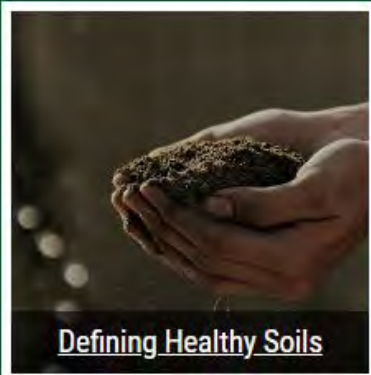
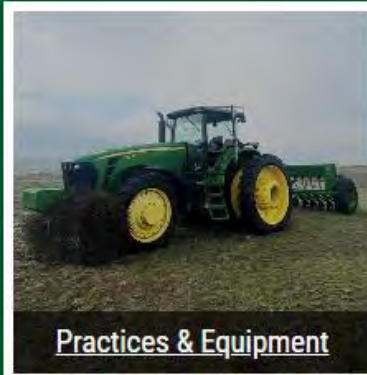


# ***CARBON SEQUESTRATION AND SOIL HEALTH***



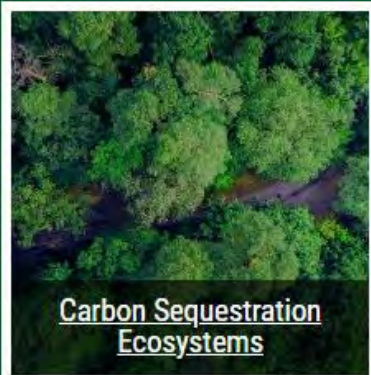
**Defining Healthy Soils**



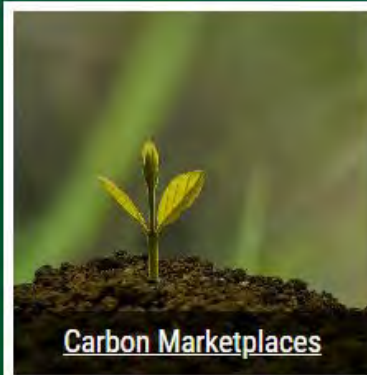
**Practices & Equipment**



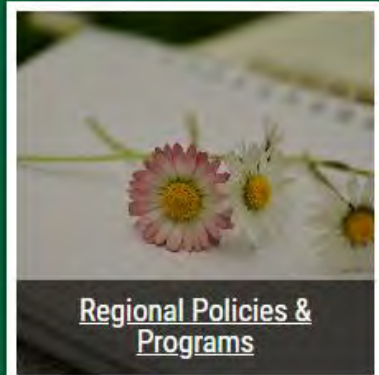
**Financial Resources**



**Carbon Sequestration Ecosystems**



**Carbon Marketplaces**



**Regional Policies & Programs**



**Training**



**Projects & Demonstrations**



**Oregon Association of Conservation Districts**

***OREGON ASSOCIATION OF CONSERVATION DISTRICTS***



This guidebook was funded by the  
**Oregon Conservation Partnership**  
a partnership of the Oregon Watershed Enhancement Board



*Oregon Conservation Partnership*



The guidebook accompanies the OACD  
Carbon Website: <https://OACDCarbon.org>

The website was funded by the USDA  
**Natural Resources Conservation Service**



and developed by the  
**Oregon Association of Conservation Districts**

# **CARBON SEQUESTRATION AND SOIL HEALTH GUIDEBOOK**

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- Section 1 – Defining Healthy Soils
- Section 2 – Practices & Equipment
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- Section 5 – Carbon Marketplace
- Section 6 – Regional Policies & Programs
- Section 7 – Training
- Section 8 – Projects, Demonstrations and Stories





## SECTION 1

# DEFINING & ACHIEVING HEALTHY SOILS

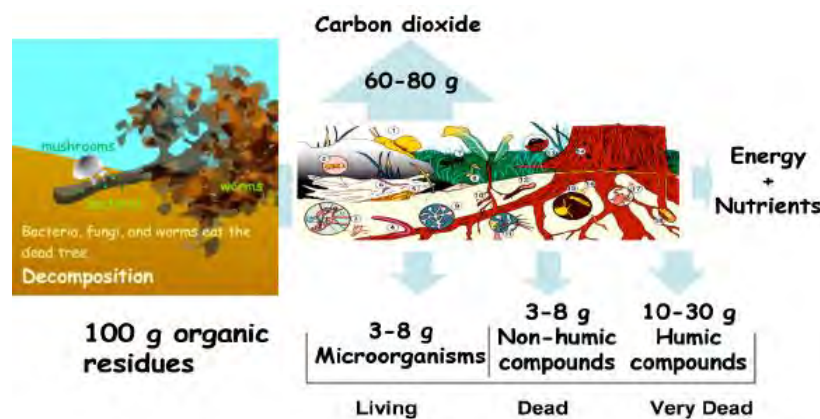
### DEFINITION OF HEALTHY SOILS

What is healthy soil? While there is not one universally accepted definition of healthy soil, the commonality is that healthy soil is a living ecosystem. Here is a hybrid definition that we will use for the purpose of this work:

***Healthy soil exhibits sustainable productivity, promoting plant growth with optimal efficiency with little to no disease or pests and without a need for major soil disturbances (like plowing and tillage) and without a need for off-farm supplements.***

NRCS defines soil health as “the capacity to function.” Healthy soil can hold more water as it contains aggregates that help it bind to avoid run-off and prevent erosion so healthy soil fares better during drought. The bacteria it contains helps fight off pests and disease while supplying nutrients that feed plants.

The upper six inches of healthy soil over a one-acre surface area typically holds 10 to 20 tons or more of soil organic matter of which up to about 1 ton consists of living microorganisms. Learn more about soil microbes and nutrients [here](#). The following illustration reflects that explanation.



## SOIL ORGANIC MATTER (SOM)

Soil organic matter (SOM) is derived from all the living and dead forms of the soil food web organisms plus fresh or dead and decaying plant components in and on the soil surface and the substances excreted from growing roots. Soil organic matter is crucial to producing healthy soils. Soil organic matter is highly complex and is derived from all the materials (including minerals) found within living plants, insects, animals, microbial cells, and tissues.

SOM is the fuel that drives the health of soils and brings all the measurable co-benefits to healthy soil ecosystems. Farmers can increase soil organic matter using specific agronomic practices. A major percentage (about 58%) of SOM consists of carbon derived from atmospheric carbon dioxide through photosynthesis. Therefore, increasing SOM may lead to sequestering or binding of carbon for long periods of time within the soil ecosystem.



Since this soil life is crucial for nurturing the next generation of plants, it becomes more important for all working landowners to understand the factors that promote the increased levels of soil organisms and organic matter. These soil organisms are commonly referred to as the [soil food web of life](#). According to the U.S. Department of Agriculture, the soil food web is the community of organisms living all or part of their lives in the soil.

It consists of a complex array of microbes (bacteria, fungi, protozoa), arthropods, ants, spiders, worms, and some higher animals. Organic matter in the soil fuels this soil food web of life. “Climate smart agriculture” is a combination of those working land practices that lead to healthy soil conditions which means increasing the soil organic matter (SOM).

[SoilLife.org](#) is a collaborative project between NRCS and the University of California Davis that aims to educate people about the necessity of soil to support and sustain life. This interactive website highlights the connection between healthy soils, healthy plants, healthy people, and a healthy planet and provides a series of webinars on soil health.

## LONG TERM STRATEGIC IMPORTANCE OF HEALTHY SOILS

There have been numerous studies that illustrate the agronomic benefits associated with healthy soil conditions in the long term. A comprehensive perspective from the Natural Resources Conservation Service of the USDA is presented [here](#).

And the benefits of storing SOM are summarized [here](#). It should not be surprising therefore that farmers everywhere are using conservation agricultural practices that increase soil health with organic matter and carbon in their soils.

## THE MANY BENEFITS OF HEALTHY SOIL

The many benefits of healthy soil include “Saving Money.” According to an August 2021 article by the USDA/NRCS entitled, “[Saving Money, Time and Soil: The Economics of No-Till Farming](#)”, on average, farmers practicing continuous conventional tillage use just over six gallons of diesel fuel per acre each year. Continuous no-till requires less than two gallons per acre. That difference leads to nearly 282 million gallons of diesel fuel saved annually by U.S. farmers who practice continuous no-till instead of continuous conventional till. The savings for individual farmers may be substantial. For example, assuming an average off-road diesel fuel price of \$2.50 per gallon, a farmer farming 100 acres of crops who switches from continuous conventional till to continuous no-till, saves about 400 gallons of diesel fuel, more than \$1,000 cost, each year.

Furthermore, a farmer who plows 15 acres per hour, for instance, would save roughly 7 hours of work with each eliminated pass over a 100-acre field by adopting no-till to benefit soil health. Depending on labor costs and equipment maintenance, that’s an additional several hundred dollars saved each year.

## TOOLS FOR BUILDING HEALTHY SOILS



**[USDA Web Soil Survey](#)**: The National Cooperative Soil Survey, provides access for viewing and printing maps for your area so that you can find a baseline for building healthy soils. For detailed information, contact your local center: [USDA Service Center Locator](#).

### **[The 5 Benefits of Sustainable Farming: A Top-Down Approach](#)**

This article explains how farmers may enhance their long-term bottom line as well as lessen environmental consequences and encourage biodiversity when employing sustainable farming techniques.

**[Farming with Soil Life: A Handbook for Supporting Soil Invertebrates and Soil Health on Farms](#)** is a user-friendly guide to identify, understand, and better manage soil life to improve the sustainability of your farming system. It is now available from the Xerxes Society.

Cornell University Framework provides a manual and fact sheets for providing a

[Comprehensive Assessment of Soil Health](#), including factors such as water capacity, active carbon quantification, a process worksheet, and a management tool box.



### CDFA Soil Biodiversity Publication

In August 2023 the California Department of Food and Agriculture released this report: [Soil Biodiversity in California Agriculture: Framework and Indicators for Soil Health Assessment](#). According to the CDFA, the report “provides targeted recommendations for policymakers and stakeholders to enhance soil health and conserve biodiversity, which plays an important role in climate resilience and food production.” The report was authored by an advisory committee of soil scientists. CDFA and other stakeholders will implement the recommendations in the report to achieve improved soil biodiversity and climate resilience.

## CO-BENEFITS OF HEALTHY SOIL

There are other economic and environmental co-benefits associated with reduced or no-till operations to improve soil health, especially when coupled with seeding of cover crops. For example, healthy soil reduces erosion, loss of precious fertile topsoil, and increases water infiltration into the soil instead of creating runoff and soil loss. SOM has a holding capacity of about 10 times its weight in water.

According to [USDA scientists](#), each 1% of SOM holds some 20,000 gallons of additional water. This is particularly valuable in drought-prone areas, where lack of water is a major concern tied to crop loss. Collectively these healthy soil practices, also called out as [regenerative agriculture](#), lead to healthier air and water quality conditions, an obvious co-benefit for land owners and those who live in agricultural areas where healthy soil practices are employed.

## SOIL TESTING AND MEASUREMENT



Oregon State University’s guide on [Soil Organic Matter as a Soil Health Indicator: Sampling, Testing and Interpretation](#) details measuring soil health and the use of management actions to increase SOM through sampling, methodology and practical implementation.

[How to Collect and Submit a Soil Sample](#)  
Oregon State University has a soil testing

accredited lab in Corvallis. This link will provide information on how to collect a sample, submit it for review, interpretation of results, cost, and other information.

The Soil Health Institute is a nonprofit with the mission to safeguard and enhance the vitality and productivity of soil through scientific research and advancement. SHI details techniques for [Enriching Soil, Enhancing Life](#) and recommends three measurement systems for scaling soil health assessments: 1) soil organic carbon concentration; 2) carbon mineralization potential; and 3) aggregate stability.

Here is a chart to [Find an Analytical Soil Testing Lab in Oregon](#), an extensive list of labs throughout Oregon where soil testing can be accomplished.

## CARBON SEQUESTRATION ON AGRICULTURE LANDS

*\*See also Section 5 - the Carbon Marketplace*

### HEALTHY SOILS & CARBON SEQUESTRATION

Increased SOM leads to healthy soil conditions with increased populations of the soil food web organisms. **SOM contains about 58% carbon** that originates from atmospheric carbon dioxide. This Greenhouse Gas (GHG) is converted to SOM through the processes of photosynthesis.

About 20-40% of the carbon contained within the SOM becomes **sequestered soil carbon**. Agronomic practices that decrease SOM content decrease soil health and release sequestered carbon from the soil in the form of carbon dioxide gas. Practices that decrease sequestered soil carbon (and reduce SOM) include aggressive plowing, tillage, and use of chemicals, including pesticides, herbicides, and synthetic fertilizers.

### OREGON SOIL CARBON CAPACITY



We want to take carbon out of the atmosphere and put it in the soil. How much carbon can Oregon soils hold? And which soils in Oregon are best suited for this?

Because the state is huge, the OSU team referenced here conducted an initial survey of data needs and availability, leading them to focus efforts on Sherman, Gilliam, Morrow, and Umatilla counties.



There are great gaps in data availability in these counties, but there is also a vibrant ag industry with the technical means to increase soil carbon levels and hence a realistic chance to actually implement any soil carbon sequestration measures.



Read this entire article with illustrations [here](#) as authored by Professor Markus Kleber, Drew Childs, and Don Wysocki from the Department of Crop and Soil Science, Oregon State University, and the Columbia Basin Agricultural Experimental Station, as funded by OWEB and the OSU College of Agriculture.

## CARBON SEQUESTRATION AS A COMMODITY

**Carbon sequestration is a sellable commodity in your soil that never leaves the farm.** Sequestering carbon requires practices that bring long-term additions of soil organic matter (SOM) to the soil. When plants die, they decompose and 60-80% of the residues undergo short term decomposition (within a year or two) and then this plant carbon re-enters the atmosphere. The rest (some 20-40% of the plant residues along with other dead or decaying matter) enter the soil and persist for years or decades, to even hundreds of years becoming sequestered carbon.

Once there is SOM, it must be retained to maintain soil health. Maintaining SOM is achieved by reducing the frequency and aggressiveness of tillage and adopting other agronomic practices such as growing cover crops, keeping the soil surface green/covered as long as possible each year, etc. The value of sequestered carbon ranges from about \$15-20 per ton. (See “The carbon marketplace” section later in this document.)

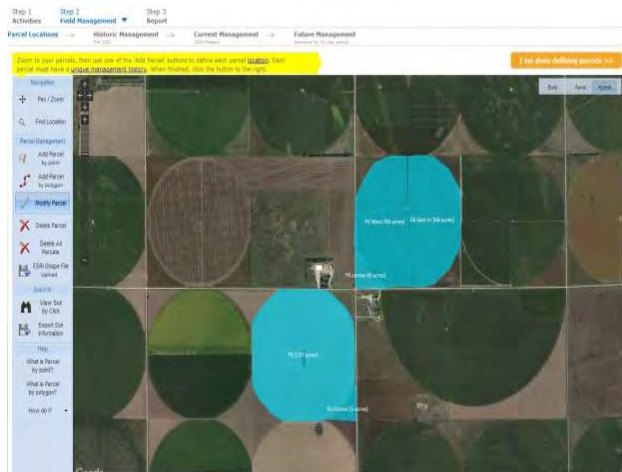
To create healthy soil, no-till was practiced on 104 million acres of U.S. lands in 2017. The number of farms practicing no-till totaled 279,370. Cover crops were seeded on 153,402 farms in 2017 (Statistics from “[No-Till Farmer](#)”). Farming practices that use no till, minimal till, no plowing, and/or cover crops are collectively referred to as conservation or regenerative agriculture. So, overall, some [140 million acres](#) of farmland in the U.S. are currently enrolled in one of several conservation-related financial and technical assistance opportunities from the federal government to install resource and wildlife preservation practices.

## COMPUTER BASED EQUIPMENT FOR IDENTIFYING CARBON POTENTIAL

[FAST-GHG Soil Tool](#) is a fertilizer and soil tool designed to help quantify greenhouse gas emissions in crop production. Developed by Cornell faculty in partnership with researchers at the Environmental Defense Fund and The Nature Conservancy, FAST-GHG quantifies how soil management practices can reduce greenhouse gas emissions using the [online calculator](#). You can select Oregon, your county and the crop to receive an estimate.

