Invest in Abundant Futures

A CITIZEN SCIENCE INITIATIVE

to install Soil Carbon Sinks

at Columbia Agriculture Park, Columbia, Missouri

a proposal by *David Yarrow*, November 2020

Melting shrinking polar ice, historic hurricane season, record western wildfires—all drive Americans growing awareness that climate change is happening now, and threatens food supply, community stability, national security and human survival.

Scientists are near-unanimous that human actions are a prime factor driving our planet's heating. A scramble is on to identify, implement and evaluate any strategy that might mitigate this climate crisis.

Science says humans must curb carbon emissions, But further, humans must remove carbon already in the atmosphere by converting it to solid substances stable at least 100 years—to "sequester" that carbon.

April 2013, soil scientists at an international conference calculated soil has the capacity to absorb all the carbon currently in the atmosphere – and more.

This new fact of geoscience was shared rapidly, globally by people concerned for our human future. Global consensus is emerging that soil is our easiest, largest and fastest way to drawdown carbon.

"A climate change solution under our feet"

Kiss the Ground

More and more Americans are talking about climate change. A few of us are doing something about the existential crisis facing our next generations.

Arctic sea ice break-up and shrinkage – October 2020

This new idea to sequester carbon in soil now has serious attention at many levels of science, politics, corporations, society. Something as humble as humus is more and more a center of attention—and hope for a human future. This has two immediate implications.

First, agriculture and farmers—as soil stewards—are crucial to adapt to, address and—ultimately—mitigate climate change. How agriculture manages soils and livestock has huge effects on greenhouse gas emissions. By changing practices, farmers can become ***Carbon Farmers*** with a pivotal role to sequester carbon and reverse global heating.

Second, food is a pivotal driver in climate change. The food we buy and eat—how that food is grown, sold & wasted—is a prime factor in climate equations. If consumers insist they will buy only carbon-smart, climate-safe food, farmers will grow it for them.

What is a Soil Carbon Sink?

A **Soil Carbon Sink** is a plot of Earth—any small or large section of *Terra Firma*—dedicated to sequester Carbon from the air into soil for at least 100 years.

Century is a technical standard in science to define "*sequester*." Green plants capture carbon to convert to carbohydrates, but most plant carbon returns to atmosphere in a few years. Few substances, systems and techniques can keep carbon in soil for 100 years.

Soil can absorb all the carbon currently in Earth's atmosphere

A plot can be any size, but must have soil. Soil is easily Earth's most complex substance. Soil is a media to support and nurture microbes, plants and advanced organisms. Dirt is inert and lifeless; but soil is alive with microbes, roots, insects and all.

A plot can be rural or urban, farm or garden, grassland, forest, seashore or desert, public or private, official or informal. The key is agreement the Carbon will be kept in soil for 100 years. Voluntary dedication by private citizen is possible, but official declaration of public property is collective commitment. My first **Soil Carbon Sink** proposal was Washington State Capitol grounds in Olympia.

In Nature, Carbon is a **Cycle**—a very busy element. Carbon moves around rapidly and changes form often. Carbon is a backbone in biomolecules: carbohydrates, hydrocarbons, amino acids, DNA. Life on Earth is communities of complex carbon-based organisms.

The world's cultivated soils lost 50 to 70% of their original carbon —much of it oxidized to CO_2.

–Rattan Lal, Ohio State University

Carbon Management & Sequestration Center

Various forms of Carbon have varied lifetimes. Carbon's life in Earth atmosphere is 50—200 years. **Cellulose**, most abundant biocarbon—*plant skeletons*—is very short-cycle. Biocarbon may exist briefly in a growing season, 1 year as new leaves, 10 years as grass & shrubs, 100 years as wood in a tree, 1000 years as forest community, 10,000 years as charcoal, 100,000 years as carbonate rock. Carbon is so mobile and labile mostly because it's digestible. Indigestible biocarbon becomes **Humus**—stable up to 100 years. **Biochar**'s half-life in soil is 1,600 years, and thus is *super-stable*.

Soil Carbon is the prime indicator of fertility, productivity, and thus, land value. Forty years ago, a foundation principle to define "*Certified Organic*" was 4—5% **Soil Organic Matter**—as a minimum. In soil, Carbon holds water, charge, electrons, ions, nutrients, microbes... Carbon seeds symmetry in soil aggregate structures to permit life to get tightly organized. Today, science knows far more about biocarbon complexities than when our organic movement started to change US agriculture half a century ago.

Now, American agriculture must lead the world and take another giant step into

Soil Carbon Stewardship.

4 per 1000:

Soils for Food Security & Climate Initiative

December 2015, COP-21 Paris Climate Summit, France proposed to increase soil carbon in farmland by **.4% per year** to balance emissions with removal — to achieve net zero carbon emissions.

France leads a coalition of 80 nations and 500 organizations to advance "**4 per 1000**" as a quick way to achieve zero net-carbon emissions, advance citizen climate initiative, soil regeneration & community food security.

