

The Efficiency Paradox

by Matt Jenkins

Why water conservation along the Colorado River — a much-vaunted silver bullet for the West's coming era of shortage — could have devastating environmental costs

MEXICALI, MEXICO

In 1937, Miguel Hernández Rentería left his hometown in the central Mexican state of Sinaloa and came to the Mexicali Valley, on the U.S. border, to grow cotton. The desert here receives less rain than the Sahara, and carving out a living with a horse-drawn plow was an act of faith as much as pluck. But Hernández proved tough enough to ultimately support 13 children.

Then, in 1946, he was confronted with a preposterous problem. Water began rising out of the ground and inundating his fields. By 1952, it was as high as his 7-year-old son Gerónimo's neck.

The water was leaking out of the All-American Canal, just over the border. The canal carries nearly one-fifth of the water in the Colorado River to farms in California's Imperial Valley. Because it was simply dug out of the earth and never lined with concrete, it leaks 22 billion gallons of water a year. That water percolates underground, migrates south across the border, and re-emerges in the Mexicali Valley.

Farmers here quickly turned the improbable scourge into a windfall. With the aid of the Mexican government, they built their own canal to capture much of the leakage, which is now funneled to farms close by. Private and government pumps also send the leaked water to farms, such as the Hernándezes'.

Today, Gerónimo Hernández, at 61, is a tornado of a man who seems to have inherited his father's tenaciousness. He also has a wicked wit, introducing himself with a reference to his namesake — “el pistolero de Cochises” — and a motion for a visitor's scalp. “My father and the first generation of farmers are dead now,” says Hernández. Horse-drawn plows have given way to mechanized cotton harvesters. But he and his brother still farm 400 acres along the border, rich fields punctuated by date palms that give the area a vaguely Mesopotamian feel. The Hernández brothers are just two of more than 14,000 farmers in the Mexicali Valley.

Now, however, San Diego and the Imperial Irrigation District are about to begin a joint effort to remove the All-American Canal from service and replace it with a new one, excavated alongside the existing one and lined with concrete to make it impervious to seepage. Then the conserved water — the windfall that has sustained the farmers here for more than half a century — will be transferred to San Diego.

The Hernándezes and other farmers here stand at the edge of an advancing campaign of water efficiency that reaches across the entire Colorado River Basin. Nearly a century

ago, the wild and undammed Colorado was, in the eyes of American engineers, a poster child for inefficiency and waste. In the 1920s, they embarked on a campaign of maximum development and tamed the river with a phalanx of dams to keep its water from running wasted to the sea. Now, in a world shaped by ever-sharpening competition for water — and nearly eight years into a drought — the promise of efficiency has been resurrected.

Water efficiency bears a patina of environmental respect-ability, and it is frequently seen as a way to conjure more water out of thin air. But a profound paradox stands at the heart of the logic of efficiency: Increased efficiency creates losers as well as winners, and the victims often inhabit places far beyond the public eye. Gerónimo Hernández and his Mexican compatriots will soon find themselves among the losers. But the biggest costs of the new obsession with efficiency could ultimately accrue to the very place that bore the brunt of the first round of development: the foundering ecosystem of the Colorado River Delta.

Environmental groups have helped shape water politics to an extent that often goes unremarked. They have labored to convince the West's traditional water power brokers to include the environment in their calculations. And it is largely due to the efforts of environmentalists that, in the last quarter century, efficiency has become a watchword on the Colorado.

In the early 1980s, water agencies in California were using more Colorado River water than they were entitled to. With urban demand booming in Arizona and Nevada, which also rely on water from the river, the agencies knew that a water crunch was imminent. In 1982, in an effort to assure itself adequate water when it was ultimately forced to reduce its take of the Colorado, the Metropolitan Water District of Southern California set its sights on the Sacramento River in Northern California. The agency, which supplies 18 million people in Los Angeles and San Diego, proposed building the “Peripheral Canal” to tap the Sacramento before it reached the San Francisco Bay-Delta and to funnel the water south. The plan sent Northern Californians into a paroxysm of rage: Not only did it sound like an unvarnished water grab, it sounded like one that would strangle the aquatic ecosystems of the Bay-Delta. In a statewide referendum that summer, voters resoundingly defeated the idea.

But Southern California's water crunch still loomed. So, in 1983, Robert Stavins, a Berkeley-based economist with the Environmental Defense Fund (who would go on to become an architect of greenhouse gas emissions-trading programs) wrote a visionary proposal called Trading Conservation Investments for Water. Why not, Stavins argued, “salvage” water that had already been diverted into California's hydraulic maw, but then had been lost to leakage? The Metropolitan Water District could fund water-efficiency improvements in the Imperial Valley, in exchange for the water saved by those improvements.

