

Carbon Farming: What Is It, And How Can It Help the Climate?

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By [Daisy Simmons](#)

An ear of corn, swaying gently before a stand of apple trees. A cow chewing slowly on clover. They're probably not what you think of when you imagine solutions to climate change. But perhaps their time has come.



*Salamander Springs farm in Berea, Ky., uses carbon-farming techniques to improve soil health and capture carbon.
(Credit: Salamander Springs farm)*

Enter “carbon farming,” a term that encompasses a host of practices aimed at keeping more carbon in the soil, from planting cover crops to managing multi-species grazing.

Improving soil-carbon retention on farms is a critical step in mitigating climate change, according to Eric Toensmeier, author of [The Carbon Farming Solution](#). He and other proponents of carbon farming believe it can improve farm productivity, too.

Tall order of idealism, or practical prospect? Let's dig in.

Carbon out of balance

Right now, the concentration of carbon dioxide in Earth's atmosphere is [up 39 percent](#) since the Industrial Revolution. Intensive farm production is adding to the atmospheric load by depleting

soil of its carbon, which then combines with oxygen in the air to form carbon dioxide. Some cultivated soils have lost [one-half to two-thirds](#) of their original carbon content.

Part of the problem is that, like a sleeping baby, soil doesn't respond well to being disturbed. Common agricultural practices like tilling fields and overgrazing expose soil carbon to the air, and winds and rains then wash or blow it away.

“During growing season, soil is burping carbon dioxide all the time,” says [Carl Bernacchi](#), a professor of plant biology who studies climate change impacts on midwestern crops at the University of Illinois.

In addition to carbon loading of the atmosphere and oceans, this loss of organic matter impairs soil health. Take it from farmer Alan Haight of [Riverhill Farm](#) in drought-stricken northern California: “The water crisis may be more obvious,” he says, “but we need to think there is also a soil crisis.”

It doesn't have to be that way. In fact, it *shouldn't* be that way, when you consider the basic science of plants and soil. Through photosynthesis, plants remove carbon dioxide from the air, converting it into sugar. When leaves fall off or plants die, the carbon naturally sinks into and enriches soil. Simple, right?

But unless farmers take action, organic matter won't stay in the soil. What do carbon-farming techniques look like in practice?

Carbon farming 101: Produce farms

For produce farms, carbon farming generally means growing fruits, vegetables, and legumes with minimal disturbance to the soil.

One important approach is [no-till](#) farming, which implicitly means less disturbance.

As much as five times more carbon can stick around in the soil under no-till than with conventional tillage, according to Bernacchi's study of corn and soybean fields in Illinois. His calculations suggest that if all farms in the U.S. stopped tilling, they'd cut national carbon emissions by 1-2 percent.

That percentage may sound small, he says. “But what you need to consider is that if we continue with massive conventional tillage, we're also looking at losing even more carbon every year,” he says. “Will no-till solve the whole problem? No. But will it prevent the problem from getting worse in the agricultural sector? Absolutely.”

The practice is becoming [more widespread](#). At the 23-acre [Salamander Springs farm](#) in Berea, Kentucky, Susana Lein has used no-till and other soil-building practices to grow thousands of pounds of beans, corn, and other staples since 2002. Today, Salamander Springs' soils boast 18-19 percent organic matter, compared with a typical healthy soil's [5 percent](#).



Farmer Susana Lein sows each season's crops into still-standing crops to ensure living plant roots are always present in Salamander Springs soil. (Credit: Salamander Springs farm)

Incorporating organic plant residue into the soil is another key element of carbon farming. This is often accomplished by spreading compost over the ground, mulching, or planting cover crops, which are non-vegetable crops that protect soil from erosion and suppress weeds as they grow, and can then be returned into the soil.

At Riverhill, farmers plant the entire 10 acres with non-cash crops like cereal rye every winter – a ritual Haight considers invaluable to soil health as well as suppressing weeds and pests.

Long-term payoff of cover cropping is real, if farmers can afford the short-term cost of removing land from cash-crop production. According to a 2016 sustainable agriculture survey, corn yields rose [an average of 3.4 bushels per acre](#), or 1.9 percent, after cover crops.

No-till farming and cover cropping help farmers hold on to and build soil carbon, but growing perennials is the gold standard. Long-lived perennials can retain far more carbon than annuals, thanks to their longer growing seasons, deeper roots, and greater biomass.

Apples and asparagus are good examples of popular perennial groceries. And Toensmeier says some crops that are usually annuals could actually be “perennialized.” [Sylvetta arugula](#), for example, may be an excellent, spicier version of its more commonly produced annual relation.

At this point, however, it's easier to grow perennial staple crops (think avocados) in more tropical than temperate climates. Toensmeier suggests a shorter-term solution lies in integrating perennials into current crops. For example, both Riverhill and Salamander Springs integrate hedgerows and fruit trees into their acreage.

