# Reclaiming Historic Water Knowledge in Modern India

From a minivan on the shoulder of Old Mahabalipuram Road on the south side of Chennai, hemmed in by honking trucks and autorickshaws, I watch a painted stork move with quiet dignity through the long grasses of Pallikaranai Marsh. With each step, knee flexing backward, the webbed foot closes, then spreads open again to find purchase on the soft land. As it tips toward a fish, white-andblack-striped tail feathers spread, flashing a surprising red whoosh. Nearby, an endangered spot-billed pelican swirls in for a landing, green-backed herons fish, and gray-headed swamphens tend to their young among cattails and sedges. I am watching from the vehicle because, with the traffic hurtling by, it's not safe to get out. Despite of the calm beauty of the birds—just a few of the 349 species of flora and fauna found here—I feel claustrophobic. For myself, but more so for this delicate ecosystem hemmed in by development. Just across the marsh, a network of power lines, buildings, and roads stretches beyond my view.

Chennai lies on the southeast coast of the Indian subcontinent, and the natural landscape on which it was built is particularly rich in water. Pallikaranai Marsh is linked hydrologically with a complex system of three rivers—the Adyar, the Cooum, and the Kosasithalaya—as well as backwaters, coastal estuaries, mangrove forests, and ancient human-built lakes. This slow water masterpiece once covered seventy-two square miles. Acting like a sponge, it held rainwa-

ter, then released it slowly, the water creeping from fresh to brackish to salt, ultimately exiting into the Indian Ocean.

But in recent decades, Chennai has sprawled into India's fifteenth-largest city by area, from 18.5 square miles in 1980 to more than 165 square miles today. The growth has cost the waterlands. An assessment by a local NGO, Care Earth Trust, found that Chennai had lost 62 percent of its wetlands between 1980 and 2010. Pallikaranai Marsh has been literally decimated, losing 90 percent of its area to malls, restaurants, hotels, hospitals, and information technology firms. Just 2.4 square miles remain. It's a problem common around the world. The relatively new IT corridor here is an echo of California's Silicon Valley, where Google and Facebook squat on filled-in marsh.

Nonhuman lives have less and less space to exist across India, where 1.4 billion people jostle to survive and thrive in a land area one-third the size of the United States. But this isn't a story of people versus wildlife. Because when wildlife suffers, people do too. The destruction of Pallikaranai Marsh and other local wetlands has not just made wildlife homeless. It has also spawned dueling water problems—both flooding and shortages—for the people of Chennai. These bifurcated water disasters are all the more tragic because early Tamil people, whose cultural and linguistic heritage continues proudly in today's residents, had developed an elegant system for capturing and holding the rain that fell during monsoons, saving it for the dry season. Their method also replenished groundwater and minimized erosion from the heavy rains. And it supported rather than devastated wetland habitats.

Ancient Tamil water techniques are of a piece with other early cultures that innovated ways to live within their local water means at a time when the world was less globalized. In southern Africa's Kalahari Desert, the San people went crepuscular, limiting their activity to dawn and dusk, staying still in the shade during the scorching midday, even breathing through their noses to avoid moisture loss through the mouth. Nabataeans in Jordan's Petra carved troughs along the red rock walls of the Siq (which had a starring role in *Indiana Jones and the Last Crusade*) to collect rainfall and funnel it to cisterns. In the Andes Mountains of Peru, farmers directed high

flows from winter rains underground, to slow the water way down and save it for the dry season (more on that in chapter 6). Across India, people came up with various methods that fit with their local climate, ecology, and geology. These ancient techniques aren't entirely lost. People still practice them in some places, including here in South India, where remnants of the Tamil system remain.

Today, a loose team of people in government, academia, and NGOs in Chennai are working to restore natural and human-built systems to soften water's peaks and valleys, while reconnecting locals with their heritage and holding space for other animals.

Chennai's natural water richness makes what happened in summer 2019 all the more shocking: the city grabbed international headlines when it ran out of water. Government trucks made water deliveries to roadside tanks, where people queued with vessels and occasionally brawled, resulting in at least one death. When I visited in mid-November of that year, water trucks still plied the streets.

But 2019 wasn't an anomaly, and Chennaiites were less surprised than the wider world. Over the past two decades, Chennai has regularly run out of water during summer months. That's because paved surfaces throughout the city prevent rain from being absorbed and replenishing groundwater that could be used during the dry season. Balaji Narasimhan, a professor of engineering who specializes in hydrology at the Indian Institute of Technology Madras, sits down with me at his office to explain the situation. Simply put, Chennai shouldn't be running out of water at all. During its few months of monsoon, the city actually receives one-and-a-half times more rainfall than it consumes annually. But today's water managers rush that rain away in stormwater drains and canals, moving it rapidly out to sea. When they need water later, they turn to dwindling groundwater, distant supplies, and desalination plants.

