Regenerative Agriculture facts
Gathered by L. Hunter Lovins, Natural Capitalism Solutions

Regenerative agriculture

Regenerative agriculture is a holistic system of farms, farmers, and customers that balances the relationship between nature and the community.

Regenerative agriculture nourishes the soil on which all life depends, especially the microbial life that sequesters carbon in the earth [See, e.g. The work of Gabe Brown]. It turns from industrial farming, now imperiling human ability to grow food, and accepts the science that small-holder organic farming is the best way to feed the world. It revitalizes rural communities as it improves the health of our food and the environment on which food production depends.

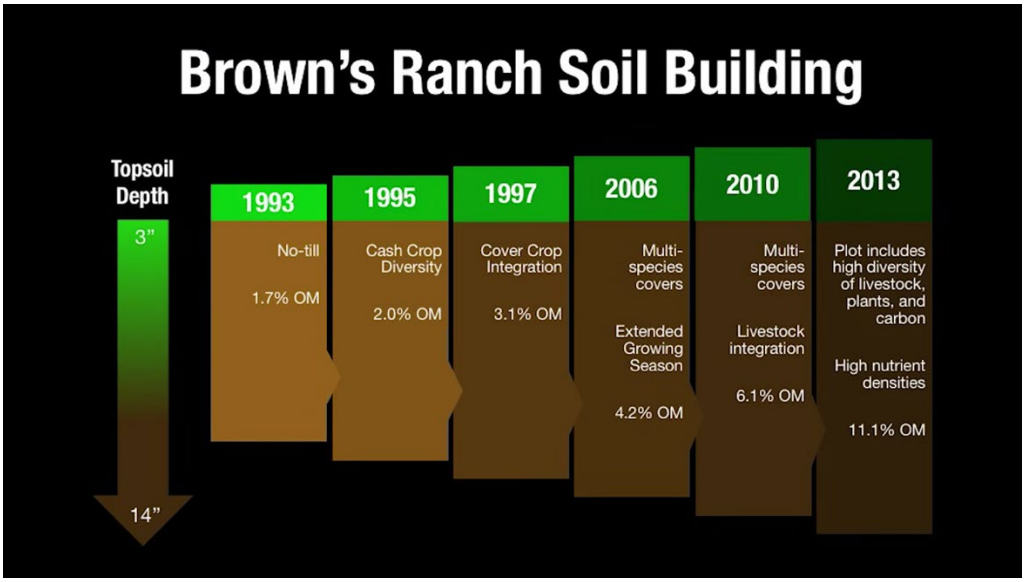
Regenerative grazing, pioneered by Savory Institute, and organic vegetable production long advocated by Rodale Institute, both restore soil structure, build healthy topsoil, nurture soil microbes, and promote biological activity, all of which contribute to long-term productivity and nutritious crops. Savory Institute's Land to Market program, and Ecological Outcome Verification enable producers to prosper from these replicable, verifiable practices.

This approach sequesters vast amounts of atmospheric CO2 as mineralized soil carbon, potentially reversing the climate crisis at a profit. Rough numbers are that every one percent increase in soil organic matter increases soil carbon five tons per acre and water holding capacity 20,000 gallons per acre. If these best practices were used on all the world's grasslands it could be possible, over 30 years-time, to return atmospheric concentrations of carbon dioxide to 280 parts per million, the pre-industrial level.

These practices enhance native biodiversity. Water use is optimized. Farm worker safety and investment in local businesses sustain farming communities. Because more people are needed to do the work that the chemicals previously did, regenerative farming increases employment, helping meet demand for jobs. Because such agriculture melds the best of modern science with ancient culture, such lives are rewarding and sustainable. For more information on the viability of these approaches see: A Finer Future, Creating an Economy in Service to Life.