[Soils Revealed](#) is a platform for visualizing how past and future management changes soil organic carbon stocks based on available soil data, information about the environment and computer simulations over time. The site offers maps with soil organic predictions and trends for the past and future scenarios. The project involves a collaboration of partners.

[Comet Farm](#) is a program developed by the USDA and Colorado State University. It is an online carbon-capture calculator computer tool with which producers enter information about their land and management, including location, soil characteristics, land uses, tillage practices and nutrient use. The tool then estimates how much carbon soil could capture on cropland, pasture and rangeland, and livestock operations. It also has an agro-forestry component. This is a [video](#) of how the program works. Here is an [article](#) and blog about using Comet Farm.



[Calculate Your Carbon Potential](#) with AGORA’s carbon measurement tool. Just type in your location and select values from the list and input acreage and selected practices to receive an instant carbon potential estimate. AGORA is based in Norway and works with carbon farm suppliers internationally. (See the story in Section 8 of a project in Oregon working with AGORA.)

USDA through NRCS and partners recently funded the [USDA Improved GHG Measurement, Monitoring, Reporting](#) project under the Inflation Reduction Act (IRA) for \$300 million to invest in improved greenhouse gas measurements, monitoring, reporting and verification (MMRV) for agriculture and forestry lands. The work begins in 2023 and will include data collection and management, models, and tools. Additional information on USDA climate mitigation efforts can be found [here](#).

## CURRENT ARTICLES ON AGRICULTURAL CARBON SEQUESTRATION

- [The Case for Carbon Farming in California](#) – High Country News
- [Can Dirt Save the Earth?](#) – NY Times
- [What Regenerative Agriculture Can Do for the Climate](#) – “Yes” Magazine

*A special thanks to Dr. Ray Seidler for some contributions to this section and to the Department of Crop and Soil Science, Oregon State University.*



## SECTION 2

# PRACTICES & EQUIPMENT

## PRACTICES

There is a range of scientifically accepted practices to achieve healthy soils and carbon sequestration. This section will detail practices to be used on the land to achieve healthy soils and the equipment that will help implement those practices. The practices will vary based upon the ecosystem to which they apply (e.g., grazing, cultivated agriculture, forestry, coastal areas, or other landscapes).

There are two major categories of practices that are widely recommended to increase soil organic matter and to increase soil health:

- minimizing physical soil disturbances through cessation of plowing and reducing the frequency or eliminating soil tillage as much as possible; and
- growing cover crops

The physical disturbances of soil impacts **soil health** because it speeds up organic matter decomposition and releases breakdown products like carbon dioxide back into the atmosphere. Soil organic matter (SOM) declines over time because of soil disturbances.

Turning cover crops into green manure is key to producing healthy soils and many variables exist to **optimize this process** through **cover-cropping** techniques.



There are numerous variations on how the agronomic practices of tillage reduction can be achieved dependent upon soil type, weather conditions, time of year, types of cash crops or types of livestock present, available mineral content (e.g., nitrogen) of soil, etc. Collectively these practices that cease/reduce plowing and/or utilize cover crops may be referred to as conservation practices. When these practices accompany tracking soil organic matter changes, they are more commonly referred to as regenerative or healthy soil practices.

These **regenerative agriculture practices** prioritize building organic matter in the soil.

## Cover Crops as a Conservation Tool

Cover crops may be used to diversify a farm's crops by providing more options and opportunities to increase farm income and lower expenditures. Cover crop plant biomass may be left on the soil surface or mowed or rolled down and allowed to decompose and become a major mechanism for improving soil health by increasing soil organic matter (SOM). Farmers will need to choose cover crop species (or a mix of them) that grow best for their region and needed soil nutrient requirements, as well as reflect growth capabilities for the longest portion of the calendar year appropriate to main cash crop species and other practices. For example, cover crops may be planted following harvest of a cash crop. **Cover crops** that stay green and/or grow over winter and into spring may also provide an early, less expensive feed source for livestock.



There are four classes of cover crops:

- grasses (such as ryegrass or barley),
- legumes (such as alfalfa or clover),
- brassicas (such as radishes or turnips, and
- non-legume broadleaves (such as spinach or flax)

Each class has its own **distinct benefits**, depending upon numerous variables as mentioned above. Here is an extensive **compilation of cover crop** plant species to consider when deciding which seeds to purchase, when to plant, and the most likely soil impact from various species (what time of year to plant, annual, perennial, water requirements, saline tolerance, etc.).

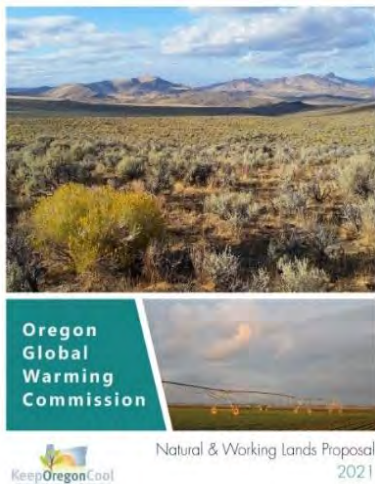
Planting cover crops is increasingly popular. It requires about two tons of feedlot manure to replace the organic material in one ton of crop residue contributed by cover crops. In addition, manure won't offer the same benefits as **crop residue** related to reduced evaporation and snow water capture. Manure, along with its environmental issues, must be stored and eventually moved to a final site (using energy) while cover crops decompose and produce green manure in place.

You are not required to be an organic farmer if you are trying to increase soil organic matter. However, the use of weed killers like dicamba or glyphosate should be avoided in killing cover crops. This is because the biological plant decomposition mechanisms of microbes are reduced through pesticide use. The use of pesticides will slow the carbon

sequestration processes and limit it in scope. Avoidance of pesticides saves money, reduces compaction in the field saving fuel and time, and avoids the slowdown of accumulated soil organic matter. By avoiding pesticides, substantial money can be saved that can actually pay for cover crop seeds.

## **PRACTICES: Implementing Natural Climate Solutions**

The Oregon Global Warming Commission (OGWC, to be renamed the “Oregon Climate Action Commission in 2024) began work on natural climate solutions for Oregon’s natural and working lands several years ago. That work was captured in a comprehensive policy document, the [Natural and Working Lands Proposal](#) in September 2021.



The OGWC worked in coordination with the Oregon Department of Agriculture, Oregon Department of Forestry, and the Oregon Watershed Enhancement Board to develop and submit the proposal for setting a carbon sequestration and storage goal for Oregon’s natural and working lands.

The Commission then established an advisory committee of 26 members in 2022, along with technical committees, resulting in a document completed in September 2023. It is to be released in October and will be available at the [OGWC website](#): “A Roadmap to Enhance Carbon Sequestration and Storage and Reduce Greenhouse Gas Emissions on Oregon’s Natural & Working Lands.”

In 2023 the Oregon Legislature approved HB 3409 which incorporated the [Natural and Working Lands Fund](#) in which \$10 million was invested to fund grant programs through the Oregon Watershed Enhancement Board, the Oregon Department of Agriculture, the Oregon Department of Forestry and the Oregon Department of Fish and Wildlife. See [Section 6](#) for the details of the program that will fund practices.

## **PRACTICES: AGRICULTURAL CARBON PROGRAMS**

This section will detail agricultural carbon projects more specifically and [Section 4](#) will address carbon sequestration relative to other ecosystems (“blue carbon,” forestry and other land or water-based strategies).

### **Agricultural Carbon Programs: From Chaos to Systems Change**

[The American Farmland Trust](#), in coordination with [Sierra View Solutions](#), analyzed the current state of agricultural carbon programs and recommended strategic changes toward program success with a focus on cropland.

### **Oregon’s Land Use Statutes Laws and Rules**

Protection of our valued natural resource lands for agriculture, forestry and other land management needs provides the basis for promoting carbon sequestration by protecting these lands from development. [See statewide goals.](#)

## **The Economics of No-Till Farming**

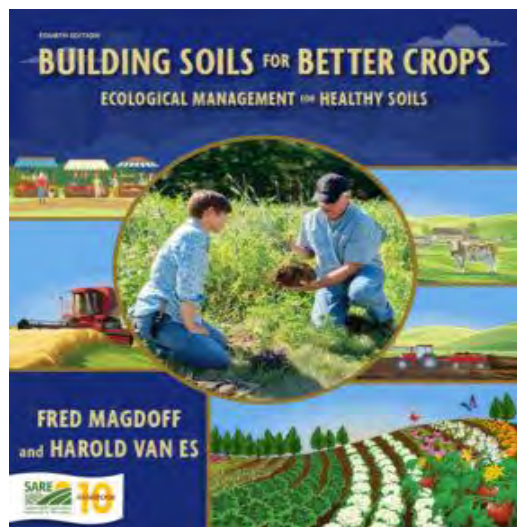
The potential benefits of no-till practices are well-documented, from improving soil health to reducing annual fuel and labor investments. For example, no-till processes can save 4 gallons per acre over tilled farm methods.

## **NRCS Conservation Effects Assessment Project (CEAP)**

Through CEAP, USDA quantifies and reports on trends in conservation practices and associated outcomes over time. CEAP findings are used to guide conservation program development and support conservationists, agricultural producers, and partners in choosing the most effective conservation actions and making informed management decisions backed by data and science. CEAP assessments are carried out at national, regional, and watershed scales for conservation efforts related to cropland, grazing land, wetlands, and wildlife.

## **New Cover Crop Survey Challenges Assumptions**

The new national survey report finds the vast majority of farmers using cover crops don't need incentive payments to continue those practices. According to the National Cover Crop Survey, 90.3% of farmers receiving cover crop incentives reported that they would definitely or probably continue planting cover crops after payments ended. These findings were among many conclusions drawn in a report, issued jointly by SARE, the Conservation Technology Information Center (CTIC), and the American Seed Trade Association (ASTA), based on insights from nearly 800 farmers in 49 states.



## **Coprehensive Guidebook for Building Soils (SARE)**

*Building Soils for Better Crops* is a one-of-a-kind, practical guide to ecological soil management. It provides step-by-step information on soil-improving practices as well as in-depth background—from what soil is to the importance of organic matter. It will show you how different physical, chemical, and biological factors of the soil interconnect, and how management practices impact them to make your soil healthy and resilient or unhealthy and vulnerable to degradation. Case studies of farmers from across the country provide inspiring examples of how soil—and whole farms—have been renewed.

## **Natural Resources Conservation Service (NRCS) Programs**

NRCS has been working with farmers and ranchers since its inception as a federal agency in 1935 following the historic ravages of the dust bowl days. NRCS provides technical services through a myriad of programs to combat climate change impacts. These programs are now part of “*climate-smart*” management practices for which the agency provides technical services. See the full chart [HERE](#) of available programs and additional practices on nutrient management, grazing and pastureland. Practices vary based on the land sector (agriculture, forestry, wetlands, etc.). Soil health practices are listed below.

# Climate-Smart Agriculture and Forestry (CSAF) Mitigation Activities List<sup>(1)</sup> FY2023



## SOIL HEALTH PRACTICES

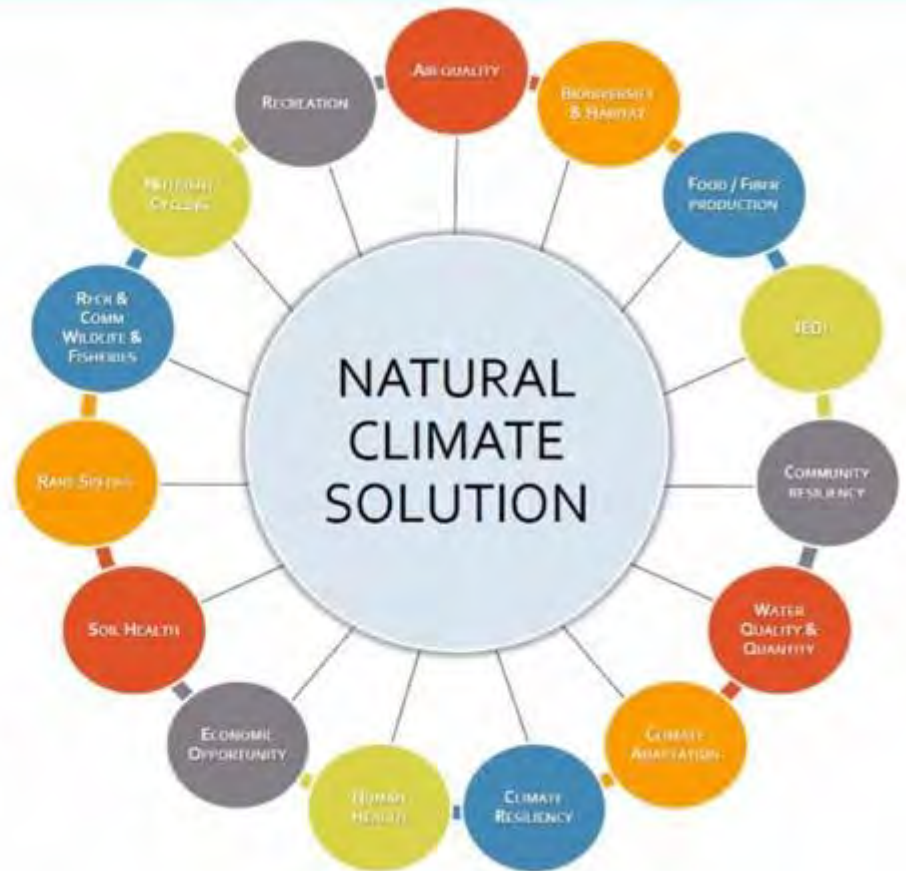
Code	Conservation Practice Standard Name <sup>(1)</sup> (units)	CSP Enhancement Code	Conservation Stewardship Program (CSP) Bundle and Enhancement Activity
		B000BFF1	Buffer Bundle#1*
		B000CPL24	Cropland soil health management system*
		B000CPL25	Climate smart advanced soil health*
327	Conservation Cover (acres)	E327A	Conservation cover for pollinators and beneficial insects
		E327B	Establish Monarch butterfly habitat
328	Conservation Crop Rotation (acres)	E328A	Resource conserving crop rotation
		E328B	Improved resource conserving crop rotation
		E328E	Soil health crop rotation
		E328F	Modifications to improve soil health and increase soil organic matter
		E328G	Crop rotation on recently converted CRP grass/legume cover for soil organic matter improvement
		E328N	Intercropping to improve soil health
		E328O	Perennial grain crop conservation rotation
329	Residue and Tillage Management, No Till (acres)	E329A	No till to reduce soil erosion
		E329B	No till to reduce tillage induced particulate matter
		E329C	No till to increase plant-available moisture
		E329D	No till system to increase soil health and soil organic matter content
		E329E	No till to reduce energy
332	Contour Buffer Strips (acres)	None Available	
40	Cover Crop (acres)	E340A	Cover crop to reduce soil erosion
		E340B	Intensive cover cropping to increase soil health and soil organic matter content
		E340C	Use of multi-species cover crops to improve soil health and increase soil organic matter
		E340D	Intensive orchard/vineyard floor cover cropping to increase soil health
		E340F	Cover crop to minimize soil compaction
		E340G	Cover crop to reduce water quality degradation by utilizing excess soil nutrients
		E340H	Cover crop to suppress excessive weed pressures and break pest cycles
		E340I	Using cover crops for biological strip till
		345	Residue and Tillage Management, Reduced Till (acres)
E345B	Reduced tillage to reduce tillage induced particulate matter		
E345C	Reduced tillage to increase plant-available moisture		
E345D	Reduced tillage to increase soil health and soil organic matter content		
E345E	Reduced tillage to reduce energy use		
386	Field Border (acres)	E386A	Enhanced field borders to reduce soil erosion along the edge(s) of a field
		E386B	Enhanced field borders to increase carbon storage along the edge(s) of the field
		E386C	Enhanced field borders to decrease particulate emissions along the edge(s) of the field
		E386D	Enhanced field borders to increase food for pollinators along the edge(s) of a field
393	Filter Strips (acres)	E393A	Extend existing filter strip to reduce water quality impacts
412	Grassed Waterways (acres)	E412A	Enhance a grassed waterway
484	Mulching (acres)	E484A	Mulching to improve soil health
		E484B	Reduce particulate matter emissions by using orchard or vineyard generated woody materials as mulch
		E484C	Reduce particulate matter emissions by using orchard or vineyard generated woody materials as mulch
585	Stripcropping (acres)	None Available	
601	Vegetative Barriers (feet)		
603	Herbaceous Wind Barriers (feet)		

## Nature Based Solutions: CO-Benefits of Climate Mitigation

### What are “co-benefits” of climate mitigation?

Co-benefits of climate change mitigation are the positive benefits related to the reduction or avoided loss of greenhouse gases

(IPCC AR4)



PowerPoint discussing nature-based solutions, co-benefits, and ecosystem management: [View HERE.](#)

### Valuing Environmental Benefits of Conservation Management Actions

The economic and social value to the public of enhanced environmental benefits resulting from conservation practices are in addition to how conservation practices enhance agricultural productivity and increase private economic value to the farmer/rancher. This analysis focuses exclusively on the value to the public of environmental benefits. OWEB contracted this study and it is being updated in the near future.