4 per 1000 Initiative adapts agriculture to local ecology, society and economy by agro-ecology, agroforestry, regenerative & conservation agriculture, and ecological land management. The emphasis is to build community food security, adapt agriculture to climate change, deliver food in quantity, quality and affordable cost.

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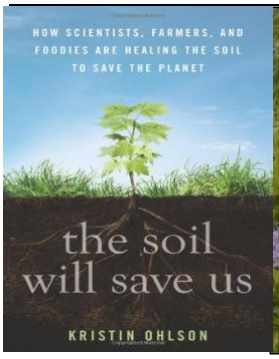
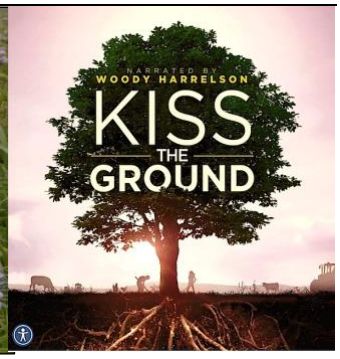


How to Create a Soil Carbon Sink

Science and experience support a few strategies to capture greenhouse gases and store them in soil for a century



Optimize Photosynthesis: First rule is maximize conversion of CO_2 into carbohydrates, since green plants fix carbon into sugar, cellulose and biomass.

Trees & Shrubs: Diverse species, multistory canopy, & polyculture plants to optimize photosynthetic density and store more biocarbon, most as cellulose—as plant biomass—as shelter, shade, food, habitat for many more species—from microbes to earthworms to songbirds.

Cover Crops: Green plant covers shelter & shade soil, keep it cool, conserve water, stop erosion, capture carbon as sugar to pump into soil as root exudates to sustain healthy microbes in **Soil Food Webs**.

Organic Matter: Mulch, manure, crop debris, and biomass wastes decay to increase soil carbon short-term & support healthy **Soil Food Webs**. Today organic matter is far more complex.

Compost: Biomass broken down by digestion is nutrients, conditioner & microbe inoculant. Well-made compost is medicinal & a growth stimulant. Process protocols, quality control & stronger standards needed.

Eating our Way
to a
Sustainable Future
one meal at a time

Biochar: Biocarbon made by burning biomass in low or no oxygen is super-stable at least 1000 years to boost porosity, water retention, cation & anion exchange, microbe habitat. Biochar can be 5%; 9% is common in Amazon *Terra Preta*.

Humics: "Black gold" residue of microbe digestion of biomatter. An inert, extra-stable biocarbon with long soil life to 100 years or over. Management can boost humus formation, microbe incubation & food web maturation.

Basalt and volcanic rocks react with CO_2 into stable carbonates for stable pH. Basalt rockdusts restore trace minerals to ancient, weathered, abused soils, form new soils, create conditions favorable to plant life.

Microbes: Organisms in invisible thin films, threads & colonies, especially fungi, are key partners to turn mineral geology into living cells, thus sustain strong green growth to move carbon further and deeper out into soil.

Farm Operations: Many changes in how farmers farm: to reduce (or-no) till, NPK fertilizer, fossil fuel, farm size; cover crops; crop diversity; rotation grazing; conservation practices. The next decade creating carbon-smart, regenerative farms.

If you burn gasoline, you'll be interested in The Soil Carbon

Soil Carbon Sink
at Columbia Agriculture Park

In 2021, a **Citizen Science** project will create **Soil Carbon Sinks** at Columbia Center for Urban Agriculture (CCUA). A citizen science team will design and install prototype plots to demonstrate three ways to boost **Soil Carbon.**

In 2015, at COP 21, France set an international goal to increase soil carbon by **.4% per year**. We can do better.

Plot #1 Accelerated +3% per year for 3 years = 9%

A small plot will be quickly loaded with a full menu of carbon-smart materials to reach optimum in 3 years. Installation begins in March by careful structured addition of assorted biocarbons, minerals & microbes. A heavy fall treatment will digest over winter to grow strong, stable **Soil Food Webs** by spring. Second & third year are lighter treatments with less soil disturbance.

Plot #2 Agriculture +1% per year for 9 years = 9%

CCUA Urban Farm integrates carbon-smart materials & methods into normal farm operation with smaller doses & slow annual changes. Many carbon-smart substances are added in spring or fall soil prep. Seed mix, transplant media, soil drench, foliar spray are strategies to boost carbon & growth while soil strengthens and matures.

Plot #3 Agroforestry +.5% per year for 10 years = 5%

CCUA Food Forest will demonstrate no-till techniques to re-carbonize soils under perennial crops, trees & shrubs. Installation begins in spring as layered surface mulch to boost roots, fungi and earthworms. Special substances, plants & techniques can penetrate dense, compact clay to build deep soil carbon & microbe ecosystems.