Stavins' report was written in the language that water managers speak, and it was politically palatable: Rather than suggesting a full-blown transfer of farmers' water, it simply proposed helping them tighten up their water-supply system and resurrect water that seemingly had vanished into the ether. The proposal set off a revolution in

California's water affairs. In 1988, Met agreed to spend more than \$200 million lining and automating the Imperial Irrigation District's canal system, freeing up enough "new" water to serve more than 200,000 homes each year.

In the years since, a raft of efficiency-funding programs has come to stand at the center of California's plan to pare back its Colorado River water use; the Imperial Valley is now a proving ground for the idea of water efficiency. All told, the Imperial Irrigation District will squeeze out 15 percent of its water for transfer to residents of Southern California's cities, without reducing agricultural productivity. Much of that water, including that saved by lining the All-American Canal, will go to the 3 million people supplied by the San Diego County Water Authority.

The Colorado River drains seven states in the U.S. before it skirts the Mexicali Valley; in the Days Before Dams, it went on to empty into the Sea of Cortez. Yet for the seven U.S. states, the Mexicali Valley might as well be the dark side of the moon.

In its last 100 miles, the river provides water to some half-million acres of farmland — more land than is farmed in the Imperial Valley — and 3.1 million people, not only in the Mexicali Valley but also in places like Tijuana, which lies on the coast, just across the border from San Diego, and is the largest city in the Mexican state of Baja California. That water is the last of the river's flow: the 9 percent that Mexico is entitled to under a 1944 treaty with the United States.

The city of Mexicali, the capital of Baja California, has a scruffy air, but it is undeniably booming — thanks in large part to the maquiladoras that have risen from the Sonoran Desert scrub to crank out products bound for the U.S. A local business group called the Mexicali Economic Development Council, led by some of the area's leading entrepreneurs and commonly known by its Spanish abbreviation, CDEM, has shouldered the somewhat contradictory task of promoting economic growth and quality of life in the city. And it has spearheaded the fight against the All-American Canal lining project.

Last year, CDEM sued the United States in U.S. court, alleging that the federal government failed to adequately consider potential harm to animals on the U.S. endangered species list that depend on leakage-fed wetlands along the border. It also alleged that the canal lining would deprive people in the Mexicali Valley of water that they had come to depend on and acquired rights to, and would set off a wave of migration by displaced farmers. The federal appeals court in San Francisco has, for now, ordered the lining project stopped until it can untangle the case.

For René Acuña, CDEM's executive director, the United States' outright ignorance of the lining project's impacts is yet one more chapter in the story of its blinkered attitude toward Mexico. "They said, 'OK. South of the border is the end of the world,'" Acuña steams, before he comes back sounding like a copywriter for next year's UNICEF cards. "We don't see the fence that divides the countries. We see a region. We are interrelated. We share roots, families, air, water, everything."

A hundred miles to the west, in the spit-shined dream that is San Diego, Dan Hentschke is not a person whose eyes turn misty at the notion of cross-border fraternity. Hentschke, who looks like a little Mr. Clean with Ben Franklin glasses, is the top lawyer for the San Diego County Water Authority. “Look. The Colorado River is fully appropriated. There is no other water to give around. It’s done,” he says. “Everybody knows what they have. And Mexico’s trying to get more than they have.”

Hentschke is fond of invoking the analogy of a leaky, 10-year-old garden hose and an unimaginably tactless neighbor. “When you turn on your faucet, the water leaks out, and trickles down into the ground, and waters your neighbor’s orange tree. So you go to Home Depot, and you buy a new hose. And the guy who owns the orange tree says, ‘Hey! You’ve had a leaky hose for years. Take a nail, and put a hole in that hose you just got, because I have a right to your water.’ ”

Even with the seepage from the United States’ leaky hose, Baja California is facing a looming water crunch. In downtown Mexicali, the local branch of the National Water Commission is housed behind a whitewashed cinderblock wall that local children have painted with water-themed murals. There, a man named Julio Navarro oversees the valley’s massive irrigation district, and it feels as if he is barricaded inside his report-stuffed office. “Managing water,” he says, with a quietly exasperated laugh, “is managing conflict.”