### Managing Cover Crops Profitability

This recently updated publication is prepared by Sustainable Agriculture Research and Education (SARE). SARE provides bulletins and articles on agricultural operations and operates in each state with a regional program format.



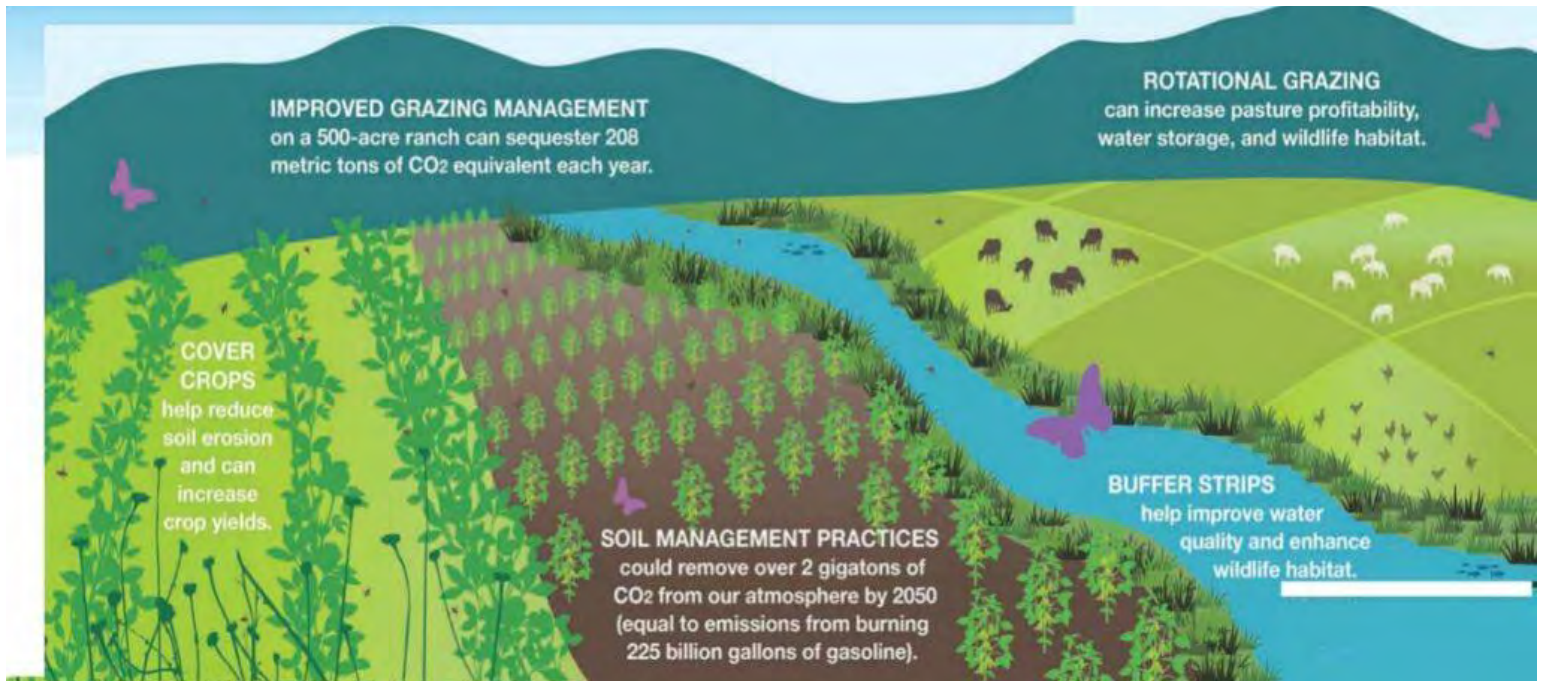
### Western Cover Crops Council

The Council makes available a range of articles on cover crops, no-till, and other agricultural practices.

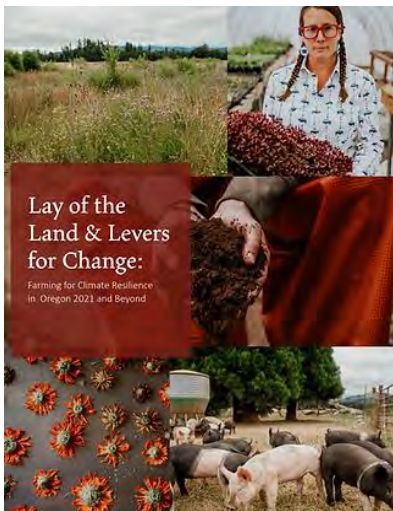


## National Wildlife Federation Climate-Smart Agriculture Practices

Fully implementing Climate-Smart Agriculture Principles could remove as much as 100-200 million metric tons of carbon dioxide annually by 2050.



- **Improved Grazing Management** on a 500-acre ranch can sequester 208 metric tons of CO<sub>2</sub> equivalent each year.
- **Rotational Grazing** can increase pasture profitability, water storage, and wildlife habitat.
- **Cover Crops** help reduce soil erosion and can increase crop yields.
- **Soil Management Practices** could remove over 2 gigatons of CO<sub>2</sub> from our atmosphere by 2050 (equal to emissions from burning 225 billion gallons of gasoline).
- **Buffer Strips** help improve water quality and enhance wildlife habitat.



## **Oregon Climate and Agriculture Network**

### Lay of the Land and Levers for Change:

#### **Farming for Climate Resilience**

- ✓ What does an agricultural economy resilient to a changing climate in Oregon look like?
- ✓ What is already happening in Oregon to make this vision a reality?
- ✓ How do farmers and ranchers need and want to improve their operations?
- ✓ Where are the gaps in research and Technical support for farmers?

## Grasslands Management and Other Practices

**One-third of the world's carbon is tamed by grass.** Landowners will eventually be paid for carbon storage and other environmental benefits that grasslands and pastures provide. Third parties reap the economic benefits grasslands provide, including watershed management, wildlife habitat and pollinators for grain production.

**[Grasslands called key to carbon future | The Western Producer](#)**



### **Pasture Management**

What are the benefits of pasture management? One study found that farms participating in sustainable agriculture practices like rotational grazing produced 19% fewer emissions than non-participating farms in the first two years, dropping to 35% fewer emissions after participating for longer than two years. W.K. Kellogg Farm's Pasture Dairy Center uses a **rotational grazing strategy** to mitigate emissions.

### **Manure and Nutrient Management**

When manure is handled as a solid or deposited on pastures, nitrous oxide production increases while little or no methane is emitted. Management of timing, rate, and amount of nutrients and amendments to soil can reduce climate impacts, promoting soil health. Anaerobic digestion is another relevant tool.

### **Composting**

Proper composting of waste can reduce the dependence on chemical fertilizers, help recover soil fertility and improve water retention and the delivery of nutrients to plants.

### **Irrigation Management**

Using alternative application methods to reduce the amount of irrigation water is also beneficial to soil health.

### **Biosolids**

Biosolids produced at wastewater treatment facilities are extensively used on agricultural land to improve soil health and soil organic carbon (SOC) stocks.

### **Riparian Management**

Developing or extending riparian areas along streams can add to soil health and sequestration opportunities, including increasing woody plant coverage.



### **Biochar**

Climate change mitigation not only requires reduction of greenhouse gas emissions, but also the withdrawal of carbon dioxide (CO<sub>2</sub>) from the atmosphere. Biochar, carbon rich charcoal-like remnants of super-heated organic matter is a hard material added to soil to provide a resilient air trap that helps in the spread of oxygen and nutrients to plant roots. **US Biochar Initiative**

# EQUIPMENT

## Equipment for growing healthy soils

As an alternative to pesticide use, cover crops may be knocked down by mowing, flailing, undercutting, or rolling down to compress or crimp them, stop growth, and to provide a non-living blanket or cover over the soil. Undercutting is when you draw a blade under the soil, and you slice the cover crop underneath the soil. For mowing use a sickle mower, a flail, a weed whacker, or a scythe, depending upon the scale of the operation. The cut cover crops decompose and a portion of these plant residues are eventually incorporated into the soil. Rain and irrigation events facilitate the entry of soluble portions of decomposed cover crops into the soil over the first year and encourage beneficial soil insects to help break down the crop residue.

As mentioned above, maintaining soil physical structure and use of cover crops provide a consistent source of food, shelter and nutrients that support active microbial functions and plant residue decomposition increases soil health and soil organic matter. Avoidance of major soil disturbances maintains soil health over longer periods. It should be acknowledged and understood that practices that encourage soil health require some specialized equipment, knowledge, and experience of use, along with potential added costs. The good news is that specialized equipment needs may be found in some Oregon Soil and Water Conservation Districts, and plans are developing to increase and diversify special equipment availability in other conservation district locations. Check with your local Soil and Water Conservation District (at least one in every county of the state) through this [directory](#)

All practices that improve soil health are scalable from the smallest of farms to the largest. The equipment needed such as no-till drills, roller crimpers, sickles, etc., are also scalable based on farm size.

## No-till drill operation

Here's a [YouTube](#) presentation featuring how a large scale no-till drill works. Regardless of size, the principles are the same, just the available options and machine settings will differ with various models and sizes. (YouTube feature from Benton SWCD)



A no-till drill is a very heavy drill with a specialized disk set-up that cuts through surface (cover crop) plant residues, places the seed at the correct depth in soil, and then presses the soil back over the seed for good soil to seed contact, all in a single pass over the field. Advantages to planting no-till with decomposing surface plant residues in place, include erosion control, fuel and time savings, and a mechanism to increase soil organic matter and increase soil health. Seed planting and cover crop termination can be achieved through a single pass over the field if/when agronomic practices allow. Through this practice, soil compaction is reduced, fuel use is lower, and soil physical structure is maintained.

See [Thinking Beyond the Plow](#).

Many [internet sites](#) offer both used and new no till drills that range roughly from \$5,000 and up.

Small sized compact tractors with 35 or more HP can accommodate small sized no-till drills of 5-6 ft width.



[Walk behind tractors](#) can be purchased for less than \$3,000 (without implements) for smaller scale farms. Custom no-till drills and roller crimpers can be fabricated to suit these small tractors.

[Soil cores](#) for taking soil health check samples can be purchased for less than \$100.

[Soil testing labs](#) are available throughout the country for receiving and testing soils for organic carbon content. We suggest soil carbon analyses be conducted by the combustion method or loss on ignition. For establishing and maintaining the highest levels of consistency of results, it is imperative that the same person be involved in sample collection and shipping for these laboratory analyses.



#### [Equipment Options](#)

No till-drill in various sizes, crop and/or pastureland  
Tractor with horsepower required for drill towing  
[Roller crimper, flail, or sickle bar](#) for terminating cover crop growth without using pesticides  
Soil coring devices for determining soil quality  
Aerators

Other equipment that would enhance carbon sequestration programs

- Pickup or other truck to house and take hydraulic core samples down to 100 centimeters
- [Comet computer software](#) to measure potential carbon
- Electric farm vehicles



#### [Electric Tractor from Solectrac Partners](#)

Forth, [Wy'East RC&D](#), Bonneville Environmental Foundation, Sustainable Northwest and Rusted Gate Farm are taking part in a demo of electrifying equipment for fuel and maintenance savings and to reduce greenhouse gas emissions. The vehicles will be rotated to different geographic areas within the state.

## EQUIPMENT AVAILABLE FROM SOIL & WATER CONSERVATION DISTRICTS

A number of SWCDs own equipment that can enhance soil and water conservation practices. Below is an example of one district's equipment and rental pricing.

### Clackamas SWCD Equipment Rental Program

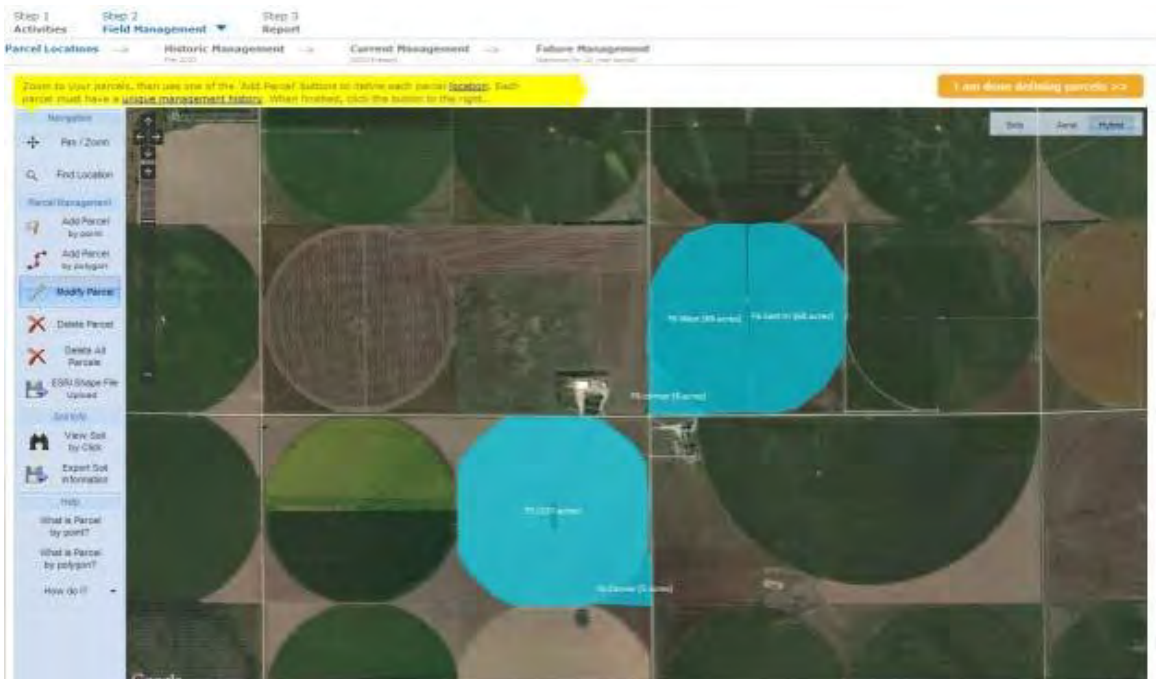


Clackamas Soil & Water Conservation District offers an [Equipment Rental Program](#) which makes a variety of agricultural equipment available at reasonable rental prices to Clackamas users. Equipment is also available at Yamhill, Jackson, Grant, Tualatin, and Malheur SWCDs, among others. The [ODA SWCD Directory](#) provides contact information for a Conservation Districts in in each county.

### Computer Based Equipment that Can Identify Carbon Potential

#### Comet Farm

USDA's online carbon-capture calculator is a computer tool with which producers enter information about their land and management, including location, soil characteristics, land uses, tillage practices and nutrient use. The tool then estimates how much carbon soil could capture on cropland, pasture and rangeland, and livestock operations. It also has an agro-forestry component. [Comet Farm Video](#)



### Calculate Your Carbon Potential

Type in your location and select values from the list, input acreage and selected practices to receive an [instant carbon potential estimate at AGORO](#).

