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Soil Power! The Dirty Way to a Green Planet

By JACQUES LESLIEDEC. 2, 2017

Credit Eleanor Taylor

The last great hope of avoiding catastrophic climate change may lie in a substance so commonplace that we typically ignore it or else walk all over it: the soil beneath our feet.

The earth possesses five major pools of carbon. Of those pools, the atmosphere is already overloaded with the stuff; the oceans are turning acidic as they become saturated with it; the forests are diminishing; and underground fossil fuel reserves are being emptied. That leaves soil as the most likely repository for immense quantities of carbon.

Now scientists are documenting how sequestering carbon in soil can produce a double dividend: It reduces climate change by extracting carbon from

the atmosphere, and it restores the health of degraded soil and increases agricultural yields. Many scientists and farmers believe the emerging understanding of soil's role in climate stability and agricultural productivity will prompt a paradigm shift in agriculture, triggering the abandonment of conventional practices like tillage, crop residue removal, mono-cropping, excessive grazing and blanket use of chemical fertilizer and pesticide. Even cattle, usually considered climate change culprits because they belch at least 25 gallons of methane a day, are being studied as a potential part of the climate change solution because of their role in naturally fertilizing soil and cycling nutrients.

The climate change crisis is so far advanced that even drastically cutting greenhouse gas emissions won't prevent a convulsive future by itself — the amount of greenhouse gases already in the atmosphere ensures dire trouble ahead. The most plausible way out is to combine emission cuts with "negative-emission" or "drawdown" technologies, which pull greenhouse gases out of the atmosphere and into the other pools. Most of these proposed technologies are forms of geoengineering, dubious bets on huge climate manipulations with a high likelihood of disastrous unintended consequences.

On the other hand, carbon sequestration in soil and vegetation is an effective way to pull carbon from the atmosphere that in some ways is the opposite of geoengineering. Instead of overcoming nature, it reinforces it, promoting the propagation of plant life to return carbon to the soil that was there in the first place — until destructive agricultural practices prompted its release into the atmosphere as carbon dioxide. That process started with the advent of agriculture about 10,000 years ago and accelerated over the last century as industrial farming and ranching rapidly expanded.

Among the advocates of so-called regenerative agriculture is the climate scientist and activist James Hansen, lead author of a paper published in July that calls for the adoption of "steps to improve soil fertility and increase its carbon content" to ward off "deleterious climate impacts."

Rattan Lal, the director of the Carbon Management and Sequestration Center at Ohio State, estimates that soil has the potential to sequester carbon at a rate of between 0.9 and 2.6 gigatons per year. That's a small part of the 10 gigatons a year of current carbon emissions, but it's still significant. Somewhat reassuringly, some scientists believe the estimate is low.

"Putting the carbon back in soil is not only mitigating climate change, but also improving human health, productivity, food security, nutrition security, water quality, air quality — everything," Mr. Lal told me over the phone. "It's a win-win-win option."

The techniques that regenerative farmers use vary with soil, climate and crop. They start from the understanding that healthy soil teems with more than a billion microorganisms per teaspoon and the behavior of those organisms facilitates hardy plant life. To fertilize their fields, regenerative farmers use nutrient-rich manure or compost, avoiding as much as possible chemical fertilizers and pesticides, which can kill huge quantities of organic matter and reduce plants' resilience. They don't like to till the soil, since tillage increases carbon emissions into the atmosphere. Some farmers combine livestock, cover crops and row crops sequentially on the same field, or plant perennials, shrubs and even trees along with row crops. Leaving soil bare during off-seasons is taboo, since barren soil easily erodes, depleting more carbon from the soil; regenerative farmers instead plant cover crops to capture more carbon and nitrogen from the atmosphere.

Until the advent of synthetics in the late 1800s, fertilizer consisted chiefly of carbon-rich manure or compost. But synthetic fertilizers contain no carbon, and as their use spread along with tillage practices to incorporate them, soil carbon content declined. The process accelerated after World War II, when America's nitrogen-based munition plants were converted into nitrogen-based fertilizer factories. Most agricultural colleges still teach soil fertility chiefly as an exercise in applying inorganic chemical fertilizer, while overlooking soil's biological role (and its carbon content). Despite soil's connection to climate change, carbon sequestration in soil was never mentioned in the 1997 Kyoto Protocol, which set down broad

greenhouse gas emission reduction targets for the world's nations.

California began an initiative in 2015 to incorporate soil health into the state's farm and ranch operations. Some of the pioneering studies showing regenerative agriculture's benefits have been carried out at the Marin Carbon Project, on a self-proclaimed carbon-farming ranch in the pastoral reaches of Marin County 30 miles northwest of San Francisco. A four-year study there showed that a one-time application of compost caused an increase in plant productivity that has continued ever since, and that the soil's carbon content grew year after year, at a rate equivalent to the removal from the atmosphere of 1.5 metric tons of carbon dioxide per acre annually.

Whendee Silver, an ecosystem ecologist at the University of California at Berkeley who is the project's lead scientist, calculated along with a colleague that if as little as 5 percent of California's grangelands was coated with one-quarter to one-half inch of compost, the resulting carbon sequestration would be the equivalent of the annual greenhouse emissions of nine million cars. The diversion of green waste from the state's overcrowded landfills would also prevent it from generating methane, another potent greenhouse gas.

Some scientists remain skeptical of regenerative agriculture, arguing that its impact will be small or will work only with certain soils. It also faces significant obstacles, such as a scarcity of research funding and the requirements of federal crop insurance, which frequently disqualifies farmers who plant cover crops. But fears that the Trump administration would squelch government support for it so far have proved unfounded.

Consider the experience of Willie Durham, a soil health specialist at the federal Department of Agriculture's Natural Resources Conservation Service in Temple, Tex. What led Mr. Durham to regenerative agriculture was his discovery while a Texas state agronomist of the "pesticide treadmill": "People I'd known for a long, long time would ask me, 'If nothing is changed in our agricultural system, why are we using two to three times as much fertilizer to accomplish the same thing?' It got to where we spent so much on inputs that we didn't make any profit."

Now Mr. Durham teaches regenerative agriculture to farmers in Texas and Oklahoma. The farmers he inspires are predominantly young, not yet habituated to conventional agriculture — he estimates that about 10 percent of his students use the information, and the percentage is increasing. In a region where rainfall is usually precious, some conventional soil has become so lifeless that it absorbs as little as half an inch of water per hour, Mr. Durham said, while regenerative fields can absorb more than eight inches an hour.

Mr. Durham's farmers are learning a lesson that resonates throughout human interactions with the natural world: People reap more benefit from nature when they give up trying to vanquish it and instead see it clearly, as a demanding but indispensable ally. Because of carbon's climate change connection, we've been conditioned to think of it as the enemy, when in fact it's as vital to life as water. The way to make amends is to put it back in the soil, where it belongs.

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