Regenerative Agriculture:
Benefits to Productivity and the Environment

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Conservation Resources

Table of Contents

Summary

Healthy soil is critical to sustaining farming productivity and is critical to supporting life on our planet. As such, soils need to be protected from degradation. (see Figure 1). At Conservation Resources, we view regenerative agriculture as farming and ranching in synchrony with nature to repair, rebuild, revitalize and restore ecosystem health beginning with life in the soil and moving to life above soil. We believe that transitioning from traditional, industrial agricultural practices to regenerative practices is necessary to promote a positive, sustainable impact for the environment and for the farmer. Our goal is to regenerate soil by increasing organic matter to enhance the health of our soil, water, and air, while increasing cash flows from improved productivity and reduced costs for the farmer. We believe this will lead to improved results for the farming community and a better overall return on our investments.

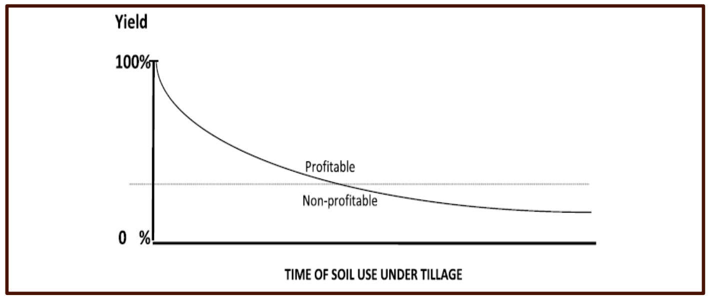

Figure 1. An illustration of yield losses due to organic matter loss and soil degradation through time with tillage. Source: Derpsch et al. 2024. Nature's laws of declining soil productivity and Conservation Agriculture. Soil Security: 14 (2024) 100127.

The key principles to regenerate the soil biology include cessation of tillage or minimal soil disturbance, permanent biomass soil cover, biodiversity in crop rotations and addition of livestock for grazing, all of which mimic natural systems[1]. Every action a farmer implements on the farm produces compounding or cascading results, which are never neutral in nature but either positive or negative. By implementing these key principles, the soil health impacts are compounded and not simply additive. For example, combining the use of cover crops and the cessation of tillage resulted in more soil carbon sequestration (110% more in arable land and 96% more in vineyards) than when these practices were applied individually[2].

From a financial perspective, loss of organic matter leads to costly management prescriptions to maintain soils and their ability to produce crops. These increased costs increase the need for nutrient inputs (e.g. fertilizers) and capital expenditures designed to mitigate the consequences of poor soil health and soil loss (see Figure 2).

Figure 2. Example of soil erosion and resulting physical degradation of the land.

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[1] Derpsch, et al. 2024. Nature's laws of declining soil productivity and Conservation Agriculture. Soil Security: 14 (2024) 100127.
[2] Villat J and Nicholas KA. 2024. Quantifying soil carbon sequestration from regenerative agricultural practices in crops and vineyards. Front. Sustain. Food Syst. 7:1234108.

Although there is an awareness of the negative consequences of tillage and other conventional methods in agriculture, there can be a resistance to change due to familiarity with traditional industry practices and risk aversion due to the variability in profits realized by farmers from one year to the next. American farmers have implemented traditional, conventional farming methods for generations and have excelled at doing so. Still, the case must be made that changing farming practices will not only benefit the environment, but also the individual farmers and their long-term economic viability. In that vein, we partner with our operators by structuring long-term leases and providing capital for efficiency and safety improvements so the regenerative transition can result in improved profits for the farmer as well as the investor – we view this as the only way to scale regenerative agriculture for the long-term.

Across our portfolio of farmland at Conservation Resources, we have eliminated or reduced tillage and soil disturbance and ensure there is a living root in the soil all year long. Prior to implementing these practices, our soils had almost no biomass soil cover and afterwards began building armor to protect the soil surface. We monitor a suite of metrics including soil carbon, soil biodiversity, aggregate stability, and water infiltration rates.

