The New Water Alchemists

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Animals, plants, soil, and air have long collaborated to regulate our climate by stimulating "the water cycle"—until we disrupted their partnership. The good news is that there is a clear pathway to reconciliation.

By JUDITH D. SCHWARTZ

Chris Henggeler and his family manage a 300-square mile ranch in a desolate corner of Australia called the Kimberley. Through a variety of low-tech management practices, they have single-handedly turned much of the dusty landscape green, with rivers and creeks once again flowing generously. *Photo courtesy of Kachana Pastoral Company*

Australia is the world's driest inhabited continent, and a nation cursed by headline-grabbing weather extremes. In 2013, Australia's Bureau of Meteorology famously added dark purple to its weather maps to denote over-the-top heat waves, the no-longer-rare days when air temperatures breach 122 degrees Fahrenheit (50 degrees Celsius). Australia's history since European settlement has been riddled with droughts and floods so dire they're etched in the books as significant natural disasters. The millennium drought, known colloquially as the "Big Dry," persisted for 15 years until finally doused by epic rains and floods that lasted from late 2010 into early 2011.

As for wildfires, the most devastating since 1851 have names, including Black Christmas and Black Tuesday. Most recently and most deadly were the Black Saturday bushfires of 2009 in the southeastern state of Victoria, which killed 173 people. The sheer extent of Australia that goes up in smoke is mind-boggling. An estimated 60,000 bushfires, many of them extensive, flame through Australia each year. (Between one-third and one-half of these are attributed to arson.) According to several tallies, between 130 and 220 million hectares (or 321 to 543 million acres) are burnt each year by either wildfires or intentional controlled burns. That's a patch of earth somewhat bigger than the nation of Liberia. The carbon emitted from these conflagrations dwarfs the amount spewed by fossil fuels.

"I think of this as solar real estate. And I look at myself as a capitalist," says Chris Henggeler, referring to his land in a hot, desolate corner of Australia. And his cattle? That's "middle management," he says. "They're our plumbers and electricians."

In the Kimberley, a remote area in the Northwestern quadrant of this continent, Chris Henggeler manages Kachana Station, a chunk of rugged terrain that spans nearly 300 square miles. With a long, craggy coastline, the Kimberley is about as thinly populated a region as you can find. Try to imagine the outback of the outback: dramatic canyons and gorges awash in hues of ochre; eighteen-foot-long crocodiles lazing on the river banks; eye-catching birds like the red-tailed black cockatoo; sparkling waterfalls like "the Horries" (for horizontal), which flow sideways (only in Oz). It is hot here year-round.

When Henggeler first visited the property in 1985 with his brother and a business partner, he found a worn-out landscape that hadn't been managed for decades. Land surfaces were riven by gully erosion, waterways so full of silt they scarcely flowed. Wide areas were swept clear by recent fires, leaving brown and dusty soil. It didn't take long for Henggeler to decide: let's invest.

Though Henggeler now raises plenty of cattle on his enterprise, called Kachana Pastoral Company, he doesn't sell livestock. His "product," rather, is restored land or, as Henggeler puts it, "enhanced natural capital." He considers his approach "environmental capitalism," which entails recognizing and making use of the income opportunity inherent in 12 hours of free solar energy. "All this is beamed at us. We just need to harness it," he says. "I think of this as solar real estate. And I look at myself as a capitalist." The central element to creating wealth at Kachana, he says, is better management of the water that falls from the sky.

Henggeler's property, called Kachana Station, dry season, 1992. *Photo courtesy of Kachana Pastoral Company*

And the cattle? That's the "middle management," Henggeler says. "These cattle had never seen humans before we arrived. Now they're working—they're more like oxen. They're our plumbers and electricians on the landscape."

If all this strikes you as unrealistic, look again. In the few areas that Henggeler has thus far been able to target—given the limitations of his "upper management" (that would be humans)—he reports they are growing grasses faster than they can expand their herd. Bare ground has drastically diminished. The cattle are healthier and there are 10 times as many of them. A creek that was a desiccated channel in the early 1990s now has clean, flowing water throughout the year. More springs are surfacing and locally endangered animals and plant species are thriving. Creeks now flow longer into the dry season, and the land rebounds more rapidly from bushfires.