A new study funded by the North American Development Bank occupies a prominent place on his desk and hints at the shape of the future. Almost all the water currently available for farms and cities in the Mexicali Valley is already being used. Farmers are also pumping out almost 25 percent more groundwater than is naturally recharged into the ground each year, running up a significant debt against the future. Cities — most prominently Mexicali, where a new wave of maquiladoras is buying up land on the outskirts, and Tijuana, on the coast — now use about 12 percent of the valley’s water, but they are expected to need twice as much by 2030.

The growing urban demand for water here is a mirror image of the water-strapped world north of the line, and the way out, Navarro says, is clear: tightening the system to recover the lost water. In fact, the Water Commission is already four decades into a water-efficiency improvement program — a program that, viewed one way, is essentially a perpetual effort to stay ahead of the coming conflict.

First, the government lined the main canals in the valley with concrete. Then it turned its attention to the secondary canals. Now, says Navarro, “we are working on the small ditches that deliver water directly to the fields” — and even on farmers’ fields themselves, footing half the cost of ominously named devices called laser levelers. These dust-billowing, laser-guided scrapers are hitched behind tractors and grade fields perfectly level, so water can be more evenly applied, increasing the amount available for consumption by crops — and reducing the amount lost to percolation and runoff.

Even after decades of efficiency efforts, however, the district still loses nearly 40 percent of the water in its system every year. Those losses materialize out of the pages of

Navarro's report and are tabulated as *pérdidas de agua*: a sort of gold worth chasing after and putting to productive use. And Baja California's booming cities are now exploring an idea lifted straight out of San Diego's book. "If the cities finance efficiency projects," says Navarro, "they can get the saved water." So far, he says, "they're only talking about it. But we think maybe in a year, two years. ..."

As overlooked as the Mexicali Valley is in the broader affairs of the Colorado River, there is a spot farther down the line that the dealmakers have ignored outright. It is the Colorado River Delta — a netherworld where, Before Dams, the river created nearly 2 million acres of lush wetlands as it flowed toward and into the Sea of Cortez. Surrounded by the Sonoran Desert, the Delta was the heart of a complex ecological web that provided crucial habitat for resident populations of wildlife, nourished marine fisheries in the Gulf of California, and formed a critical link in the Pacific Flyway for birds flying north from Central America. And it is only here that the true impacts of the obsession with wringing out every last drop of water all the way down the Colorado River ultimately become visible.

For millions of years, the Delta received the entire flow of the river. As the first round of water conservation began playing out in the 1930s and the phalanx of dams went up, that water disappeared. The graph of the river's annual flow through those years looks like a hospital patient flat-lining.

Ed Glenn is a researcher at the University of Arizona who has extensively studied the Delta. The river ecosystems here, he says, "were shaped by the pulse flood regime that's common on arid-zone rivers, and especially ones driven by El Niño cycles: In really wet years, pulse floods germinate the trees, and then the water retreats and those trees can live on groundwater." Without the floods that the native cottonwoods need to germinate and reproduce, they were crowded out by invasive tamarisk. By taming the floods — nature's ultimate form of "waste" — the dams undercut the resiliency of the Delta and turned it into a land of cracked mud and impenetrable thickets of salt-sucking tamarisk.

In the early 1980s, however, El Niño provided a brief, brilliant reminder of just what it is that natural "inefficiencies" do — most spectacularly in 1983, when storms stuffed so much snow and rain into the Rockies that the U.S. government was forced to crank wide the spill gates on Glen Canyon Dam as torrents of water charged toward the sea. The downriver surge created a massive, defibrillating spike on the hydrograph that burst Mexican levees and inundated much of the Delta. Like a patient swimming up out of a coma, the Delta showed signs of renewed life.

In 1999, Environmental Defense and several other conservation groups took up the Colorado River Delta's cause. They suggested that a reliable source of water for a "base flow," backed up with the occasional flood, could probably keep alive the 150,000 acres of wetlands that had come back. With the reservoirs upstream brimming with water, holding the line in the Delta did not seem like a preposterous proposition: It would take just two-tenths of 1 percent of the river's long-term annual average flow, boosted by a flood pulse every four years of 1.8 percent of the river's flow.

Almost as soon as the proposal hit the streets, the current drought descended on the Colorado River, and the surplus water evaporated.

The Delta cannot conceivably be restored unless the seven Colorado River states in the U.S., which control 91 percent of the water in the river, lift a finger to help. There is a clear ecological link between the United States and the Delta: The river in Mexico provides crucial habitat both for birds that are federally protected as endangered in the U.S., and for migratory birds that wing their way up the Pacific Flyway into what the farmers along the border refer to as *Gringolandia*.