Characteristics of Regenerative Management

No-Tillage

The Dust Bowl era of the 1930s exemplified the negative consequences that indiscriminate tillage practices can generate. In the Midwest United States, two factors created ideal conditions for large scale farming and the implementation of mechanized tilling and harvesting; huge expanses of land with few natural borders and soils that were easily plowed. For years, deep-rooted native grasslands across the plains that held soils in place over the millennia were tilled and farmed until little native grasslands remained. The continued tillage of these soils dissipated organic matter, leaving soils exposed and vulnerable to the elements. Exacerbating the potential for soil loss was a "perfect storm" of weather patterns that developed across the plains over several years in the 1930s. These were characterized by unseasonably high temperatures, a prolonged

Figure 3. Dust storm in 1937 - Hooker, Oklahoma

drought, and continual windstorms across the region (see Figure 3). The scale of the Dust Bowl catastrophe was significant. As stated in an article in the Foundation for Economic Education[3]:

- On a single day, April 14, 1935, known to history as Black Sunday[4], more dirt was displaced in the air (around 300 million tons) during a massive dust storm than was moved to build the Panama Canal.
- Dirt from as far away as Illinois and Kansas was blown to points east, including New York City and states on the East Coast.
- By 1934, it was estimated that 100 million acres of farmland had lost all or most of its topsoil to the winds.
- During the same April as Black Sunday, 1935, one of FDR's advisors, Hugh Hammond Bennett, was in Washington, DC, on his way to testify before Congress about the need for soil conservation legislation. A dust storm arrived in Washington all the way from the Great Plains. As a dusty gloom spread over the nation's capital and blotted out the sun, Bennett explained, "This, gentlemen, is what I have been talking about." Congress passed the Soil Conservation Act that same year.

Although there were a significant number of factors that came together for the Dust Bowl to occur, tillage practices established the physical conditions that subsequently drove this negative outcome. If the lands had not been tilled, the soils would have remained in place despite this period's elevated temperatures, drought conditions and rampant winds

The basic definition of tillage involves inverting and turning the first 6-12 inches of soil prior to planting crops. The practice has always been incorporated to facilitate several factors in the farming process, such as planting preparation, weed suppression, soil aeration, turning over cover crops and forages, burying heavy crop residue, leveling the soil, incorporating fertilizer into the root zone, and other attributes[5]. Unfortunately, over time the negative consequences of this practice can outweigh the benefits.

When soil is tilled, plant matter previously covering the soil is turned over. As a result of exposure to air and water, via precipitation, plant matter begins to decompose, and organic matter dissipates. Although some believe that tilling the top layer of plant growth into the ground balances out any loss of organic matter, research shows that the actual loss of organic matter is up to four times the amount of organic material that was tilled in the soil, if the process continues[6].

With the soil exposed, bad outcomes occur in both dry and wet weather conditions. During dry conditions, wind crossing over the unplanted fields sweeps up topsoil and blows it away, such as when that occurred in the Dust Bowl era. Conversely, when it rains, each raindrop hits the exposed soil and causes micro-explosions, shooting soil into the air (see Figure 4). This subsequently results in erosion (see Figure 2) as stated in an article written by Mahdi Al-Kaisi and Mark Licht of Iowa State University.

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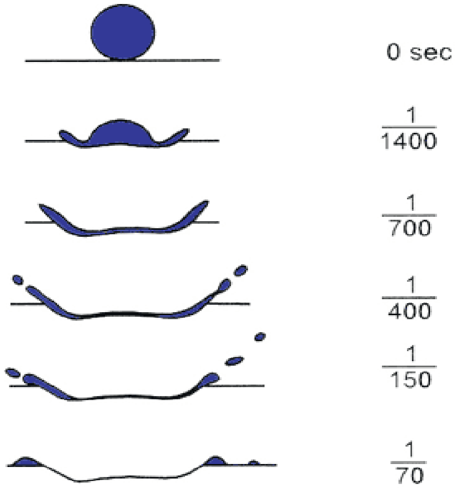
[3] Foundation for Economic Education. 2020. The Great Dust Bowl of the 1930s was a Policy-Made Disaster. https://fee.org/articles/the-great-dust-bowl-of-the-1930s-was-a-policy-made-disaster/

[4] National Weather Service. 2023. 88th Anniversary of April 1935 Dust Storm (Black Sunday). https://www.weather.gov/ddc/BlackSunday1935

[5] Iowa State University Extension and Outreach. Frequent tillage and its impact on soil quality. https://crops.extension.iastate.edu/encyclopedia/frequent-tillage-and-its-impact-soil-quality

[6] Franzluebbers, A.J. 2005. Soil organic carbon sequestration and agricultural greenhouse gas emissions in the southeastern USA. Soil & Tillage Research 83: 120–147



In a normal rainfall, raindrops range in size from 1 to 7 millimeters in diameter and hit the ground going as fast as 20 miles per hour. The impact of millions of raindrops hitting the bare soil surface can be incredible, dislodging soil particles and splashing them 3 to 5 feet away. A heavy rainstorm may splash as much as 90 tons of soil per acre. However, the majority of the soil splashed is not immediately lost from the field. Most of the splashed soil particles don't leave the field; they clog surface pores, which in turn reduces water infiltration, increases water runoff, and increases soil erosion.