Among Chennai residents, the more emotionally and politically destabilizing event than the water shortage in 2019 was the 2015 flood that killed at least 470 people, displaced hundreds of thou-



FIGURE 5.1 Water trucks such as this one ply the streets of Chennai and other cities throughout India and worldwide, delivering water to people who are unconnected to city water or when the city cannot deliver. In Chennai, Nairobi, and elsewhere, truck water is often groundwater.

Photo © Erica Gies

sands, and left many stranded in their homes for weeks. My friend Uttara Bharath lives with three generations of her family in a building designed by her architect parents in the Saidapet neighborhood. Their home is not far from the Adyar River, which winds through the center of the city, and her apartment is on the ground floor.

While visiting, I asked about their experiences in the flood. During the night, water rose steadily in their home, reaching five feet in their living room and kitchen. Uttara's daughter, Anya Kumar, was twelve at the time. "It was honestly very bizarre to see our furniture floating in the murky water," she tells me. As Anya walked across the wooden floorboards, "they started rising underneath my feet. I sort of floated my way to the kitchen to see what we could salvage."

Uttara's mother, Jayashree Bharath, was surprised to see a large SUV floating in front of their house. "A lot of defense people were swimming up and down on the roads, trying to save people," she recalls. "Whenever they felt tired, they used to get up on the SUV and sit there." Also rescuing people were members of the fishing community, who had boats.

As the recovery got underway, so came the reckoning. The family's cleanup took more than a year and demolished their savings. For people of lesser means, who lost everything and had no reserves, it was even more traumatizing. The water had come in surprisingly fast. A lot of people who lived closer to the river "didn't have any time to run away," Uttara's mother says sadly. "Still, to this day, there's not been a proper count of the number of casualties."

Ironically, it was likely the local mindset of water scarcity that made the flood more deadly. As writer Krupa Ge documents in her book about the flood, *Rivers Remember: #ChennaiRains and the Shocking Truth of a Manmade Flood*, reservoir managers were reluctant to release stored water ahead of the monsoon rains. When they finally recognized the threat, they discharged too much, too fast.

Although the 2015 flood was extreme, it's not uncommon for rains to flood vast swaths of Chennai. The sprawling pavement that prevents water storage underground also pools heavy rain. The city has seen increasingly frequent and intense cycles of both flooding and drought over the past two decades. Although it may sound bizarre for a place to suffer both flooding and water scarcity, a growing number of urban areas around the world, such as Mexico City and Beijing (more on the latter in chapter 7), are experiencing similar problems. Poorly planned development, amplified by climate change, is exacerbating water extremes.

As a moderate rain fell when I was there in early December and streets began to flood, one local aptly captured Chennai's dysfunctional relationship with water in a tweet: "till last week, the residents were booking water tankers and from today they will book rescue boats. What a city!"

# Protecting What Remains

Beneath the peepal and tamarind trees, among the flower stalls and idli restaurants, greater Chennai's eleven million people go about

their business. Some men wear traditional *lungis* (others wear button-down shirts and pants), and women are dressed in vividly colored *sarees* or *salwar kameez*, with strings of fragrant frangipani in their plaited hair. Cows and dogs wander and nap at will, while jungle crows, magpies, and dragonflies swirl above the fray. Chennai is more chill than the northern megalopolises Delhi and Mumbai, but it shares that quintessentially Indian sheen of chaos that, upon longer observation, reveals an innate order. An unspoken dialogue of push and pull among countless beings following their individual paths somehow manages to keep the whole in a constant state of flow.

Now people are freshly motivated to once again include water in that flow. The 2015 flood seems to have been a turning point that led both the public and the city government, called the Greater Chennai Corporation, to recognize that Chennai needs to change its relationship with water. There's a growing understanding of the role that poor development planning plays in making water shocks worse, and a dawning realization that water scarcity, flooding, pollution, and groundwater recharge are all connected. One government official makes that link clear: "We do not want to compromise our infrastructure development by sacrificing or destroying or degrading the nature," he tells me. After the flood, the Dutch Office of International Water Affairs advised officials on recovery, underscoring that message of holistic water management. The following year, in 2016, the Dutch engaged local government officials, water experts, NGOs, and communities in a multiyear design-and-development program called Water as Leverage.

Together they produced reports that linked existing projects and laid out new ones that would conserve and restore natural and human-built water systems across the entire watershed. The ambitious plans would slow the flow of water to soften the peaks of floods and droughts by reclaiming floodplains, protecting remnants of marshes, restoring ancient human-built water systems, and reconnecting these disjointed places to give water a human-friendly path to flow. As with the other Slow Water projects we've seen so far, doing so requires many small projects rather than standard development's few big ones. To get a sense of what this looks like within a

densely inhabited city, I visited numerous projects across Chennai.

An obvious step is to protect any remaining waterlands, such as the remnant of Pallikaranai Marsh I visited. The fact that any natural water arteries still remain in Chennai is thanks in significant part to Jayshree Vencatesan, a biologist who founded Care Earth Trust in 2001 to protect the marsh and other bodies of water around Chennai.

