

# CLIMATE, CARBON SEQUESTRATION IN THE SOIL AND FARMING

Kathy Voth, OnPasture.com

There is a lot of information out there right now about soil carbon sequestration and what farmers and ranchers can do to sequester more carbon in their soils. There are also a wide variety of new companies hoping to cash in on working with farmers and ranchers on carbon credits. As with anything humanity is involved in, there is some truth, some misinterpretation, some deception, and some P.T. Barnum thrown in.

We do not have a lot of room for error when it comes to the climate or the time and money we have to spend on these things. Let's start by arming ourselves with some basics about soil carbon.

## How Does Carbon Get into the Soil?

Let's start with John Wick's excellent explanation drawn from the research on carbon sequestration done on his ranch with UC Berkeley. I have added some additional information in the Transcript below. See <https://youtu.be/KB6cqXZZ2MY>.

### Transcript

It all starts with sunshine, soil, a seed, and a little grass plant. As the grass plant gets rain and sunshine it grows roots down into the soil. This is quite a simple thing, and it happens on more land area on earth than any other cover type. There are more acres of grassland than forest or tundra or anything else.

There are several things involved: there's air, sunshine, soil, and water. And what I wanted to talk to you guys about today is how important this combination of things is. As managers, we can start to interact with this system in a way that can stop and reverse global warming while producing fiber and food and fuel, and flora. And the way it works is really quite simple.

Grass plants, as we all learned in school, produce oxygen and a bit of moisture to the atmosphere. We live in an oxygen-rich environment. CO<sub>2</sub> is the fourth most abundant gas in the atmosphere and as a gas, it spreads itself evenly throughout the vessel it is in, and the atmosphere is a vessel. As a result, the moment these little microscopic holes in the bottom of the leaf open to release oxygen and moisture, the CO<sub>2</sub> rushes in and fills the leaf.

So now, we have a leaf full of CO<sub>2</sub> and then under the sun's energy, the plant

pulls in soil moisture and soil nutrients through the microscopic hairs on the roots and recombines all of that to create carbohydrates, which we represent as C<sub>6</sub>H<sub>12</sub>O<sub>6</sub>. All the carbon in carbohydrates comes from the air and nowhere else.

I always thought it came out of the soil through the roots. It turns out that there is a lot of carbon in the soil and that soil is important. But the reason it's important is that the more carbon there is in the soil, the more water soil holds.

Our research project starting on our ranch looked at that whole process and what is involved in getting carbon from the air through the plant and into the soil.

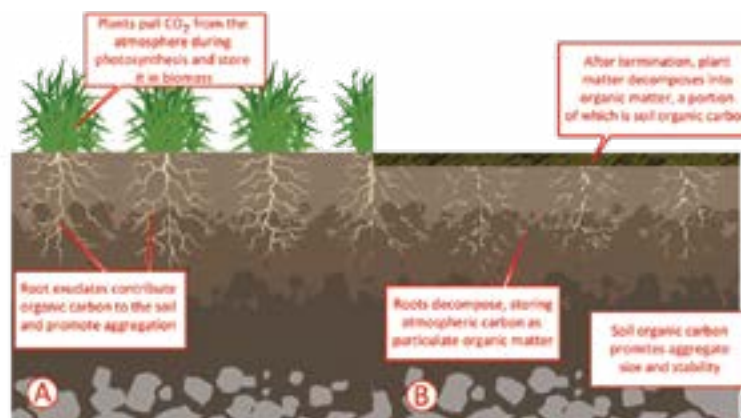
To understand how that works, it is very important to understand that carbon in the soil represents itself in three fractions.

### Labile Fraction

The Labile Fraction is fresh carbon and it is very temporary. Most of it is in the bodies of microorganisms and plants' roots. Most of it is going to go back to the atmosphere as CO<sub>2</sub>. A healthy soil system is very busy. It is full of microbes, trillions of them, and as they're going through their life processes, they oxidize carbon just as we are right now. Every single one of us is exhaling CO<sub>2</sub> into the atmosphere. We are actually recharging the resource base from which all this happens.