Soil Carbon Sinks aren't created in one operation, or a year. Like a tree, soil is a complex community of living cells that take time to fully develop and mature. Seasonal treatments are added in spring and fall over several years. The goal isn't to dump carbon, but to build fully fertile soil as habitat to regenerate soil biology.

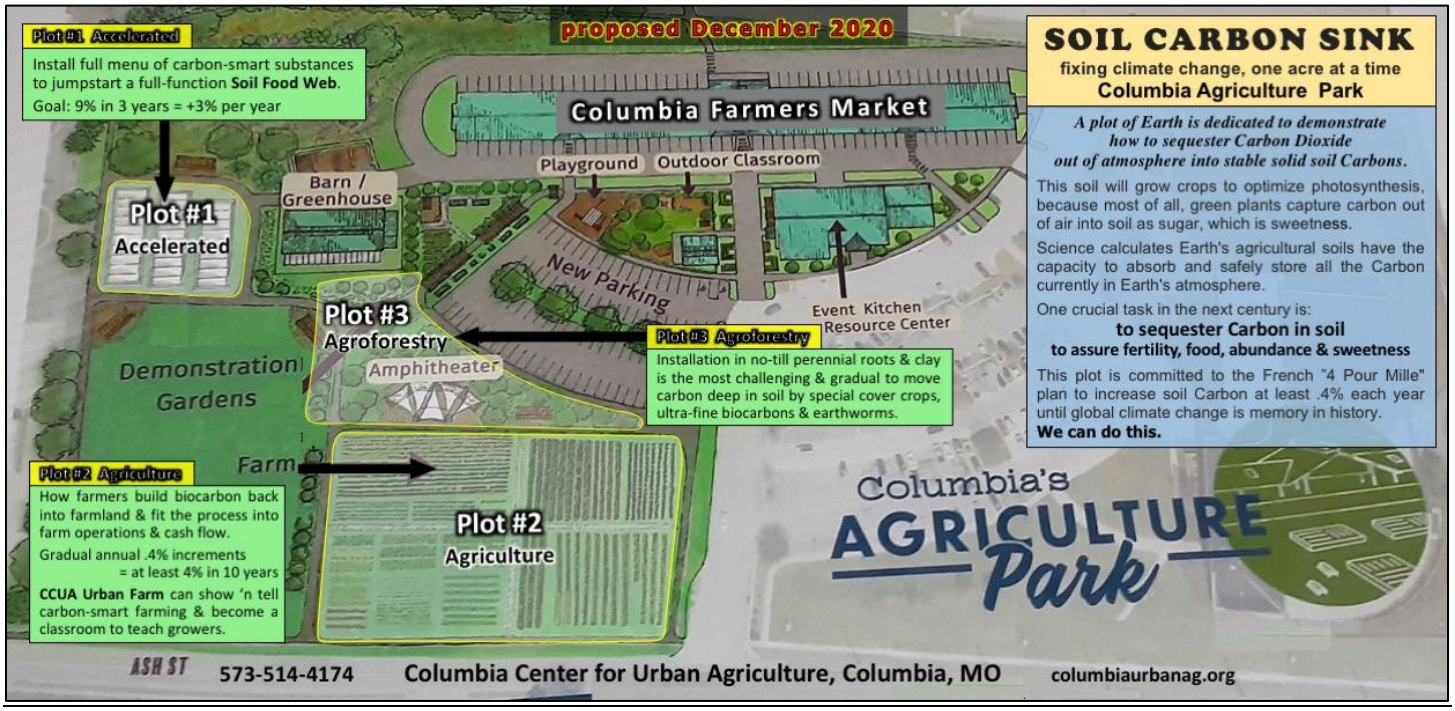
Citizen Science is ordinary people doing extraordinary research, often difficult, complex, cutting-edge, in-the-field studies. Soil carbon sequestration—an emerging technology, unknown to most, misunderstood by many—is a new stew of widely varied strategies & substances, most with a short history & few studies.

This **Citizen Science** investigation of sequestration will install a variety of **Soil Carbon Sinks**, and gather data to document the effects of various carbon-smart materials & methods. Annual soil tests will measure & monitor carbon and other soil health indicators. Yields, outcomes & observations will document each process. Uniform parameters & protocols to measure & monitor soil carbons are essential to integrate standardized data into regional and national certified **Soil Carbon Databases**.

A Soil Carbon Team of staff, volunteers & consultants meets at noon, third Saturday each month, after Farmers Market, to discuss progress, organize installations, conduct work projects, plan & host public events.

Summer Event: feature ***Kiss the Ground*** documentary, followed by **Community Discussion** on food resilience and the **Soil Carbon Sink** as climate strategy. A guided tour of CCUA prototype plots, and a talk to teach strategy, spread awareness, raise money, gather support, recruit members.

Fall Event: Carbon-Smart Field Day will focus on our climate challenge, to inspire responsible human action, and **Soil Carbon Sink** strategy. Keynote speaker on soil health, food quality and climate action. Network session for community, environment, farm, food and nutrition health groups.



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