Vencatesan thwarts cultural norms pushed on her gender almost as a raison d'être and is used to being the only woman in the room. Yet she's weary of men telling her, with a mixture of admiration and disapproval, "You're not a normal woman." During early fieldwork for her doctorate, she tells me that she would booby-trap her sleeping quarters to protect herself from harassment or worse. At her office not far from Adambakkam Lake, pictures of her beloved, deceased Dalmatian along with posters of local birds decorate the walls. Dressed in a salwar kameez, her long hair pulled back in a traditional braid, she is the undisputed leader of the organization. Our interview is interrupted when an employee brings in his young daughter for a traditional blessing from Vencatesan. She seems a little embarrassed but also flattered. Nevertheless, she is not a person who lets others' perceptions of her-pro or con-slow her down. When she began her conservation work, "people said it was the stupidest thing anyone could do," she laughs. "But if people challenge me, saying, 'you cannot do a bit of work,' I will take it up."

Vencatesan documented the historical cascading system of sixtyone wetlands and water bodies across the watershed that drain into
Pallikaranai Marsh and juxtaposed them with time-series maps
showing what's been lost. Catalyzing public awareness, her findings
were the basis for a ruling by the Madras High Court to prohibit further encroachment on wetlands by development. It also called for a
state plan to restore some of these ecosystems to reduce city flooding and slow water on the land, giving it time to recharge aquifers.
National regulators took note, calling out the state of Tamil Nadu for
endangering national marshlands and water bodies. The result was a
mandate and a budget to improve the situation, including protecting
and restoring the city's remaining water bodies.

Vencatesan and Care Earth Trust have been closely involved with

the Dutch-local Water as Leverage initiative. Initially, "the government was amused" by the groups' presentations, she remembers, given the officials' general bias in favor of standard development approaches, such as desalination plants, levees, and filling in wetlands to "reclaim" land. Even now the government still plans to build two new desalination plants and a distant reservoir in a bid to reduce water scarcity. But when officials reviewed the final proposal, they were impressed by the water detectives' understanding about the city and its hydrology, Vencatesan says proudly. This initiative and the court ruling have helped put the city on course for change: "Until now, nature has been treated in Chennai as an externality, never factored into urban planning." As this revolutionary shift takes shape, Vencatesan predicts that sand dunes, marshes and other wetlands, and remnant patches of dry forest will once again become "the natural buffers to the city's shocks."

# Back to the Future: The Eris System

To make that course change, people can look to how their ancestors worked with nature to finesse water cycles. Starting at least two thousand years ago, ancient Tamil people ensured that they had water year-round by building a series of connected ponds that run from the Eastern Ghats—a mountain range forming a north-south spine down the middle of the subcontinent— downslope east to the Bay of Bengal. These eris (the Tamil word for "tanks") are open on the higher side to catch water flowing downhill, while the lower side is closed with an earthen wall called a bund. An overflow divet in the top of the bund gives excess water a path to continue on to the next eri downhill. "System eris" were built off rivers and creeks to capture their peak flows, while "non-system eris" were dug in areas without natural waterways to capture rainfall in a series of connected depressions. Eris were described in early Tamil literature and temple engravings, says enthusiastic amateur historian Krishnakumar  $\mathrm{TK}_{\scriptscriptstyle J}$ whose day job is in information technology.

To learn more about the history of the water bodies, I visit Krishnakumar, who goes by KK, at his apartment in a newish develop-

ment on the southwest outskirts of town. He invites me in, gesturing for me to leave my sandals outside, in the Asian custom. His elderly mother comes in to listen but soon lies down and dozes off. A few years ago, as KK saw traditional water bodies in Chennai disappearing to development, he began to research and map them, soon expanding his work to include those already gone. He blogs about them and takes people on walking tours to explain what's lost, like Joel Pomerantz with his Seep City outings in San Francisco.

The *eris* system is the opposite of modern development's tendency to move water off the land as fast as possible. The early Tamils understood that by slowing water's flow, the *eris* reduced flood peaks and prevented soil erosion. Most important, the tanks gave water time to seep underground, filtering it and keeping the water table within reach of wells. Because they were connected to the water table, the *eris* also served as visual indicators of water availability, says Vencatesan. Seeing the water level in a pond signaled to farmers when to sow their crops and when they need to conserve. Tanks were also part of every temple complex, bringing water into the heart of religion and culture. Rituals and rules dictated system maintenance and water sharing.

The *eris* were not just reservoirs for irrigation; they became part of the region's hydrology and ecology. Because many were connected to creeks, rivers, coastal wetlands, and freshwater marshes, they provided natural waterways their due along the way. Even *eris* not directly connected to rivers helped feed the local hydrology because groundwater systems are extensive, so water absorbed in one place could feed a river some distance away. In fact, the words *lake*, *tank*, and *water body* are interchangeable here because, after so many generations, no one remembers whether a particular water body is natural or human made.