Figure 4. Sequential profile of a raindrop splash pattern. Source: Hillel, D. 1998. Environmental Soil Physics. Academic Press.

As the organic particles which bind the soil disappear either through decomposition, wind, or precipitation, the soils become less stable and with each tillage pass, the problem compounds until the land can no longer effectively support productive agriculture without significant inputs (e.g. fertilizers).

There are varying degrees of tillage, each classified by the amount of residue left on the soil surface. Each degree can be categorized into three systems:

1. Conventional tillage approaches typically involve a primary pass with a heavy tillage tool to invert the soil and bury materials, such as fertilizers, amendments, weeds, etc., at the surface, followed by one or more secondary passes to break clods and create a friable[7] seedbed. Conventional tillage practices usually leave little crop residue in its wake.

2. Reduced tillage systems limit the number of passes over the field, recognizing significant fuel savings. Conservation tillage is a subset of reduced tillage systems and typically leaves more than 30% of the soil surface covered with crop residue. Note: Without a friable seedbed, specialized planters are used to drill seeds to known depths and pack the soil tightly, ensuring good seed-soil contact for germination.

3. No-till systems are based on the idea that tillage can be eliminated except for specialized seed drills that create a shallow and narrow slice to drop the seed. Traditionally, no-till has been associated with genetically modified crops and herbicides to control weeds. Today, however, growers are beginning to plant crops into dense stands of cover crops (see next section)—all without tillage and using rolling crimpers (see Figure 5) to kill the cover crops when planting. The cover crops reduce erosion, build soil health, and mitigate climate change by sequestering carbon.

Figure 5. A regenerative method (the roller crimper) for cover crop termination instead of using either tillage or herbicides.

[7] Friable means easily crumbled or pulverized, per Merriam-Webster dictionary.

Figure 6 pictorially portrays each of the three tillage systems and the number of tractor passes in each system. As depicted, in the first system, a tractor will pass over the soil five times to produce one growth cycle in crops. Reduced tillage generally requires three tractor passes, while with no-till there generally needs only one tractor pass, which is also the planting pass (Note: When introducing crimping to kill the cover matter, a no-till system will require two passes).

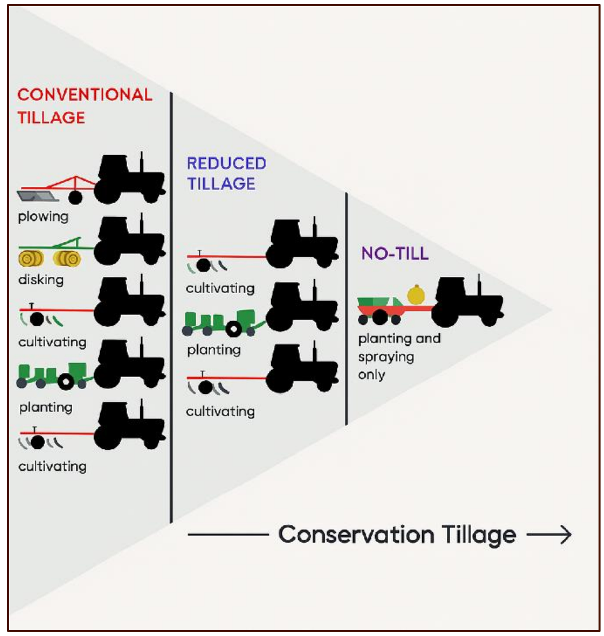


Figure 6. Depiction of tillage practices highlighting the number of trips over the field (costing labor and fuel).

Within the spectrum of tillage approaches, soils possess varying abilities to absorb and hold water. This is related to the number and connectivity of pores in the soil which allows water to run through and/or collect. With each subsequent tillage pass, the soil becomes less absorbent due to this loss and connectivity caused by tillage. In one experiment, the absorption rate of soil was measured between a no-till farm to an adjacent field with conservation tillage[8]. The absorption rate was calculated indirectly by measuring water runoff during a rainstorm dropping 1.76 inches of water on both fields. On the conservation-tilled farm, 60% of the water ran off the property while on the no-till farm, there was a runoff loss of 3%. The loss of organic matter due to tillage results in a less porous soil structure. With less pores in the soil, the water had few spaces to fill in the soil and so ran off in greater quantities on the tilled farm. It only takes one tillage pass to disrupt organic matter and pores contained in that matter, thus restricting the ability of water to seep into the soil and be absorbed.

