

# A Climate Change Solution Beneath Our Feet

Source: [washingtonpost.com](http://washingtonpost.com)

Published: May 17, 2017

Content from UC Davis

**There's too much carbon in the atmosphere and not enough in the ground where it's useful. Healthy soil can help flip the picture.**

When we think of climate change solutions, what typically comes to mind is the transportation we use, the lights in our home, the buildings we power and the food we eat. Rarely do we think about the ground beneath our feet.

Kate Scow thinks a lot about the ground, or, more precisely, the soil. She's been digging into the science of how healthy soils can not only create productive farmlands, but also store carbon in the ground, where it belongs, rather than in the atmosphere as carbon dioxide.

Looking across the landscape on a spring day at [Russell Ranch Sustainable Agricultural Facility](#), most people would simply see a flat, mostly barren field. But Scow—a microbial ecologist and director of this experimental farm at the [University of California, Davis](#)—sees a living being brimming with potential. The soil beneath this field doesn't just hold living things—it is itself alive.

Scow likens soil to the human body with its own system of “organs” working together for its overall health. And, like us, it needs good food, water and care to live up to its full potential.



*UC Davis professor, Kate Scow, center, works with UC Davis students during a Soil Science 100 class at Russell Ranch Sustainable Agricultural Facility in Davis, Calif. They collected soils from natural grassland, a conventional agriculture plot and an organic plot to test carbon storage, infiltration rate, microbial diversity and soil type. Photo credit: Gregory Urquiaga*

### **Solutions beneath our feet**

Farmers and gardeners have long sung the praises of soil. For the rest of us, it's practically invisible. But a greater awareness of soil's ability to sequester carbon and act as a defense against [climate change](#) is earning new attention and admiration for a resource most of us treat like dirt.

Soil can potentially store between 1.5 and 5.5 billion tons of carbon a year globally. That's equivalent to between 5 and 20 billion tons of carbon dioxide. While significant, that's still just a fraction of the 32 billion tons of carbon dioxide emitted every year from burning fossil fuels.

Soil is just one of many solutions needed to confront climate change.

But the nice thing about healthy soils, Scow said, is that creating them not only helps fight climate change—it also brings multiple benefits for agricultural, human and environmental health.

“With soil, there's so much going on that is so close to us, that's so interesting and multifaceted, that affects our lives in so many ways—and it's just lying there beneath our feet,” she said.

### **Ranching's role in building healthier soils (video)**

Skyelark Ranch uses rotational grazing while raising sheep in Northern Calif. This can benefit plant growth, drought resistance and the climate. (UC Davis)

## Subterranean secrets

Underground, an invisible ecosystem of bugs, or microorganisms, awaits. In fact, there are more microbes in one teaspoon of soil than there are humans on Earth. Many of them lie dormant, just waiting to be properly fed and watered.

A well-fed army of microbes can go to work strengthening the soil so it can grow more food, hold more water, break down pollutants, prevent erosion and, yes, sequester carbon.

“I love the word ‘sequestration,’” said Scow, who thinks the word is reminiscent of secrecy, tombs and encryption. “Soil is filled with microbes who are waiting it out. The conditions may not be right for them—it’s too dry or too wet, or they don’t have the right things to eat. They’re sequestered. They’re entombed. But if the right conditions come, they will emerge. They will bloom, and they will flourish.”

## How soil sequesters carbon

Soil sequesters carbon through a complex process that starts with photosynthesis. A plant draws carbon out of the atmosphere and returns to the soil what isn’t harvested in the form of residue and root secretions. This feeds microbes in the soil. The microbes transform the carbon into the building blocks of soil organic matter and help stabilize it, sequestering the carbon.

“You can’t sequester carbon without microbes,” Scow said. “They’re far more important than we ever imagined.”



*Scott Stone, a Winters, Calif. rancher, uses compost on his rangelands, which feeds microbes in the soil and helps sequester carbon. Photo credit: Kat Kerlin*

## Healthy soils

There’s too much carbon in the atmosphere and not enough in the ground where it can be used. A new effort in California aims to flip that picture.

The state’s [Healthy Soils Incentives Program](#) is considered the first in the nation to provide state funding to help farmers and ranchers enhance their soils to reduce greenhouse gas emissions.

