A Boon for Soil, and for the Environment

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At a farm in Peru, charcoal from bamboo burned in special ovens is used to fertilize the soil. Carbon farming is seen as a way of replenishing depleted farmland and helping reduce damage to the environment. Credit/Enrique Castro-Mendivil/Reuters

By Beth Gardiner

LONDON — When Gabe Brown and his wife bought their farm near Bismarck, North Dakota, from her parents in 1991, testing found the soil badly depleted, its carbon down to just a quarter of levels once considered natural in the area.

Today the Brown farm and ranch is home to a diverse and thriving mix of plants and animals. And carbon, the building block of the rich humus that gives soil its density and nutrients, has more than tripled. That is a boon not just for the farm's productivity and its bottom line, but also for the global climate.

Agriculture is often cast as an environmental villain, its pesticides tainting water, its hunger for land driving deforestation. Worldwide, it is responsible for nearly a quarter of all greenhouse gas emissions.

Now, though, a growing number of experts, environmentalists and farmers themselves see their fields as a powerful weapon in the fight to slow climate change, their very soil a potentially vast repository for the carbon that is warming the atmosphere. Critically for an industry that must produce an ever-larger bounty to feed a growing global population, restoring lost carbon to the soil also increases its ability to support crops and withstand drought.

“Everyone talks about sustainable,” Mr. Brown said. “Why do we want to sustain a degraded resource? We need to be regenerative, we need to take that carbon out of the atmosphere and put it back into the cycle, where it belongs.”

Since people began farming, the world’s cultivated soils have lost 50 percent to 70 percent of their natural carbon, said Rattan Lal, a professor of soil science at the Ohio State University. That number is even higher in parts of south Asia, sub-Saharan Africa and the Caribbean, he added.

Globally, those depleted soils could reabsorb 80 billion to 100 billion metric tons of carbon, reducing atmospheric carbon dioxide by 38 to 50 parts per million, Mr. Lal said. That does not include the carbon that could be simultaneously sequestered into vegetation, but the numbers are significant on their own, equaling up to 40 percent of the increase in concentrations since pre-industrial times. Last year, atmospheric carbon dioxide for the first time hit a monthly average of 400 parts per million, a symbolic threshold but one that many experts say could indicate that warming will soon spiral beyond control.

When carbon escapes from soil, it combines with oxygen to form carbon dioxide. Sometimes the loss is gradual, the result of plowing that leaves upturned layers of earth exposed to the elements, or of failure to replant or cover fields after harvest.

Sometimes it happens more suddenly. The thick prairie sod of America’s Great Plains was a rich carbon store until settlers tore it up for farms, leaving hundreds of millions of tons of topsoil to be blown away in the Dust Bowl years. The destruction of millions of acres of carbon-rich Indonesian peatlands for palm oil plantations is helping to drive climate change today.

Low carbon levels leave the ground nutrient-poor, requiring ever-greater amounts of fertilizer to support crops. They also make for thin soil that is vulnerable to erosion and less able to retain water, so yields suffer quickly in times of drought.

To bring levels back up, a set of techniques known as carbon farming, or regenerative farming, encourage and complement the process by which plants draw carbon dioxide from the atmosphere, break it down and sequester carbon into soil. They include refraining from tilling, or turning, the soil; mixing crops together rather than growing large fields of just one type; planting trees and shrubs near or among crops; and leaving stalks and other cuttings on fields to decay.

Mr. Brown keeps his fields planted for as much of the year as possible to minimize nutrient loss. When he mixes clover and oats in the same field, the clover fixes nitrogen into the soil. After the oats are harvested, livestock graze the clover and leave their manure behind.

Such strategies have allowed him to stop using synthetic fertilizers and pesticides, reducing costs. And the rich soil not only yields higher volumes, but the crops are more nutritionally dense than those grown on depleted land, he says.

“Economically, it’s much, much, much more profitable,” he said.

Mr. Brown's approach is very different from the techniques of industrial-scale farming that have taken hold in the United States and other wealthy countries, where single crops stretch over many acres, and fertilizers and pesticides are used heavily.

Things are worse in poorer nations, where farmers' desperation often means they are unable to care for the soil, Mr. Lal said. He recalled seeing a Mexican sharecropper carting corn straw away from the fields to sell: "I said, 'Why don't you leave it on the land? The land will be better next year.' And he said, 'This land will not be mine next year, and I need money now.'"

There is some momentum behind a shift. The French government, which helped broker last year's landmark Paris Agreement on climate change, is pushing an effort to increase soil carbon stocks by 0.4 percent annually, which it says would halt the rise in atmospheric carbon dioxide levels.

Mr. Lal called the target unrealistic, but said achieving just a quarter of that sequestration would be meaningful. In a generation, he said, agriculture could become carbon neutral, removing all the emissions it creates, for example through the energy used by farm equipment.

Worldwide, 5 percent to 10 percent of growers are using regenerative, climate-friendly techniques, said Louis Bockel, a policy officer at the United Nations' Food and Agriculture Organization. That number is likely to increase, he said, as multinational institutions and wealthy nations start incorporating carbon sequestration incentives into existing aid to farmers in poor countries.

"More and more additional funding will be available" to encourage such efforts, Mr. Bockel added. "We are moving quite quickly on this."

Farmers need financing to help them adopt new techniques, though generally only through a two-to-three-year transition period, said Eric Toensmeier, author of "The Carbon Farming Solution." That money could come through a higher price charged for foods whose cultivation encourages sequestration, via a carbon tax or through trading systems in which polluters buy credits to offset their emissions, he said. Programs known as payment for environmental services, in which governments or others pay farmers for stewardship of land, are another potential avenue.

With that kind of support, the industry could be ready to do things differently, said Ceris Jones, a climate change adviser at the National Farmers Union in Britain.

"People say that farmers are pretty conservative, but actually practice can change quite quickly," she said.

Another obstacle is the lack of an agreed-upon system for measuring carbon sequestration in soil, which will be required as the basis for any payments, Mr. Toensmeier said.

Technically, though, many elements of carbon farming are ready to be put into practice quickly, he said. Something as simple as planting trees around fields drastically increases the amount of carbon fixed into soil, Mr. Toensmeier said.

“I would love to see a huge, major transformation of agriculture in the industrialized world, but if we started with just adding trees to the system we have, it’s a huge gain,” he said. “We can sort of meet farmers where they are”

It’s not just crops. The earth beneath the world’s grasslands, from America’s Great Plains to the Tibetan Steppe and the Sahel of Africa, holds about a fifth of all soil carbon stocks, the Food and Agriculture Organization estimates. In many places that soil is badly depleted.

“This land is waiting to be filled up again with carbon if we could manage it sustainably,” said Courtney White, author of the book “Grass, Soil, Hope.”

That means moving livestock frequently so each patch of land is grazed just once a year, mimicking the patterns of the native bison that once roamed the American West, he said. The combination of stimulation during animals’ brief presence and long periods of rest encourages plants to lay down more carbon, Mr. White said.

With policies that encourage change, Mr. Toensmeier said, agriculture could benefit the climate rather than harming it. “There do seem to be a remarkable number of win-win opportunities, which is great news,” he said. “You don’t hear a lot of great news about climate change.”