Cover Crops

No-till practices are a key farming method to reverse the loss of soil organic material due to modern agriculture practices. No-till and, to a lesser extent, conservation tillage, significantly reduce soil erosion and loss of organic matter. When traditional tillage practices are terminated, organic matter is restored when a continual base of plant life is established on the topsoil. To effectively regenerate soil organic matter, cover crops need to be added to the no-till management regime. Cover crops are various species of plant life introduced and grown for the protection and enrichment of the soil when it would otherwise be left fallow or have a perpetual weed or grass cover. Introducing a cover crop speeds up organic matter formation in the soil. In addition, depending on the cover crops introduced, different advantages to productivity can be achieved

Cover crops, depending on the management regime they are part of, provide several agroecosystem benefits including, but not limited to:

- erosion control,
- weed and pest suppression,
- nutrient retention and supply,
- wildlife habitat and biodiversity,
- soil health improvement, and
- carbon sequestration.

[8] Waddell and Weil. 1996. Water distribution in soil under ridge-till and no-till corn. Soil Science Soc. Am. J. 60:230-237.

Cover crops can be valuable regardless of the type of tillage implemented. They are most effective in conjunction with no-till as their benefits will improve soil health and, ultimately, farm productivity.

Different mixes of cover crops produce different benefits in the soil beyond holding it in place. Grasses have fibrous root systems that scavenge leftover nutrients, incorporating those valuable nutrients and then redistributing them back in the soil. Legumes' taproots create nitrogen fertilizer from the air with symbiotic bacteria. Radishes burrow, alleviating compaction and discouraging soil pests. In addition to this, root systems of each cover crop sequester carbon, which is reintroduced via the increased organic matter of the soil.

Synergistic results can develop by planting varying cover crops on the same land. For example, when legumes and grasses are planted together, nitrogen fixed by legumes can be transferred through soil to the companion grass mixtures, boosting the production of both species as compared to seeding separately. While nitrogen and other nutrients created or mined by cover crop roots create short-term benefits such as reduced fertilizer needs, cover crops can also ensure the longer-term benefit of assuring that the soil stays active, well fed, and continues to develop organic material as a result of the roots that are living and biodegrading under the soil. Today, various blends of cover crop seeds are tailored to soil and climate conditions for a variety of functions that combine to create healthier soils, enhanced productivity, and sequestered carbon.

Economics of Implementing No-Till with Cover Crop

Minimizing tillage is a key component of a soil health management system. As a result of improved soil organic matter after implementing no-till and cover crops, many other physical, chemical, and biological soil properties are positively affected. As a result, many capital inputs such as fertilizers, soil stabilizers, water systems, and drainage systems can be reduced or entirely removed.

Switching to No-Till

There are many factors that impact the time it takes for the benefits of no-till to make up for the loss in the productivity of standard tillage practices. In various farm regions, switching to no-till will yield immediate results due to the water savings and cost reductions, whereas in other regions it may be years before no-till productivity gains are cost effective when compared with tillage approaches.

A review of research was conducted taking data from several discrete tests conducted across the United States and Canada which compared tillage and no-tillage practices on corn and soybean farms[9]. The tests, when averaged together, revealed that differences in yield between the two practices were negligible (-0.5% for corn and +0.7% for soybeans). However, when the tests were grouped by region, they did show that there were significant differences in yield between the two practices influenced by environmental conditions.

For example, during the first growing season, no-till yields were equal to or slightly less than tillage yields in the northern US and Canada, where cold, wet spring conditions and poorly drained soils cause slower emergence and development of crops without the tilling.

[9] DeFelice, et al. 2006. Can we end the debate on no-till yields? Mississippi Soybean Promotion Board.