## **FAST-GHG Soil Tool**

This is a fertilizer and soil tool designed to help quantify greenhouse gas emissions in crop production developed by Cornell faculty in partnership with researchers at the [Environmental Defense Fund](#) and [The Nature Conservancy](#). FAST-GHG quantifies how soil management practices can reduce greenhouse gas emissions using the [online calculator](#).

## **OTHER ARTICLES**

### **Cornell University Working Lands Resources**

Cornell College of Agriculture and Life Sciences' website dedicated to helping farmers, forest owners and policymakers find meaningful ways to Reduce Greenhouse Gases (GHG) from the land—includes a variety of resources and tools. While some of the resources are relative to the region, a number of resources can be applied more broadly.

### **Farming with Soil Life**

Adaptation resources for agriculture response to climate variability and change: USDA, Xerces Society and SARE (Sustainable Agriculture Research and Education)

### **Empowering Farmers with Regional Farm Equipment**

**AB 552** was enacted by the California Legislature to provide a program that would be housed at the California Department of Food and Agriculture in coordination with the Department of Conservation to provide financial and technical assistance through the Regional Farmer Equipment and Cooperative Resources Assistance Pilot Program to support regional farm equipment sharing. The law provides for a small farms advisory committee. This is a pilot program through 2029.

### **The Case for Carbon Farming in California** – [High Country News](#)

### **Can Dirt Save the Earth?** – [NY Times](#)

### **What Regenerative Agriculture Can Do for the Climate** – [“Yes” magazine](#)





## SECTION 3

# FINANCIAL RESOURCES

A number of programs exist for investment in achieving healthy soils and natural climate solutions, including those from federal and state agencies. USDA continues to develop and enhance climate programs that will achieve healthy soil benefits.

Oregon passed new legislation in 2023 for funding climate related projects on forest, agriculture lands and coastal/wetlands projects, providing natural climate solutions on natural and working lands. NRCS provides an array of federal programs to support carbon sequestration and storage, soil health and other related programs.

## FEDERAL FINANCING FOR AGRICULTURE PROGRAMS

### USDA Conservation Reserve Program - Soil Carbon Monitoring

USDA is investing \$10 million in a new initiative to sample, measure, and monitor soil carbon on Conservation Reserve Program (CRP) acres to quantify climate outcomes from the program. The “Daily Century Model” (Day Cent) simulates the movement of carbon and nitrogen through agricultural systems. Data will be used to strengthen the COMET-Farm and COMET-Planner tools. See also the Comet-Planner Report. For lands enrolled in CRP there are new incentives for environmental practices and a more targeted focus on the program’s role in climate change mitigation. See the What’s New fact sheet. FSA offers multiple CRP signups for its ongoing programs.

### About the Conservation Reserve Program

CRP is administered by the Farm Service Agency (FSA) and provides annual rental payments for farmers enrolling in the program to plant species to improve environmental health and quality. Contracts are for the term of 10-15 years with a goal of re-establishing valuable land cover to help improve water quality, prevent soil erosion, and reduce loss of wildlife habitat.



CRP enrollment options include:

- General CRP
- Grassland CRP
- Continuous CRP (CLEAR30)
- Conservation Reserve Enhancement Program
- State Acres for Wildlife Enhancement (SAFE)
- Farmable Wetlands Program

The Conservation Reserve Enhancement Program (CREP) is a part of the [Conservation Reserve Program \(CRP\)](#). CREP leverages federal and non-federal funds to target specific state, regional or nationally significant conservation concerns. Interested producers should contact their local [USDA Service Center](#). Harney County is one of the counties in Oregon where CREP is now available. More Information [here](#).

## USDA CONSERVATION RESERVE PROGRAM What's New?

	UPDATE	BENEFIT
OVERALL	Increase collaboration with partners and other USDA agencies on projects to monitor, measure, and verify the climate benefits, and environmental performance of CRP.	Improves environmental benefit estimates of CRP Increases program effectiveness by informing science-based program policy changes.
	Increase technical assistance capacity through the Natural Resources Conservation Service (NRCS).	Enables producers to plan and implement conservation practices that are appropriate for their needs.
CRP GENERAL	New Climate-Smart Practice Incentive to incentivize practices that sequester carbon, reduce emissions.	More land enrolled, using practices that maximize benefits for climate mitigation.
	Additional one-time, 10 percent <b>"inflationary"</b> adjustment for the life of the contract.	Increases program payments to encourage more land enrollment.
	Adjustment of county rental rates, upward or downward, using a soil productivity index range of 50-150 percent of the county rental rate.	Increases program payments to encourage more land enrollment
CRP CONTINUOUS	New Climate-Smart Practice Incentive to incentivize practices that sequester carbon, reduce emissions.	More land enrolled, using practices that maximize benefits for climate mitigation.
	Add a one-time, 10 percent <b>"inflationary"</b> adjustment for the life of the contract.	Increases program payments to encourage more land enrollment.
	Allow for the adjustment of county rental rates, upward or downward, using a soil productivity index range of 50-150 percent of the county rental rate.	Increases program payments to encourage more land enrollment
	Increase Water Quality Incentive from 10 to 20 percent for water quality benefiting practices	More land enrolled, using practices that maximize benefits for water quality.
	Move State Acres for Wildlife Enhancement (SAFE) Practices from the CRP general signup to the CRP continuous signup.	Improves attractiveness of wildlife practices, including extending the signup to year-round, thus more habitat.
	Make Highly Erodible Land Initiative (HELI) Practices available in both the CRP continuous and general signups.	Improves attractiveness of program by extending the signup to year-round, thus more land enrolled for natural resource benefits.
	Increase Practice Incentive Payment from 20% to 50%.	Increases program payments to encourage more land enrollment.
CRP GRASSLANDS	Establish a CRP Grassland minimum rental rate of \$15.	Returning to this minimum rate would benefit 1,347 counties that are currently under the \$15 minimum.
	Establish National Grassland Priority Zones.	Increase enrollment of grasslands in migratory corridors and environmentally sensitive areas.



## USDA ACTION PLAN FOR CLIMATE ADAPTATION AND RESILIENCE

USDA's [Action Plan for Climate Adaptation and Resilience](#) describes how USDA is integrating climate adaptation into its mission, programs and operations.



[The Action Plan for Climate Progress Report](#) provides an update on USDA's adaptation efforts, illustrates examples of crosscutting adaptation actions, and responds to specific priority topics, including climate risk.

### Inflation Reduction Act

The Inflation Reduction Act (IRA) of 2022 makes an historic \$20 billion investment by increasing funding in four existing Farm Bill conservation programs for practices that increase soil carbon or reduce carbon dioxide, methane, or nitrous oxide emissions. Most of the money will be appropriated across the country over fiscal years 2023–2026 as follows:

- Environmental Quality Incentives Program (EQIP) - \$8.45 billion
- Conservation Stewardship Program (CSP) - \$3.25 billion (including some funding for organic transition)
- Regional Conservation Partnership Program (RCPP) - \$4.95 billion (includes forestlands)
- Agricultural Conservation Easement Program (ACEP) - \$1.4 billion (for farmland easements)

### [USDA Support for Climate-Smart Agriculture in 2022](#)

The USDA Natural Resources Conservation Service (NRCS) is providing new and expanded opportunities for climate smart agriculture, including nationwide availability of the [Environmental Quality Incentives Program](#) (EQIP). The Conservation Incentive Contracts option, a new and streamlined EQIP Cover Crop Initiative, added flexibilities for producers to easily re-enroll in the [Conservation Stewardship Program](#) (CSP). These improvements to NRCS' working lands conservation programs, combined with continued program opportunities in all states, are part of the Biden-Harris Administration's broader effort to support climate-smart agriculture.

See also [Environmental Incentives Program fact sheet](#) on incentive contracts.

CODE	ASSET	UNITS	LIFESPAN
328	Conservation Crop Rotation	Ac	1
329	Residue and Tillage Management, No Till	Ac	1
333	Amending Soil Properties with Gypsum Products	Ac	1
338	Prescribed Burning	Ac	1
340	Cover Crop	Ac	1
345	Residue and Tillage Management, Reduced Till	Ac	1
368	Emergency Animal Mortality Management	No	1
373	Dust Control on Unpaved Roads and Surfaces	Sq Ft	1
375	Dust Management for Pen Surfaces	Ac	1
376	Field Operations Emissions Reduction	Ac	1
399	Fishpond Management	Ac	1
400	Bivalve Aquaculture Gear and Biofouling Control	Ac	1
449	Irrigation Water Management	Ac	1
450	Anionic Polyacrylamide (PAM) Application	Ac	1
484	Mulching	Ac	1
511	Forage Harvest Management	Ac	1
528	Prescribed Grazing	Ac	1
548	Grazing Land Mechanical Treatment	Ac	1
554	Drainage Water Management	Ac	1
590	Nutrient Management	Ac	1
591	Amendments for Treatment of Agricultural Waste	AU	1
592	Feed Management	AU	1
595	Pest Management Conservation System	Ac	1
609	Surface Roughening	Ac	1
610	Salinity and Sodic Soil Management	Ac	1
633	Waste Recycling	No	1
644	Wetland Wildlife Habitat Management	Ac	1
645	Upland Wildlife Habitat Management	Ac	1
647	Early Successional Habitat Development-Mgt	Ac	1
808	Soil Carbon Amendment	Ac	1
810	Annual Forages for Grazing Systems	Ac	1
817	On-Farm Recharge	Ac	1
207	Site Assessment and Soil Testing for Containments Activity	No	1
216	Soil Health Testing	No	1
217	Soil and Source Testing for Nutrient Management	No	1
218	Carbon Sequestration and Greenhouse Gas Mitigation Assessment	No	1

## EQIP-CIC Eligible Practices



See NRCS Oregon for a full description of the programs that focus on soil health and conservation and for a list of local service centers for [technical and financial assistance](#).

See also [Oregon Index of Conservation Practice Standards](#).

## STATES' SOIL HEALTH AND CARBON INITIATIVES

By 2021, twenty states formalized soil health or carbon initiatives through resolutions and laws and an additional twenty have signaled interest through related policy activity. See the [State Healthy Soil Policy Map, 2021](#). Click on Oregon on the map to see legislation enacted or in progress.

See the Section 6 Policies and Programs segment of this guidebook for a number of state programs for carbon storage and soil health work incentives.

## OREGON SOIL HEALTH AND CARBON INITIATIVES



### Oregon Adopts Natural Climate Solutions Program for Natural and Working Lands

The 2023 Oregon Legislature adopted [HB 3409](#), an omnibus climate bill that included the policy for natural climate solutions on natural and working lands (formerly SB 530). The legislation implements a portion of the 2021 OGWC policy proposal. The legislation provides for the new Natural and Working Lands Fund with an initial investment of \$10 million as incentive for development of projects on private property.



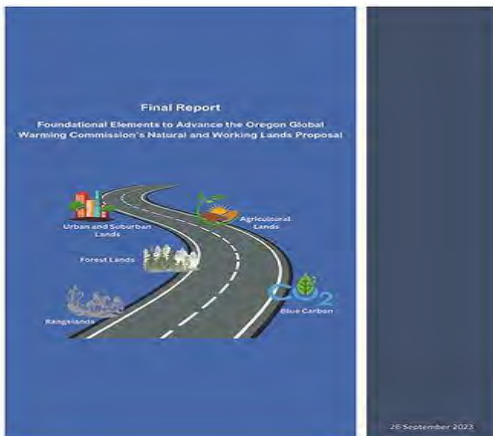
This is an outline of the program from the Oregon Global Warming Commission describing tasks related to the funding mechanism.

**Declares it a state policy** to implement and incentivize strategies to advance natural climate solutions and improve understanding of natural climate solutions

**Establishes Natural and Working Lands Fund** for allocation to certain state agencies to provide incentives and conduct research related to natural climate solutions with an initial investment of \$10 million

- Oregon Climate Action Commission (was Oregon Global Warming Commission) to determine annual Fund allocations to four natural resource agencies
  - Oregon Department of Agriculture
  - Oregon Watershed Enhancement Board

- Oregon Department of Fish & Wildlife
- Oregon Department of Forestry
- Annual report summarizing uses of the Fund and identifying additional funding needs due by September 15 annually
- Biennial Report on funded and planned projects and funding sources (state, federal, and private) for projects funded by the Fund by December 1 of even numbered years
- Agency consultation and coordination and public comment opportunities
- OCAC and agency rulemaking in coordination with OCAC (if needed)



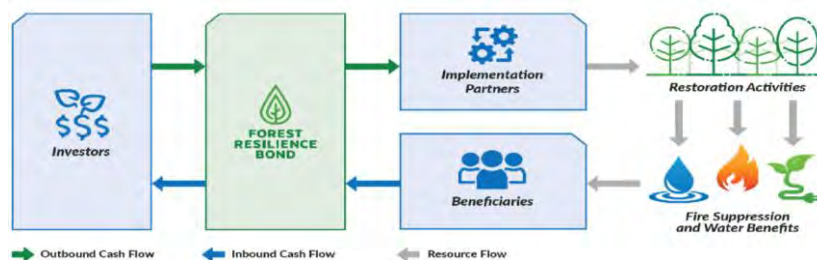
In August of 2022 the Commission appointed an advisory committee of 26 people (including OACD's representative) to work on policy objectives such as natural climate solution recommendations for practices for agriculture and other carbon sequestration and conservation work. See the final report, [\*\*Foundational Elements to Advance the Oregon Global Warming Commissions' Natural and Working Lands Proposal.\*\*](#) (Also see more information in Section 6.)

## **Forestry Finance – Forest Resilience Bonding**

The Forest Resilience Bond (FRB) seeks to overcome the funding gap for forest restoration by allowing private capital to play a role in support of public land management. Over \$3.1 billion in sustainable investment capital remains undeployed due to a lack of investment opportunities in the conservation finance space, according to a report by Forest Trends and JP Morgan. As a result, conservation-focused investors have not had an opportunity to support these projects due to a lack of viable deals.

The goals of the FRB are to:

- 1) Drive new financial and technical resources to accomplish restoration projects
- 2) Create a highly replicable financing model that can accelerate the pace and scale of forest restoration country wide
- 3) Restore watershed and forest health
- 4) Mitigate wildfire risk to forest ecosystems and surrounding rural communities



## FEDERAL FUNDING – FORESTRY



### **U.S. Department of Agriculture Forest Service Conservation Finance Toolkit: A compilation of definitions, guidelines, and case studies**

This report introduces a number of programs for financing forest related conservation projects. Browse the USFS Conservation Finance Toolkit for overviews of financial programs and case studies.

The toolkit lists a number of programs for forestry projects:

## **Federal Funding Sources through USDA for Forestry Projects**

### **Collaborative Forest Landscape Restoration Program**

This FS program provides funds for the collaborative, science-based restoration of priority forest landscapes. Projects must encourage sustainability, reduce wildfire risk, demonstrate ecological restoration techniques, and promote utilization of restoration by-products. The program can fund up to 10 projects per year, up to 50% of the costs of implementing/monitoring treatments on non-FS lands, and up to \$4 million/project dollars annually.

### **EPA Clean Water State Revolving Fund**

One of the project mechanisms is the EPA Clean Water State Revolving Fund (SRF). That program is available in Oregon through the Department of Environmental Quality. SRFs can result in low-interest loans to eligible applicants and may provide additional subsidies in the form of principal forgiveness, grants, or negative interest loans. “Green” loans can be partially forgiven under the program. Loans can provide for a variety of conservation projects.

### **Joint Chiefs’ Landscape Restoration Partnership**

This jointly administered FS and NRCS program, which focuses on improving the health of forests where public forests or grasslands abut private or tribal lands, funds restoration activities that reduce wildfire threats and protect water quality. Each year, the FS and NRCS select new three-year projects to fund. There are two Joint Chiefs’ projects in Oregon, one in Southeast Oregon and the other in Central Oregon.