British engineers in the nineteenth century were gobsmacked by the scale of the *eris* system—reportedly more than fifty-three thousand bodies of water across southern India—and the deep knowledge of topography and hydrology required to build it. Alas, British respect had limits. Its centralized management supplanted the traditional system by which villages managed their own local

eris, removing the accumulated silt each year and using it to fertilize fields. The British neglected this maintenance, and the eris fell into disrepair, making it easier to justify filling them in and building on top of them—sadly, a pattern that continued after independence.

As they built roads, the British obliterated the flow pathways that had linked water bodies, says KK, giving the rainwater nowhere to go. "They did not understand our system." Today, many famous city landmarks and neighborhoods—Loyola College, Central Chennai Rail Station, T. Nagar, Nungambakkam—sit atop former tanks and lakes. KK uses old government and British maps in his research, but in some cases, he doesn't need to. "My mother, who is eightyone years old, she would have seen Nungambakkam Lake when she was twelve or thirteen," he tells me. Street names such as Spur Tank Road and Lake View Road commemorate ghost water bodies that once sustained and protected their neighborhoods. Fewer than one-third of the 650 water bodies that KK has documented in and around Chennai remain, decreasing the surface area of water to one-fifth its 1893 extent. And Chennai is not alone in this: Bengaluru, India's booming technology capital in the neighboring state of Karnataka, has followed a similar development path, filling in its eris and creating parallel problems with water.

Ironically, given KK's passion for finding and documenting historic water bodies, the IT company he works for is in a special economic zone built atop Pallikaranai Marsh and the neighboring Perumbakkam wetland. He chuckles ruefully, showing me the area on a map. "We used to have hundreds of thousands of migratory birds visiting this marshland some twenty years ago. I have seen [it] getting destroyed in front of my eyes." With just 10 percent of the marsh area remaining, he says, "even I can't [see] the water from my workstation, and I'm on the fourth floor." But as the title of Krupa Ge's book invokes, rivers remember. This area hasn't forgotten it is a marsh. During the 2015 monsoon, it flooded to the second story.

One place KK can find water is right outside the front door of his apartment. What appears to be a lake is lapping up against the building at the time of my visit. Ducks swim by, their quacking juxtaposed against the ever-present car horns that Indians wield as accident insurance. In fact, this is not a lake but farmland flooded by recent rains. It's a small echo of 2015, when flooding prevented KK from leaving his home for almost a month. "There was no electricity. There was no drinking water. There was no telephone connection, nothing." But, he adds, "I was fortunate because I did not have all these buildings in those days," gesturing toward neighboring apartments, so water receded to those areas.

"You mean those buildings have gone up in the last four years, since the flood?" I ask in disbelief. That means a 2015-level flood now would be even worse for him.

"Yeah." KK's tone is matter-of-fact. "That, you cannot avoid."

#### Wetlands = Wastelands

Back at the Care Earth Trust office, Vencatesan points out another British legacy that facilitated the destruction of wetlands: their official designation as wastelands. To her, the notion of wetlands as wastelands is anathema. "I grew up in the hinterlands, where this notion of waste doesn't exist. To us, nothing is a waste." That attitude was once widely shared across southern India. The fact that the "wasteland" label still applies makes Care Earth Trust's success in conserving some areas all the more remarkable.

Many areas the British saw as waste had been previously designated as shared-use commons, called *poromboke* in Tamil and dating back to medieval times. The ethics surrounding the use of the commons are even older, Vencatesan tells me, rooted in Tamil scriptures. They describe the resources that wetlands provide—fish, seasonal agriculture, grass to weave mats, fodder for animals, medicinal plants—helping people to understand that wetlands and other ecosystems are multifunctional habitats, supporting not just humans but other species as well. They also make clear the requirement to protect wetlands, including penalties for those who don't. As a common property resource, water was subject to rules regarding how it was allowed to overflow from one water body or wetland to another. "This is essentially upstream-downstream equity, you know?" Vencatesan says.

As she learned more about wetlands throughout her career—in part by working with agrarian groups who continue to live close to the land and water—Vencatesan internalized these values of multipurpose landscapes. She also learned that it's critical to allow certain wetlands to follow their natural rhythm and go dry part of the year to support the life cycles of animals and plants, including crops. "All of our melons and gourds and stuff like that used to be grown when the moisture is retained but the surface flow is not there."

Since the British viewed land as property, these commons, which could not be bought, sold, or built upon, "presented a very peculiar problem" for the colonizers, says Nityanand Jayaraman, a community activist with a collective called Vettiver Koottamaippu. "From a revenue point of view, it was wasteland." Jayaraman works with people in North Chennai, where industrial facilities like coal plants are displacing fishing communities. He also advised the Water as Leverage project. In shorts and a T-shirt, with graying, shoulderlength curly hair, he sits cross-legged in his tiny office, his quiet-yet-fierce voice sometimes drowned out by the enthusiastic roar just outside from the youth activists he's training. As lands surrounding *poromboke* areas were developed, tension mounted over these two sets of competing values. "Of course, the old values lost," Jayaraman concludes. "And what we have is a disaster called Chennai."