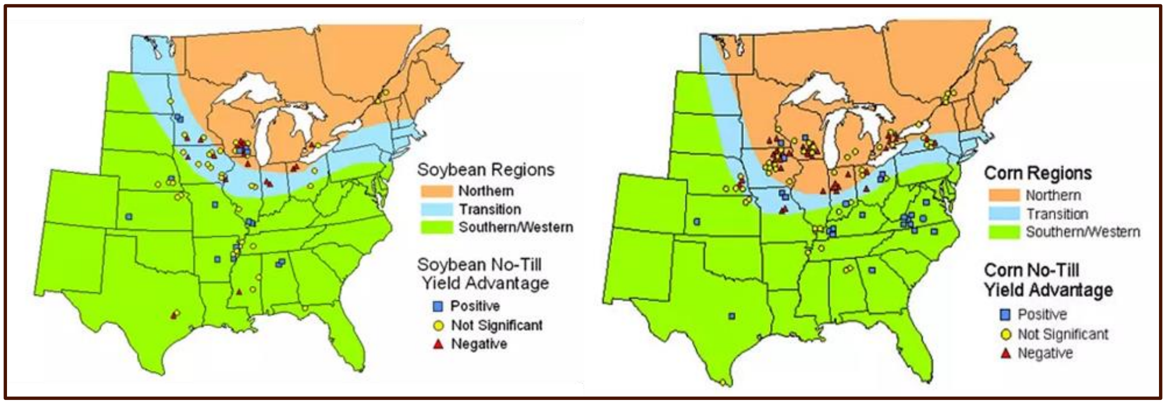


Figure 8. Corn and soya yield comparisons in tilled and no-tilled farms in the major production regions of the United States and Canada. Source: DeFelice, et al. 2006. Can we end the debate on no-till yields? Mississippi Soybean Promotion Board.

The snapshot presented in Figure 8 includes both new and established no-till farms. The Kellogg Biological Station in southwest Michigan measured a 3 metric ton (tonne) per acre loss in yield after implementing no-till compared to conventional tillage systems. After the second season, no-till yields increased at a rate of 1 tonne per acre per year over the next 30 years compared to conventional tillage systems[10]: In other words, yields in the no-till system caught up after year 3. Soil moisture was found to increase immediately after abating tillage, increasing 0.03% every year.

Climate patterns across this region of Michigan produce ample rain for crops, however, they can cause significant run-off on tilled soils. The introduction of no-till reduces costs associated with this run-off and erosion. In Kansas, a drier region where soil water storage is key, no-till yields are superior to tilled yields for corn, soybeans, wheat, and sorghum[11] as the benefit of increased soil water absorption is magnified. Since no-till allows more rain to enter the soil and the soil then holds this water like a sponge, no-till fields indicated in Figure 9 will almost always have increased yields and, by extension, reduced costs associated with irrigation.

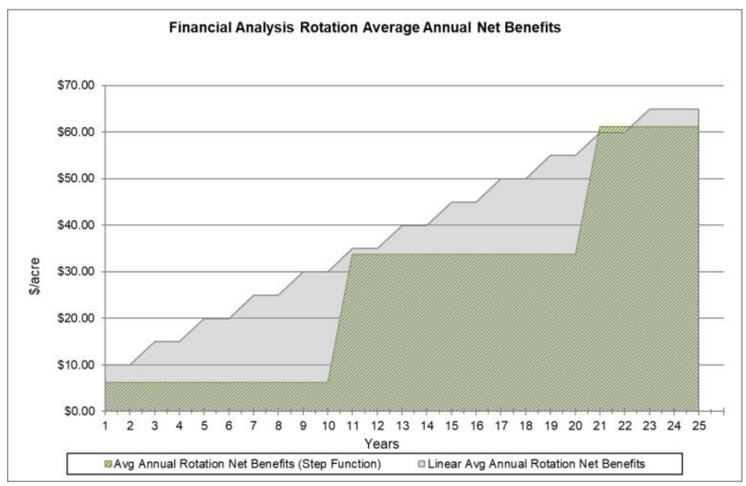


Figure 9. Financial analysis of implementing a no-till cover crop in a corn/soy rotation in the US Corn Belt. Source: USDA Cover Crop Economics Tool.

In eastern, southern, and western U.S. farmland regions where the weather was hotter and drier, the no-till yields outperformed due to a more efficient absorption of water in the soil in these drier areas.

Adding Cover Crops

As discussed, no-till efforts will mitigate erosion and build a healthy pore system in the soil. It is also beneficial as a transitional process where the lands lay fallow. The USDA's Cover Crop Economics Tool[12] assesses the financial costs and benefits of incorporating cover crops into a crop rotation. The tool assesses both short-

[10] Cusser et al., 2020. Long-term research avoids spurious and misleading trends in sustainability attributes of no-till. Glob. Change Biol. 2020;26:3715-3725.
[11] Ibendahl, G. 2016. A profitability comparison of no-till and tillage farms. Kansas State Publication GI-2016.5.
[12] USDA Cover Crop Economics Tool. Iowa NRCS Cover Crop Economics. https://www.nrcs.usda.gov/resources/guides-and-instructions/iowa-nrcs-cover-crop-economics

term and long-term expected costs and benefits. For example, taking a corn/soybean rotation, with a cover crop that costs $49.20 per acre per year, or roughly 7.5% of crop revenue[13], results in the following short-term and long-term financial benefits:

Short-Term Benefits	**($/Ac/Yr)**	**% of Revenue**
Herbicide/Insecticide/Fungicide Input Reduction	$4.60	0.82%
Erosion Reduction	$28.12	4.98%
Yield Improvement after Cover Cropping	$11.30	2.05%
Total Short-Term Benefits	$44.02	7.79%

In the "Long-Term Benefits" table below, the two benefit categories (Overall Soil Fertility Benefit and Water Storage Benefit) assume a 1% soil organic matter increase every decade and are exclusive to the long-term analysis performed.