### **Landscape Scale Restoration Program**

This FS program funds state forestry agencies’ implementation of restoration activities on non-federal priority landscapes identified in State Forest Action plans.

## Land and Water Conservation Fund

This Fund, a portion of which is administered by the FS, uses revenues from offshore drilling and gas to assist federal, state, and local governments in conserving land and water through the purchase of property or conservation easements. The Fund is capped at \$900 million annually, although funding levels have only twice met that level.

## FINANCING FOR BLUE CARBON



Conservation Finance, as detailed above, promotes private capital investment in conservation initiatives such as the financing for coastal Oregon blue carbon development.

The [Blue Forest](#) organization states conservation finance in coastal Oregon would provide an opportunity to increase multi-agency collaboration, attract new funding sources, and accelerate the pace and scale of planned action by providing up-front capital.

The Pew Charitable Trusts, the Bonneville Environmental Foundation (BEF), and other local partners have laid the foundation for this work through previous stakeholder outreach, support of scientific research, and policy engagement. The relationships and knowledge that Pew and BEF bring to the table make this a unique opportunity to build on previous efforts and support these partnerships. Blue Forest's objective is to explore and assess the feasibility of conservation finance in coastal Oregon. Initial steps will be taken to meet with these partners to understand the problems and needs of coastal resilience and restoration projects and explore opportunities to support their work.

## Other Financing Options for Blue Carbon Projects



The Nicholas Institute at Duke University has developed a publication [Financing Options for Blue Carbon Opportunities and Lessons](#) for financing blue carbon projects.

The Nicholas Institute is comprised of multi-disciplinary programs focused on helping decision makers weigh the risks and rewards of policy choices.

- [Climate and Energy Program](#)
- [Ecosystem Services Program](#)
- [Ocean and Coastal Policy Program](#)



## SECTION 4

# CARBON SEQUESTRATION IN OTHER ECOSYSTEMS

In addition to agricultural sequestration, there are other sources that can provide and store carbon. This section covers forest and blue (coastal) carbon sources mapping, current projects, data, and other resources.

## FORESTS

Forests hold the potential to sequester significant amounts of atmospheric carbon. Management practices are crucial in reducing net emissions during and after timber harvest. It is essential that scientists and landowners learn more about the complex factors that optimize net sequestration in forests, including timber production and harvest time cycles, forest floor undergrowth, soil health, applications of pesticides that diminish forest ecosystem biodiversity, as well as the decomposition of nonliving downed wood, prior to obtaining offset credits in a forest carbon market.

Right now, healthy forests are sequestering carbon into trees and this process increases as long as the trees remain healthy and are not harvested. Historically, forests were sequestering more carbon than today; in recent decades, the situation has reversed. Some processes can create more emissions (such as shorter harvesting intervals, fires, insect infestations that kill trees and land use changes). These processes tend to increase as the earth warms, e.g., larger and more intense fires, warmer wetter climates that enhance decomposition rates and release more carbon dioxide. These and additional interacting complex processes require sophisticated mathematical models to study and evaluate to make forest management a consistent net sink and not net source of carbon emissions. A carbon balance can be obtained through the use of carbon sequestration and storage.

### OREGON'S FOREST CARBON TASK FORCE

The Oregon Climate Action Commission (formerly Oregon Global Warming Commission) established a **Forest Carbon Task Force** in 2017 and in 2018 the Oregon Legislature established the **Office of Carbon Policy**. The Oregon Legislature adopted the policy requiring the Commission to “*track and evaluate the carbon sequestration potential of Oregon’s forests, alternative methods of forest management that can increase carbon sequestration and reduce the loss of carbon sequestration to*



wildfire, changes in the mortality and distribution of tree and other plant species and the extent to which carbon is stored in tree-based building materials.”

### **Forest Carbon Project Report**

Oregon forests contain on the order of 3 billion tons of carbon. Since the early 1990s, Oregon’s publicly and privately owned forests in aggregate appear to have removed from the atmosphere and stored between 23 million and 63 million tons of CO<sub>2</sub>e (carbon dioxide equivalent) on average every year. The Office of Carbon Policy was funded to further develop an assessment of the amount of carbon in Oregon forests. The Forest Carbon Report provides detail.

## **OREGON DEPARTMENT OF FORESTRY CLIMATE CHANGE & CARBON PLAN**

**The plan** was adopted by ODF in November of 2021. The goal was to make forestry in Oregon a leader in climate change mitigation and adaptation, a leader in promoting climate-smart forest policies and actions that achieve the vision by operationalizing goals, implementing actions, and measuring progress to achieve climate goals.

**HERE** is a PowerPoint that summarizes intent and goals.

## **OTHER FOREST CARBON INFORMATION**

### **Forests as Carbon Sources for Carbon Balance & Monitoring**



**Forests are key to reducing Oregon climate emissions** How much carbon can forests remove from the atmosphere and which carbon strategies can reduce emissions in an integrated strategic approach?

**Forests can absorb carbon more quickly than thought** The Nature Conservancy states previous estimates of carbon accumulation rates for forests are projected at too low rates.

### **Governments Join Forces on Forest Health and Climate Impacts**

Rural economies are the first to feel climate impacts. A key goal of the MOU among Washington, British Columbia and California is to promote investments in natural and working lands that increase carbon sequestration and enhance forest resilience to mitigate the increased risk of wildfire, drought, invasive pests, and disease.



## Potential Carbon Sequestration Rate from Natural Forest Growth

Global Forest Watch has developed aerial imagery mapping showing the rate of carbon growth by area with statistics based on your choice of location.



## US Forest Service Carbon Bibliography

The U.S. Forest Service provides a listing of articles that address how forestland managers and owners can achieve climate smart forestry as well as other references related to forest carbon.

## Calculating Carbon Credits from Harvest Deferral

Here is a strategy for calculating sequestration value when harvesting trees is deferred.



## Washington Launches First-in-the-Nation Carbon Project, Protecting Forests and Creating Carbon Credits

The Washington State Department of Natural Resources launched a historic carbon project on state trust lands that will offset millions of metric tons of emissions by protecting an estimated 10,000 acres of Western Washington's most ecologically valuable forests. The forests will be entered into leases stipulating their use for storing carbon and generating revenue for state trust land beneficiaries through carbon markets.

## Ecosystem Carbon: Encroachment and Control of Juniper Systems in Oregon

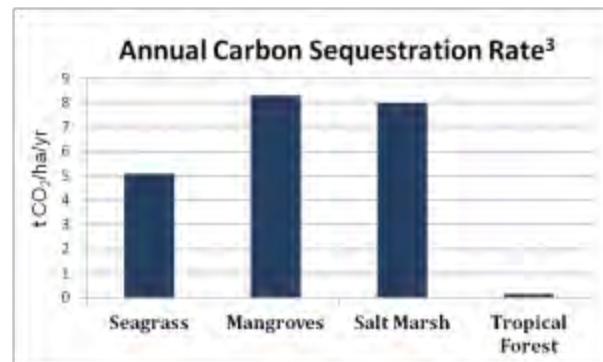
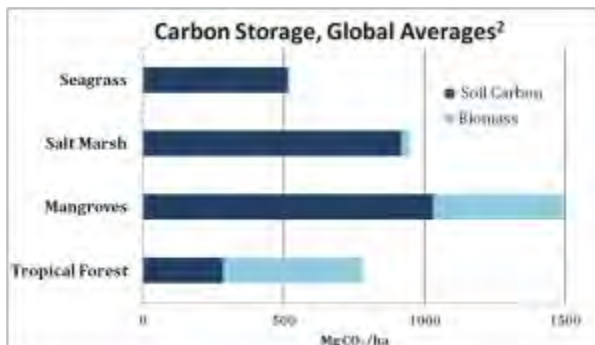
Western Juniper encroachment can affect carbon sequestration capacity for an area, as a recent study projects. Grass-root carbon storage and total belowground carbon content was greater in the treated watershed than in the untreated area and resulted in restored hydrological function, as determined in a study in Central Oregon.

## BLUE CARBON

“Blue carbon” is carbon sequestration by the world’s oceanic and coastal ecosystems, mostly by algae, seagrasses, macroalgae, mangroves, salt marshes and other plants in coastal wetlands. This occurs through plant growth and the accumulation and subsequent burial of organic matter in the soil. Because oceans cover 70% of the planet, ocean ecosystem restoration has the greatest blue carbon development potential for removing (sequestering) carbon from the atmosphere. Research is ongoing, but in some cases, it has been found that “these types of ecosystems remove far more carbon than terrestrial forests and store it for millennia.”



Unlike forests, the largest store of carbon in wetland habitats is in the soil not above ground. In the first meter of soil, coastal ecosystems contain about 2,400 Mg (metric tons) CO<sub>2</sub>eq per ha (carbon dioxide equivalent per hectare) compared to about 250 Mg per hectare in tropical forests. **The annual carbon sequestration rate in coastal ecosystems is about 100-times greater than in tropical forests.** Once sequestered into marine soils, carbon persists for centuries in the soil because when kept wet, the oxygen concentration remains low, hence decomposition of SOM is slow. Sadly, when coastal ecosystems become disturbed or drained, oxygen penetrates the soil and massive amounts of carbon dioxide are soon returned into the atmosphere.



Although coastal ecosystems cover less than 2% of total ocean area, mangroves, seagrasses, and salt marshes account for half of the carbon stored in oceans due to their ability to draw down carbon and store it for extended periods of time. The nonprofit Verra just released the first blue carbon conservation methodology approved under any major GHG program. The **Verra methodology** adds blue carbon conservation and restoration activities as an eligible project type and is expected to unlock new sources of finance for tidal wetland conservation and restoration activities. **Verra** is a nonprofit that provides the registration that keeps track of verified carbon trades.

Registries are essential to creating a credible carbon offset commodity. Registries record ownership of carbon credits and trades are **taking off** everywhere in the world. “Carbon markets for blue carbon are taking off and growing exponentially” although rules for claiming carbon credits are new and Verra is at the forefront of developing approved methods to keep track of carbon sequestration and trades as blue carbon.

**The rules for claiming carbon credits from restored blue carbon habitats are new.** There are a few experimental programs that are developing proof of concept. For example, a collaborative **project** — with planting done by the Virginia Institute of Marine Science (VIMS) and the Nature Conservancy, and long-term carbon data provided by the University of Virginia — is the first seagrass project in the world to apply for carbon credit certification with the Washington-based nonprofit Verra, the world’s largest overseer of **carbon credit projects**.

## BLUE CARBON PROGRAMS AND INFORMATION

### Oregon's Blue Carbon Ecosystems: State of the Science

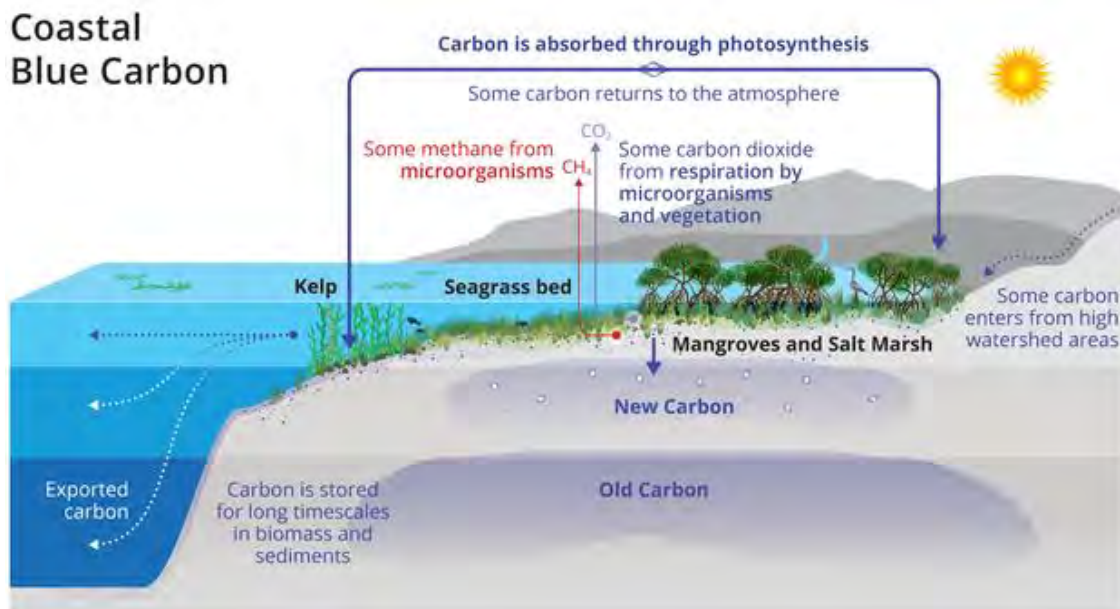
A summary of the current understanding of the climate mitigation potential of Oregon’s coastal and marine habitats – from The Nature Conservancy

### Blue Carbon Value in Coastal Ecosystems

This YouTube video developed by The Nature Conservancy explains the potential of blue carbon.

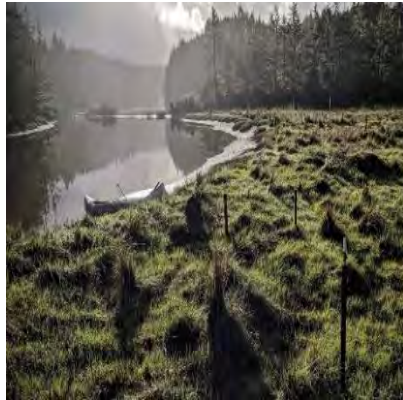
### Understanding Blue Carbon

This National Oceanic and Atmospheric Administration (NOAA) site discusses blue carbon and addresses inventory.



## **Market for Blue Carbon Poised to Take Off**

This article from Yale Environment 360 describes the growing blue carbon marketplace.



## **Oregon Climate Plan Is First in U.S. to Account for 'Blue Carbon' Benefits of Coastal Habitats**

The Pew Charitable Trusts describe how the adoption of the Natural Solutions for Climate on Natural and Working Lands **report** developed by the Oregon Global Warming Commission shows Oregon is poised to be a national leader in harnessing the power of blue carbon ecosystems in the fight against climate change.

## **PNW Coastal Blue Carbon Working Group**

The Pacific Northwest (PNW) Blue Carbon Working Group has completed two Science Collaborative-supported blue carbon research projects representing critical “Phase 1” steps for providing data to regional end users in support of climate mitigation planning and coastal wetland management.



“Phase 1” projects include the **Pacific Northwest Carbon Stocks and Blue Carbon Database Project** and **Feasibility Planning for Pacific Northwest Blue Carbon Financing Projects**, supported by the Science Collaborative. More about the PNW Blue Carbon Working Group can be found **here**.

## **Blue Carbon Conservation Methodology Scales up Coastal Restoration and Conservation Activities**

Verra just released the first blue carbon conservation methodology approved under any major GHG program. The methodology, which is a revision to the **VCS REDD+ Methodology Framework (VM0007)**, adds blue carbon conservation and restoration activities as an eligible project type and is expected to unlock new sources of finance for tidal wetland conservation and restoration activities.

## **Blue Carbon Calculator**

The Oregon Watershed Enhancement Board has requisitioned a blue carbon calculator tool that should be available later this year. Watch for it at their website under the Climate and Water Committee or the Oregon Agriculture Heritage Program.

*A special thanks to Rhianna Simms of Verdant Phoenix LLC for some of the contributions in this section.*



## SECTION 5

# THE CARBON MARKETPLACE

Carbon markets have been established, valuing sequestration and resulting in agreement forms. This section presents the general requirements and trends in establishing voluntary market opportunities. The first portion of this section applies to agricultural sequestration, followed by information on forestry sequestration, and then blue carbon sequestration.

## The Carbon Marketplace

- ✓ *What is it?*
- ✓ *How does it work?*
- ✓ *Programs and opportunities*
- ✓ *Is it right for me?*
- ✓ *Can I qualify?*

### WHAT IS THE CARBON MARKETPLACE?

The carbon market makes it possible to pay people to remove carbon dioxide from the atmosphere. The agricultural carbon market refers to mechanisms available for working landowners that enable the financial sale of accumulated soil carbon found in soil organic matter.