The lost values are arguably as significant as the declines in sustainable subsistence and healthy, functioning ecosystems; and, of course, they are linked. Because people's identities are entwined with their land, when development annihilates a place's natural heritage, people also suffer deep cultural loss, a loss of identity. For example, Pallikaranai Marsh is home to neithal—an endemic, striking, blue-violet water lily, one of the earliest flowers described in Tamil literature. Other beloved creatures of the swamp include the glossy ibis and, perhaps surprisingly, the venomous hump-nosed viper. "Snakes are revered in Tamil Nadu," says Vencatesan, who grew up in a neighboring state.

In North Chennai, parts of which remain somewhat rural, Jayaraman has witnessed that loss in a single generation. "Among the older people, there is a far more intimate knowledge of hydrology, of sea-

sons," he laments. "Among the younger people, that is eroding quite quickly. It erodes with the landscape. Your culture also goes with the landscape."

With Chennai's growing population, much of the remaining *poromboke* lands along water bodies and rivers have been occupied by marginalized people. During the 2015 floods, people living along the Cooum and Adyar Rivers were among the hardest hit—but their homes were also part of the problem, hardening embankments and floodplains, leaving no open land for the excess water.

In a controversial decision, local and state government agencies relocated tens of thousands of people from river banks and canals near the city center to newly built high-rise tenement buildings on the city's southern edge. Close to the IT corridor, the tenements are in the Perumbakkam neighborhood, the name commemorating the Perumbakkam wetlands it sits atop. "In its infinite wisdom," Jayaraman says sarcastically, to protect people from flooding, the government moved them from a river floodplain into a wetland just zero to two feet above sea level. It was an out-of-sight/out-of-mind decision that completely ignored the reality of local hydrology. For that reason, the move failed to make vulnerable people safer, Jayaraman concludes.

Instead, "greening the Cooum [River] has become an excuse to evict people we don't like, and those are Dalits and Muslim minorities who live on the river banks because the city has not provided them with a decent place to live," he continues. Because their new residences are about fifty minutes by car from their former homes, many of them have effectively lost their jobs too. And the city's actions have actually made all of Chennai more vulnerable by filling in even more wetlands for the new developments.

The government has also begun to evict and resettle thousands of families from the banks of the Adyar River. But this time, it has vowed to take a different approach. Called proximity relocation, the idea is to redevelop homes in place or to find areas for people to live near their former homes so they can remain within their neighborhoods and communities.

The architecture firm Madras Terrace, which has experience in nature-based water management, is working with Water as Leverage to plan for proximity relocation in Chitra Nagar, a neighborhood of corrugated tin-and-wood shacks and tenement buildings that abuts the Adyar. On another day I visit the area with Sudhee NK, an engineer and financial planner who works for the firm. We turn off Anna Salai, a main thoroughfare in the middle of the city, onto a dirt road, where goats, chickens, and dogs wander about. During the 2015 floods, this neighborhood flooded as high as two stories, Sudhee tells me, shaking his head. The architecture firm is proposing to redevelop rather than relocate this community. The plan calls for restored, taller apartment buildings next to treatment wetlands that would use plants and natural processes to clean the buildings' sewage. It would also expand the floodplain along the riverbanks, reclaiming space to detain water and buffer human neighbors when the next flood comes.

#### Chennai's Citizens: Water Warriors

In a way, modern Chennai residents are much more savvy about water than most North Americans or Europeans because clean water doesn't automatically flow from their taps. As in most Indian cities, the piped city water supply is available for just a few hours a day or every few days. People must plan to obtain the water they need. My hotel room has a bucket and scoop in the shower because the idea of just letting a shower run is "sacrilegious," explains my friend Uttara.

I learn more about this daily reality when I meet up with Naaz Gani, a young journalist who writes for the *New Indian Express* and lives in a neighborhood called Gopalapuram. Water is delivered to her apartment building in the middle of the night, she tells me, and a building manager pumps it to the roof to establish water pressure. It is available to residents from 7:30 to 9:30 a.m. She runs the tap and fills a bucket or two for her daily bathing, dishwashing, and toilet flushing. But if she doesn't get up at 7:30, or if she has to be at work early . . . "Too bad. You ask your friend to do it for you." Entertaining guests is also difficult. When her parents visited, she had to borrow extra buckets from friends.

But the 29 percent of the population who lives in informal settle-

ments without city connections has it much worse, Gani reminds me. People queue with plastic buckets to take water from government tanks or from public groundwater pumps on the side of the road, rolling it back to their homes on hand-pulled trolleys. Still more problematic, city water is not considered safe for drinking. If people can afford it, they either run the city water through a purifier or buy treated drinking water.

