Carbon Farming

Increasing fertility & water holding capacity
Providing solutions for climate change

The Carbon Cycle

Carbon constantly cycles through five pools on planet earth. Light energy coming from our sun functions as the fuel for the carbon cycle. The carbon cycle is a critical natural process that moves carbon through our atmosphere, biosphere, pedosphere, lithosphere, and oceans.

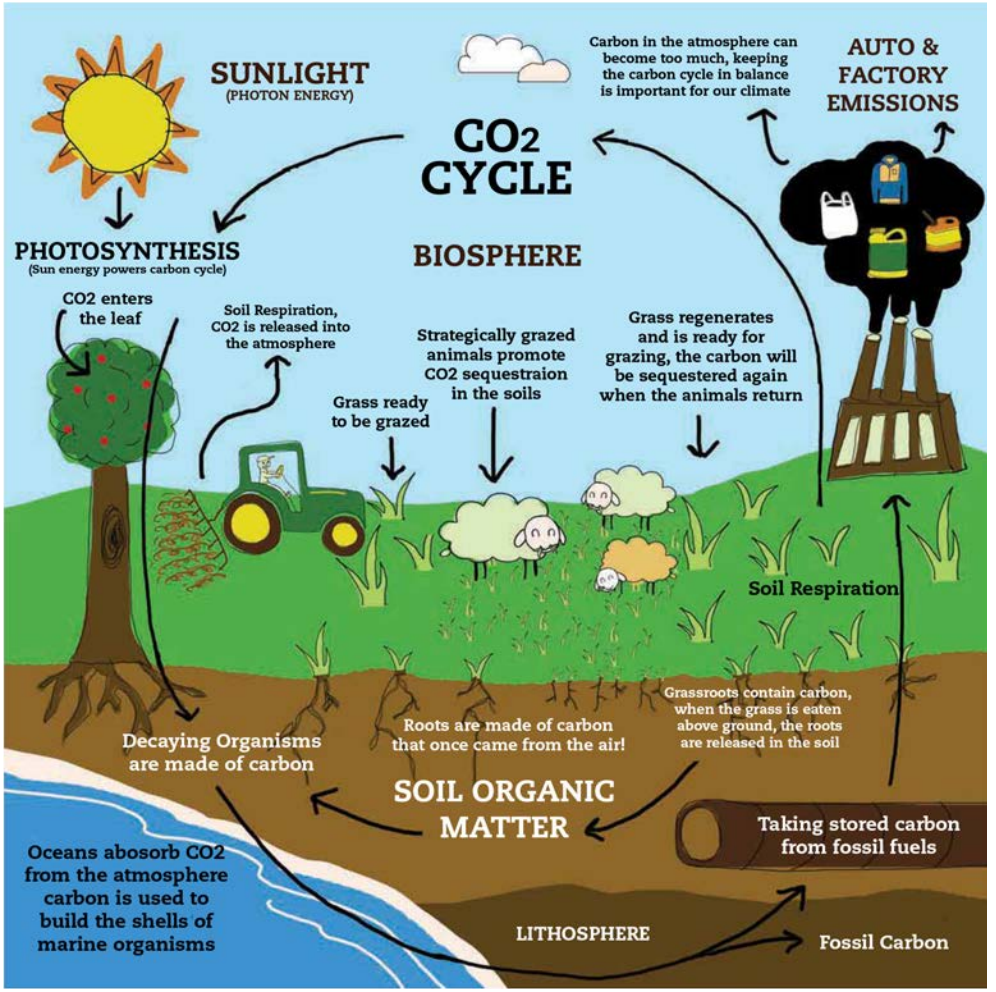
Human activity has tipped the balance of the carbon cycle through extracting enormous quantities of deeply sequestered fossil carbon as fossil fuels. These dense forms of carbon, when burned, release massive amounts of energy and carbon dioxide.

More carbon dioxide is now being released than the earth's land-based plant life and oceans can naturally reabsorb. The excess carbon dioxide has formed a blanket in our atmosphere—trapping the sun's heat and changing our climate, as seen in shifts in our earth's jet stream, ocean currents, and air temperature. Rainfall patterns are changing and glaciers (water storage for many communities) are melting quickly.

We have an opportunity to restore balance within the carbon cycle in a way that will ameliorate climate change, build resilience to drought and increase our agricultural productivity naturally. This document is an introduction to a natural solution called **Carbon Farming**.

