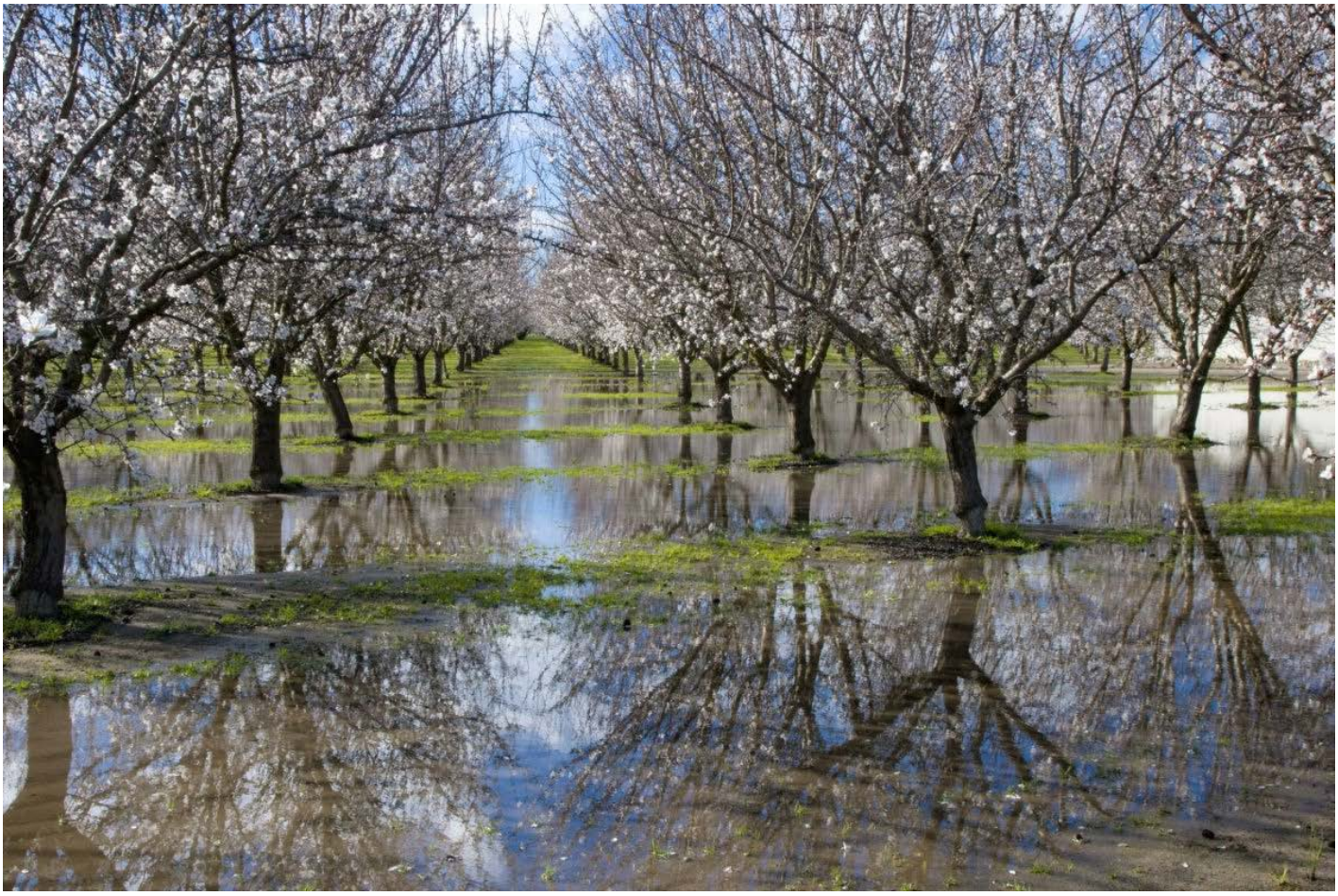
These Farmers Recharged Groundwater by Catching Atmospheric Rivers

After years of drought and dozens of recent atmospheric rivers, Central California farmers have revamped an old practice: intentionally flooding fields for deep irrigation and restoration of underground aquifers.

BY GREY MORAN APRIL 17, 2023



Standing water in a blooming almond orchard cause by excessive rain near Manteca, California.

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After the first of California's winter storms, Michael Naito went out into his dormant fields to open his water valves, intentionally flooding the land. The fields filled up like a bathtub over the next three days. The water rose until it covered the feet of his leafless pistachio and almond trees, as well as the tangles of barren grape vines. It looked like an ephemeral pond that disappeared over the next few weeks.

"It's kind of a deep irrigation," said Naito, who has continued this practice over the past few months, flooding 250 acres of his 600-acre farm in California's Central Valley.