The \$7.5 million program, expected to launch this summer, encourages farming practices known to boost microbial communities underground and sequester carbon.

The program may also open the door for farmers and ranchers to participate in the state's carbon market, where they could create and trade carbon offsets under the [California Global Warming Solutions Act](#). In short, they could be paid to store carbon.

An increased demand for compost from farmers and ranchers could also help reduce food waste and landfill emissions.

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someone you can create a relationship with."*

– Kate Scow, microbial ecologist and director of  
Russell Ranch Sustainable Agricultural Facility at the  
University of California, Davis

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## **Soil food**

Similar to how people can feed probiotics and prebiotics to the microbes in their guts to improve their health, farmers can use cover crops and apply compost, yard waste and other organic matter to feed microbes in the soil. Reduced tillage, efficient irrigation and other methods also strengthen the soil's ability to store carbon.

Such techniques have long been used by farmers to enhance soil—particularly on organic and small farms.

"This is ancient knowledge, really," said Pelayo Alvarez, outreach director for the Petaluma-based Carbon Cycle Institute and a graduate of UC Davis. "When you increase soil organic matter in the soil, good things happen. But climate change is bringing new attention to it. And regardless of climate change, we should be doing this for many reasons—for productivity, erosion control, drought tolerance. It's going back to our roots, no pun intended."



*Sheep from Skyelark Ranch graze a field planted with a cover crop in Brooks, Calif. The grazing encourages plants to grow and capture carbon dioxide from the atmosphere through photosynthesis. Photo credit: Joe Proudman*

### **Ranching roots run deep**

The roots run deep for Scott Stone at Yolo Land & Cattle Company outside Winters, California. His late father, Hank Stone, bought the 7,500-acre ranch about 40 years ago, and it's now owned and operated by Scott and his brother Casey. Stone is as much a natural resources manager as a rancher, with a protective eye on the ranch's watersheds, trees, pasture and grass-fed cattle, and a genuine desire to leave the land better than he found it.

He rotates his cattle frequently across the pasture to avoid overgrazing. Most of the ranch—7,000 acres—is in a conservation easement. He avoids fertilizer. And, increasingly, he composts.

Rotting hay bales compost in place. Where they once fed the cows, they now feed microbes—growing greener grass and sequestering more carbon as a result. A large mound of compost rests on his lower fields, awaiting application.

“It's the right thing to do,” Stone said. “As ranchers, we're busy here making a living, and we don't get out to tell our story as much as we should.” He wants people to better understand that land stewardship and ranching can work together to protect the whole ecosystem.

### **Carbon on the range**

Sustainably managed ranches like this one, with their swaths of grasses and trees mixed with cow manure and hay, suck up carbon by their mere existence.

“The first thing to do to store carbon on rangelands is to avoid converting them to other things,” said Kelly Gravuer, who worked on the Healthy Soils Initiative as an intern for the California Department of Food and Agriculture while she was a graduate student in Scow's lab. “But people are asking if there are additional things we can do to store carbon, like compost.”



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– Scott Stone, co-owner and operator,  
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California loses about 20,000 acres of rangeland each year, much of which become greenhouse-gas-emitting housing developments, shopping centers, roads and parking lots. The remaining 63 million acres of rangeland in the state—part of the 770 million acres nationwide—represent significant opportunities for additional carbon storage, and can help offset some of the emissions for which the meat industry is often criticized.

Scientists estimate that U.S. rangelands could potentially sequester up to 330 million metric tons of carbon dioxide in their soils, and croplands are estimated to lock up more than twice that amount—up to 770 million metric tons. That’s the CO<sub>2</sub> emissions equivalent of powering 114 million homes with electricity for a year.

“When you look at the cow, you think of emissions,” Stone said. “But the whole system is actually sequestering carbon. There are so many opportunities in agriculture to move the needle on climate change.”

### **Everywhere and nowhere**

Back at Russell Ranch, Scow walks into a field, bending down to pick up a clump of soil. She crumbles it in her hands. She views soil as a metaphor for a world that needs healing.

“It’s not a crying baby,” she said. “It’s easy to ignore. It’s everywhere and it’s nowhere. That’s the challenge. But if soil is alive, it’s like someone you can create a relationship with.”

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