Over 140 million acres of U.S. farms currently have adopted some form of practices that lead to healthy soils. These practices are commonly referred to as conservation or regenerative agriculture. Currently, the vast majority of these acres that accumulate soil organic matter are not enrolled in a financial carbon market as the carbon marketing process is fairly new to the industry.

In Australia 116 million acres are voluntarily enrolled in 570 projects where landowners are accumulating wealth and agronomic savings while accumulating soil organic matter.



There are two types of carbon markets that are driving demand today:

- Voluntary markets – generally corporate buyer or incentive program driven
- Compliance markets – based on governmentally imposed limits on greenhouse gas emissions (such as California’s Cap and Trade Program)

Today, most carbon markets are voluntary, incentive-based markets where companies are linking buyers and sellers of carbon credits. The sellers, typically farmers, are paid for generating carbon credits by adopting management practices that meet specific beneficial ecosystem criteria. The most common practices include no-till/reduced-till, cover crops, crop rotation, and buffer strips that sequester carbon. Farmers are typically paid based on the amount of carbon sequestered, either on a per-acre basis or per ton of carbon sequestered.

Once the carbon credit is generated, it enters the market where buyers can purchase those credits to meet their sustainability goals (e.g., carbon neutral by 2040). Today, most transactions occur through a third-party entity (aggregator), which links sellers (farmers) to buyers (corporations). Since carbon markets are still developing, price discovering is occurring, and payments for carbon credits may or may not always cover the cost of implementing new management practices. Agency programs providing incentives can balance those costs.

Links for more general information: [Carbon Markets 101](#)  
[Carbon Marketing Resources](#)  
[Ecosystem Marketplace](#)

## HOW DOES IT WORK?

### Define your project

Get your project qualified and accepted by a carbon marketing company.

- Provide the record history of land use (called the “intake form”)
- Define and implement some new, additional practice(s)
- Hire an independent third-party validator to verify project feasibility

**Sign an agreement** or contract

**Establish a baseline** amount of soil organic matter in the soil.

**Carry out the approved project** enriching soil carbon levels.



Develop **agreement with an international carbon registry**, assuring a project is then internationally registered with SOM increased.

**Claim carbon credits.** A serial number is assigned by the carbon registry for each verified offset credit to create a viable, credible, trackable offset.

**Remeasure soil organic matter (SOM)** levels at future intervals.

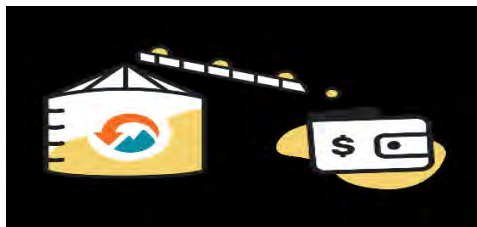
**Interim Verification Reports:** Interim verification reports will be required to provide reasonable assurances that the Supplier's Annual Project Data represents the practice and operating history for the lands that comprise the project.

## PROGRAMS AND OPPORTUNITIES

Some Carbon Markets determine eligibility for participating farmers/ranchers and land managers through computer modeling of carbon sequestration and others use onsite soil testing. There are advantages and disadvantages to both. The best practices are still emerging.

### Programs based on computer modeling

Some carbon markets, [Nori](#) for example, determine if a farmer is eligible to qualify for the carbon marketplace by inputting cropping data into an online program that creates a reasonable estimate of the carbon sequestered based on practices such as the crop planted, how it was harvested or terminated, what amendments were applied, and how the field was irrigated, etc. The U.S. Department of Agriculture suggests using [Comet Planner](#) to estimate if your farm is sequestering enough carbon to apply in the carbon marketplace.



### Programs based on soil samples

[Agoro](#), for example determines if a farmer is eligible to qualify for the carbon marketplace through extensive soil testing. Agoro Carbon™ Alliance is creating a new solution to our carbon challenge that's grounded in the soil.

## IS THE CARBON MARKETPLACE RIGHT FOR ME?

The Comet Planner is an evaluation tool designed to provide generalized estimates of the greenhouse gas impacts of conservation practices and is intended for initial planning purposes. Site-specific conditions (not evaluated in this tool) are required for more detailed assessments of greenhouse gas dynamics on the farm. Please visit [COMET-Farm](#) to conduct a more detailed analysis of the farming practices.

Farmers will be asked if they have:

- Currently farmed cropland in the continental United States
- Adopted any of the [agricultural conservation practices](#) listed below or other practices identified at this link by USDA (as defined after 2012)\*

- reduced or no till
- cover cropping
- increased biodiversity
- adding or changing crop rotations
- Verifiable farm records from the change in practices through the present time
- Ability to pay for project verification costs (\$3,000-5,000)
- Rights to secure [assignment of authority](#) from any involved landowners
- Willingness to sign a contract or agreement for a specific time period (varies according to marketer)

\*More on who is eligible: It is important to determine which practices are highly effective in sequestering carbon in the soil. These practices are important in both your baseline and future practice switches to help understand the project's potential Soil Organic Carbon gain:

- reduced tillage or no-till
- cover crops (particularly legume mixes)
- adding or increasing organic manure
- perennials (grasses, alfalfa)
- increased biodiversity in crop rotations
- winter wheat following an annual
- longer growing seasons
- adding crops to alleys of orchards and vineyards



## CAN I QUALIFY?

In order to determine if the project will qualify for the carbon marketplace, it will be helpful to run some projections of the farm's carbon sequestration through the Comet Planner tool mentioned earlier. This information will be useful when the farmer is ready to complete an intake form. Here is an [example](#) of the information needed to determine if the farm will qualify.

## HOW DO I REGISTER?

It is necessary to measure and report to a registry to maintain your credits. A registry

assures that contracts clearly identify ownership of an offset credit and define who bears the risk in case of project failure. Carbon offset registries track offset projects and issue offset credits for each unit of emission reduction or removal that is verified and certified.



Registries record the ownership of credits and are vital in creating a credible offset commodity. A serial number is assigned to each verified offset credit.

Here are the major registry firms:

[American Carbon Registry](#) (ACR)

[APX Inc.](#)

[Gold Standard Registry](#)

[Climate Action Reserve](#) (CAR)

[Verra](#)

[Registries & Enforcement](#) – Here is an explanation of how registries work

## OTHER INFORMATION

The following site provides carbon marketing information generally and offers weekly podcasts on current information on the carbon marketplace.



The [Climate Action Reserve](#) includes

Carbon Market Directory

Public Registry

Map of Projects

Newsletter

Weekly Podcasts

## AGRICULTURE & GRAZING MARKETS

While a number of carbon marketers may seek carbon from any of the ecosystem components (agriculture, grazing, forestry, or blue carbon), some are distinctive to certain market sectors. Here are some of the agriculture and grazing opportunities.



[Nori](#) is an accessible entry into carbon markets for regenerative agriculture suppliers. They work directly with all sizes of ag businesses and farmers who have adopted regenerative agriculture practices within the last 10 years in the United States. Nori also distributes a farmers' newsletter.

**Indigo Ag** provides income to farmers providing carbon on agricultural lands and covers the cost of third-party verification and soil sampling. Contracts are for 5 years. There are a number of videos and webinars at this site discussing marketing, including *“What I Wish I had Known: Lessons from Experienced Carbon Farmers.”*



## **ESMC**

Economic Services Market Consultants (ESMC) provides the **Noble Research Institute LLC** (a site on regenerative agriculture) study developed through years of research resulting in an economic assessment for ecosystem service market credits from agricultural working lands. The ESMC consortium is housed under the **Soil Health Institute**. The study addresses carbon credit potential values, water quality credit values, and discusses both demand and supply. A section of the study addresses different crop results, using Comet-Planner.

A presentation on reporting, measurement and verification is **HERE** and at the ESMC website.



## **TruTerra Carbon Sequestration Program**

Tru Terra is a division of Land O’Lakes co-ops and dairy product manufacturers. They have undertaken a **carbon sequestration program** direct with farmers. In their climate-smart submittal to USDA in 2022 they indicated future programming in Oregon.

FORESTRY MARKETS

## **NCX**

A total of 4,000 landowners have signed up for their nearly five million forested acres with NCX. With NCX there are no land acre minimums, and they use annual (year-to-year)

agreements, no long-term contracts, and no fees. Every acre of enrolled forest is measured annually using remote sensing and other practices.

## **ANEW**

For 20 years anew has been working with private forest landowners. Their program requires 40-year contracts with independent certification (FSC, SFI, AFTS), annual reporting and verification every 5 years and field measurements every 10 years.

**Finite Carbon** is a developer and supplier of carbon offsets for forestland owners.

## **U.S. Forest Protocol**

The Protocol provides requirements and guidance for quantifying the net climate benefits of activities that sequester carbon on forestland. The protocol provides project eligibility rules, methods to calculate a project's net effects on (GHG) emissions, and approaches for long term project monitoring and reporting.

## **Family Forest Carbon Program**

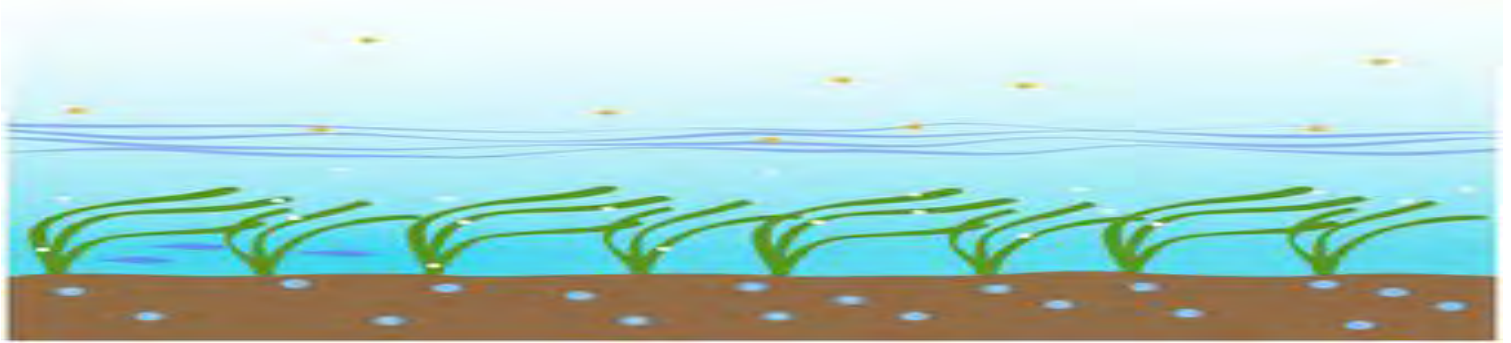
Developed by the American Forest Foundation and The Nature Conservancy, the Family Forest Carbon Program enables family forest owners to access climate finance from carbon markets—empowering them to help address climate change while earning income from their land.

## **Oregon Forest Resources Trust**

The Oregon Department of Forestry houses the “Oregon Forest Resources Trust” to develop and market a protocol for carbon sequestration offsets for forestry projects. The Trust has broad authorities, including the ability to enter into agreements with other public bodies and a segregated fund that could make it a workable vehicle for offsets without additional legislative authority. The Trust is an underutilized asset and needs further investment to grow. The trust was set up in 1993 (ORS 526.695 to 526.775) and has both a loan and grant program. A backgrounder

**Carbon Sequestration and Reforestation through the Oregon Forest Resources Trust** describes the program.





## BLUE CARBON

BLUE CARBON is the carbon stored in coastal and marine ecosystems. The [Blue Carbon Initiative](#) currently focuses on carbon in coastal ecosystems – tidal marshes, seagrasses and other vegetation. These ecosystems sequester and store large quantities of blue carbon in both the plants and the sediment below. For example, over 95% of the carbon in seagrass meadows is stored in the soil. Blue Carbon has an even higher density than forest carbon.

### [Investing in Blue Carbon for a Resilient Future](#)

This article by the Nature Conservancy describes blue carbon sources. EPA states “2,110,125,875 barrels of oil burned can be offset by restoring coastal wetlands.”

### [Library of Blue Carbon Information](#)

The library provides numerous articles on blue carbon.

Thanks to Dr. Ray Seidler and to Rhianna Simes of Verdant Phoenix LLC for their contributions to this section.



## SECTION 6

# POLICIES & PROGRAMS

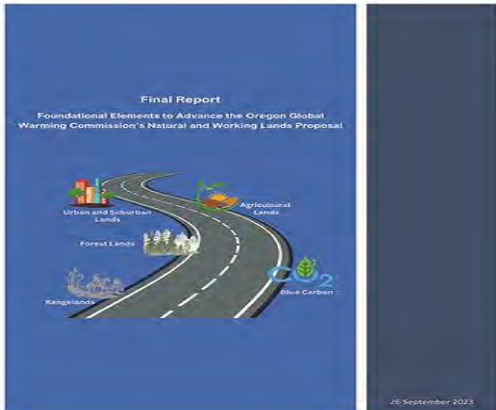
Oregon adopted new policies in 2023 that will fund and acknowledge the value of soil health and carbon sequestration practices. Other states and regions have developed policies as well that may help promote carbon sequestration programs and soil health outcomes.

## OREGON

### OREGON CLIMATE ACTION COMMISSION

#### Oregon Climate Action Commission Policy

The Oregon Climate Action Commission (OCAC, formerly the Oregon Global Warming Commission) adopted the [2021 Natural and Working Lands Proposal](#) for natural climate solutions on natural and working lands.



In August of 2022 the Commission appointed an advisory committee of 26 people (including OACD's representative) to work on policy objectives such as natural climate solution recommendations for practices for agriculture and other carbon sequestration and conservation work. See the final report, [\*Foundational Elements to Advance the Oregon Global Warming Commissions' Natural and Working Lands Proposal.\*](#)

#### Oregon 2023 Legislation Promotes Carbon Sequestration



The Oregon Legislature approved a package of climate-related bills in [HB 3409](#) in June of 2023. Sections 53-66 of the bill (pages 33-40) include the following policy.

#### Outline of the “State Policy for Natural Climate Solutions”

- Establishes the concept of natural climate solutions as state policy
- Establishes a permanent fund for “natural climate solutions” on natural and working lands with an initial investment of \$10 million: Natural & Working Lands Fund
- Defines natural and working lands, recognizing private lands, equating to about 10

million acres of privately managed forests and farms and coastal habitats as important to mitigating climate change

- Encourages carbon sequestration – removes carbon dioxide from the atmosphere or prevents its release once it has been stored
- Provides funds to ensure conservation, restoration, and improved management of lands and waters
- Recognizes ecosystem sequestration needs for agriculture and grazing lands, forestlands, and “blue carbon” from tidal and wetland resources
- Creates a process to engage tribes
- Requires state to develop a natural and working land carbon inventory
- Renames the Oregon Global Warming Commission as the Oregon Climate Action Commission, expands its membership, scope and charge
- Identifies a study of workforce and training programs necessary to support natural climate solutions
- Establishes an advisory committee to advance the bill’s initiatives
- Requires development of goals for including natural and working lands in the state’s climate program by the year 2025

### **Natural and Working Lands Fund**



The fund will be continuously appropriated to the Oregon Watershed Enhancement Board (OWEB) agency and then distributed to:

- The Agriculture Natural Climate Solutions Fund – Oregon Department of Agriculture
- The Forestry Natural Climate Solutions Fund – Oregon Department of Forestry
- The Fish and Wildlife Natural Climate Solutions Fund – Oregon Department of Fish and Wildlife
- The Watershed Natural Climate Solutions Fund – Oregon Watershed Enhancement Board

The Oregon Climate Action Commission will determine annually how much money to allocate to each of the four funds, based on the ability of each agency to carry out programs for this need. OCAC will consult with the four agencies in the allocation.

Funding existing programs is a priority as is using funds to secure federal or other matches. A summary of the uses of the fund will be reported to the legislature.

### **Other features of HB 3409:**

**Baseline Inventory and Goals:** The bill also requires the establishment of a baseline inventory and requires that by January 1, 2025, the Department of Energy and the OCAC, in consultation with the 4 agencies named above, establish nonbinding biological carbon sequestration and carbon storage goals for Oregon’s natural and

working lands. The inventory will be updated and reported to the Oregon Legislature by the 1<sup>st</sup> of December in every even-numbered year. EPA provides a state inventory and projection tool that could be used in this analysis. It is available to the public.