COWS, TOMORROW'S HEROES

The reasons that Henggeler's land bounced back so dramatically have to do with some very basic but often ignored principles of biology. This includes the cycling of carbon, the building block of life. When cattle eat, they make use of the organic carbon that is in all plant matter. As they graze—defecating, urinating, and stomping down the foliage under their feet—the cows return organic material to the earth. Meanwhile, a grass plant's response to being nibbled is to release carbon compounds (sugars) in the root zone. As the soil grows richer, it attracts worms and dung beetles, which create paths for air and water and provide ongoing feasts for microorganisms. These are the "little beasties" above and below the ground that, in Henggeler's lexicon, are "the workers"—the labor force that upper management strives to keep productive.

Kachana Station, same season, 2013. *Photo courtesy of Kachana Pastoral Company*

The new levels of soil nutrients and moisture stimulate additional plant growth, thereby setting up a beneficial feedback loop. With new moisture throughout the environment, the system itself begins to deter fire. Furthermore, the accumulated carbon helps prepare the land for rain. Enhancing ground cover or "armor," says Henggeler, "changes raindrops from bombshells into mist-irrigators that help to grow grass. Reinvest your carbon and you can become productive."

Henggeler's philosophy and methodology draw directly from a Zimbabwean wildlife biologist named Allan Savory, who has, since the 1970s, been developing a system of land stewardship called Holistic Management. Many people, upward of 3 million to be precise, are aware of Savory primarily through his 2103 TED Talk, "How to Green the Deserts and Reverse Climate Change." The 22-minute presentation sparked a lot of attention and immediately entered that dubious media category of "controversial."

Henggeler likes to point out that grass in areas like this is not here because of the water. The water is here because of the grass. *Photo courtesy of Kachana Pastoral Company*

To many viewers, the idea that grassland ecosystems require periodic animal impact stood in flagrant opposition to what they'd been taught. But years of observation convinced Savory that grazing animals and grasslands are interdependent: time and again he saw land deteriorate when animals were

removed. In nature, plants are to a large extent managed by herbivores, and those plant-eating animals are managed by predators. The alteration of the landscape and the absence of natural predators have left a management void. With what we now understand about rangeland systems, this void can be filled in a way that at once bolsters ecological function and economic viability. This is especially crucial in areas with seasonal rainfall, where ruminants play a pivotal role in maintaining moisture from one rainy season to the next.

A number of vegan activists and a few range-science researchers have sought to discredit Savory's theories. From what I have been able to tell—based on my own reading and conversations with other ecology experts—their arguments are based on just a few academic articles, which are about experiments that don't actually test the Holistic Management model. Some assess grazing systems that appear similar—like "mob grazing" or "short-term rotational grazing"—but are actually quite different. Savory says there are at least 13 grazing systems with names that have been used interchangeably with Holistic Management.