Uttara's family, like many who own property here, dug a borewell to supply additional water when shallower rain-fed wells run dry. If the borewell also runs dry, they buy tanker water to store in their cistern, "which is definitely something that only some people can afford," she acknowledges.

It's not just poor people who lack city water connections, a water utility official told me. Many newer areas of the city, especially to the south, are also unconnected. Residents there buy tankers of water. Almost fifty-three million gallons daily are shipped around the city. Water served up in tanker trucks is often extracted from underground. But groundwater pumping here is unsustainable because rainwater cannot percolate back underground where it's blocked by pavement. With few restrictions on use, Chennai's groundwater table is dropping about four to eight inches every year.

And just as the Pajaro Valley farmers in California experienced, pumping out groundwater near the ocean creates a pressure vacuum that lures in seawater, turning aquifers salty. Long-term residents here have seen this problem firsthand, and one of them was inspired to do something about the problem. I meet Sekhar Raghavan, known as the Rain Man, when I go to the Rain Centre, a showplace of rain-harvesting methods just south of the Adyar River. For Raghavan, it all started when he moved to the beguiling beachside neighborhood of Besant Nagar in 1970, shortly after it was developed. In front of laid-back coffeehouses and diverse restaurants, the wide beach is often the scene of carnival games, music, and other events. When Raghavan moved in, the beach was still the domain of fishers. Monsoon rains absorbed rapidly into the sandy ground, and open wells filled up nearly to the surface. Sometimes fishers would draw the sweet water to sell door to door.

But soon, as new developments spread more pavement, Raghavan noticed the water table was dropping and Besant Nagar's formerly sweet water was turning brackish. A small, older man with big hand gestures and rectangular black glasses framing sharp, yet kind eyes, he recounts his realization at the time: "The only solution is to push rainwater into the soil." Raghavan founded the Rain Centre to educate others how to do this. He shows me a plexiglass replica of the building we're in, then pours a glass of water onto its roof. Its runoff drains to one corner, through pipes, and down into the well and cistern. In 2002 he convinced the state's chief minister to mandate rainwater harvesting at every house. Despite that success, a Rain Centre survey a few years ago revealed a compliance rate of only about 40 percent. But the 2019 water shortage ramped up interest again, he says with a slight air of vindication.

Narasimhan, the hydrology professor, is not surprised at the low rate of compliance. Not all geology is ideal for storing water underground, he points out. About 70 percent of Chennai overlies rock or heavy clay, which water cannot move through easily. But in such places, people can drill down through the impermeable layer to move water underground. Both the city government and private individuals are now digging these recharge wells.

Outside the Rain Centre on the day I visit, four men are digging a recharge well by hand. Barefoot, wearing traditional *lungis* and button-down shirts, two guys at the bottom of a deep hole shovel dirt into a shallow basket. Two others hoist it up with rope, while a fifth squats on the rim, watching. They must dig about fifteen feet down to reach porous geology here, Raghavan tells me. The wells have a diameter of three to five feet, depending on the extent of the catchment area they're meant to drain, from one hundred to three hundred feet. Erosion is kept at bay with cement rings that line the well, separated by one-foot gaps to allow some water to seep into the ground through the sides. But most infiltration happens at the bottom. The width also allows people to descend into the well periodically to clean it of sediment and garbage. In Chennai today, these wells are becoming more frequent sights, their round perforated covers pocking city streets and sidewalks.

## Restoring Temple Tanks

Through Water as Leverage, Madras Terrace has proposed another approach for getting water into the ground across the city: using a remnant of the *eris* system, the temple tanks. KK told me that in the past, every village had a temple, and every temple had a water body. Today, many of those villages, temples, and water bodies have been subsumed by the city.

One bright, blue-sky day, I meet up again with Sudhee NK so he can explain this project to find space for Slow Water within the city. We rendezvous in charming, bustling Mylapore, a neighborhood centered around Kapaleeswarar Temple, marked by a 120-foot-high, pyramidal tower intricately carved and painted brightly with some of Hinduism's more than three thousand gods. Vendors sell flower offerings, small deities, and unglazed clay cups traditionally broken after drinking. One of Chennai's most notable tanks sits alongside the temple, occupying a city block. With its top at street level, an inverted, stepped pyramid descends into the ground so people can continue to access water as the table falls.

Sudhee is wearing a purple linen kurta, white pants, and sandals, and as he guides me around, he is frequently on his phone, texting. Yet somehow he effortlessly steps over cow patties, for which my sandals seem to have a homing device.

"How do you do it?" I asked him, marveling.

Glancing up from his phone, he laughs briefly. "Years of practice."

Sudhee explains that, historically, the tank bottoms were unpaved, so they were connected to the groundwater system. Underground water replenished the tank from below, and rain and runoff from above helped recharge the water table. Temple tanks were connected to larger *eris* systems and served ritual purposes as well. Today the Kapaleeswarar tank holds water—ducks swim along the side and turtles bask in the sun—but only because the bottom was paved about ten years ago to retain water for religious ceremonies. This water is effectively a mirage.