Carbon farming 102: Of cows and hens

Self-described foodie Michael Kovach has been raising grassfed beef at [Walnut Hill Farm](#) in Sharpsville, Pennsylvania, since 2008.

“Sequestering more carbon – that’s not what we were thinking when we said ‘Let’s be grassfed farmers,’ but it’s really good,” he says.

Like other livestock operations with an emphasis on feeding animals what they would eat naturally, his farm depends on quality soil. “We try to take advantage of the natural evolutionary habits of these animals we’re raising for meat,” he says. “And that means they are improving our ground at the same time.”

One of the farm’s core tactics, and a key attribute of carbon farming, is managing animals to prevent over-grazing and allow for some of the forage to return to the soil.

At Walnut Hill, this means chickens, turkeys, pigs, sheep, and cattle take turns browsing different sections of the landscape, each adding their own value to soil health. For example, pigs can trample and clear brush in an overgrown area. And their penchant for rooting out nuts and seeds can help restore the growth of grasses whose seeds lie buried in the soil.



Sheep take their turn grazing Walnut Hill Farm’s grasses, which help hold carbon in and are also browsed by cows, chickens, and turkeys. (Credit: Walnut Hill Farm)

Later, when a cow or sheep chews on that newly grown grass, the roots send carbon into the soil. Heavy hooves also trample grass as they go, creating a buffer that can help retain moisture in the soil. And then when a chicken or turkey scratches around the same grounds, it helps work dead, carbon-rich grass back into the soil.

Toensmeier says soil-carbon benefits multiply when perennial trees are also mixed in. [Silvopasturing](#), which calls for combining trees with animal-farming systems, is one of Kovach's other preferred techniques. Roughly 50 acres of the farm are open pasture, while the other 50 acres are covered with wooded areas – and usually frequented by hungry pigs.

“Pigs are not all that discerning when it comes to diet. They're the ultimate omnivores,” says Kovach. By dining on acorns, seeds, nuts, and fruit, pigs make it prudent for the farm to keep those long, carbon-rich tree roots around. Those trees also include help the farm save on feed costs and add niche-market appeal.

“You can also get artisan about it,” says Kovach, “by doing things like have this batch of pigs only forage under hazelnuts, or this one only under apple trees. A happy, well-fed pig usually makes for an extraordinarily good-eating pig.”

With old practices come new perks – and challenges

Carbon farming may be a buzzword, but the practices themselves are not new – they were simply left by the wayside during the rise of modern industrial farming in the latter part of the 20th century. Today, they're being rediscovered by some for their climate-friendly ways, but for most, simply because they're practical once they are up and running.

“None of the core carbon-farming techniques we have were developed for sequestering carbon,” Toensmeier says. “They were developed because they're good for the farm.”

Improving soil also boosts its water-holding capacity – which will become increasingly vital as drought and severe storms continue to increase. It can also potentially mean better yields.

Still, it's risky for farmers to adopt techniques that may be new to them. For example, moving to no-till can be challenging for organic farmers who rely on tilling to kill weeds, and also for cover-crop operations that use tilling to work the plant residue back into the ground.

“We can't afford to have crop failures, and that's probably one of the biggest obstacles to innovation,” says Haight. “For most farms, especially small ones, there's very little margin for error.”

Lein, who teaches permaculture classes, advises farmers looking to make a change to start small. “Don't take a huge risk, and make a slow move into these practices to see how it works on your place.”

Toensmeier says it won't be possible to scale up carbon farming without a system of support for farmers. In addition to government support, loans, and grants, he would like to see a certification system for carbon-friendly foods.

Research still emerging

Can healthier soil really address climate change?

On its own, no.

“There’s a limit to how much you can actually put back in the soil and biomass,” says Toensmeier. “It’s not a silver bullet. But we can’t mitigate climate change without agriculture as part of an integrated approach.”

A developing body of research appears to back up his assertion, including [a study](#) of 12.6 million farms in developing countries that showed that carbon-farming methods like low-to no-tillage, agroforestry, and livestock integration are estimated to save 11.4 million tons of carbon annually and increase yield 79 percent.

As Bernacchi says, however, research like this is still emerging and there is much yet to learn. “We have a long way to go to resolve how soil carbon is changing under a variety of soil practices.”

A call for consumer involvement

In some ways, the success of this piece of the climate solution will come down to a mix of more science and government support for farms – as well as pure people power.

Haight believes a strong base of consumer support for small farms has done more for their success than any recent state and federal policy. “It’s really quite remarkable. Often when these farms are thriving, it’s because people are buying their food because of how they grow it.”

Kovach also champions consumer power, saying the biggest thing that non-farming folks can do to support carbon farming is to support the people who do it now.

“Vote with your dollars, and like Michael Pollan says, with your forks,” Kovach says. “You can’t lose by having more biologically active, healthy living soil, rather than soil on life support.”