Long-Term Benefits	**($/Ac/Yr)**	**% of Revenue**
Overall Soil Fertility Benefit	$9.82	1.74%
Water Storage Benefit	$8.20	1.45%
Total Long-Term Benefits	$18.02	3.19%

The long-term benefits, both financial and environmental, are greatest when cover crops are introduced to a no-till farm. However, such a radical change relative to traditional farm practices of the last few hundred years can be challenging, so first introducing cover crops, before moving to no-till, can ease that transition. Agricultural systems that mimic the natural world tend to be more efficient, sustainable, and profitable. Using continuous, long-term no-till practices with cover crops is an agricultural system that mimics the natural world and restores ecosystem functionality.

Outcomes of Regenerative Management

For the last few decades, a large proportion of the scientific community has accepted that no-till management systems with low soil disturbance, biomass soil cover, and diversity of crops (including cover crops) offer many advantages that are not possible with conventional tillage-based systems[14]. The advantages and benefits of regenerative management include:

- Reduced labor and time
- Reduced machinery wear and tear
- Fuel savings
- Improved long-term productivity
- Improved surface water quality
- Reduced soil erosion
- Higher soil moisture retention
- Improved water infiltration
- Improved soil health
- Increased biodiversity
- Reduced release of CO_2 to the atmosphere
- Increased carbon sequestration

The list above reflects a consensus of the scientific community as to the advantages of regenerative management. This has led to the concept of a "living soil" acknowledging the importance of ecological concepts and their importance in carbon and nutrient-, water-, energy-cycling. This requires following the

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[13] Assumes average revenue of $565 per acre from a corn/soya rotation (corn: $4.00/bu * USDA trendline yield of 170 bushel per acre, soya: $9.00/bu * USDA trendline yield of 50 bushels/acre)

[14] Triplett, G.B., W.A. Dick. 2008. No-tillage crop production: A revolution in agriculture! Agron. J. 100 (2008), 153-165. https://doi.org/10.2134/agronj2007.0005c.

key concepts of regenerative management to enable synergistic benefits for a fully functioning soil ecosystem and the entire agro-ecosystem and delivering a wider range of ecosystem services.

Carbon

Approximately 60% of soil organic matter is comprised of carbon and, as stated above, tillage exacerbates the loss of organic matter and the release of carbon into the atmosphere. To provide context, from the beginning of the industrial revolution through the mid-1970s, more carbon was released into the atmosphere because of agricultural land use practices than was released by burning fossil fuels. Fossil fuel combustion only overtook agriculture as the top emitter of carbon[15] after this period in the 1970s which is remarkable when one considers that the Industrial Revolution and its ensuing global economic development was fueled by fossil fuel-intensive activities prior to this timeframe. Despite the Industrial Revolution, two world wars and the post-World War II reconstruction of many regions of the world occurring during this 1760-1970 period, the loss of carbon from modern agricultural practices exceeded that caused by other means. Even today, agriculture, grazing practices, and agricultural biomass burning are estimated to be responsible for as much carbon in the atmosphere on an annual basis as fossil fuel burning[16].

Since the advent of the plow, approximately two-thirds of the carbon in the world's agricultural soils have been displaced[17]. Today, a typical Midwest agriculture region may hold the equivalent to 24,000 pounds of carbon in the top 6.5 inches of an acre of soil. For context, an acre slice of soil 6.5 inches deep ("acre slice") weighs approximately 2 million pounds[18]. A healthy soil mix in this region would traditionally be comprised of 6% organic material, equating to a carbon weight of 72,000 pounds per acre slice. With the loss of organic matter, on average in these soil types, each acre slice has lost 48,000 pounds of sequestered carbon to the atmosphere, primarily due to tillage practices. Our strategy for these soil and agriculture types is to move agriculture practices to no-till and reduced-till, along with the introduction of cover crops. In these cases, we estimate that we can build carbon in the soil at a rate of 1 tonne, or approximately 2,200 pounds per acre slice, per year. Over a decade, that equates to 10 tonnes or 22,000 pounds of CO_2 sequestered back into the soil. In twenty-five years, we estimate that changing to these practices can regenerate the organic matter of these agriculture soils to their original condition. Given the widespread degree of tillage used on such agriculture soils, the potential for mitigating climate change through carbon sequestration is significant. Financially, we believe there is an untapped opportunity to create verifiable carbon credits for the growing world market.

