REGENERATING PARADISE

rebuilding soil carbon in Hawai'i

HAWAI'I
CENTER FOR
FOOD SAFETY

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THE CHALLENGE

Currently, an excess of carbon dioxide (CO_2) currently exists in the Earth's atmosphere, which is warming the planet, acidifying our oceans, and increasing the frequency and severity of extreme weather events. These changes to our climate, resulting from high concentrations of atmospheric CO_2, are harming ecosystems and threatening our means of food production.

THE OPPORTUNITY

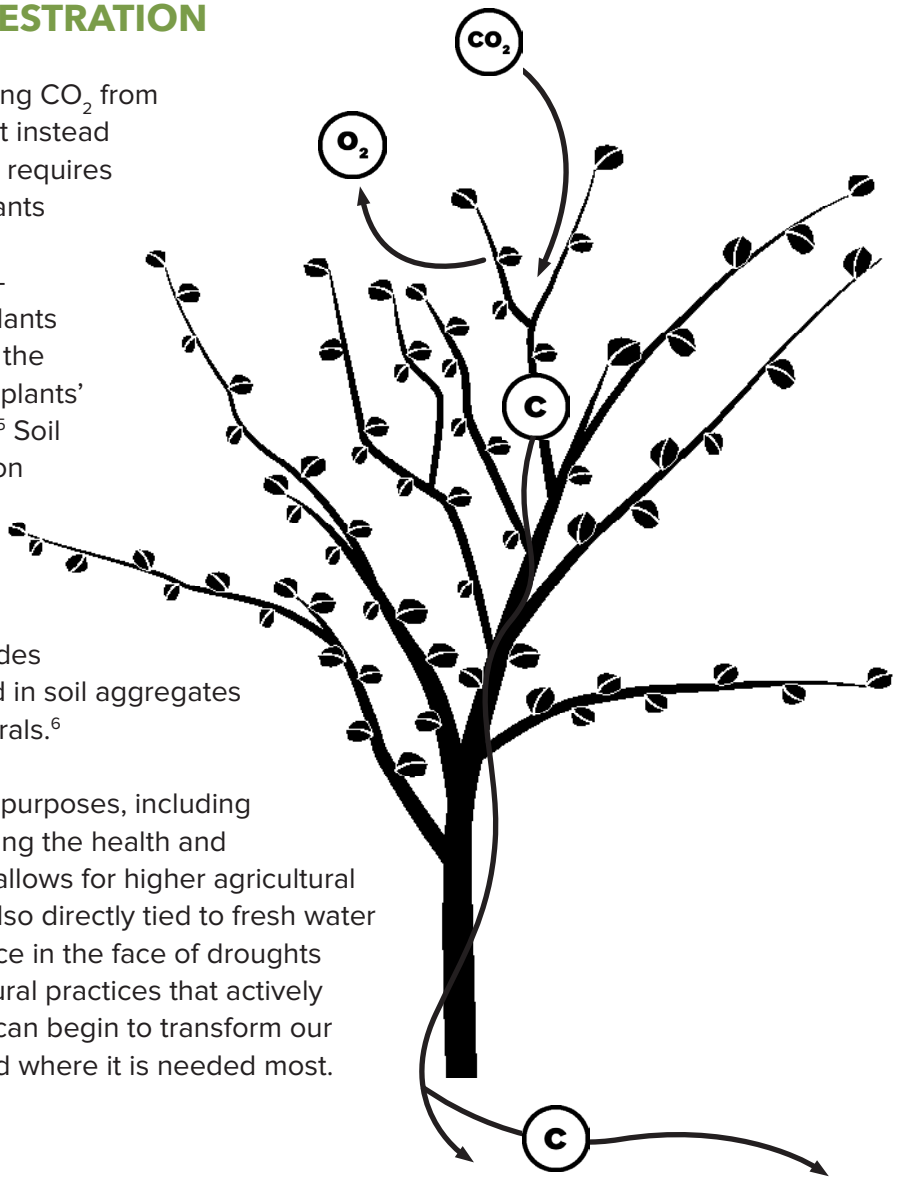
Thankfully, the resources necessary to address this challenge are within reach. Healthy soil captures and stores vast amounts of carbon. When managed with sustainable farming practices, soil can serve as a valuable tool in combatting climate change, by pulling carbon out of the atmosphere and storing it in the ground beneath our feet – a process called carbon sequestration. Soil carbon sequestration reduces the atmospheric concentration of CO_2, while supporting a more sustainable food production system and offers a risk-free, systemic solution.