Meet Gabe Brown, the farmer whose *Dirt To Soil* book is mentioned above.[i] He began farming his 2,000 acres near Bismarck, North Dakota, in 1993. Growing commodity corn and soybeans, he converted to regenerative agriculture to cut costs that were threatening his business. His soil quality was poor the shallow topsoil required annual inputs of fertilizer, pesticides, and herbicides to produce a crop. In 1995, Gabe implemented no-till production. In the ensuing years, he diversified into a variety of cash crops and began rotating his fields. In 1997, he added the use of a wide variety of multi-species cover crops. In 2006, he introduced Savory-style grazing practices, adding different livestock species, so that he now raises cows, sheep, broiler hens, and bees as well as corn and soybeans. His system has allowed him to stop using chemical inputs, dramatically cutting his costs and increasing his profitability. For example, in 2014, it cost him $1.35 to produce a bushel of corn, which he sold for more than $3.50. He cannot keep up with demand for his grass-finished beef and lamb, and his fields have never been healthier.

The water-extractable organic carbon (WEOC) is, however, the most amazing number. Gabe is recarbonizing his soils at a profit.



When Gabe bought his farm in 1993, it had shallow soils with 1.3 percent soil organic matter (soil carbon). By 2013, he had some plots with more than 11 percent soil organic matter. As Gabe puts it, if your soil is healthy you will have clean water, clean air, healthy plants, healthy animals, and healthy people. You will have a healthy ecosystem.

Carbon Underground[ii] and Soil4Climate believe that regenerative agriculture can displace all of the carbon emitted by humans each year and begin rapidly reversing global warming. A wealth of videos on the Soil4Climate site show the extent to which soil can sequester carbon and reverse climate change.[iii]

New science is showing that they might be right.

In some California experiments, manure from dairy and beef operations is blended with green waste that would otherwise go to landfill, impose costs, rot, and release methane. The mix is composted and spread on pastures. Scientists from the University of California, Berkeley, take annual soil cores a meter deep and test whether that soil has soaked up additional carbon. The answer? One application of compost to rangeland doubled grass growth and increased carbon sequestration by up to 70 percent.[iv] Every year the carbon increases. The study found that this can achieve total greenhouse gas (GHG) mitigation rates, over a 30-year time frame, of
more than 18 tons of CO2-equivalents per acre of land treated with organic amendments.[v]

The researchers noted,

> Sequestration of just 1 Mg C ha^{1} y^{-1} (or one metric ton per hectare — a hectare being 2.2 acres — per year) on half the 23 million hectares of rangeland in California would offset 42 million metric tons of CO_2e, an amount equivalent to all of the annual GHG emissions from energy use for commercial and residential sectors in California.[vi]

David Johnson, director of the Institute for Sustainable Agricultural Research at New Mexico State University, has developed a similar approach. His research has shown that[vii]
Promoting beneficial interactions between plants and soil microbes increases farm and rangeland's efficiency for capturing carbon and storing it in soil. These same interactions increase soil microbial carbon-use efficiencies reducing the rate at which soil carbon, as CO2, is respired from the soil. When

this bio-technology is promoted in agroecosystems, it is feasible to capture and sequester an average of 11 metric tons of CO2 per hectare per year in rangeland soils[viii] and >36.7 metric tons CO2 per hectare per year in transitioning farmland soils[ix] all for less than one-tenth the cost of EPA's recommended Carbon Capture Utilization and Storage (CCUS) technologies.

Using his biologically enhanced agricultural management approach (BEAM), he developed to create fungal-dominated compost, Johnson documented that during an agricultural field study lasting 4.5 years, there was a 25-times increase in active soil fungal biomass and an annual average capture and storage of 10.27 metric tons soil carbon per hectare per year year (approximately 38,000 pounds of CO2 per acre per year). That's 20-50 times the currently observed soil carbon increase in the 40 equivalent no-till soils tested. Crop yields were also dramatically improved. Johnson reports that the cotton he used in his testing grew 6 feet high and produced over five bales of cotton per acre without fertilizers, herbicides or insecticides. The average in his area is about two and a half bales per acre. Australian farmers using similar methods have seen yields of 3 tons of wheat in areas that produced about 1.6 tons previously.[x]

A team from Tufts University[xi] wrote,

> Soil carbon restoration is emerging as a potential strategy to mitigate global warming while also enhancing food and water security. The Paris Agreement, although a laudable achievement for the international community, is insufficient to meet its basic goal of 2ÅãC (2 degrees Celsius warming) by 2100, while scientists have warned that, in fact, 1.5ÅãC is the maximum that should be permitted to avoid catastrophic impacts. In order to close the emissions gap between nationally determined contributions under the Paris agreement and necessary carbon reductions to avoid the most extreme climate disruptions, extensive sequestration of carbon dioxide from the atmosphere is required.
>
> Globally, soils have the potential to sequester up to 3.4 GtC (gigatons of carbon) per year, just enough to close the "emissions gap." If combined with other atmospheric CO2 removal efforts, such as reforestation, yearly additional carbon capture in soils and forests could be as high as 5 GtC per year. When combined with deep cuts in fossil fuel emissions, this could lead to a substantial overall reduction in atmospheric carbon dioxide.

