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'Dirt Rich' — Importance of Biochar and Regenerative Systems

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STORY AT-A-GLANCE

- An estimated 80% of soil carbon in heavily farmed areas has been lost due to destructive plowing, overgrazing and the use of carbon-depleting chemical fertilizers and pesticides
- By adding more carbon back into the soil and preventing carbon losses, we can address many of today's most pressing problems, including dwindling water reserves, soil degeneration and poor nutrition
- Carbon sequestration can reduce the carbon dioxide load in the atmosphere, and once sequestered in the soil, the carbon actively nourishes soil health and improves water retention
- Organic carbon is stored in soil by exclusively binding to certain soil structures, and the soil's capacity to absorb carbon dioxide is directly related to its health
- One way to increase carbon in your soil is to add biochar, which is created by slowly heating a biomass in a low-oxygen environment (such as a kiln) until everything but the carbon is burned off

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It's easy to forget that at one point, not so long ago, all food was organically grown in a way that supported the ecosystem and environment. This abruptly changed in the 1940s when the Green Revolution took hold and industrial, chemical-dependent farming techniques quickly spread to become the norm.

Organic farming sustained mankind for millennia. Industrial farming, on the other hand, has created a series of unsustainable situations in less than 70 years, and evidence suggests we may not make it until the end of the century if we continue along this path.

The good news is that there are answers, and that a growing section of our farming communities are starting to heed the warning signs. Consumers are also becoming increasingly aware of the problems associated with industrial farming and are demanding higher quality, more nutritious foods grown in a way that supports rather than strips the environment of its resources.

The featured documentary, "Dirt Rich," looks at these issues from the ground up, focusing on how we can improve soil quality — specifically by adding more carbon back into the soil and preventing carbon losses. It's now become clear that by doing that, we can turn many of today's most pressing problems around.

Industrial Farming Has Led Us Down a Dangerous Path

Topsoil destruction, erosion and desertification are all exacerbated by industrial practices such as tilling, chemical use, monocropping and not using cover crops. Maria-Helena Semedo of the Food and Agriculture Organization of the United Nations has warned that at the current rate of topsoil degradation, all the world's topsoil will be gone in less than 60 years.[1]

At that point, it'll be "game over" because without topsoil you cannot grow food no matter how many chemicals you add. Closely related problems are the loss of soil fertility and biodiversity, which is directly related to the loss of natural carbon in the soil.

An estimated 80% of soil carbon in heavily farmed areas has already been lost[2] due to destructive plowing, overgrazing and the use of carbon-depleting chemical fertilizers and pesticides. These practices, along with poor water management approaches, also contribute to climate change.[3]

Overall, the importance of carbon sequestration simply cannot be overstated. Not only will it reduce the carbon dioxide (CO_2) load in the atmosphere, but once sequestered in

the soil, the carbon actively nourishes soil health and improves water retention.

According to some estimates, a mere 1% increase in organic soil carbon could increase the land's water holding capacity by an additional 20,000 gallons per acre.[4] Moreover, any rain that falls will also be more effectively absorbed and used, rather than evaporating into the air or eroding soils by rapid runoff.

Dirt Rich — A Look at Carbon Sequestration

As discussed in the featured documentary, "Dirt Rich," raising the amount of carbon in soil — also known as carbon sequestration — will improve soil quality while combating climate change at the same time.

Indeed, the top 6 inches of soil are the most precious yet least understood ecosystem on Earth. To fully appreciate its importance to our survival, you need to understand the role carbon plays in maintaining the ecological balance. Importantly, carbon-rich organic matter is what gives soil its water-retention capacity, its structure and fertility, so it's really imperative to add organic matter back into the soil.

Even soil microbes need carbon to flourish, which is why slow and steady carbon depletion from our soils will inevitably lead to ecological collapse.[5] Deprived of carbon and critical microbes, soils become sterile, devoid of the microbial ecosystem.