CARBON CYCLE INSTITUTE

fibershed®
local fibers • local dyes • local labor



Why Carbon Farming?

Land management is the second largest contributor to carbon dioxide emissions on planet earth. Agriculture is the ONE sector that has the ability to transform from a net emitter of CO_2 to a net sequesterer of CO_2—there is no other human managed realm with this potential.

Common agricultural practices, including driving a tractor, tilling the soil, over-grazing, using fossil fuel based fertilizers, pesticides and herbicides result in significant carbon dioxide release. Alternatively, carbon can be stored long term (decades to centuries or more) beneficially in soils in a process called soil carbon sequestration. **Carbon Farming involves implementing practices that are known to improve the rate at which CO_2 is removed from the atmosphere and converted to plant material and/or soil organic matter.**

Carbon farming is successful when carbon gains resulting from enhanced land management and/or conservation practices exceed carbon losses.

Compost Protocol

Research by the Marin Carbon Project scientists indicates that a single application of a half-inch layer of compost on grazed rangelands significantly increases forage production (by 40-70%), increases soil water holding capacity (to 26,000 liters per hectare), and increases soil carbon sequestration by at least 1 ton per hectare per year for 30 years without re-application. Compost decomposition provides a slow release fertilizer to the soils, which, with improved soil moisture conditions, leads to increased plant growth. More plant growth leads to more carbon dioxide being removed from the atmosphere through the process of photosynthesis, leading to increased transfer of carbon dioxide through the plant to the soil as roots, root exudates and detritus, yielding additional soil carbon and water holding capacity increases. More water and more soil yields more plants, and the cycle ascends and spirals regeneratively, all from one initial compost application.

Implications for Our Climate

According to Marin Carbon Project research, sequestration of just one metric ton per hectare on half the rangeland area in California would offset 42 million metric tons of CO_2e, an amount equivalent to the annual green house gas emissions from energy use for all commercial and residential sectors in California.

Grasslands Are Key

Initial research was conducted on actively grazed rangelands. There are 23 million hectares of rangeland in California alone, and it is the largest land type on our planet today. Grasslands co-evolved with ungulates (hoofed animals) over millions of years. Properly scaled in space and time, grazing stimulates plant growth through a variety of mechanisms, resulting in increased cabon capture by the grazed ecosystem. Grasslands have great potential to function as a sponge for carbon dioxide from our atmosphere. However, test plots where grazing alone was measured continued to lose more carbon than they sequestered, illuminating that our rangelands might require a practice in addition to grazing to restore their natural carbon cycle balance. Test plots where compost was applied showed the greatest carbon sequestration gains. Not only has compost applied to grazed lands been demonstrated to be an effective way to increase soil carbon sequestration, it is also a proven method for avoiding emissions related to the anaerobic decomposition of organic waste material in landfills.

Efforts are now underway to adopt the compost protocol at state, national and international levels to support the financial incentivizing of this practice for the benefit of the landowner and the climate. The non-profit organization known as the American Carbon Registry (ACR) has approved a voluntary methodology for greenhouse gas emission reductions from compost additions to grazed grasslands. The ACR is a leader in creating high standards and protocols and has issued 37 million carbon off-sets since its inception.

In Addition to Compost..
Preliminary Carbon Farm Practice List

(The majority of these practices were selected from the USDA-NRCS GHG Ranking Tool)

- Mulching/compost application
- Residue and Tillage Management, No Till/Strip Till/Direct Seed
- Anaerobic Digester
- Multi-Story Cropping
- Windbreak/Shelterbelt Establishment
- Silvopasture Establishment
- Forage and Biomass Planting
- Nutrient Management
- Tree/Shrub Establishment
- Forest Stand Improvement
- Contour Buffer Strips
- Riparian Restoration
- Riparian Forest Buffer
- Vegetative Barrier
- Windbreak/Shelterbelt Renovation
- Alley Cropping
- Riparian Herbaceous Cover
- Range Planting
- Herbaceous Wind Barriers
- Critical Area Planting
- Residue and Tillage Management
- Forest Slash Treatment
- Filter Strip
- Grassed Waterway
- Hedgerow Planting
- Cross Wind Trap Strips Conservation Cover
- Wetland Restoration

Implications for Wool Producers

Rangeland systems are the foundation for the production of a significant quantity of our regional wool pool. Alpaca, llama and mohair producers also utilize pasture (*grazing lands, planted to introduced or domesticated native forage species, which receive periodic renovation and/or cultural treatments such as tillage, fertilization, mowing, weed control and irrigation*) and to some degree rangeland (*land supporting indigenous vegetation that either is grazed or that has the potential to be grazed, and is managed as a natural ecosystem; range includes grassland, grazable forestland, shrubland and pastureland*) for their agricultural practices.