As the water sinks in, it travels deeper underground to slowly percolate into the underlying aquifer. The practice, called managed agricultural groundwater recharge, probably looks strange to the uninitiated, but it's seen as an increasingly important task during years with a water surplus in the state.

After a series of very dry years in California, this year 31 atmospheric rivers have brought reams of moisture from the tropics, drenching once-dry basins, capping the Sierra Nevada mountains with snow, and flooding several regions. The state's water cycle is broken, and it has created a crisis of misplaced water. In addition to an ongoing war over surface water, in which the agriculture industry and conservation community have often been at odds, there's widespread consensus that the disappearing groundwater has reached crisis level. Wells have run dry, deeper wells have been dug, and the land in many counties is literally sinking after water was rapidly drained from underground aquifers.

That's why Naito and several other farmers have been intentionally flooding farmland to stow water underground, helping restore underground aquifers.

"You're putting the water on when the plants don't need it very much," said Naito. The water stays on the field longer, and it is less prone to evaporation in the winter. He'll generally flood the sandiest parts of his land, where the water can move quickly downward.

This practice requires the same tools as flood irrigation, an approach that was once practiced by most farmers in California. It's still the most common form of irrigation globally. "You put the water out and what the plant didn't use, the majority of it went back into our aquifer," said Naito. But over the past couple decades, many farmers converted to drip irrigation, giving their crops only the water they need. As a result, very little water returns to the aquifer.

Like many farmers, Naito retired his flood irrigation system, but now it's back in use for managed recharge in the winter months. As the temperature rises and his trees grow leafy, he'll typically switch back to drip irrigation. However, this year he is expecting to be able to flood irrigate well into the summer, letting the water fill up for about 24 hours. It's less water than he used for recharge in the winter months, but still more than typical irrigation.

Overwhelmed with a surplus of water this year, the irrigation district where he farms in Madera County offered water to farmers for very cheap at first, and now for free. Naito was quick to take advantage of the offer, largely motivated by the goal of restoring the health of the aquifer.

He acknowledges that there's still a long way to go; so far recharge provides just a trickle of a solution, and the Central Valley is still rapidly losing water. "It's going to take years of this, a lot of people putting a lot of water in, until you really start to see the benefits," Naito said. While practiced by a handful of farmers in his irrigation district, he's confident that active groundwater recharge will soon become mainstream. Farmers across the state will join together, he hopes, flooding their orchards every time there's water to spare.

Restoring a Broken Water Cycle

The emerging interest in managed recharge is largely driven by the early implementation of the Sustainable Groundwater Management Act (SGMA), the first law to regulate groundwater in California. It requires bringing overdrafted groundwater basins into balance by 2042, ensuring that at least an equal amount of groundwater is returned to the aquifer as what gets withdrawn every year. Each basin has been tasked with coming up with a plan for sustainability, including for groundwater storage and land subsidence from chronic water loss.

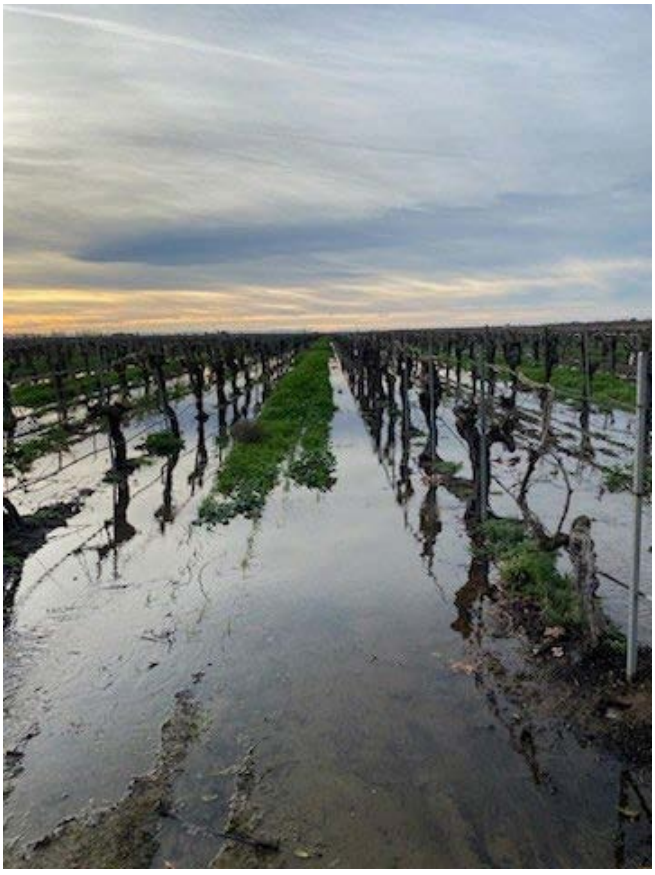
As committees around the state develop local plans, one recent study found that groundwater has been depleted at an increasing rate in recent years in the Central Valley, leading to "significant cumulative water loss" over the course of the last two decades.