### Occluded Light Fraction

Some of the labile carbon in the Labile Fraction is consumed and is digested by the microorganisms and some of that carbon enters the Occluded Light Fraction. This is interesting carbon because this carbon starts to change the electrical properties of the soil structure and it starts to hold more water in a plant-available form. Consequently, the more carbon there is in the soil, the more plant there is.



How plants sequester carbon (A) as they grow and (B) after they die. (University of Nebraska-Lincoln)

This water ordinarily would have passed through the system subject to gravity and left, recharging our aquifers and things like that. But when you have carbon-rich soil, that water now is interested in hanging out.

**This is the carbon that we're hoping to sequester with our management activities. It meets renowned soil scientist Rattan Lal's definition of soil carbon sequestration:**

**"Carbon sequestration implies transferring atmospheric CO<sub>2</sub> into long-lived pools and storing it securely so it is not immediately re-emitted."**

### Heavy Fraction

After more processes, some of that carbon enters the heavy fraction. This can take millions of years. This is fossil carbon. It also stays there for millions of years because this carbon now is chemically bonded inside microsites within the soil structure and not available for microorganisms.

This is important, good carbon. All human civilization has occurred where we have carbon-rich soils like that. The challenge for us is in our agricultural practices, the conventional ones. When we plow, we actually break up the soil's structure and allow organisms to digest what has been permanent carbon. They oxidize it into the atmosphere so we're getting more and more agriculturally produced CO<sub>2</sub> to the atmosphere, and we're burning up our fossil carbon.

## How does a carbon molecule escape from being eaten by microbes to become sequestered?

That's the puzzle that scientists have been working on, and they've recently discovered how carbon molecules escape: through very tiny pore spaces in the soil.

A team of researchers led by Alexandra Kravchenko found that the pores in the range of 30-150 µm (about the size of one to three human hairs) can trap carbon molecules, making them inaccessible to the microorganisms that might otherwise consume them and send them back into the atmosphere. Of course, the more of these tiny spaces there are, the more carbon is effectively sequestered in the soil. What Kravchenko learned is diversity is key.

"What we found in native prairie, probably because of all the interactions between the roots of diverse species, is that the entire soil matrix is covered with a network of pores," said Kravchenko. "This gives carbon molecules lots of places to hide. Without them, most of the carbon was oxidized into CO<sub>2</sub> and returned to the atmosphere."

## A soil's potential also determines carbon sequestration

Different soils have different capabilities when it comes to carbon sequestration and what a soil can hold is also influenced by climate, rainfall, the soil microbial community, management, and many other variables. Under favorable conditions, soil organic carbon will increase until the soil reaches saturation (whatever that might be for that soil) and then no more is added. Think of it as a paper towel wiping up spilled water. There's a point at which your towel becomes saturated and can hold no more.

That is a first step in understanding the complexity of trying to sequester carbon in the soil. The research done on John Wick's ranch is a story of how we can use this understanding along with a simple practice, spreading compost pastures and fields, to rapidly increase carbon sequestration. We will talk about that more in future issues.

Kathy Voth produces On Pasture. This resource translates science and experience into practices graziers can use. Learn more at [www.onpasture.com](http://www.onpasture.com). 🌱

## CSA: CREATING A RESILIENT LOCAL ECONOMY AND FOOD SYSTEM

Eva Barta

Community Supported Agriculture (CSA) is a partnership between community members and farmers to share in the bounty and the risks of farming. The roots of the popular CSA model, used by farms around the world, can be traced back to the beginnings of commercial agriculture. Families no longer needed to produce everything on their own land and purchased food directly from their local farmers.

As modern agriculture and technology developed, farms became less central to communities. Food could travel longer distances from the farmer to consumer, and with the rise of large-scale industrial agriculture in the early 1900s, customers were mainly connected to their farmer simply through a need for food.

Towards the end of the century, movements to reconnect with the source of our

food gained momentum, and knowing your farmer once again became important. Though it is disputed and almost impossible to determine who actually had the first idea to create a system connecting community members and farmers through a pay-up-front model, such programs emerged in Japan, Europe, Chile, and the United States in the early 1970s. The closest "grandparent" of CSA as we know it today was a club designed by Booker T. Whatley.