[Download the State Inventory and Projection Tool | US EPA](#)

**Workforce and Training Programs:** The Department of Energy, in coordination with the OCAC, will study the necessary workforce and training programs needed to support the adoption of natural climate solutions on natural and working lands. An RFQ has been released; results are to be provided to the legislature by September 15, 2024.



#### **Advisory Committee for the Program**

OCAC will appoint an advisory committee of at least 15 members representing the following interests:

The commission may appoint additional members as needed to provide additional expertise or represent other interests.

- 1) 1 member with expertise in tribal culture, customs, and government
- 2) 1 local government representative from a county whose primary economic activity is derived from the agriculture, forestry, fishing, and hunting industries
- 3) 1 member with expertise in urban forestry or parks management
- 4) 3 members with experience in forestry or forest products, including one member who is a private forest landowner with less than 5,000 acres of forestland
- 5) 2 members with expertise in agriculture, including one member who owns a small family farming operation
- 6) 1 member with expertise in livestock
- 7) 1 member with expertise in blue carbon (wetlands and coastal habitats)
- 8) 1 member with expertise in environmental justice
- 9) 2 members with expertise in conservation or environmental management
- 10) 2 members with expertise in landowner technical assistance

#### **OCAC Work Plan**

The OCAC has proposed a [work plan](#) for the Natural and Working Lands Program at the August 2023 meeting. Page 5 has a chart showing tasks and timeline for the natural and working lands program.

#### **Oregon Agricultural Heritage Program**

The Oregon Agricultural Heritage Program (OAHP) is a program housed within the Oregon Watershed Enhancement Board (OWEB) agency. The program provides voluntary incentives to farmers and ranchers to support practices that maintain or enhance both agriculture and natural resources such as fish and wildlife habitat on agricultural lands.



See also the OAHP study “[Review and Feasibility Determination of Methodologies for Valuing Agricultural Conservation Management Actions](#)” to be updated in the fall of 2023

## Other States' Programs

It's important to be aware of programs in other states as there may be portions of those programs that can model additions to Oregon's policies to provide conservation incentives. Examples from some of the programs listed in this section, such as tax credits, revising the State Revolving Fund through EPA and DEQ, and other ideas could help promote more beneficial carbon storage.

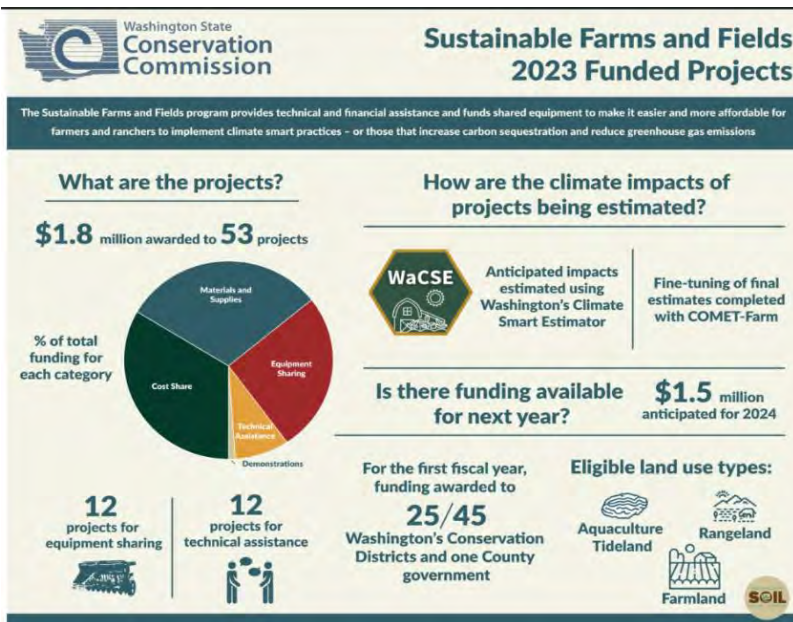
## WASHINGTON

### Washington Policy for Carbon Sequestration on Natural & Working Lands

The WA Department of Natural Resources developed as the basis of its program a Natural and Working Lands Carbon Inventories and Incentive Program.

### Washington's Cap and Invest Program

Washington's program includes greenhouse gas emission reductions set in state law and a marketing component, "Cap and Invest". The program rule defines operation of the program. Quarterly auctions spur investment and the fund provides dollars to implement projects.



### Washington's Sustainable Farms and Fields program

created in 2020 makes it easier and more affordable for farmers and ranchers to complete projects that increase carbon sequestration and reduce greenhouse gas emissions. The Agriculture Conservation Commission is working with the Department of Agriculture, WA State University and USDA NRCS in development of the program.

See [Program Fact Sheets](#)

## CALIFORNIA

### California's Natural and Working Lands Program

California's natural and working lands--forests, rangelands, urban green spaces,



wetlands, and farms, underpin the State’s water supply and support clean air, wildlife habitat, and local and regional economies. They are also the frontiers of climate change and are often the first to experience the impacts of climate change. The [Natural and Working Lands Implementation Plan](#) evaluates implementation and identifies long term goals for resiliency. In October 2020, Governor Newsom signed [Executive Order N-82-20](#) calling for restoring nature and landscape health to deliver on climate change goals and other critical priorities. See also [Healthy Soils Program](#).

### **California’s Legislation – Expanding Nature-Based Solutions**

[Assembly bill 1757](#) requires the California Natural Resources Agency to set up an ambitious range of targets for nature-based climate solutions that reduce greenhouse gas emissions to support state carbon goals. The bill would provide an increased climate program for natural and working lands.

## ***OTHER STATES***

### **Wisconsin climate Program for Carbon Sequestration**

Wisconsin’s plan for farm and forestry climate practices and sequestration begins on page 54 of the plan.

### **New Mexico Healthy Soils Program**

The [NM Healthy Soil Act](#) was enacted in the spring of 2019. The NM Healthy Soil Working Group continues to advocate for expanded resources and additional funds for the Healthy Soil Program. [HB 89 “The Healthy Soil Tax Refund Contribution Option”](#) passed in April 2021 allows any New Mexico tax paying resident who qualifies for a refund on their personal income tax return to voluntarily donate all or part of their refund to the Healthy Soil Program. The state has developed an open portal data center for climate change that references sequestration and other project work (registration required).

**Oregon might benefit from a similar program to New Mexico’s to set up a tax credit opportunity for investment.**

### **New York’s Climate Scoping Plan**

New York recognizes the importance of current and future use of natural and working lands programs for mitigation of greenhouse gas (GHG) emissions and carbon sequestration and storage, including protecting high-value lands through acquisition and avoiding conversion. The [Scoping Plan](#) is New York’s action plan for achieving the directives of the Climate Leadership and Community Protection Act and includes recommendations for state-wide action.

New York’s Climate Resilience Farming (CRF) grant program demonstrates how climate responsive efforts can be integrated alongside existing environmental and water quality agricultural programming through awarding \$20 million in project funding resulting in an estimated 370,000 MT COe (metric tons of carbon dioxide equivalent) reduced.

## Maryland Loan Guarantee for Natural Climate Solutions

Maryland became the first state to approve a loan guarantee through its Water Quality State Revolving Fund (SRF) to finance “natural climate solutions.” The loan guarantee was made possible by legislation enacted in 2021 to expand the authorized uses of the guarantee authority under the state’s SRF program.

**Oregon might structure its SRF program to provide a similar benefit.**

## Soil Health Legislation in US States

Healthy soils legislation at state levels is not new to the U.S. There are some 29 States with passed or pending legislation, including 10 that have already passed legislation. These state programs reflect bipartisan support.

### Passed Healthy Soils Legislation

State	Bill #	Year(s)	Title or Brief Summary
California	<a href="#"><u>SB-859</u></a>	2016	Healthy Soils Program (HSP)
Illinois	<a href="#"><u>HB 2737</u></a>	2019	Soil & Water Conservation Dist
Maryland	<a href="#"><u>HB687</u></a>	2020	Agriculture - Cost-Sharing Program
Maryland	<a href="#"><u>SB0597</u></a>	2020	Expansion of the Maryland Agriculture Water Quality Cost-Share program
Massachusetts	<a href="#"><u>Bill H.5250</u></a>	2021	Healthy Soils Program part of Economic Stimulus Package
Nebraska	<a href="#"><u>LB 243</u></a>	2019	Create the Healthy Soils Task Force
New Mexico	<a href="#"><u>HB 204</u></a>	2019	Healthy Soil Act
New Mexico	<a href="#"><u>HB 89</u></a>	2021	HEALTHY SOIL TAX REFUND CONTRIBUTION OPTION
Oklahoma	<a href="#"><u>HB 1192</u></a>	2001	Carbon Sequestration Enhancement Act
Utah	<a href="#"><u>H.B. 296</u></a>	2021	Soil Health Amendments: This bill addresses programs related to health of soil, creates the Utah Soil Health Program, and establishes the Soil Health Advisory Committee. Signed into law on March 16th by Governor Cox.
Vermont	<a href="#"><u>H.525</u></a>	2019	Vermont Environmental Stewardship Program
Vermont	<a href="#"><u>S.160</u></a>	2019	Incentives for practices that improve soil health

State	Bill #	Year(s)	Title or Brief Summary
Vermont	<a href="#">H.656</a>	2020	An act relating to miscellaneous agricultural subjects
Washington	<a href="#">SB 5947</a>	2019, 2020	Establishing the Sustainable Farms and Fields Grant Program
Washington	<a href="#">SB 6306</a>	20	AN ACT Relating to creating the Washington soil health initiative; and adding a new chapter to Title 15 RCW. - An educational partnership to "promote and implement voluntary soil management actions."

## NATIONAL CONFERENCE OF STATE LEGISLATURES (NCSL)

### Section on Agriculture and Rural Development

Rural America makes up 72% of the nation's land, and is home to 46 million Americans, according to the U.S. Department of Agriculture. Agriculture continues to play a major economic role in rural America, along with manufacturing, services, and trade. NCSL follows state legislative activities on agriculture and rural economic development, tracks changes in federal policy—including the Farm Bill—concerns on health care and education and highlights novel approaches lawmakers undertake to address these issues in their states.

There is an interactive database on state legislation and updated news on actions relative to agriculture and rural development in this section of the NCSL website.



## SECTION 7

# TRAINING

Training opportunities to achieve healthy soils and carbon sequestration are listed here as schedule and recordings are available when provided.

Watch the website for other future opportunities: [www.OACDCarbon.org](http://www.OACDCarbon.org).

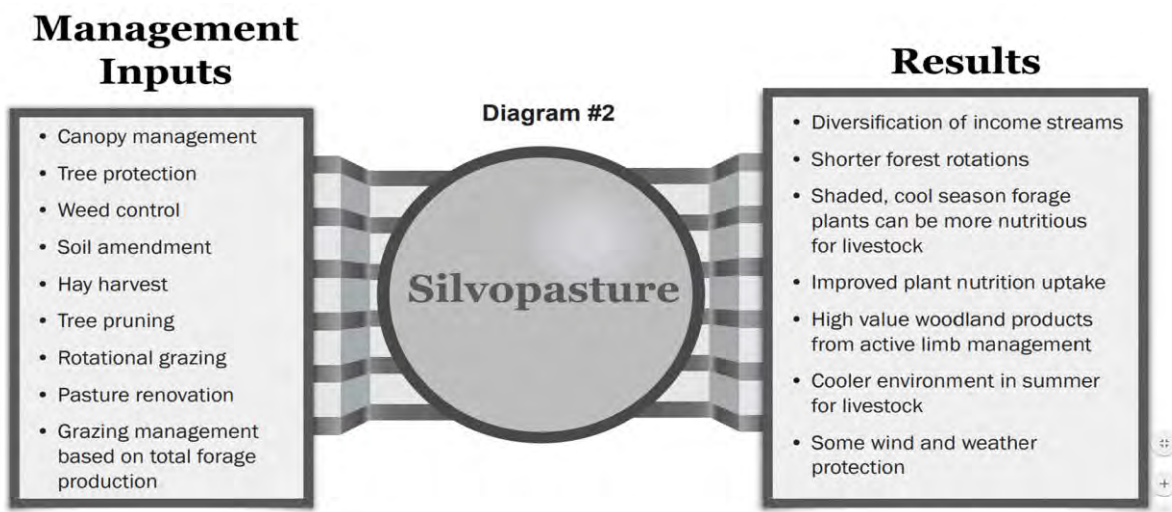
## CARBON CYCLE INSTITUTE

The Carbon Cycle Institute (CCI) is a non-profit organization that is continually evolving to meet the growing demand among producers, Soil and Water Conservation Districts, and other key partners for Carbon Farm Plan development. CCI has worked with the [Colorado State University COMET Team](#) to develop an on-line, multi-module carbon farm planning education platform designed to be paired with guided training with the CCI Staff. The curriculum was first launched in 2020 to scale carbon farm planning education and training opportunities for students, farmers and ranchers, conservationists, and natural resource management agencies.

Its "[Café Hours](#)" recording section provides various webinars on carbon farming topics such as biochar, composting, silvopasture, carbon on dairy farms, and many other topics.

## SILVOPASTURE TRAINING – US Forest Service

Silvopasture is the deliberate integration of trees and grazing livestock operations on the same land. These systems are intensively managed for both forest products and forage, providing both short- and long-term income sources. [Training/information sheets](#) (bottom of web page) and [course modules](#) provide detailed information to carry out the practices.



**Well-managed silvopastures** employ agronomic principals, typically including introduced or native pasture grasses, fertilization and nitrogen-fixing legumes, and rotational grazing systems that employ short grazing periods that maximize vegetative plant growth and harvest. The annual grazing income helps cash flow the tree operation while the tree crop matures and creates easy access, if and when the trees or tree products are harvested. While these systems can require a number of management activities, the benefits can make it worthwhile. One of the benefits can be management of carbon in the soil. Silvopasture systems **introduce forage into a woodland or tree plantation** or **introduce trees into a pasture**. **Rotational grazing** is a key management activity when using silvopasture and can also increase wildlife diversity.



## Train the Trainer

### **OrCAN – TRAIN THE TRAINER SERIES**

The Oregon Climate and Agriculture Network has produced a series of interactive trainings for Oregon agricultural professionals to advance their knowledge of farm-based solutions for climate resilience. These solutions reduce risks from extreme weather events, store more carbon in the soil, and work for a farmer’s bottom-line.

The primary audience for these workshops is agricultural technical service providers, farm advisors, and researchers throughout Oregon. For example: OSU Extension, Soil and Water Conservation Districts, Oregon Natural Resource Conservation Service, Watershed Councils, Land Trusts, researchers, non-profits, and agricultural education providers. For more information go to [www.oregonclimateag.org](http://www.oregonclimateag.org) or contact Carly Boyer, Program Manager, at OrCAN: [carly@oregonclimateag.org](mailto:carly@oregonclimateag.org).

**Take this engagement survey** to stay updated when registration becomes available.

**2022 TRAINING RECORDINGS**

**2021 TRAINING RECORDINGS**

## **NEW UPCOMING TRAININGS**

### **2023 TRAININGS “CLIMATE RESILIENCE FOR OREGON AG PROFESSIONALS”**

These current 2023 trainings are listed with detail as they will continue to be available in the future as recordings. If you miss them at the time of the scheduled webinar, you can go back to the OrCAN website to watch the presentation.

The following workshop segments will be included in November from 9:30-11:30 a.m.

### **Session 1: Wednesday November 1**

#### **Farmer Perceptions of, and Barriers to, Climate Adaptation in Oregon**

*Speakers: Margiana Peterson-Rockney, PhD and Melissa M Parks, PhD*

What does research tell us about the climate adaptation and stated beliefs of farmers in Oregon? How do producers navigate perceptions of social risk? And, how can agricultural service providers support farmers to adapt and mitigate risk with the appropriate soil conservation practices?