"It's very typical to see some recharge and replenishment of groundwater during wet seasons, like this one," said Jay Famiglietti, a hydrologist and lead author on the study. But in the dry months, "there is a much longer period of overpumping of groundwater, as the surface water starts to disappear." Groundwater recharge is widely recognized as critical to closing this gap, balancing the periods of pumping and replenishing.

California has shown interest in the approach. Last year, it called for managed groundwater recharge to expand by at least 500,000 acre-feet annually, recognizing this as "one of the fastest, most economical, and widely available ways to harness the bounty of wet years." In March, Governor Newsom temporarily suspended permitting regulations, enabling floodwaters to be easily diverted for recharge, while the state approved a plan to divert water from the swollen San Joaquin River for recharge. There are many forms that groundwater recharge can take, including refilling larger-scale basins, sharing the principle of moving water underground to replenish the aquifers.

"The groundwater reserves we have stored underground are so much larger than any surface water storage that we have combined in rivers, lakes, and man-made reservoirs. So, it really is a much more convenient way of storing water for multiple years," said Helen Dahlke, who leads a laboratory focused on catchment hydrology under a changing climate at the University of California, Davis. "California is coming to realize that our surface water storage is only typically carrying us over for two or three years," she added.

Intentional groundwater recharge works especially well in California's Mediterranean climate, which has a natural pendulum of wet and dry seasons. "Water tends to come in these big, really fast gulps," said Caity Peterson, who researches water policy at the Public Policy Institute of California. "We've always relied on a relatively small number of wet days to get us through the entire rest of the year."



A flooded vineyard in California. (Photo credit: Michael Naito)

Climate change has heightened the pendulum's swing, between extreme drought and relentless rainfall. It has exacerbated what Peterson described as the root of California's water challenges: "The disconnect between the timing of water demand versus the timing of water supply." This is where she sees groundwater recharge coming into play, as a way to balance out this increasing climatic volatility that feeds a broken hydrological cycle with either too much or too little water.

The Uncharted Path to Implementation

While interest is building, California is still in the early stages of adopting and incentivizing groundwater recharge on farms. Many of the nuts and bolts of larger-scale implementation, crucial to balancing out returns and depletion, remain to be determined.

This includes a plan for expanding water infrastructure, mainly aboveground canals that Dahlke explains aren't designed for moving floodwater. "The existing infrastructure is mainly to move small amounts of water around, to irrigate crops," said Dahlke. "It's not quite large enough to move large amounts of water around."

These infrastructure challenges extend to farmers who have land only partially located within an irrigation district, or in no water district whatsoever. For instance, part of Naito's land isn't in an irrigation district, and he lacks infrastructure to move surface water onto it, so he instead resorts to pumping groundwater there.

Even when farmers have surface water available, many lack incentives to spread it on their fields in the winter months. In most irrigation districts, farmers don't receive immediate benefits from doing so, even if the effort will benefit all farmers in the long run. There is a growing discussion of how to credit individual farmers for the recharged groundwater.

In Tulare County, one of the most productive ag counties in the Central Valley, the irrigation district has made some headway. It has put together quick rules in advance of state-level ones, crediting farmers for the amount of water they return to the aquifer. This figure is slightly less than the amount of surface water they spread on the field, given that some is lost to evaporation and consumed by plants.

In the end, farmers who recharge the aquifers receive a credit, adding to the overall amount of allocated groundwater they can use in the dry season. Since implementing this last year, Aaron Fukuda, the water district manager, says it has been a turning point for the district, spurring widespread recharge. After January's atmospheric rivers, he opened the district for surface water deliveries and received more orders than ever before at that time of year, amounting to nearly a third of the district's irrigation capacity.

"We had 80 orders right off the bat that morning. And we just went up from there. Within a week or two, we were up to 100," said Fukuda. In previous years, he'd receive just six to 12 orders in January.

“Our growers were basically flood irrigating in the dead of January,” he said. “It was a mess. It took a lot of teamwork. The growers were very patient with us; we were very patient with the growers.”

As more districts find ways to credit farmers for the water they put back into the aquifers, Naito and others are turning their focus on the long game.

“You have to look at this as, ‘Hey, we’re doing this for a time and a lot of people are going to do this, and collectively it is going to help,’” he said. “One year doesn’t solve this. You have to do this whenever possible when the water is there and over time.’ After all, he notes, the existing groundwater accumulated over millions of years.

Grey Moran is a Staff Reporter for Civil Eats. Their work has appeared in *The Atlantic*, Grist, Pacific Standard, *The Guardian*, Teen Vogue, The New Republic, *The New York Times*, The Intercept, and elsewhere. Grey writes narrative-based stories about public health, climate change, and environmental justice, especially with a lens on the people working toward solutions. Read more >