The states and the U.S. federal government have, however, consistently refused to include the Delta in the equation by which they run the river. They have, in the language of economists, largely externalized the environmental costs of water development from their calculations. In 2005, for example, California, Nevada and Arizona signed what they hailed as a landmark Multi-Species Conservation Program for the Lower Colorado River, designed to protect endangered species while allowing those states to continue siphoning water out of the river. The Delta is conspicuously absent from the plan.

Now, the drought on the Colorado is dragging into what could be its eighth year. The seven states are urgently finalizing a plan to prepare for the catastrophic shortages that will come with a prolonged megadrought of the sort that climate researchers have found evidence of in the not-so-distant past. From synching up the operation of Hoover and Glen Canyon Dams to meet water demands more efficiently, to building a new “Drop 2” reservoir in the Imperial Valley to catch inadvertent “overdeliveries” and flash floods that otherwise would escape down the river to Mexico, the states are turning their collective weight toward ironing out every last inefficiency on the river with an enthusiasm unseen since the original dam-building campaign.

It is hard to believe that there’s much left to iron out. Today, about 20 miles below Morelos Dam, where Mexico siphons the majority of its share of Colorado River water to the Mexicali Valley, the river is literally as dry as dust. And yet, further downstream, in a no-man’s land of marginal farms that the Mexican government ordered depopulated in 1976 and is slowly being reclaimed by the desert, the river, amazingly, re-emerges.

The vast majority of the Mexicali Valley drains to the Colorado River, and, somewhere out on the west edge of the valley, reed-lined drainage canals gather the water that has run off the area’s farm fields. Like some mystical essence of the universe revealing itself, this is Julio Navarro’s *pérdidas de agua* — water that has leaked from the valley’s irrigation network, but has not been truly lost. The drains merge to form the Rio Hardy, a short tributary that returns water to the very bottom of the Colorado River watershed and the Delta. Much more drainage water remains unseen, in the form of groundwater that lies just below the surface, where plants can tap it with their roots.

By the standard calculations of the Colorado River’s water users, the wastewater that makes its way back here is the merest trickle of the river’s total flow. But it can be quantified in another extremely important way: It is enough to sustain life. Today, even though they are choked with tamarisk, the Delta’s lagoons are secret worlds full of

herons, pelicans and cranes. The place feels like the world after humans are done with it, the world left over. It is filled with the birds, and the sound of the wind, and crowned by an infinite expanse of sky.

Few people know the Delta better than Francisco Zamora, who works for the Tucson, Ariz.-based Sonoran Institute and manages its Delta restoration program. Zamora has a habit of making himself look small under his ball cap, but his mind is constantly at work puzzling out the enigmas of the Delta. His group is now partway into a pilot restoration project on the river, an effort largely focused on re-establishing cottonwood, willows and mesquite in areas overtaken by tamarisk. But the main need now, says Zamora, is water.

The behavior of the entire hydrologic cycle in the Delta — how water is taken out of the Colorado at Morelos Dam, how it flows through the irrigation district, and the ways in which it returns to the Delta — is poorly understood. As a nonprofit, Zamora says, “We haven’t been able to get all the resources we need” to tackle those questions. But he is working on it.

Zamora has cajoled numbers from the National Water Commission, sought money to install stream gauges to quantify how much water now makes its way through, and scrounged up \$70,000 so scientists at the Autonomous University of Baja California and the University of Arizona can construct a computerized hydrologic model to tease out the intricacies of flow patterns. It is an effort that would normally cost close to a half-million dollars.

Wastewater flows into the Delta are now, at most, 2 cubic meters per second — less than four-tenths of 1 percent of the river’s long-term annual average flow. Zamora is trying to scare up another 2 cubic meters per second. And he has possibly found it, or at least knows where to start looking.

Zamora is trying to get the city of Mexicali to agree to “donate” the outflow from a new wastewater treatment plant to the Delta, rather than selling the treated water for re-use in Mexicali. But working closely with Osvel Hinojosa and the Mexican conservation group Pronatura, he has also identified nearly 15,000 acres of farmland in the Mexicali Valley that could be bought or leased to free up more water for the Delta. Last year, Hinojosa found the money — in a somewhat promising sign, it came through a grant from the U.S. Fish and Wildlife Service — to buy water rights from 114 acres of farmland. He is now using a new provision in Mexican national water law to dedicate that water for the Delta. “We wanted to test the process and show that it can be done,” Hinojosa says. “Hopefully, now, other organizations will be interested in providing funds” to expand the effort.

