timing, with the amount and timing of precipitation in the community.