

# Native Americans' farming practices may help feed a warming world

'We've had 5,000 years of farmers trying out different strategies for dealing with heat, drought and water scarcity. We need to begin to translate that.'



Crops are grown under a solar canopy that is key to an agrivoltaic project at Biosphere 2 in southern Arizona.

By Samuel Gilbert

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TUCSON — Indigenous peoples have known for millennia to plant under the shade of the mesquite and paloverde trees that mark the Sonoran Desert here, shielding their crops from the intense sun and reducing the amount of water needed.

The modern-day version of this can be seen in the Santa Catalina Mountains north of Tucson, where a canopy of elevated solar panels helps to protect rows of squash, tomatoes and onions. Even on a November afternoon, with the temperature climbing into the 80s, the air under the panels stays comfortably cool.

Such adaptation is central to the research underway at Biosphere 2, a [unique center](#) affiliated with the University of Arizona that's part of a movement aimed at reimagining and remaking agriculture in a warming world. In the Southwest, projects are looking to plants and farming practices that Native Americans have long used as potential solutions to growing worries over future food supplies. At the same time, they are seeking to build energy resilience.

“We’re taking Indigenous knowledge,” said Greg Barron-Gafford, a professor who studies the intersection of plant biology and environmental and human factors. But instead of relying on tree shade, “we’re underneath an energy producer that’s not competing for water.”

Vegetables such as squash, tomatoes and onions are being tracked in the agrivoltaic project at Biosphere 2.

Planting crops under solar panels is a 21st-century version of farming techniques used by indigenous people in the Southwest, notes Greg Barron-Gafford, who is leading research at the facility north of Tucson.

Dozens of solar panels rise skyward as part of the project.

On both sides of the Arizona border with Mexico, scientists are planting experimental gardens and pushing the potential of an “agrivoltaic” approach. Thirsty crops such as fruits, nuts and leafy greens — which require elaborate irrigation systems that have pulled vast quantities of water from underground aquifers and the Colorado and other rivers — are nowhere to be found.

“We’ve had 5,000 years of farmers trying out different strategies for dealing with heat, drought and water scarcity,” said Gary Nabhan, an ethnobotanist and agrarian activist who focuses on plants and cultures of the Southwest. “We need to begin to translate that.”

Some of the methods at Biosphere 2 — a facility marked by the largest closed ecological system in the world — are being applied in fishing villages on the parched Sonoran coast of Mexico. A multiyear effort there will help ensure water, energy and food sources for some 1,500 members of the Comcaac (or Seri) community.

Other researchers are creating a sustainability model for urban settings.

The University of Arizona's Desert Laboratory on Tumamoc Hill will break ground next spring on [Tumamoc Resilience Gardens](#), an initiative to be located at the base of a saguaro-studded hill within an 860-acre ecological preserve in the heart of Tucson. It will show how people can feed themselves in a much hotter, drier future.

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The core of the project's design will be passive rainwater harvesting to support a variety of edible, arid-adapted plants. Some of those will be planted under solar panels, while others will benefit from centuries-old strategies such as rock berms and rock piles to increase moisture, according to Benjamin Wilder, the lab's director.

Southern Arizona is an epicenter of the movement not just because of the intense environmental pressures that the region faces but because of the presence of the [Tohono O'odham Nation](#) southwest of Tucson.

Tohono O'odham farmer Sterling Johnson has long worked to spread knowledge of the Nation's farming practices and ancestral values.

The San Xavier Cooperative Farm is run by members of the Tohono O'odham Nation in the Tucson area.



Crops sprout at the San Xavier Cooperative Farm.

The Tohono O’odham have farmed in the Sonoran Desert for several thousand years. Like many Indigenous groups, they now are on the front lines of climate change, with food security a paramount concern. Their expansive reservation, nearly the size of Connecticut, has just a few grocery stores. It is a food desert in a desert where conditions are only getting more extreme.

Since the early 1970s, a group of Nation members have run the [San Xavier Cooperative Farm](#) and grown “traditional desert cultivars” in accordance with their ancestral values — particularly respect for land, water and plants.

Sterling Johnson, a member of the Tohono O’odham Nation, has worked for the past decade to share that expertise broadly. His partner, Nina Sajovec, directs the [Ajo Center for Sustainable Agriculture](#), a Native American-governed food justice organization that several years ago founded its own seed bank and already has distributed over 10,000 seeds to farmers.

“We’re all about using what is out there,” Sajovec said. Among the center’s heirloom varieties: 60-day corn, a fast-maturing desert-adapted vegetable, and the tepary bean, a high-protein legume particularly suited to the climate because of leaves that can fold to withstand direct sunlight during the peak of summer.

Johnson captures precipitation during the [Arizona monsoon season](#) to sustain crops on his field in the desert lowlands. “It’s using the rainwater,” he explained, “using the contour lines, using your environment and nature to grow food.”

This once common dryland farming practice was all but erased by this country's [Indian boarding school system](#), which “ripped” children away from their families and severed the transfer of knowledge, he noted. The increasing interest in Native ways is generally welcome, yet it can feel once again like “Anglo society taking when they need something.”

“We really would like to see these crops and techniques ... still used to serve the Native community,” Johnson added.

Scientist Greg Barron-Gafford checks a meter under the solar canopy at Biosphere 2.

Specialized equipment monitors air and soil conditions.

Interns working on the agrivoltaic project record key measurements of non-canopy plants.

Perhaps even more daunting than the rising temperatures of climate change are the water shortages that many parts of the world will confront. In Tucson, the Santa Cruz River is now dry because of too much diversion and burgeoning demand, according to Brad Lancaster, an expert on rainwater harvesting.

“The majority of the water that irrigates landscapes and Tucson and Arizona is not local water” but tapped from the Colorado River, Lancaster said. Unless severe drought conditions reverse and the river level improves, [mandatory federal cutbacks](#) mean farmers will lose a significant amount of that critical resource starting next year.

“The goal is how can we use rainwater and storm water, passively captured, to be the primary irrigator,” said Lancaster, who lives in a local neighborhood that has been transformed through passive water harvesting into an [“urban forest,”](#)

with wild edible plants such as chiltepin pepper and desert hackberry lining the sidewalks.

Butternut squash flourishes under the solar panels.

He is planning a similar system at Tumamoc Resilience Gardens, using basins and earthen structures to spread water across the landscape and reduce channelized flows. Nabhan, who also is involved in the site's design, sees it as replicable and, more importantly, scalable.

“We hope [planting] these gardens will be the same as planting an apple orchard,” Nabhan said, walking around his own creation at his home in Patagonia, a small town about 18 miles north of the Mexico border. The fenced space holds 40 species of agave, three species of sotol, prickly pear and other varieties of cactuses and succulents.

“The key concept,” he said, “is that we’re trying to fit the crops to the environment rather than remaking the environment.”

[\[This tribe helped the Pilgrims survive for their first Thanksgiving. They still regret it 400 years later.\]](#)

[\[Indigenous activists come to D.C. with a message for Biden: Declare a national climate emergency\]](#)

[\[Tribes want ‘immediate action’ to reverse Trump’s cut to Bears Ears National Monument\]](#)

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