Soil's Ability to Absorb Carbon Is Related to Its Health

Organic carbon is stored in soil by exclusively binding to certain soil structures, and the soil's capacity to absorb CO_2 is directly related to its health;[6] therefore, soil preservation and restoration needs to be incorporated into today's climate models.[7]

Much of the focus on reducing greenhouse gases revolves around reducing carbon emissions, but now that we're armed with rapidly expanding knowledge about carbon storage in soils, greater attention really should be paid to carbon sequestration and soil restoration.

Today, just 3% of North America's tallgrass prairie remains, resulting in a massive loss of soil carbon into the atmosphere. Wetlands are also crucial in this respect, as they keep carbon under water where it cannot escape. Many scientists say that regenerative agricultural practices can turn back the carbon clock, reducing atmospheric CO2 while also boosting soil productivity and increasing its resilience to floods, pests and drought. According to Yale:[8]

> *"The importance of soil carbon — how it is leached from the earth and how that process can be reversed — is the subject of intensifying scientific investigation, with important implications for the effort to slow the rapid rise of carbon dioxide in the atmosphere.*
>
> *Scientists say that more carbon resides in soil than in the atmosphere and all plant life combined; there are 2,500 billion tons of carbon in soil, compared with 800 billion tons in the atmosphere and 560 billion tons in plant and animal life. And compared to many proposed geoengineering fixes, storing carbon in soil is simple: It's a matter of returning carbon where it belongs."*

Rattan Lal, director of Ohio State University's Carbon Management and Sequestration Center, has also commented on this issue, saying:[9]

> *"The top priorities are restoring degraded and eroded lands, as well as avoiding deforestation and the farming of peatlands, which are a major reservoir of carbon and are easily decomposed upon drainage and cultivation ...*
>
> *Bringing carbon back into soils has to be done not only to offset fossil fuels, but also to feed our growing global population. We cannot feed people if soil is degraded."*

Industrial Agriculture Prevents Needed Carbon Sequestration

Plants draw CO2 out of the atmosphere and into the ground through the process of photosynthesis, and this is a far more efficient method than any carbon-reduction scheme man has been able to come up with. The plants convert this CO2 into a carbon

fuel used to stimulate and promote their own growth. Up to 40% of that carbon fuel also goes to the roots of the plant, where it's leaked out into the soil.

There, it becomes food for soil microorganisms. So, the plant nourishes the soil as much as the soil nourishes the plant. As mentioned, we've already lost up to 80% of the soil carbon in heavily farmed areas — a fact that really highlights the urgent need to improve carbon sequestration.[10]

Biochar Is One Way to Boost Carbon Content of Your Soil

So, how do you increase the amount of carbon in your soil? One way, which is the focus of the featured documentary, is to use biochar. Biochar is created by slowly heating a biomass in a low-oxygen environment, such as a kiln, until everything but the carbon is burned off. The resulting biochar — similar to charcoal — is then added to compost, sawdust or fish waste, for example, before being placed into the ground.

Historically, fire has been the driving force of the earth's carbon cycle. Natural fires started by lightning burned large swaths of plants and trees, returning the carbon back to the soil in the form of charcoal. Today, most societies take steps to prevent wildfires and greatly restrict burning practices.

"Dirt Rich" starts out on the big island of Hawaii, where a local farmer shows how he makes his own biochar in a simple burning pit. He also sells it to others, but notes that while the environmental benefits are at the top of his own list of why biochar is so great, it's nearly impossible to sell it on those grounds alone.

It's very difficult to make a living as a farmer, so unless it can boost profits, farmers often aren't willing to buy it. However, when farmers can see how environmental benefits also end up "landing in their own pocket," then it changes the dynamic and allows for a mutually beneficial exchange to take place between farmer and environment.

The filmmakers continue to Sonoma, California, where David Morell, vice president of the Sonoma Ecology Center, notes that as "magic" as biochar appears, it's ironically also one of its greatest drawbacks. It simply has so many positive impacts that it starts

sounding too good to be true. To the uninitiated, it can come across as an overhyped sales pitch.

Despite initial reluctance, it's hard to argue with the effects. One important factor that finally sold some California farmers on biochar is the fact that by improving soil quality, you significantly reduce the amount of water you need to use to raise a successful crop.