THE CARBON CYCLE

Carbon is the building block of life and it's constantly cycling in between the land, ocean and atmosphere in various states — liquid, solid, and gas. Human activities have radically altered the natural cycling of carbon creating an imbalance in the system. Centuries of land use changes, extractive farming practices, and, the burning of fossil fuels for energy, have removed solid carbon from the earth and released it as CO_2, a gas, into the atmosphere.[1] While it is difficult to measure exactly how much carbon has been lost from our soils globally, an additional 292 billion tons have been added to the atmosphere through the burning of fossil fuels.[3] Once in the atmosphere, CO_2 acts as a greenhouse gas, allowing sun to pass through on its way to the Earth's surface, but trapping the heat that bounces back. An increase in the concentration of CO_2 in the atmosphere means that more heat is being trapped, leading to a rise in the Earth's average temperature and an imbalance in the global climate system.

BASICS OF CARBON SEQUESTRATION

Carbon sequestration involves removing CO_2 from the atmosphere naturally and storing it instead in soil and plants.[4] This transformation requires photosynthesis, a process in which plants convert sunlight, water, and CO_2 into carbohydrates. Some of these energy-rich molecules are then used by the plants to fuel growth, but as much as 40% of the CO_2 captured is released through the plants' roots to feed the soil microbes below.[5] Soil microorganisms transform these carbon resources, resulting in a complex mixture of plant and microbial biochemical compounds in various stages of decomposition. Soil organic carbon can persist in the soil for decades or millennia when physically protected in soil aggregates and chemically protected by soil minerals.[6]



Carbon sequestration serves multiple purposes, including mitigating climate change and improving the health and biodiversity of our global soils, which allows for higher agricultural yields. Healthy, carbon-rich soils are also directly tied to fresh water availability and create greater resilience in the face of droughts and floods.[7] By implementing agricultural practices that actively encourage carbon sequestration, we can begin to transform our soils and put carbon back into the land where it is needed most.

Project Drawdown estimates that by 2050, regenerative agriculture will increase from the current 108 million acres to 1 billion, resulting in a total reduction of 23.2 gigatons of carbon dioxide from both sequestration and reduced emissions.[9]

REGENERATIVE AGRICULTURAL PRACTICES

Soils are dynamic. They can act as a source or sink of carbon, depending on how they are managed.[8] The conversion of native grasslands to cropland, wide-scale deforestation, and practices that leave soil uncovered and exposed to the elements, encourage soil to act as a source of carbon, releasing it as CO_2 into the atmosphere. Regenerative agricultural practices do just the opposite, fostering soil's natural role as a carbon sink and enabling it to store carbon in a stable, solid form. Here are a few common regenerative practices well-suited to farming in Hawai'i:

CROP MANAGEMENT

CROP ROTATION

The practice of growing different crops on the same land in succession, in order to preserve a balance of nutrients in the soil and enhance ecosystem processes.

- Reduces the prevalence of early-season pests and damage from these insects.
- Improves productivity of rotation crops.
- Reduces the need for synthetic inputs and chemicals.
- Improves water quality.
- May increase farmers' profits, due to lower input costs and higher yields.

COVER CROPS

The practice of planting and maintaining crops that return nutrients to the soil and are typically not harvested, in order to avoid bare soil.

- Suppresses weed growth and common crop diseases.
- Lowers soil temperatures during hot weather.
- Improves soil fertility.
- Reduces soil erosion.
- Provides habitat for beneficial organisms.

PERENNIAL PLANTS

The practice of selecting and planting perennial crop varietals, which are better able to capture and store carbon than their annual counterparts.

- Increases soil's ability to capture and store carbon.
- Extensive root networks protect against soil erosion and runoff.
- Lowers annual labor and input costs.
- Improves soil structure and nutrient content.
- Increases soil's water storage capacity.

ORGANIC MATTER

COMPOSTING

The practice of collecting organic waste, such as food scraps and yard trimmings, and allowing them to decompose and transform into a nutrient-rich agricultural input.

