HARVEST THE WATER REAP THE REWARDS

L.G. Ketchum

by Don Dale

(above) Sloped catchments collect three-fourths of the water needed to grow wine grapes at Dr. Gordon Dutt's vineyard near Elgin, Arizona.

What happens to the rain? Where does it go after it hits the ground? How can we utilize more of it?

Only Mother Nature and the computer models know.

Fortunately, the UA has researchers who have access to the data. Maybe not through nature, but certainly through the computer models. They produced many of the models themselves. And although they are modest people not given to nature's pronouncements, they say these modeling techniques can provide a guide by which a water-scarce state can alter the environment in order to harvest more water.

"We could go through a set of simulations and predict what the consequences would be," says Dr. Peter Ffolliott, a professor of watershed management in the School of Renewable Natural Resources. Furthermore, he can work backwards and, given a desired result, advise which environmental changes could bring it about.

"The whole natural resources game is integrated," says Dr. Martin Fogle, a watershed management professor who works with Ffolliott. Fogle's specialty is hydrologic modeling, and his emphasis is working with land management agencies to fit the gameland world of computers into the real world of active management.

For example, Fogle is working with Pima County to develop precipitation models that allow real time (as it's happening) predictions of the effects of rainfall—predicting flooding is an important area.

A closer look at Ffolliott's field specialty—snow—reveals just how significant modeling could be in the water harvesting picture. Computer models are based on data collected over the years, and regarding snow, much of that data is Ffolliott's. Over 15 years he led 60 graduate students in one of the largest snow research projects in the U.S.

"If snowmelt water yields were increased by 10 percent, an additional 150,000 to 350,000 acre feet of water might be realized annually to help meet the growing needs of downstream users," he says. One method of doing so might be to thin trees, since snow accumulates better in open areas.

Ffolliott has 42 computer models, many of which he built himself, with which to make environmental predictions, and they are easily fitted together to interrelate subjects as varied as water chemical quality, sedimentation and wildlife habitat.

By asking "what if" with enough models, Ffolliott could predict what an alteration such as removal of chaparral vegetation would do to stream flow, livestock grazing, timber yield and bighorn sheep. Theoretically, he could play mother nature and order up an extra few thousand acre feet of water through an alteration of the forest.

Realistically, Ffolliott says, Arizona is a ways from doing that. Although models tell what would happen and have proven useful in drawing up agency environmental impact assessments, there are a lot of factors that stand in the way of large-scale environmental alterations. Political and economic considerations weight heavily, but probably the greatest drawback is in carrying out such improvements on a massive scale and maintaining them for long periods of time.

"You're not home free," he says of planners who use models. "But you're able to predict."

By networking with other university researchers, such as Dr. Donald Graybill in the Laboratory of Tree-Ring Research, some very wide-sweeping vistas begin to become more transparent. It may be possible to use Graybill's rainfall data (he recently reconstructed runoff trends for the years 740 to 1370 and 1800 to the present) to become more predictive about rainfall in the near future.

This ability is of more than state-wide interest. Ffolliott has worked with the University of Minnesota to help them develop computer simulation models for other ecosystems, and he recently presented a paper on the subject, written by himself and watershed researcher Dr. Phillip Guertin, at a workshop in the People's Republic of China. Ffolliott headed the U.S. delegation to China.

L.G. Ketchum

Bureau of Land Management ranger Andy Wigg constantly measures water flow through central Arizona's Aravaipa Canyon.

But let's scale down our water harvesting dreams a minute. Grandiose renovations of the environment may be in the cards for the future, but small-scale, large-return augmentation of a city's or farm's water supply is now being done in and around Tucson.

"It's an ancient technique where we're concentrating the water and banking it," says Dr. Martin Karpiscak, a research scientist in the UA's Office of Arid Lands Studies (OALS). Biblical-era Egyptians and ancient American Indians used different means of harvesting and storing water that fell on an agricultural site—why can't we?

We can. And do.

The Avra Valley water harvesting agrisystem established on retired farmland west of Tucson by OALS is a working example of what can be done with rainfall harvesting. In keeping with Karpiscak's aim of keeping such projects simple and easily constructed and operated, the principles are common sense and inexpensive.