Cover Crops Cut Carbon Release

Aside from adding biochar, another key strategy that helps sequester carbon in soil is to grow cover crops. In other words, soil should never be left exposed, as without root systems holding the soil in place, soil erosion speeds up. Mixed grasses also nourish the soil microbiome, which need the plant interaction.

Nature abhors monoculture. In 1 square foot of pristine prairie land, you'll find about 140 different plants, and this is the type of natural biodiversity regenerative farmers aim to mimic. As noted by Regeneration International:[11]

> *"Storing carbon in the soil and maintaining perennial living soil cover (trees, pasture, grazing animals …) brings a host of benefits, including increased soil fertility and biological activity, improved wildlife and pollinator habitat, less vulnerability to disease, increased crop yield, increased drought and flood resilience and increased water-holding and filtration capacity."*

Wood Chips — Another Simple Way to Improve Soil Health

While not discussed in the featured documentary, another cost-effective alternative that will radically improve soil quality and the nutrient content of your food is to mulch with wood chips. Simply lay down uncomposted wood chips on top of your garden, using whatever is available locally, typically a combination of leaves, twigs and branches.

The chips gradually break down and are digested and redigested by a wide variety of bacteria, fungi and nematodes in the soil, which is exactly what happens in nature. After

a year or so, you'll develop lush soil underneath the chips that will happily support trees, vegetables or whatever else you're trying to grow.

The longer you leave the chips on and the deeper you heap them, the thicker your topsoil will be. Wood chips also significantly reduce the need for watering and eliminate your need for fertilizers.

If allowed to compost properly (they should not be disturbed by raking or tilling), woodchips can form massive amounts of humus, which is a component of healthy soil. Humus, which is only formed in nature,[12] consists mostly of carbon in complex molecules or aggregates, and because microorganisms cannot further decompose it, it's extremely stable.

In fact, humus can persist in soil for hundreds and even thousands of years. This is in contrast to "active" topsoil carbon, which is in continual flux between microbial hosts and the atmosphere. Some of the characteristics that make humus so beneficial includes the following:

- Like a big sponge, humus can hold up to 90% of its weight in water
- Because of its negative charge, many plant nutrients stick to humus (nitrogen, calcium, magnesium, phosphorous and others), preventing them from washing away and acting as nature's slow-release fertilizer
- Humus massively improves soil's structure, making it loose and friable and helping plants root by providing them better access to nutrients, water and oxygen
- Humus also helps filter toxic chemicals out of the soil, much like carbon-based water filtration systems filter toxins out of your water

The Need for Regenerative Agriculture Has Never Been Greater

Chemical-based agriculture has resulted in the destruction of rural economies, water and air pollution, depletion of aquifers, destruction of pollinators and biodiversity, soil erosion and loss of soil fertility, climate destabilization, food contamination, nutrient

degradation and the deterioration of public health. Even the government admits about half of all American adults now live with one or more chronic diseases, many of which are rooted in a nutrient-poor diet.[13]

Research shows organic foods contain higher amounts of antioxidants, especially in no-till regenerative systems,[14] and an antioxidant-rich diet is associated reduced risks for chronic diseases. So, to improve health we really need to improve nutrition, and to do that we must address food at its literal roots.

Healthy microbe-rich soil associated with regenerative, soil-centered, organic practices produces crops with higher levels of nutrients, without which maintaining health is difficult if not impossible.

Fortunately, while still in a clear minority, regenerative agriculture is growing exponentially with each passing year. Clearly, it is the way forward, as it addresses everything from rising CO2 levels to soil fertility, nutrition, ecological health and human health.

"Dirt Rich" discusses many of these benefits, specifically highlighting the importance of wetlands, polyculture and natural grazing within this larger scheme. As noted in this film, nature knows what it's doing. Nature, when left alone, takes care of itself and persists because everything works in a symbiotic fashion. The lesson we must learn is how to become more in sync with nature again, to help the soil and the planet as a whole. After all, we have nowhere else to go.

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