Texas A&M soil scientist Richard Teague, chronicling what he calls Adaptive Multipaddock (AMP) essentially Holistic management grazing in east Texas, has measured sequestration of 3 tons of carbon per hectare per year over a decade (tC/ha/yr).[xii] Soil scientist Megan Machmuller measured the increase in carbon in a conversion from row cropping to management-intensive grazing achieving as high as 8 tons per hectare per year in Georgia, or almost three times the mount measured by Teague.[xiii]

Put all of these numbers together and what does it add up to? Current emissions from fossil fuels are about 10 GtC/yr. Teague and his colleagues calculated that almost a gigaton could be soaked up just in North American soils.[xiv]

The world's permanent pasture and fodder lands amount to roughly 3.4 billion hectares. Back-of-the-envelope calculations with Seth Itzkan of Soil4Climate show that multiplying Teague's carbon capture findings of 3 tC/ha/yr (conservative when compared with the 8 tC/ha/yr values Machmuller identified) by the global hectares of pastureland gives 10.2 GtC/yr potential soil carbon capture via grazing. That, alone, would offset all human emissions.[xv] Itzkan and his colleagues point out that this calculation assumes only modest sequestration. If more aggressive assumptions are used, it would be possible over

30 years-time to return atmospheric concentrations of carbon dioxide to 280 parts per million, the pre-industrial level.

Itzkan cites new work in Zambia where pig farmers, using mobile cages are achieving dramatic increases in soil carbon. He writes:

> Using this method, Sebastian Scott has increased his soil organic matter (SOM) from approximately 0.5% (typical for the sandy soil in the area) to 2.5%. For those of you doing math at home, that equates to 9.6 TONS of carbon per acre or 24 TONS of carbon per hectare *increase*. Over large enough areas (such as size of Zambia) that equates to 1.8 BILLION TONS or 1.8 GIGATONS of sequestered CARBON. The numbers get large, quick, and if you're trying to mitigate global warming, this is what you want. Of course, this is more than just a carbon play, for each additional 1% of SOM (such as from 1% to 2%), you are increasing the water holding capacity by 20,000 gallons per acre or 50,000 gallons per hectare. Converting to liters, this is about 190,000 liters per hectare. Think that would mitigate drought and extend the growing season in semiarid areas?[xvi]

Daniel Riordin, in his book Averting Global Collapse, described the numbers necessary to scale this approach. Using current global livestock numbers of 2.24 billion standard animal units, rangeland and crop/ pasture land could carry 10.33 billion livestock. Doing this would require a minimum of 2.5 million herders (assuming 1,000 head/ herder). Like most sustainable agriculture, Holistic Management is more labor-intensive, not a bad thing in a world needing jobs.[xvii]

The natural and organic foods sector is growing. Globally, organic retailers are seeing up to a 30% boost since COVID. Nationally the food market as a whole grows at a bit over 1%, but the organic market, now at over $50 billion a year, grows at over 5% annually. With the shutdown in big supply chains, more people are looking to local agriculture. Subscriptions for Community Supported Agriculture are on a waiting list basis. Local dairies that deliver are seeing dramatically increased business. Joe Cloud, who owns T&E Meats in Harrisonburg, Virginia, observed, “These big plants are being forced to shut down, they slaughter 6,500 animals a day — six times my annual output,” he said. “A plant like mine is inefficient and our meat prices are higher, but there’s a lot more resiliency.”