### **Session 2: Wednesday November 8**

#### **Drought and Heat Mitigation Practices, Obstacles & Needs**

*Speaker: Berit Dinsdale, PhD*

Farmers and ranchers across Oregon are increasingly facing challenges related to extreme drought and heat. While emergency funds have been made available to producers impacted by these pressures in recent years, their recurrence indicates the need for both pre-emptive and longer term solutions. Learn about OSU's research and participant interview driven assessment of current drought mitigation practices, obstacles and resource needs.

### **Session 3: Wednesday November 15**

#### **Climate Resilience and Adaptive Management on Rangelands**

*Speaker: Hailey Wilmer, PhD*

What processes and strategies support adaptive decision making in ranching and grazing systems operating under highly variable weather conditions? At what scales do adaptive decisions take place? What are the ecological outcomes of rancher decision-making strategies? As a social scientist, Hailey Wilmer will share her research on adaptive management through diversification and community resilience on rangelands on both a social and farm scale.

**[Register here!](#)**

## **BIOCHAR LEARNING CENTER**

**[Visit the Biochar Learning Center Database](#)**



**SEARCH CASE STUDIES, VIDEOS, ARTICLES AND MORE**

**[Visit the Biochar Learning Center Database](#)**

The site shares a number of videos and presentations, ranging from “What is Biochar?” to application on the ground.

**Sign up for the USBI Newsletter** to read farmer profiles when they are published.

**Pacific Northwest Biochar Atlas**

The Pacific Northwest Biochar is a resource for biochar users and producers. .

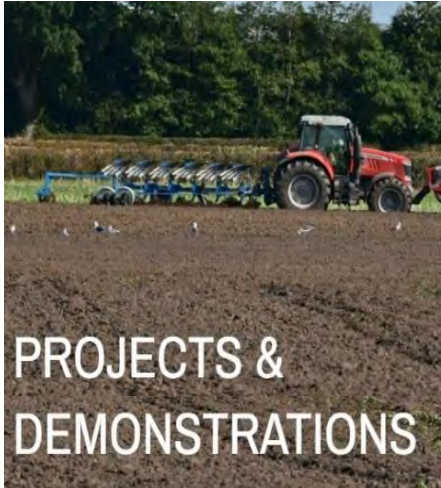
## **OSU Extension Service**

Soil is a vital living ecosystem.. Watch the video below to discover how different management practices can impact soil.

Presenter: Heather Y. Medina Saucedo, Natural Resources Conservation Service, Basin Team Leader, USDA

Read about this workshop on [our blog!](#)

Watch on YouTube: <https://extension.oregonstate.edu/video/soil-health>



## SECTION 8

# PROJECTS, DEMONSTRATIONS & STORIES

Current carbon sequestration projects lead the way to discovery of opportunities. Stories and programs developed are featured in this section, along with upcoming events and resources.

## PROJECTS & STORIES

### A Story of Rotational Grazing: A Tale of Four Pastures



Rotational grazing and intensive management can often feel like a daunting task. Getting hung up on the how, when, where, and why is normal for new and experienced farmers alike. However, [Oregon Pasture Network](#) (OPN) member, Mike Guebert of [Terra Farma](#), shares help with demystifying this practice! Mike is also a board member of the East Multnomah Soil and Water Conservation District.

Check out the blog post on the OPN website and learn from Mike about, specifically, the **WHY** question. Why is it that rotational grazing supports healthy ecosystems, combats climate change, and improves year over year growth? Mike has answers to these questions and more. This blog post is the first in a series that will be rolling out with Mike to help with rotational grazing. Be sure to check in and stay up to date!

See Mike's story from the Oregon Pasture Network [HERE](#)

### Shaniko Wool Company Carbon Initiative: A Model Project in Measuring the Ecosystem Impacts of Ranching Practices

Since the late 1980s, the Carvers have been working on improving land stewardship in cooperation with their local agency partners, inclusive of the Wasco County Soil and Water Conservation District and the local NRCS office. On their Imperial Stock Ranch

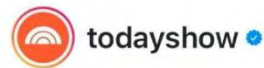


(established 1871) located in north central Oregon near Shaniko, sheep, cattle, grain, and hay production have been continuous throughout their history. They implemented a Conservation Management Plan in 1989, which has served as their guiding document and philosophy since.



The Carvers' focus on resource stewardship became important in a new way beginning in 1999. With the loss of traditional wool markets due to offshoring, they adapted and took their harvests of wool and lamb direct to consumers in value-added marketing. They had been implementing their Conservation Management Plan for 10 years at that point and were observing many positive changes on the land. They paired the products with their heritage and progressive agricultural practices, and it proved to be at the leading edge of the culture.

Fifteen years later, they provided their wool to Ralph Lauren for the Team USA uniforms at the 2014 Winter Olympics in Sochi, Russia. Their conservation story has been linked to the provenance of the wool since they began this new marketing journey. A year later Patagonia asked them to be 3<sup>rd</sup> party audited for their land stewardship and animal welfare, under a new global certification program. When the Responsible Wool Standard (RWS) launched in 2016, their Imperial Stock Ranch became the first ranch in the world to be certified. The comprehensive RWS has more than 270 criteria that must be met to achieve certification, and includes benchmarks for land, animal, and worker care.



With the increasing demand for certified wool in 2018 the Carvers launched **Shaniko Wool Company** to scale the supply of wool produced in the U.S. that meets this leading global standard. Today Shaniko Wool Company includes 10 ranches (and growing) that collectively graze 2.6 million acres in the western U.S. In early 2020, in response to the growing concern over ecosystem and climate impacts of food and fiber production, Shaniko Wool launched a new initiative--**the Shaniko Wool Carbon Initiative**. Working with a team of range scientists from Oregon State University, Dr. John Talbott developed a comprehensive research and measurement model implemented beginning in the spring of 2020. The purpose was to determine the ecosystem and climate impacts of each ranching operation with carbon as a **key performance indicator**, plus collateral benefits.

As the soil organic carbon levels are increasing *significantly* over time, additional positive benefits include:



- Increases in soil organic matter
- Nutrient availability
- Water infiltration and holding capacity
- Systems biodiversity
- Improved habitats
- Resilience to weather extremes
- Disease resistance
- Improved livelihoods

Jeanne Carver says, “Until now, we had our observations, yield data, resource agency testimony, field and species counts, and certification to third-party standards in support of our work. However, as ranchers, we had never formally “measured” or quantified our ecosystem deliverables. This work, giving us information we never had before, is a tool to influence future management and practices and supports an increased value of our harvest in markets. Importantly, it provides us with the data needed to potentially enter emerging ecosystem markets – an entirely new income stream.”



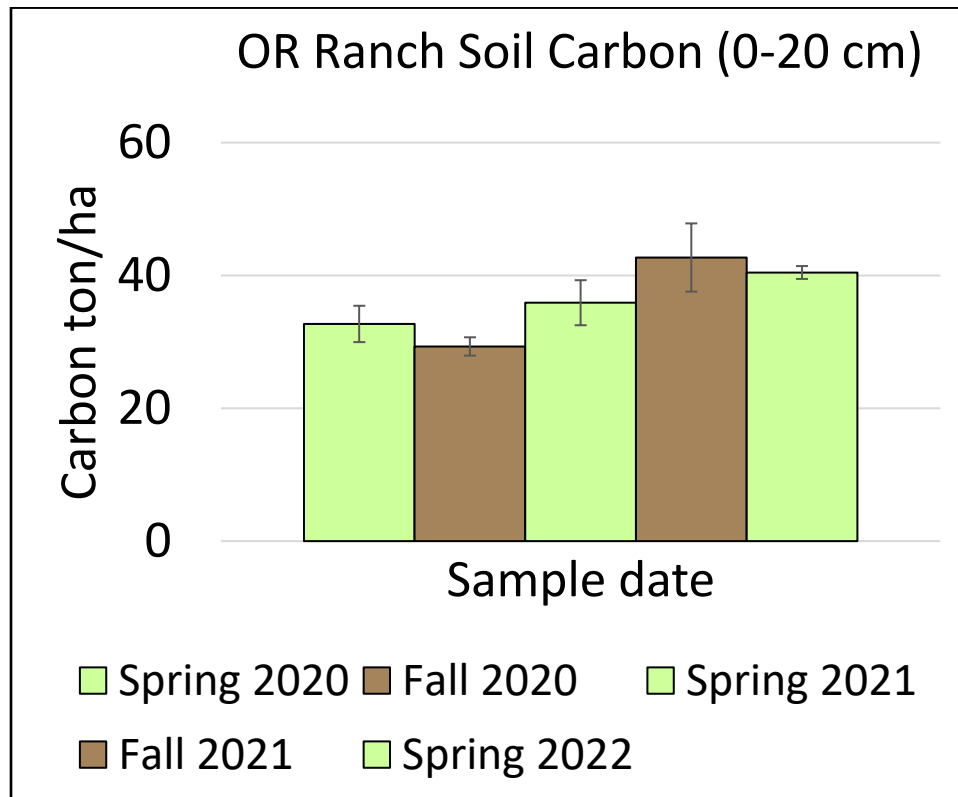
The Shaniko Wool Carbon Initiative includes third-party verification of:

- the research methodology (annual soil and biomass sampling + use of leading computer models to determine carbon inputs, e.g., equipment/fuel, electricity, methane emissions, fertilizers etc.)
- sampling protocols – number and location of sampling points
- data collection
- laboratories used for sample analysis
- data analysis
- findings and
- feedback to farmers/ranchers

Jeanne says, “We did not know what we would find when we began measuring. But it has been very encouraging to see the preliminary results from the first 3 years of measurements on our north central Oregon ranch”:

- The annual *NET* carbon capture is 1.86 tons/acre on 32,000 acres.

- Through improved practices, an additional 60,000 tons of carbon/year is being captured (NET).
- This is equivalent to removing more than 218,000 tons of CO2 from the atmosphere.
- GHG emissions total a NET negative value.
- And our improved practices have us *avoiding* an additional 8,880 tons of emissions of CO2 equivalents/year.



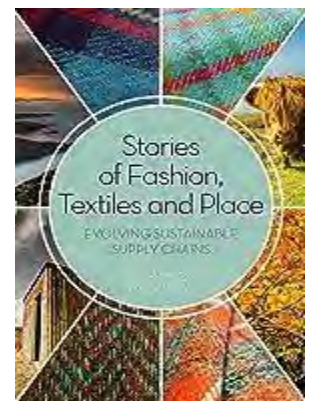
Shaniko Wool has two years of data on 1.5 million acres and has baselined another 1 million acres within the RWS farm group of ranches. As the research continues, they look forward to knowing the aggregate ecosystem impacts of the collective Shaniko wool supply. Jeanne says this is important information for their brand customers, and the most important work she has ever done. “In agriculture today, we have the opportunity for new stakeholders to join our work. I see voluntary carbon market companies who provide the framework, and brand partners who are investing in carbon insets to move their companies toward corporate sustainability targets, as new partners in agriculture at the origins of fiber.”

Shaniko Wool has been working with Agoro Carbon Alliance since February 2022. The hope is that in the near future, all ranches in the farm group will hold contracts for their measured carbon credits.



In 2022 Jeanne Carver hosted a tour of the Imperial Stock Ranch led by the Oregon Association of Conservation Districts through its legislative tour program that is part of the Oregon Conservation Partnership work. Key legislators, agency staff, Oregon Agriculture Heritage Program Commissioners, and Wasco Soil and Water Conservation District staff took part and reviewed the work on the ranch supporting soil health and carbon sequestration. Their ranch has successfully transitioned to the next generation, building for the future.

Note: To learn more about Jeanne Carver's work, read [Stories of Fashion, Textiles, and Place: Evolving Sustainable Supply Chains](#) by Jeanne Carver and Leslie Davis Burns. The book follows the journeys of companies with evolving sustainable supply chains in the fashion and textile industry. Those companies are committed to advancing the cultural traditions of a particular place. They value, honor, and are all deeply rooted in the geography, culture, and people of a specific location and their success is attributable to their connection to that place. With this shared value, their unique stories highlight the conditions, risks, strategies, and successes in creating and maintaining sustainable supply chains. (Amazon)



Jeanne Carver at Imperial Stock Ranch

More to the Story:  
About a year and a half ago, OPB went to Jeanne's ranch and took photos and interviewed her. The story [New Funding Aims to Help Landowners Sequester Carbon in the Soil of Working Farms & Ranches](#) was just published on September 18, 2023.

## Boundless Farmstead

Provided by Megan and David [info@boundlessfarmstead.com](mailto:info@boundlessfarmstead.com) Bend, Oregon

Boundless Farmstead is a CSA farm and a 20-acre property, ten acres in mixed vegetable production and cover crop, one acre orchard, three acres in mixed outbuildings and house, and about six acres in pasture.



Here is sort of a crude map from Central Oregon Irrigation District that shows our field. The top half of our rectangular field is ten acres (where all of the rows are), the bottom half another ten acres (approximately). The top half is where we grow all of our vegetables/fruit and cover crop.



We practice crop rotation to minimize pests and disease. We cover crop with Rye, Triticale, Peas, Clover, and more to add green manure back to the land to sequester carbon. We wash our vegetables in fresh, clean Central Oregon water without adding bleach. We grow a diverse array of vegetables and never monocrop.

We divide the tens acres of production into 20 Blocks (Labeled 1 through 20). In a given year, the blocks will essentially alternate between cover crop and cash crop/vegetable production. All of these groupings will stay together and will move in rotation together. Our farm fertility and health are based around these practices: cover cropping and crop rotation.

We find it absolutely crucial to practice this level of crop rotation and cover cropping for a few reasons. Crop rotation is important because: (a) different crop families use different nutrients in the soil and growing them over and over again can either deplete soil or make it so more micronutrients and amendments must be added and (b) crop families can harbor diseases and pests and moving them frequently helps keep from a buildup of either. Cover cropping is very important to our farm specifically because (a) our soil quality is so poor (a very sandy loam), that we are trying to increase organic matter as much and as quickly as possible, (b) it helps from our topsoil eroding in our extremely windy environment, (c) it adds nutrients back to the soil in “green manure” form, (d) an added bonus is many cover crops act as insectaries and pollinator habitats.



Here is a photo of some of our cover cropping areas. We are very passionate about this practice. We plant rye, triticale, winter peas, and crimson clover to overwinter, we then mow and till in the crop. We then plant a non-frost tolerant but fast-growing cover crop like Sudan grass or buckwheat in blocks that will be planted early the following spring so that the cover crop will “frost kill” and will lay over to protect the soil the during the winter but be easy to work up in the spring. In blocks that won’t be planted until later in the season, we plant oats. The whole point of this type of cover cropping is to work in as much biomass every season as possible. Our rye cover crop can be up to seven feet tall, and our Sudan grass cover crop is currently over ten feet tall. This is a lot of organic matter to add back to our very sandy soil.



When we moved onto this farm, it had been a conventional hay farm for at least 12 years prior. The soil was very depleted and the microorganisms severely lacking. We have found that we still need to add micro and macro nutrients to the soil every year.

So, what do we do about amendments? First, we do soil testing every fall/winter. We do a test for each of our greenhouses, the east field cover crop blocks, the east field vegetable blocks, the west field cover crop blocks, and the west field vegetable blocks; in all, we do eight different tests.

Soil testing is crucial to know the right amount of nutrients to add without adding too much. Even in organic agriculture, too much organic fertilizer/amendments can be added and can create harm in the environment.

A video on our website shows a drive down the field. Notice the different blocks of vegetables, then cover crop, then vegetables, and so on. The blocks of white flowers are a cover crop: flowering buckwheat. The “blank” spaces are spots that have been harvested already and are tilled and ready for more cover crops.

You will find this and more of the information on their farm by going to their website and entering the “blog” section.



Megan and David of Boundless Farmstead

## OTHER

### Northwest Climate Hub

The Northwest Climate Hub features monthly newsletters on climate and conservation resources that are helpful for those interested in soil health and sequestration, as well as other topics. It is a USDA supported site.

Example newsletter: [September 2023](#)

*“Integrating climate change into USDA’s planning and decision making is critical to ensuring that America’s producers, who are on the front lines of climate change, are positioned to be successful in the long term.” Agriculture Secretary Tom Vilsack*