All of these grass-fed, fiber-producing animals have the potential to graze on managed landscapes where carbon farming practices are being implemented. The financial incentives to support these practices are being built now. Carbon Farming Practices can be measured and monitored for the enhancement of permanent soil carbon storage, and therefore material coming from these landscapes can be verified as "Climate Beneficial™."

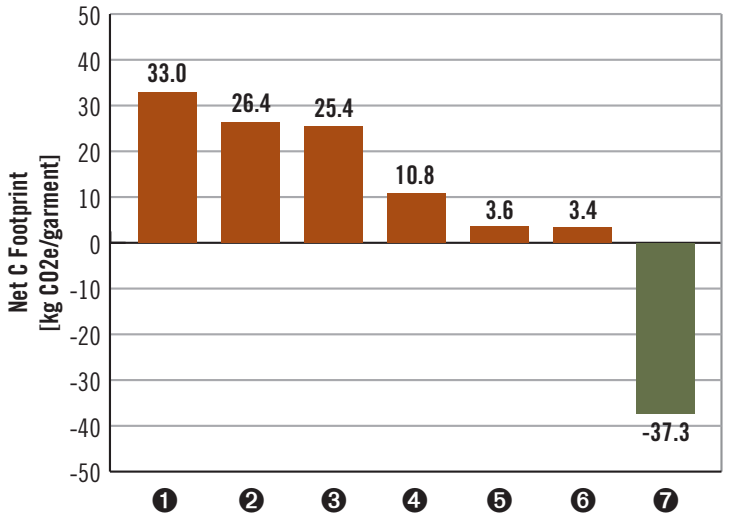
In an initial research study by Dr. Marcia deLonge of UC Berkeley's Silver Lab, it was shown that sheep grazed on compost-applied rangelands produce wool with a net carbon benefit; and subsequently moving this wool through a regional and renewable energy powered supply chain would produce a garment with a negative CO_2 footprint. Comparing conventional to carbon beneficial production shows a carbon footprint differential of over 150 pounds of CO_2 per garment.

Implications for Brands and Artisans

California wool was recently assessed for its quality and quantity. It is now known that a considerable amount (over 900,000 pounds per year) of California's wool is high enough quality for some form of garment production.

Breeds typical to the coastal range vary from breeds that are raised inland and in the foothills. This variation in breed and fiber type can be utilized to the advantage of brands and artisans in 'terroir to skin' programs— whereby the wool's geographical source becomes a determinant in creating the most appropriate garment.

Regional and place-based clothing will offer a new wave of opportunity to explore the potential of our landscape. Fibershed is developing a system for brands and artisans to invest directly into a non-profit fund to pay for the implementation of Carbon Farming on our local ranches and farms. Donations made to this fund create measurable beneficial climate impact, while supporting the drought resilience, and a diversity of forage and habitat. These early stage investments will bring about the creation of certified climate beneficial fiber for use in multiple garment and durable good contexts. Contact us directly for status updates and details.



❶ **Conventional Realistic:** CA grid-derived energy, slightly higher C footprint relative to other cases due to loss in soil C, synthetic fertilizer use, higher transportation costs

❷ **Conventional Optimistic:** CA grid-derived energy, but no increase in soil C

❸ **Fibershed Neutral Soil:** geothermal-derived energy, but no increase in soil C

❹ **Fibershed Conservative:** geothermal-derived energy, good land management increases soil C at a more conservative rate than Case7

❺ **Fibershed Realistic:** geothermal-derived energy, conservative compost credit, good land management increases soil C at a more conservative rate than Case7

❻ **Fibershed Possible:** solar-derived energy, conservative compost credit, good land management increases soil C at a more conservative rate than Case7

❼ **Fibershed Optimistic:** solar-derived energy, optimistic compost credit, good land management increases soil C at optimistic rate, minor reductions in C footprint relative to other cases at several steps (transportation distances, commuter mpg, animal emissions, air-dried clothes, etc.)

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