Interestingly, some small-scale farmers, although they have been largely excluded from bailout programs, are adapting better than their industrial competitors. Nationally, more than 167,000 small farms sell $8.7 billion worth of meat and produce directly to consumers, restaurants and retailers each year. With some farm stands and farmers markets closed due to the pandemic, many shifted their businesses online, and farms across the country report that customers are following in droves. Huffington Post profiled Longmont’s Sky Pilot Farms, scrambling to meet increased demand from on-line and drive-up customers to their farm stand.

Brian Coppom, Director of the Boulder Farmers’ Market stated, “The silver lining in all of this, is that more folks are waking up to the inadequacies of the industrial food system, and that they’re responding by buying locally. It’s a foundation we can build on — Coppom estimates that based on acreage alone, agriculture done on Boulder County could feed 25-30% of the population.” How much of our needs could Colorado supply, and how would doing that improve our economy?

Even before COVID, the world faced food shortages. Climate change threatens global food supplies, and the way we are doing agriculture is worsening climate change. Many of the world’s refugees are fleeing

global warming driven farm failures. Even in the U.S, almost 90 million people were food insecure before COVID. COVID has brought hunger to many more.

The growing popularity of regenerative agriculture is attracting major agricultural companies. General Mills has committed to help farmers on a million acres implement regenerative practices. Danone, Kellogg, Nestlé, and a dozen other companies, at the recent United Nations Climate Action Summit in New York City, announced the One Planet Business for Biodiversity (OP2B) coalition to promote regenerative agriculture. Land O'Lakes, the large dairy conglomerate promises to increase sustainability on 1.5 million acres of U.S.-grown corn. Microsoft has pledged to go not only carbon neutral, but carbon negative by 2030 using regenerative agriculture and nature-based solutions to remove all of the carbon that the company ever emitted. Walmart has pledged to become a regenerative company, tho it has no idea what that means or how to do it. It is good that these giants are seeking to transform, but essential that we realize that authentic regenerative agriculture starts by listening to the farmers on the ground and supporting small holder producers.

Urban dwellers tend to think that food comes from a grocery store, forgetting that such establishments are a relatively recent phenomenon, dating only from the late 1940s, and that food comes from the hard work and spare lifestyles of our rural residents, or from brittle supply chains bringing produce from half a world away.

Those supply chains are breaking under COVID, as prized products from toilet paper to bacon disappears from store shelves, and food lines stretch for blocks. The system of vertically integrated confined animal feeding operations delivers 105 billion pounds annually of poultry, pork, beef and lamb every year in the U.S, nearly double what it produced three decades ago, but this model of efficiency has proven unable to cope with any dislocation.

Most meat processing takes place in a small number of plants controlled by four corporations, Tyson Foods, Smithfield Foods, JBS USA Holdings Inc., and Cargill Inc, that process over 80 percent of the beef and more than 60 percent of poultry and pork sold in supermarkets. Poultry is so vertically integrated that corporations like Tyson own the chickens. Everybody getting that chicken to the store is a contractor for Tyson. Since COVID, meat processing capacity in the U.S. is down 40 percent. That amounts to 200,000 excess pigs a day that will become a million pigs a week with nowhere to go but a mass grave because meatpacking plants to process them are closed by COVID. Millions of chickens, pigs and cattle are being culled because front-line workers in the meat packing plants, operations more reminiscent of Upton Sinclair's *The Jungle* than the corner butcher shop, are dying of COVID-19.

A study by Oklahoma State University projected that the pandemic could bleed the beef industry of an estimated $13.6 billion. This means that prices to the consumer are up but livestock prices for farmers are collapsing.

One report observed, "The same features that allow a steady churn of cheap meat also provide the perfect breeding ground for airborne diseases like the coronavirus: a cramped workplace, a culture of underreporting illnesses, and a cadre of rural, immigrant and undocumented workers who share transportation and close living quarters….As of May 20, officials have publicly linked at least 15,300 COVID-19 infections to 192 U.S. meatpacking plants, according to tracking by the Midwest Center for Investigative Reporting. At least 63 workers have died." In the 1950's meatpacking workers were unionized, and earned almost $35,000 a year, with paid sick time. Now the norm is under $30,000, and only one in five packers are unionized.

Farm laborers and grocery store workers are also at risk. The United Food and Commercial Workers (UFCW) International Union, warns that more than 100,000 grocery workers have been exposed and 68 have died. Clearly, one of the challenges to the industry is to ensure worker safety, and rethink the supply chains to make them more locally robust and resilient.