- Reduces greenhouse gas emissions from landfills.
- Increases nutrient content of soil.
- Improves soil's ability to retain water.
- Increases agricultural yields.
- Supports the development of beneficial bacteria and fungi that facilitate soil carbon sequestration.

BIOCHAR

The practice of applying a porous charcoal made from organic matter (biochar) to the soil. While there are legitimate concerns about land grabs being made in the name of industrial-scale biochar farms, biochar can be part of a regenerative farming system if char is made from crop residues, farm wastes and unwanted invasive plant species.

- Improves soil's ability to retain water and nutrients.
- Reduces runoff.
- Increases soil fertility and crop yields.
- Protects against some soil-borne diseases.
- Increases soil's capacity to capture and store carbon.

CROP RESIDUE

The practice of leaving crop remains after harvest in the field to decompose rather than clearing them from the land.

- Reduces soil erosion.
- Increases nutrient availability.
- Moderates soil temperature.
- Suppresses weed growth.
- Increases biological activity.
- Improves soil fertility.

LAND USE SYSTEMS

AGROFORESTRY

The practice of incorporating trees and shrubs into crop and livestock production systems.

- Provides additional habitat for beneficial organisms.
- Decreases atmospheric CO_2 concentration and increases oxygen content.
- Reduces soil erosion.
- Improves health and stability of soil.
- Improves soil's ability to retain water.
- Increases crop yields.

SILVOPASTURE

The practice of incorporating forestry and forage into livestock production systems to enhance the grazing terrain.

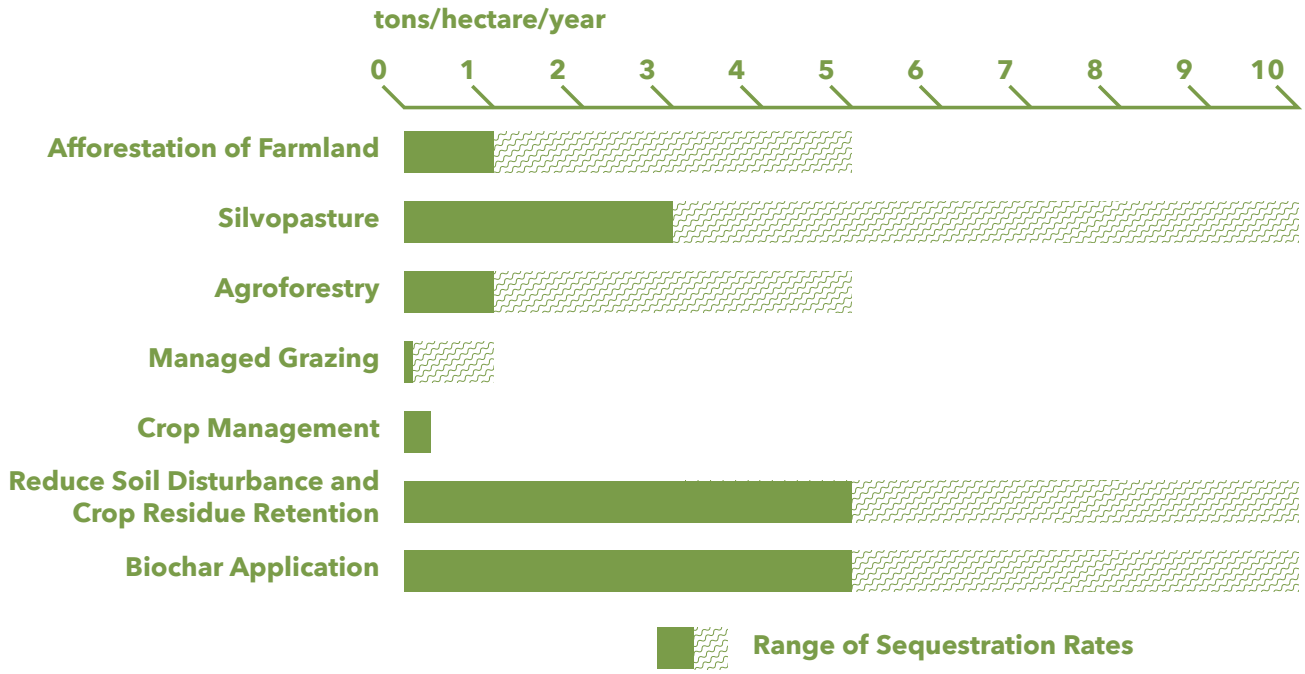
- Decreases atmospheric CO2 concentration and increases oxygen content.
- Reduces soil erosion.
- Improves health and stability of soil.
- Improves soil's ability to retain water.
- Improves economic viability of the production system through diversification.
- Protects livestock from heat and other extreme weather conditions.