"I think where we're headed for in agriculture is not in maximizing production but in minimizing input—maximizing return per input," says OALS Director Dr. Kennith Foster. The Avra Valley project, established on retired farmland bought by the city of Tucson for its water rights, has only the rain for its water input.

Sixteen water catchments, treated with salt to facilitate runoff and reduce weed growth, direct rainwater to untreated planting areas—a catchment is nothing more than a V-shaped apron with drought-tolerant crops planted in the point of the V. The plants selected are able to withstand long periods without rainfall.

"We're looking at low water use pines, eucalyptus, salt bush," Karpiscak says. "We're trying to revegetate these areas."

Although an ultimate goal will be to get an economic return from the crops grown under such conditions, revegetation is an end in itself. Hundreds of

L.G. Ketchum

Researcher Les Rawles oversees the drip irrigation system at the OALS Avra Valley water harvesting project near Tucson. The system relies exclusively on harvested rainwater.

thousands of acres of Arizona farmland have gone out of production over the decades, and the environmental hazards of weeds and dust (valley fever, traffic accidents and allergies, to mention a few) are a societal problem. Desertification is a negative trend that is difficult to reverse.

"If you want to grow cotton you can come to the university and get a book," Karpiscak says. "If you want to retire land, there is no book."

Thus, the people at OALS and others are writing the book on reclaiming abandoned or retired lands. One encouraging aspect of all this is that an economic benefit, other than avoiding health problems, is possible.

"We've found out it's possible to grow a lot of different crops this way," says Dr. Gerald Matlock, who has used the same water harvesting techniques on the UA's Oracle Agricultural Center north of Tucson. An agricultural engineer who retired this year, Matlock has integrated modern irrigation technology with apron-type harvesting to grow high-value crops on low-value land.

"The only water we have is what we catch," Matlock says. The farm, which grows 20 acres of grapes, figs and other crops, has no well. But it does get 14 inches of rain per year, on average, and excess runoff is directed from treated harvesting aprons to three earthen reservoirs where a gas-powered pump sends it to a 10,000-gallon tank. During dry periods, the tank provides water by gravity flow through drip or spray emitters.

The commercial possibilities of such a system have been proven at the Oracle site, and carried out by Matlock's colleague Dr. Gordon Dutt on a personal basis. Using his own studies of grapes in an arid climate as a background, Dutt invested in 30 acres of wine grapes in the Sonoita area.

"I decided to put my money where my mouth was," Dutt says. As a result, he has a vineyard thats only irrigation is a low-volume well. Of the approximately 24 acre-inches of water used by the grapes annually, only 4 to 6 inches are irrigation water. By using sloped catchments combined with drip irrigation, Dutt has proven the technique—which shows promise not only for small-plot agriculture in America but also in many Third World countries where a small acreage has to make a family's living.

Matlock sees the same water harvesting principles—what he calls "a little bit of applied science"—benefitting isolated ranchers who have inadequate water for livestock. He was part of a university team that last year evaluated the kinds of water problems that exist. As part of the three-year study, UA researchers hope to turn a survey of techniques into concrete assistance.

One project underway is to develop some collection material that can be applied to small watersheds to collect water and store it. The trick will be to find a material that's easy to transport, easy to install, safe for the environment, efficient and inexpensive. The UA has worked with the U.S. Bureau of Land Management on the project, which would benefit wildlife as well as livestock.

Water harvesting is a principle that can also be applied to the urban environment. Arizona's cities, where much of our water consumption occurs, are actually ideal water catchments.

"The streets and rooftops already catch the water," says Karpiscak. "We want to change that runoff from a problem to a benefit."

Rainfall runoff at Tucson's Casa del Agua, the residence turned into a water conservation experiment, is estimated to be 15,500 gallons from the roof alone. This low-mineral water is perfect for evaporative coolers and toilets, Karpiscak says, and by using low-cost collection and storage systems to acquire water during the winter and summer rainy seasons a homeowner could greatly reduce his water costs.

That in turn would reduce demands on the city and the ground water which is now its sole source of the precious liquid. By harvesting runoff on the grounds and diverting it to drought-tolerant landscaping plants, the homeowner could cut his ground water consumption considerably.

That in turn could make the future of Tucson, as a large and growing metropolis, a little more predictable and secure.