Crop Nutrient Density

Emerging research provides a scientific basis for the connection between regenerative agriculture and enhanced nutrient density in crops. At the core of this relationship is the restoration of soil biology – particularly the increase in soil organic matter, microbial biomass, and root-microbe interactions – which collectively improve the plant's access to essential nutrients and bioactive compounds.

Studies comparing regenerative and conventional systems show that regenerative farms, characterized by reduced or no tillage, the use of diverse cover crops, and minimal chemical inputs, consistently produce crops with higher levels of micronutrients and phytochemicals. For instance, a recent study found that regenerative systems produced wheat and other crops with improved mineral content (e.g., higher concentrations of iron,

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[15] Lal, R. Managing world soils for food security and environmental quality. Advances in Agronomy, volume 74, p 155-192.
[16] Allan Savory with Jody Butterfield, *Holistic Management*, *A Common Sense Revolution to Restore Our Environment*, Island Press 2016
[17] Penn State Extension 2022. What Is an "Acre Furrow Slice" of Soil? https://extension.psu.edu/what-is-an-acre-furrow-slice-of-soil
[18] Ibid

magnesium, and zinc), along with elevated levels of vitamins B1, B2, C, E, and K. Notably, leafy greens and legumes exhibited the most pronounced nutritional improvements[19].

The rhizophagy cycle – a biological process through which plants extract nutrients from endophytic bacteria and fungi – has also been shown to be more active in biologically rich, regeneratively managed soils. Healthy root systems surrounded by diverse microbial communities can actively internalize and digest microbes to gain access to otherwise unavailable nutrients, a mechanism dependent on healthy soil biology and continuous root presence throughout the year[20].

These mechanisms appear to reverse decades of nutrient loss associated with conventional farming. A comparative study found a 19% loss in magnesium, 29% in calcium, 37% in iron, and 62% in copper from common foods since 1940[21]. Regenerative practices are positioned as one of the most effective solutions to this trend by revitalizing the soil's biological nutrient cycling pathways.

Beyond minerals and vitamins, regenerative agriculture enhances phytochemical levels, which are plant compounds associated with long-term human health benefits. Research shows that regenerative systems increased levels of carotenoids by 15%, phenolics by 20%, and phytosterols by 22% across various crops, with some crops such as cabbage containing more than twice the phenolics and phytosterols as their conventional counterparts[22].

Taken together, the evidence suggests that restoring the biological function of soils through regenerative practices can significantly improve the nutrient density of food—benefiting both human health and ecosystem integrity.

Biodiversity

Regenerative agriculture fosters biodiversity across the entire agro-ecosystem, restoring complex relationships between soil, plants, and wildlife that are often disrupted in conventional systems. By emphasizing practices such as no-tillage, diverse cover cropping, rotational grazing, and the reduction or elimination of synthetic inputs, regenerative systems create environments where life above and below the soil can thrive in tandem.

At the microbial level, regenerative management significantly enhances soil biodiversity. Eliminating soil disturbance allows for the development of stable microhabitats, where bacteria, fungi (particularly mycorrhizal fungi), nematodes, protozoa, and beneficial arthropods can flourish. These organisms form the foundation of a living soil ecosystem, driving critical processes such as nutrient cycling, carbon sequestration, disease suppression, and aggregate formation. For example, a 2022 study found that regenerative farms, when compared to paired conventional operations, had 80% more soil organic matter and Haney test scores that were 1.5 times higher – clear indicators of a richer, more biologically active soil profile[23].

This enriched microbial community is also essential for nutrient exchange between plants and microbes. The rhizophagy cycle described by White et al. (2018) highlights how roots internalize and extract nutrients from

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[19] Montgomery, et al. 2022. Soil health and nutrient density: preliminary comparison of regenerative and conventional farming. PeerJ 10:e12848.

[20] White, J.F., K.L. Kiingsley, S.K. Verma, and K.P. Kowalski. 2018. Rizophagy Cycle: An oxidative process in plants for nutrient extraction from symbiotic microbes. Microorganisme (22018) 6:95.