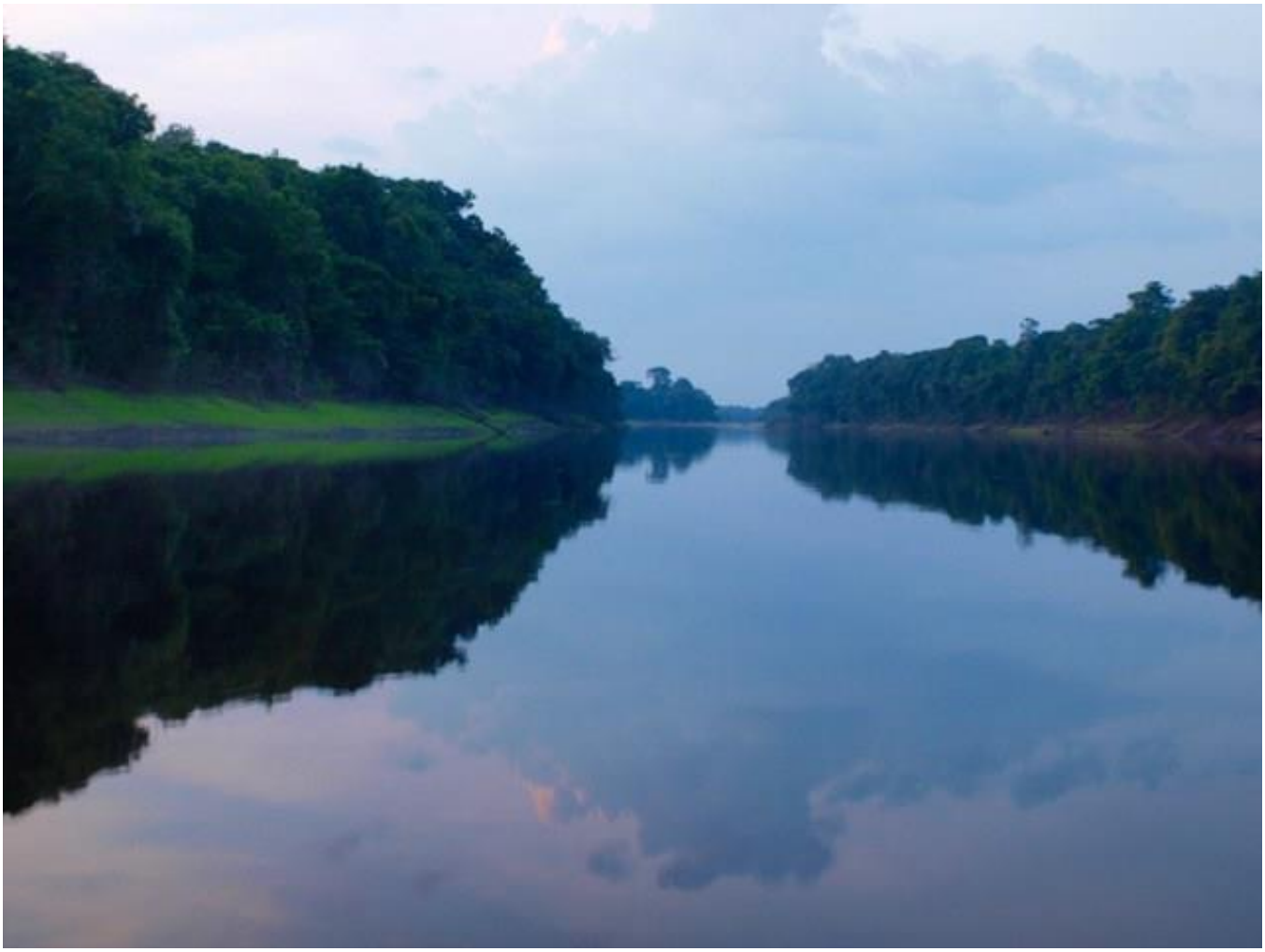
To be fair, Holistic Management is difficult to measure. Standard research protocol calls for carefully monitoring a set of clear, controlled variables. Under Holistic Management, landscapes are seen as constantly evolving, with a host of constantly changing variables. In that sense, they are very much like the natural ecosystems that Savory strives to mimic.

"Sao Paulo is following on California's footsteps," said Antonio Nobre, a scientist in Brazil. "This area has been green forever. But for most of 2014 people were looking to the horizon and seeing the same atmosphere as you'd see in the Sahara: the same layer of dust and blue sky and heat. People are scared, shaking in their boots."

When I wrote "Water in Plain Sight" (published in 2016 by St. Martin's, and from which this article is adapted), I was motivated by my conviction that water should be integral to discussions of climate change. I don't mean merely from the perspective that a changing climate will put stress on available water sources worldwide—an important link and one that is generally known. I also mean the influence of water on climate. While researching my previous book, "Cows

Save the Planet" (published in 2013), I learned a lot about the carbon cycle in our soil, and how that cycle intersects with others—the nutrient cycle, the energy cycle, and the water cycle. Water, I have come to understand, can be a particularly powerful ally as we grapple with climate change.

To learn more about the ways of water I spent two years visiting or talking to people in California, Mexico, Brazil, West Texas, Australia, and Africa. At each stop I found what might be called new water—water held in the soil, cycled through plants, captured as dew. This provided insight into how water flows across the land and through the atmosphere—insights that can help us replenish our water resources and make the best use of what we have.



In the Ariaú region of the Brazilian state of Amazonas, along a tributary of the Rio Negro, dusk is an ideal time to see the jacarés, or alligators, that live along

the banks. This is actually the Amazon's dry season, November; the riverbanks are covered in water during the rainy season, as well as much of the forested shores themselves. *Photo by Pamela Petro*

ARBOREAL AIR CONDITIONERS

In early 2015, Sao Paulo, Brazil—a megacity in a country known for its legendary rainforests—was suffering from a severe drought. The network of reservoirs that provides water to nearly half of the city's 20 million residents languished at a mere five percent of capacity. Experts predicted that, without strict rationing, the water supply wouldn't last 10 weeks. Some apartment dwellers saw their water shut off without warning, for up to five days. Commentators noted the irony that Brazil, which has been called "the Saudi Arabia of water"—was confronting such a dire shortfall.

If cattle were managed well on native grasslands, we could stop cutting down the rainforests to make room for them. These trees would then be around to maintain the water cycle, through functions that have generally been overlooked in rainforest discussions.