ROTATIONAL GRAZING

The practice of dividing up land and allowing grazing in one area at a time, while the remaining areas "rest" and recover.

- Improves drought and flood tolerance.
- Reduces soil erosion and runoff.
- Enhances soil structure.
- Improves soil health and plant growth.
- Increase soil's capacity to capture and store carbon.

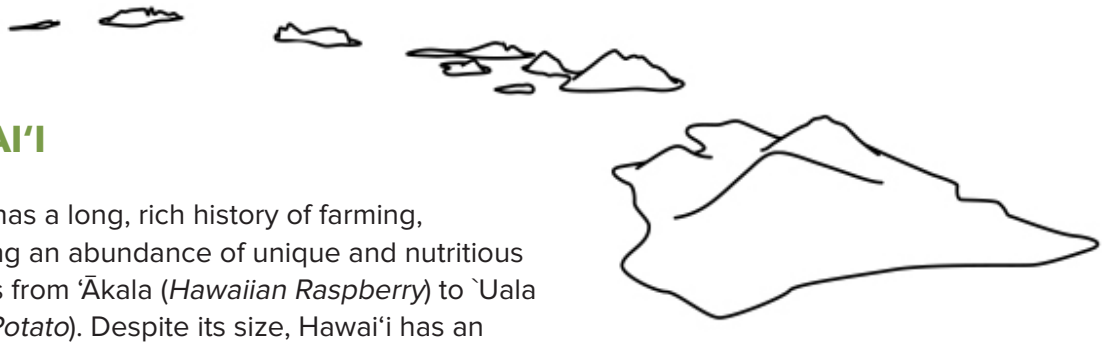
CARBON SEQUESTRATION RATES[10]



AGRICULTURAL PRACTICES TO AVOID

These practices pull carbon out of the soil and release it into the atmosphere.

- Paving over productive land
- Converting native grassland to cropland
- Large-scale deforestation
- Draining wetlands
- Burning peatlands
- Leaving soils uncovered and exposed to the elements
- Failing to feed microorganisms living in the soil with organic matter
- Burning fossil fuels
- Repeated tillage



HAWAIʻI

Hawaiʻi has a long, rich history of farming, producing an abundance of unique and nutritious products from ʻĀkala (*Hawaiian Raspberry*) to `Uala (*Sweet Potato*). Despite its size, Hawaiʻi has an incredible diversity of soil types and ecosystems. Of the 12 orders of soil in the world, 10 can be found in Hawaiʻi and over 70% of climate zones are represented within the state.[11] This diversity is ideal for producing a wide range of agricultural products year-round. As a result, Hawaiʻi is home to over 7,000 farm operations, which account for approximately 30% of the total land usage.[12]

The agricultural landscape in Hawaiʻi, once dominated by plantation and industrial scale production systems, has started to change since the decline of the sugar industry.[13] As these lands return to the hands of small-scale producers and as interest in reviving indigenous farming knowledge grows, there is an immense opportunity to redefine Hawaiʻi's production model and build a more diversified, regenerative system that benefits producers and consumers, while actively combatting climate change.

In addition to implementing regenerative farming practices, broader complimentary efforts, including establishing an expanded soil monitoring program, developing seed saving and exchange platforms, fostering farmer and rancher training programs, and investing in research on viable cover crops, perennial staple crops, and locally-sourced fertilizers would help to create a more sustainable and resilient Hawaiʻi.[14]

"Carbon is like the real estate business. It's all about location, location, location.

Carbon in the atmosphere is an enemy. Carbon in the soil is a friend."

- Christiana Figueres
Executive Secretary of
UNFCCC 2010-2016

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