Whatley was a Black horticulturist, author, and professor. While much of his work focused on regenerative and sustainable agriculture practices, Whatley also thought deeply about how to support his community. Recognizing that black farmers struggled more than white farmers to receive loans from the federal

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## COMMUNITY SUPPORTED AGRICULTURE

**CSA Cards** — A flexible, debit-style card that can be used at our farmstand, Hello Café, and farmers' market booths. All cards come with a 10% spending bonus.

**Friday Night Dinner CSA** — Let us make dinner for you on Fridays! Pickups monthly in the summer and weekly in the fall.

**PYO Bouquet CSA** — For 10 weeks of the summer, pick 25 flower stems per week in our certified organic cut flower garden.

[cedarcirclefarm.org/csa](http://cedarcirclefarm.org/csa)





# MONADNOCK FOOD COOP'S TEN YEAR ANNIVERSARY AND EARTH DAY CELEBRATIONS

Say "Cheers to 10 Years" with Monadnock Food Co-op this April. The Co-op will celebrate its 10th Anniversary for ten days starting on Thursday, April 13 and culminating with the 2023 Monadnock Region Earth Festival, which will take place throughout downtown Keene, NH and the Co-op at 34 Cypress Street on Saturday, April 22, from 12 pm to 4 pm.

For these ten days, Monadnock Food Co-op will highlight and feature what sets their community-owned business apart; this includes: being a welcoming and accessible community-owned downtown market, having a dynamic and passionate staff, offering a diverse variety of products (including the option to buy in bulk!), its local products, farmers, and producers, community partnerships forged, and a vast number of sustainability strides made over the last decade.

Enjoy promotions and giveaways, tastings from local producers and farmers, raffle drawings daily, member-owner incentives, community offerings, family-friendly activities, and more. Everyone is welcome to take part in the region's Earth Festival on Saturday, April 22, from 12 pm to 4 pm.

## Earth Day Festivities 2019



The Co-op's annual Monadnock Region Earth Festival celebrates some of the many things that make the region special.

- A commitment to ever-greater sustainability.
- Healthy communities for all.
- Preserving and sustaining our planet, which is increasingly threatened by the impacts of climate change.

Join the Co-op in learning about what others are doing and making, buy delicious whole foods, meet local farmers and producers, learn something new, enjoy performers and activities throughout the Co-op, Railroad Square, and amphitheater (behind Monadnock Food Co-op), and celebrate all the things we are doing well and renew our commitment to keep striving ever onward.

Learn more at <https://monadnockfood.coop/event/earthfest/>. ♻️

## CSA: RESILIENT ECONOMY AND FOOD – Cont'd from p.20

government, Whatley devised methods to support them through the winter, advocating in the 1960s for what he called "Clientele Membership Clubs." Members would pay during the off-season for produce that they would receive during the coming growing season, effectively supporting farmers through the unproductive months. These clubs were the central part of Whatley's plan for a successful small farm as they make the winter months easier logistically and financially.

Many components of a CSA as we know it today --commonly a share is a box of in-season produce picked up weekly -- are borrowed from programs first run in 1986 at Temple-Wilton Farm in Wilton, NH and Indian Line Farm in South Egremont, MA. The CSA movement effectively supports farmers through off-seasons when input costs for seeds, labor, and planning are high but income is low, exactly as Whatley intended more than half a century ago. With fewer financial worries, farmers can focus their energy on improving agricultural methods to best support their environment, employees, and communities. You can help create a



Art courtesy of Cedar Circle Farm and Education Center, East Thetford, Vermont. (Cecily Anderson)

more resilient local economy and food system by joining a CSA through your local farm.

Much of the information for this article comes from "You Can Thank Black Horticulturist Booker T. Whatley for Your CSA," written by Shelby Vittek for *Smithsonian Magazine* in 2021, and from a 1982 interview with Whatley by *Mother Earth News* titled "The Small Farm Plan."

Eva Barta is the Marketing Assistant at Cedar Circle Farm and Education Center in Thetford, Vermont. Cedar Circle is a nonprofit, certified organic farm committed to developing regenerative agriculture systems that build connections between our food, ecosystems, and community.

More at [www.cedarcirclefarm.org](http://www.cedarcirclefarm.org). ♻️

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MONADNOCKFOOD.COOP/EARTHFEST/

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and pledge to reduce our trash.

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Climate Change and sustainability.



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