Making Every Drop Count

Irrigation research and demonstration at Hubbell Trading Post

By Joanne Littlefield

Ed Martin

At the Hubbell Trading Post, "Big Bucket" systems are used to irrigate corn.

When rains are sporadic, the urban-dwelling home gardener is able to drag a hose out to water the plants. And large-scale agriculture operations can order irrigation water timed for delivery when the plants need it. It's those in-between growers and gardeners, though, who often struggle to bring in a crop during the dry and dusty desert growing season. For them, one viable solution is drip irrigation. Drip irrigation has been shown to be more efficient because it delivers water only to the plant's root system. The drawback is the cost of installing and maintaining drip tubing, emitters, timers and pumps.

Ed Martin, a University of Arizona irrigation specialist from the Department of Agricultural and Biosystems Engineering, is studying how the use of large holding vessels in a gravity system might more efficiently irrigate small plots and gardens on the Navajo Nation. For the past two years the College of Agriculture and Life Sciences (CALS) researcher has been looking at how gravity-fed irrigation systems compare with traditional surface systems in terms of yields, health of crops and more efficient use of water.

Two separate projects located at the Hubbell Trading Post on the Navajo reservation near Ganado are providing valuable research data and the demonstration component lets local farmers and gardeners react to the techniques.

On the Navajo Nation, people haul large amounts of water to their homes and fields—sometimes up to 20 miles away, says Gerald Moore, CALS lead extension agent on the Navajo Nation.

"This project would fit right in with the way of life," he says. Gravity-fed irrigation would enable Navajo farmers to use the hauled water to efficiently irrigate their gardens. "We are just talking about a small garden or backyard gardening—maybe 15 by 30 feet."

A national historic site, the post was chosen for this project in part because of the number of visitors—193,000—who pass through its doors and over the grounds each year. Members of both the staff and the research team recognized the opportunity to teach about the crops grown on the Navajo Nation and how the use of a low-tech drip irrigation system can conserve resources.

Moore and another CALS extension agent from the Navajo Nation, Jeannie Benally, have been able to provide valuable feedback. Both have been involved with the Ganado Irrigation and Conservation Project, a comprehensive water management plan the Navajo Nation has been working on for the Ganado Irrigation District. With technical assistance from the Arizona Department of Water Resources, the U.S. Department of the Interior's Bureau of Reclamation and the University of Arizona, the project has been in the works since the late 1990s.

After the reconstruction of Ganado Lake was completed in 1995, new opportunities for crop irrigation techniques and education programs became available. The original dam was built in the 1880s.

Besides staff at the Hubbell Trading Post, other key consultants on the irrigation project include members of the Navajo Departments of Agriculture and Water Resources, the Ganado Irrigation District Farm Board.

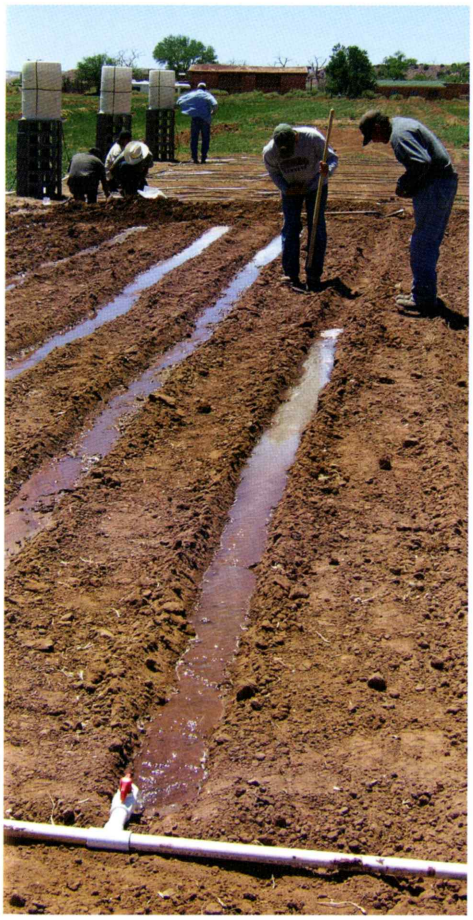
The two gravity-fed irrigation systems investigated for the project go by the names "Hanging Bucket" and "Big Bucket." They are the brainchild of New York inventor Richard Chapin,

who designed them to mirror the type of irrigation setup that would typically be used in the field.

The simplicity of the system is astounding: for each row, a bucket with holes punched in the bottom is hung more than three feet off the ground from a tree or pole. Drip tubing is attached to it that then extends down the rows, where it's covered or buried. Up to 10 rows can be placed on one bucket system. The bucket is filled periodically, depending on weather conditions, and slowly waters the plants.

"The water for the system is either put into a small five-gallon bucket and hung from a stand or is placed in large 50-gallon drums that are raised up about four feet in the air," Martin says.

Because no power is required, the method is effective for more remote parts of the reservation. Chapin Watermatics sells the bucket kits to farmers in areas of the world where getting electricity and running water can be a challenge. Another plus is the ability to add fertilizer to the water buckets for slow release to the plants.



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By monitoring the water flow from the Big Bucket system during early crop development, researchers are able to more precisely compare it to other irrigation methods.

At the Hubbell Trading Post these systems were used to grow corn, an important food and ceremonial crop for the Navajo people. The public setting of the demonstration project attracted many people who wanted to harvest the corn the moment it was ready. Martin's challenge was to hold the crop long enough to get yield data. The analysis he conducted on total grain and biomass showed that both systems produced good yields in 2005.

Along with the demonstrations for the two sizes of buckets, the research team planted corn in a plot irrigated with a surface drip system that didn't perform nearly as well as the bucket system.

"With water going right to the crop, there is up to 90 percent efficiency," he says. In contrast, water efficiency for surface drip systems, where the drip tape is not buried, is about 60–70 percent.

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Overall, the gravity-fed systems used less water than the surface irrigated drip system. At a 15.5 percent moisture rate, in 2005 they produced 69 bushels per acre with 26.1 inches using the bucket system; in the surface plot 85 bushels per acre were produced with 39 inches of water. "While we got more yield with surface plot irrigation, we were more efficient with the bucket drip," Martin says. The yield was 2.6 bushels per acre-inch of irrigation water applied with the bucket drip and 2.1 bushels per acre-inch of water applied with the surface irrigated plot.

Excessive water evaporation problems are decreased when the drip tape is either covered with mulch or slightly buried in the ground. A downside of the system—such as the buildup of algae and salts in the drip tubes—can be overcome with periodic maintenance.

The demonstration project already has begun to change some irrigation practices on the reservation. "Diné College did take to the idea, developing a system using 55-gallon drums as their big bucket," says Moore. "I think the idea of this bucket system is great."

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Gravity forces the water to flow through the thin irrigation tubing via a hole in the bottom of the bucket hanging more than three feet from the ground. The drip line is covered with mulch to reduce water evaporation.

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