Studies have shown that areas with high rates of organic farming have lower levels of poverty and higher household incomes. One piece of research identified 225 counties in the United States in organic hotspots—counties with high levels of organic agricultural activity that have neighboring counties with high organic activity. It looked at how the organic hotspots impact key county-level economic indicators. Organic Hotspots boost household incomes and reduce poverty levels—and at greater rates than general agriculture activity, and even more than major anti-poverty programs. Being an Organic Hotspot increases median household income by over $2,000. Being an Organic Hotspot lowers a county's poverty rate by as much as 1.35 percentage points.

A 2012 study by M+R Strategic Services found that organic agriculture creates 21 percent more jobs than conventional agriculture, with 28,000 jobs for every $1 billion in sales. A similar study in the UK found that organic agriculture delivers 32 percent more jobs than conventional.

Most Federal farm programs are oriented only to support big farming. Globally agricultural subsidies top $1 million a minute. A recent report from the Food and Land Use Coalition called for a 10-point program to reverse destructive agriculture practices, including:

1: Promoting healthy diets
2: Scaling productive and regenerative agriculture
3: Protecting and restoring nature
4: Securing a healthy and productive ocean
5: Diversifying protein supply
6: Reducing food loss and waste
7: Building local loops and linkages
8: Harnessing the digital revolution
9: Delivering stronger rural livelihoods
10: Improving gender equality and accelerating the demographic transition

The European Union recently published its Farm to Fork and Biodiversity strategies as part of its strategy on the European Green Deal, which remains a priority for Europe. This calls for:

- Reduction in pesticides by 50% and fertilizers by 20% by 2030 and an increase in organic farming.
- EU sales for antimicrobials for farmed animals and in aquaculture will be reduced by 50% while the share of organic farming would be increased by 25% by 2030.
- "The EU Commission is committed to halve per capita food waste at retail and consumer levels by 2030." It will use new data expected by the member states in 2022 to set a baseline for legally binding targets.

It calls for sustainable food systems that:

- have a neutral or positive environmental impact
- help to mitigate climate change and adapt to its impacts

- reverse the loss of biodiversity
- ensure food security, nutrition and public health, making sure that everyone has access to sufficient, safe, nutritious, sustainable food
- preserve affordability of food while generating fairer economic returns, fostering competitiveness of the EU supply sector and promoting fair trade

Even in the U.S. change is coming. Elizabeth Warren and Cory Booker recently introduced The Farm System Reform Act to prohibit new large factory farms from going into business and force others to cease expansions before halting operations entirely within two decades. It would impose an immediate ban on new CAFOs and phase our all large factory farming by 204, with voluntary buyouts for smaller operations. "The COVID-19 crisis will make it easier for Big Ag to get even bigger, gobble up smaller farms, and lead to fewer choices for consumers….We need to start reversing the hyper-concentration in our farm economy."

Fake meat is, well, just that: fake. A study of the regenerative operations at Will Harris' White Oak Pastures found that their agriculture sequesters at least 3.5 (about 1.3 kilograms) of carbon being stored in White Oak Pastures' soil for every pound of White Oak Pastures beef meat. In comparison, proponent of Impossible Burger show that their industrial farming of GMO-soy or peas for their meat substitute releases at least 3.5 lbs of carbon dioxide equivalent for every pound of fake meat that is consumed. "*The irony is you'd have to eat almost exactly one pound of our grass-fed beef to offset the carbon emitted from eating a pound of their stuff made from commodity crops*," laughed Harris.

In general, regenerative farmers seek to use only manure from livestock produced onsite as fertilizer, supplanting synthetic nutrients derived from natural gas. They grow their own organic seed, rejecting costly industrially produced, genetically modified, chemically-coated seed. They trade locally for what they cannot produce themselves, creating a vibrant web of community.

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[iii] Soil 4 Climate, https://www.soil4climate.org/resources.html

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[xvi] Seth Itzkan, "This is How You Build Soil Carbon in Zambia: With Pigs," Facebook, 16 January 2020, https://www.facebook.com/groups/Soil4Climate/permalink/2593480324257039/

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