To show me the true status of the water table here, Sudhee leads me across the street to another temple tank, Chitrakulam Pond, be-



FIGURE 5.2 Kapaleeswarar Temple tank in the Mylapore neighborhood of Chennai covers a city block. It has been paved at the bottom so water is permanently available for ceremonies, but local water detectives want to remove the concrete, restoring it and other tanks across Chennai to their functional purpose as water catchments and groundwater recharge sites.

Photo © Erica Gies

lieved to be more than two thousand years old and not cemented. Its bottom is carpeted with a mat of fresh grass, sprouted from recent rains, but the water has descended deep underground. "This is the real situation," Sudhee bemoans. Too much pavement and too many borewells are to blame for water levels more than sixty feet below the surface.

Sudhee and his colleagues at Madras Terrace want to restore temple tanks across Chennai to their natural, unpaved state to move water underground. The city government is connecting stormwater drains to temple tanks wherever possible to allow for groundwater recharge. And Sudhee's team is also helping to raise the water table by collecting rainwater from buildings via bioswales, those vegetated ditches, placed wherever they can find room along streets, on

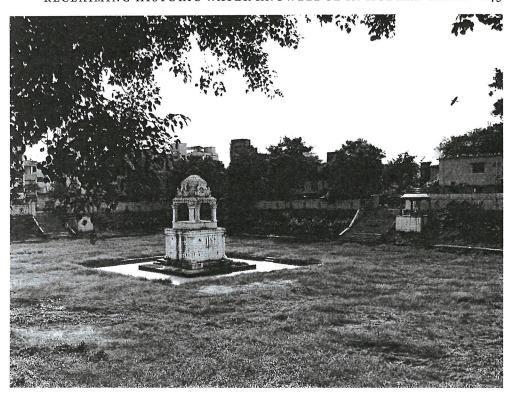


FIGURE 5.3 This temple tank, known as Chitrakulam Pond, shows the real status of the water table: belowground. This tank is just across the street from Kapaleeswarar tank. Photo © Erica Gies

hotel properties, in backyards, and in schoolyards. A pilot project in a neighborhood school is underway, which has the added benefit of educating the next generation about these issues, says Sudhee. However, water doesn't always just infiltrate open space. In another neighborhood, a man pointed to the schoolyard over his fence and told me water pools there when it rains. If soil is compacted, say, from children's feet, or if it's mostly clay, people might need to mix in some sand or build recharge wells to allow water to percolate.

This patchwork of small bits of permeable land can collectively make a big difference. The Mylapore project is expected to provide an average of one million gallons of water per day, nearly half the neighborhood's demand. Replicating the project across fifty-three other temple tanks in Chennai could result in sixteen million gallons per day of recharge, about 6 percent of the city's demand, according to the Water as Leverage team's projections.

### Connecting to Flow

Larger areas of open water and wetlands still remain in Chennai, mostly on the south end of the city. Care Earth Trust is working to conserve these elements of the natural water system along with Pallikaranai Marsh. On a visit to a few of these sites with Care Earth Trust staff, I see candleflower—a medicinal plant whose flowers exude a milk that soothes skin injuries—as well as bronze-winged jacanas, fish eagles, black bazas, northern shovelers, and many other species.

At Thalambur Lake south of the city, an area that had been devastated by quarrying, the Care Earth Trust team cleaned and repaired drainage channels that had been clogged and encroached upon. We walk along a bund they shored up to keep water in the lake longer so fish can lay eggs in it once again. Across the bund's surface, they've planted young saplings of peepal and native bamboo to stabilize it. Looking down into the restored lakebed, I see the small hummocks they built and planted with trees to serve as island nesting sites for birds once the water returns. A year after my visit, they invited the water back in. Thalambur Lake now covers seventy-six acres, is protected as a conservation area, and has a laboratory on site for scientists to study its ecology.

At another spot just off Mahabs Highway, south of Pallikaranai, is a dock where people rent pedal boats to explore Muttukadu Backwater, an estuary close to the Indian Ocean that is buffered from full tidal flows by a sandbar. Dozens of pelicans sit on the water, bobbing on its calm surface. Here, as in Besant Nagar and in other neighborhoods near the ocean, excessive groundwater use has allowed seawater to push in. Muttukadu has grown too salty for some of its native fish, and water levels have dropped. In response, Care Earth Trust staff are educating local people, petitioning the government to regulate water extraction, and restoring pathways upstream to allow fresh water to flow into the wetland and replenish it. They are also replanting mangroves to protect the coast, clean the water, and improve breeding habitat for fish.