[21] Thomas, D. 2007. The mineral depletion of foods available to us as a nation (1940-2002), Nutrition and Health, 19:21-55.

[22] Montgomery, et al. 2022. Soil health and nutrient density: preliminary comparison of regenerative and conventional farming. PeerJ 10:e12848.

[23] Montgomery, et al. 2022. Soil health and nutrient density: preliminary comparison of regenerative and conventional farming. PeerJ 10:e12848.

soil bacteria in a process that depends on the continuous presence of living roots and a diverse microbial community – conditions facilitated by cover cropping and low-disturbance farming[24].

Above the ground, regenerative practices expand habitat and food resources for a diverse array of species. Polyculture cropping systems, hedgerows, flowering cover crops, and rotational livestock integration all support increased abundance and diversity of pollinators, birds, predatory insects, and other wildlife. For instance, multi-species cover crop blends provide forage and shelter throughout the year, enhancing habitat continuity and supporting natural pest control mechanisms. Likewise, livestock-managed grazing stimulates grassland rejuvenation and supports ground-nesting bird populations by preventing monoculture dominance.

The integration of these biological communities enhances not only the ecological integrity of farmland but also its resilience. Farms with higher biodiversity are generally more resistant to pest outbreaks, more adaptable to climate variability, and less dependent on synthetic inputs for fertility and pest control. Ultimately, regenerative agriculture does not simply conserve biodiversity, it actively rebuilds it, aligning agricultural productivity with the preservation and enrichment of life at all levels of the ecosystem.

On-Farm Results

At Conservation Resources, all investment properties are farmed regeneratively and/or organically. Key indicators we track include organic matter content, soil microbial biodiversity, aggregate stability, water infiltration rate, and biomass surface cover, among others. We intend to continue taking soil samples at regular intervals to track and validate our progress.

Figure 12. Sheep resting after grazing under our wine grapes (June 2025).

We have eliminated tillage on all our farms except one in southeast Arkansas, where we have implemented a conservation tillage program, consistent with the regenerative practice of reducing tillage but appropriate for the region's specific soil, water and climate characteristics. In Arkansas, we are growing so called "row rice," an activity where we irrigate down the row instead of flooding the entire field. Farming rice this way has several environmental benefits compared to traditional flood irrigation. Row rice requires a minimal amount of tillage in order to establish the crop. To facilitate row irrigation, the tenant "disks" the soils and pulls a "hipper" to create a small channel to carry the water to the end of the field. The ensuing soya crop is

[24] White, J.F., K.L. Kiingsley, S.K. Verma, and K.P. Kowalski. 2018. Rizophagy Cycle: An oxidative process in plants for nutrient extraction from symbiotic microbes. Microorganisme (22018) 6:95.

produced without tillage. Row rice has lower methane and nitrous oxide emissions than flood irrigated rice[25]. The carbon sequestered and emissions reduced are monetized through our partnership with the Agoro Carbon Alliance, producing additional income. This farm is also unique because we are reforesting the riparian buffer of a nearby river to create habitat, increase diversity, and provide additional income from carbon sequestration.

On our Texas properties, we have created permanent pasture, improved fencing, and upgraded water supply for cattle grazing. Tillage and synthetic fertilizer on the permanent pasture has been eliminated. We are fulfilling all the principles to regenerate soil carbon and health and have received carbon revenue for these efforts, producing additional income for the investments.

Figure 13. Cover crop planted the previous fall under our cherry trees.

While technically, permanent pasture is not a cover crop, it serves the same purpose to ensure a living root in the soil all year long. So, on all our farms besides those in Texas, we have planted diverse cover crop blends (grasses, legumes, and forbs), to ensure a living root in winter, provide diversity, and reduce weed emergence in spring. On our wine grape vineyard in California, we employed sheep to terminate the cover crop this past spring for the first time (see Figure 12). As a result of the grazing, budgeted mowing costs were reduced, more than offsetting the cost of the cover crop seed. Likewise, on our cherry orchard in Washington, the cover crop smothered emerging weeds in the spring and protected the soil from erosion (see Figure 13). These two results show the short-term benefits and cost effectiveness of implementing regenerative practices.

Conclusion

At Conservation Resources, we believe that a regenerative agriculture program that implements reduced tillage methods and cover crops can lead to positive outcomes and have a favorable impact. In our opinion, placing an emphasis on building organic matter is not only smart, but necessary.

[25] Jiang, et al. 2019. Water management to mitigate the global warming potential of rice systems: A global meta-analysis. Field Crops Research: 234 (2019) 47-54. Doi: 10.1016/j.fcr.2019.02.010

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