"Sao Paulo is following on California's footsteps," said Antonio Nobre, a senior scientist at Brazil's National Institute for Amazonian Research. "This area has been green forever. But for most of 2014 people were looking to the horizon and seeing the same atmosphere as you'd see in the Sahara: the same layer of dust and blue sky and heat. People are scared, shaking in their boots." In response, he said, Brazil's government ignored the problem "as if the next wet season would save us."

Judging from the latest scientific evidence, if Brazil fails to maintain its forests there won't be many more wet seasons.

Granted, much of the rainforest is being decimated to make room for cattle. But if livestock were raised in native grasslands that require animal impact—and

managed in the adaptive manner that Henggeler and Savory have found effective—we could start leaving the rainforests alone. These trees would then be around to maintain the water cycle, through functions that have generally been overlooked in rainforest discussions.

The idea that there's a connection between forests and water sufficiency is far from new. Plato and Aristotle wrote about how deforestation leads to the loss of water resources. In his 1864 book "Man and Nature" (original title: "Man the Disturber of Nature's Harmonies"), George Perkins Marsh catalogs numerous troubles observed during his diplomatic and literary travels. "When the forest is gone," Marsh wrote, "the great reservoir of moisture stored up in its vegetable mould [soil or humus] is evaporated, and returns only in deluges of rain to wash away the parched dust into which that mould has been converted. The well-wooded and humid hills are turned to ridges of dry rock." More recently, popular histories such as Jared Diamond's "Collapse" and David Montgomery's "Dirt: The Erosion of Civilizations" are full of cautionary tales about societies—the Mayans, Pacific Islanders, communities in the French Alps—that squandered their tree cover, only to face catastrophic flooding and drought.

On a superficial level, most people understand the value of trees beyond supplying wood. Their roots stabilize the soil, allowing it to hold rainfall rather than letting water stream away, carrying off the topsoil's nutritious stores of organic matter. Tree canopies also intercept downpours, so the water doesn't pummel the ground, leaving craters and overwhelming the land's ability to absorb it.

During the daily "transpiration" process of a single tree, the heat consumed represents three times the cooling power of an air-conditioning system in a five-star hotel room.

On a deeper level, however, trees do a lot more heavy lifting for the environment—and for climate regulation—than most of us realize. Just for starters, the shade of a tree canopy cools the ground so that moisture is less prone to evaporate, thus keeping water in the system. Trees also recycle oxygen and water vapor, which improves the quality of the air and lends it a soft

humidity. Everyone knows how soothing it is to be near trees. (There's even a healing practice in Japan called Shinrin Yoku, translated as "forest bathing," which research has found lowers stress and boosts immunity.) Bill Mollison, the late biologist and teacher considered the "father of permaculture," has found that the rainwater that filters through the canopy is distinct from ordinary rain. "It's a much richer substance," Mollison says—a kind of arboreal elixir with a different ionic makeup. This "throughwater" contains trace elements that rainwater doesn't necessarily have, he says, and it's less acidic. "The most nutritious pasture," Mollison says, "is near trees."

And trees cool the air—significantly. Jan Pokorný, a Czech botanist, argues that trees are the world's most perfect air conditioners, largely because of a process they go through called "transpiration." Every day, trees and other plants emit water vapor through small openings on the underside of their leaves (in grasses, on the blades). Think of this as the plant "breathing," or, more precisely, "sweating." Consider an ordinary tree, whose leaf crown spans about 16-1/2 feet (or five meters). On a sunny day, Pokorný says, this tree would have at least 150 kilowatt-hours of solar energy shining upon it. Given sufficient water, over the course of the day the tree would transpire upward of 26 gallons of water (more than 100 liters). The heat consumed during that process represents three times the cooling power of an air-conditioning system in a five-star hotel room, Pokorný says. And he isn't the only scientist thinking this way. Research from Australia found that tree canopy cover of a mere 40 percent cooled an area by nine degrees.

In a verdant tropical forest like the Amazon, the soil-plant-sky circuit is running very quickly. This makes the carbon, nutrient, and water cycles all accelerate. The rate of transpiration in the Amazon Basin is such that each tree is a veritable fountain. On a given day, Nobre writes, a large tree in the rainforest "can pump from the soil and transpire over a thousand liters of water." That's more than 260 gallons—from one tree, in a single day.

With the growing mounds of data like this, why are discussions on climate change so narrowly focused? Says Pokorný: "Our understanding of the role of

water and plants in landscape functioning is the equivalent of medicine before Pasteur.”