These myriad projects to reduce droughts and floods, scattered

across the broad landscape of the city, are decentralized management, a partial return to the region's traditional ways. Yet despite stated government support for these Slow Water projects, getting utility engineers to embrace green solutions is difficult, mulls Narasimhan, the hydrologic engineer at the university. The systems are more complex than concrete-lined drainage channels, levees, and dams. Slow Water projects usually have a biological component, such as plants that may require soil amendments to achieve the chemistry or filtration they need, he says. Also, because such projects tend to cover a larger area than concrete solutions do, the public is more likely to come in contact with them, so project managers need to cultivate community understanding and support. But that requirement can be a benefit, Narasimhan hurries to add—reconnecting people with their water.

When water "magically" arrived via centralized distribution, people stopped caring for their water bodies. It was a marked change from the ancient Tamils' active stewardship of their local water. "Even two hundred years ago, people used to worship rivers as goddesses," KK had told me. "Because of that, we were preserving water. Now we've lost those cultural values; we forgot." But maybe it's possible to reverse that trend. As government agencies and NGOs reclaim space to reestablish Slow Water, and as people harvest some of their personal water from local supplies, Narasimhan hopes they will become newly motivated to keep them clean and replenished.

One project, also included in the Water as Leverage vision, is directly targeting the next generation. On a warm, partially overcast day in early December, I grab an autorickshaw to Tholkappia Poonga Eco-park, a 58-acre green haven in the heart of the city, near the mouth of the Adyar River. Separated from the beeping traffic outside by concrete walls, the tree canopy is thick here. The peaceful walking paths—earth below and air above—are bustling with butterflies, beetles, blue-and-yellow grasshoppers, crane flies, lizards, lorikeets, and other birds.

Years ago, a tributary of the Adyar River on this site was filled in for development. But instead, this place became a dump, piled high with garbage and human waste and used for illegal activities. Then more than a decade ago, local NGO Pitchandilkulam Forest Consultants and city agency Chennai River Restoration Trust began restoring the area's former river and estuary habitats. The goals were to counteract pollution and biodiversity loss.

My guide here is K. Ilangovan, an ecologist and wetlands specialist who has overseen this project from the beginning. He has planted thousands of the trees himself, including mangroves and 250 other species of plants. (He has a particular fondness for mangroves; some of these trees he planted south of the city actually saved his life during the infamous 2004 tsunami, when he clung to them to avoid being swept out to sea, then waited there for hours until waters receded.) Since the eco-park project began, he's seen snakes, mongooses, mice, and even jackals that feed on crabs and fishes. "We didn't introduce anything here," he says. After replanting the site, "everything came."

People from nearby neighborhoods were involved in the planning and planting so that they would better understand the area's purpose, and some still have jobs here taking care of the plants. During the monsoon, the whole park becomes flooded, slowing and storing water. The surrounding neighborhoods have seen higher water levels in wells and reduced flooding, including during 2015, when they were spared the worst impacts of the devastating flood. The microclimate has also changed, keeping the air a little cooler than the concrete jungle elsewhere in the city. Another phase of restoration has recently been completed, bringing the total to 358 acres.

Aside from offering homes to a variety of creatures in the middle of the city and mitigating water problems, the eco-park is a favorite field-trip destination for schoolchildren, who come here and are blown away. Living in the city with little exposure to nature, "they are so happy to touch and feel the plants," Ilangovan says with obvious emotion. "You can see the brightness in their faces." That outreach—which he also extends his own young son—is critical to changing the direction of society, he believes. "We can't go and change the people with forty or fifty years' age. So I focus more on the kids."

Amid the growing environmental awareness among the general

public and the government, several of the projects proposed by the Dutch–local partnership are moving forward, reports Vencatesan, including the Mylapore tank and Muttukadu Backwaters. A state wetlands panel recently designated four more water bodies in Chennai for protection and is considering another thirty-one. Separately, Vencatesan's nomination of Pallikaranai as a Ramsar site, a wetland of international importance, is under consideration by the central government in Delhi. But development pressure remains intense. "We as a country are trying to become more of a wealthy nation," Vencatesan points out. "And if we assume that people don't want that, we are wrong."

Back at Pallikaranai Marsh, walking down a muddy path at the edge of shallow open water, we pass trees planted by Care Earth Trust, trunks wrapped in cuttings of an unpalatable plant to deter nibbling cattle. Bee-eaters and kingfishers whiz by, and a fanthroated lizard darts under a rock. The sun glints off something, catching my eye, and I lean into a bush to find an iridescent-green jewel beetle with black spots, bumpily navigating stems and leaves. Antennae waving about as if flailing for balance, the insect suddenly flips, revealing a bright-orange undercarriage. Despite the staggering losses in recent decades, there's still plenty to amaze here.

For Vencatesan, educating people about the value of water systems and biodiversity is a long-term process, one that she's been working toward with her characteristic persistence for decades. Near the spot where I had been stuck in the minivan, she is planning to reroute traffic away from the marsh and build a pedestrian "ribbon walk," where people can interface with nature. "They should see a value in it," she says. "Otherwise, it's not going to last."