Yet the push for efficiency weighs heavily on both men’s minds. “If we buy two cubic meters per second, but we lose two” because of efficiency improvements elsewhere, says Zamora, “then we go back to the same thing. Or even worse.” And so, here, at the end of the line, a somewhat absurd possibility has suggested itself to Zamora and his colleagues: Deploying efficiency to fight the environmental impacts of efficiency itself.

The Sonoran Institute and Pronatura are now trying to identify opportunities to fund water-efficiency improvements in the Mexicali Valley and deliver the saved water to the Delta. It may be the only way for the restoration effort to hold the line in a spiraling arms race of efficiency whose costs will otherwise fall entirely on the environment.

Zamora and his colleagues are at a decided fiscal disadvantage, however, when compared with the wherewithal that the seven states and the West's booming metropolitan areas can bring to bear on efficiency. They may be stuck trying to play penny-ante stakes in a game that they cannot afford to win.

Meanwhile, not far north of the Delta — and in several spots throughout the Mexicali Valley — Julio Navarro's plan for staving off a water war is taking shape. The scene is eerily reminiscent of what is planned for the All-American Canal. Alongside an old, unlined canal, a backhoe with a special scoop shaped like the cross-section of a canal is slowly digging a second, parallel trench. Close behind, a dump truck and six men with shovels and trowels are lining the new canal with concrete, to save water for the Mexicali Valley irrigation district.

In the face of the renewed quest for efficiency by the seven basin states and Mexico, the paradoxical need to protect the "waste" that keeps the Delta alive is more important than ever. Jennifer Pitt, a Boulder, Colo.-based analyst with Environmental Defense, says, "I'm in a really awkward position, having to argue against efficiency projects, but we need to get water dedicated to the environment."

Pitt and other environmental advocates have alternately pleaded for and strong-armed access to the world of the water bosses as they make plans to tighten the screws down even further. In an effort to reduce some of the pressure on the river, the Delta advocates have proposed a further expansion of the trading-conservation-investments-for-water idea, in which water users in the U.S. could fund water-efficiency programs in Mexico, in exchange for the conserved water. That could obviate the need for new projects like the Drop 2 reservoir, which will essentially vacuum up any unintentional "slop" that heads down the river toward the Delta. It would also potentially allow U.S. water users, like snowbirds doddering across the border for cut-rate dental work, to get more bang for their efficiency-improving buck in Mexico.

The seven states are interested in investigating such possibilities — a move, Pitt concedes, that puts the restoration effort on somewhat perilous ground. "If we get everybody playing nice to increase efficiency, and we make no progress on environmental flows," she says, "then we're really screwed."

In the Mexicali Valley, people are contemplating how the cascading impacts of efficiency will change their lives. Not far from Gerónimo Hernández's farm, a farmer named Jesús Figueroa stands on the edge of a field of flood-irrigated alfalfa, his pants rolled to his knees. After 25 years in the U.S., Figueroa returned to Mexico in 2001 to help his father run the family's farm. If the All-American Canal seepage dries up, he says, "there are no other options in the valley," and he will likely head back across the line. It would save

him a lot of trouble, Figueroa laughs, “if they just move the border line down here” — either way, he’ll end up in the U.S.

The problem for the Delta, too, is ultimately less one of technical fixes than of borders and horizons. The contemporary focus on efficiency is a significant shift away from the mindset that tried to outflank the harsh realities of the desert with dams and concrete. It seems to fit the curves of the Western landscape far better than a dam. Yet instead of vanquishing the demons of aridity, efficiency has only chased them into the dark. And it has now run up against the quintessential problem of the West.

The entire Western pioneering enterprise was, at its core, an effort to push the world’s boundaries ever farther. Far horizons offer eternal promise: another river, just over the next ridge, to be tapped for its water; another planet to mine. But we have never expanded our field of vision enough to include all the real costs of being here. We have not civilized the West so much as savaged it — leaving Francisco Zamora and Osvel Hinojosa rattling a tin cup in an effort to pay down the ecological debt run up by every single person who depends on water from the Colorado River.

Untangling the competing demands on the river will be an incremental and possibly perpetual endeavor. It is tempting to argue that the enterprise of developing the Colorado was made feasible in the first place only by writing off the cost of its environmental effects on the Delta. But that simply is not true: Those costs are mere fractions of the total amount of water in the river and the money spent to develop that water. They are so small that including them in the dealmakers’ calculations from the very beginning would have never come even remotely close to breaking the entire river-development proposition. And so we are now left with a choice: endlessly pursuing yet one more house-of-mirrors fix — or, finally, trying to set the equation right.

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