The Promise of Regenerative Agriculture: Environmental and Operational Benefits of Conservation Tillage and Cover Cropping

Over the past two decades, global farming practices have been changing rapidly, responding to the need to stay competitive in increasingly global markets while adapting to changing consumer behavior. Consumers have become increasingly aware and sensitive to the environmental impacts resulting from growing, processing and delivering the food products they buy. Major food companies are responding to their customers and are increasingly tracking and documenting the sourcing of the farm products they use, to be able to demonstrate that they were produced in a sustainable manner with farming practices that minimize negative impacts on the environment.

The process of developing and codifying environmentally-friendly sustainable practices for the U.S. farm sector has been gaining momentum. In February 2020, the USDA announced the Agriculture Innovation Agenda, which includes new sustainability targets for U.S. agriculture. These goals include reducing net carbon emissions and improving water quality. In 2020, Leading Harvest, a non-profit, was established as an industry standard for third-party certification of sustainable agricultural practices, and now covers over 2 million acres in the U.S., including all the directly operated properties managed by HNRG. Improving soil health and soil conservation is one of the top objectives of Leading Harvest.

A set of farming practices known as regenerative agriculture encompasses many of the operational practices that enable the attainment of these sustainable agriculture goals, including building soil health and preserving the quality of the natural environment. Regenerative agriculture is defined by Regenerational International as “farming practices that...rebuild soil organic matter and restore...soil biodiversity, resulting in carbon sequestration and improving the water cycle.”

Some of the largest food companies, which purchase crops from individual farmers across the U.S. and globally, have embraced these goals: General Mills committed to sourcing from one million acres of farmland operated with regenerative agriculture practices by 2030; and PepsiCo targets having 100% of its purchases of potatoes, corn, oats, oranges and sugar meet its sustainable farming standard in 2020. Key elements of regenerative agriculture, including conservation tillage, crop and biological diversity, crop rotation, cover crops, and integrated management of weeds and pests, are incorporated across these standards.

This research note focuses on the two most widely deployed regenerative agriculture practices, conservation tillage and cover cropping, which are already utilized on millions of acres of farmland across the U.S. Conservation tillage has the potential to reduce soil erosion and runoff and can help retain soil moisture. Cover crops have the potential to prevent erosion, improve soil’s physical and biological resilience, supply nutrients, suppress weeds and enhance soil water availability to primary crops. In the U.S., conservation tillage is practiced on the majority of cropland (Chart 1), while cover crops are used on just 5% of cropland but the practice is growing rapidly (Chart 2).

These practices can impact soil health, water quality and store carbon, while enhancing farmland value. While potentially applicable to a wide range of both row and permanent crops, neither conservation tillage nor cover crops are appropriate for all farms. The applicability of either of these regenerative agricultural practices is dependent on a combination of factors including soils, climate and local growing conditions (Figure 1).

Conservation Tillage
Conservation tillage methods reduce the intensity of soil tillage compared to conventional farmland soil tillage completed using a disc or plow. Conventional tillage prepares soil for planting, aerates and warms the soil and promotes the decomposition of crop residue into the soil. However, conventional tillage may lead to a loss of soil organic matter (carbon), which may reduce soil fertility and lead to air and/or water pollution from erosion.

The most dramatic form of conservation tillage is no-till, a system in which farmers plant directly in the soil with crop residue from the prior crop still present.

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Another key variant of conservation tillage practice is strip-till, where only soil near the planting area is tilled and prepared for planting, with the balance of the field left undisturbed. The benefits of conservation tillage include the potential to reduce soil erosion and runoff, and in more arid areas, conservation tillage may help retain soil moisture. The benefits of conservation tillage are also cumulative over time, as soils farmed using no-till methods for multiple years generally have a higher water holding capacity than conventionally tilled fields. These benefits can translate into economic gains such as increased productivity and lower operating costs.

Compared to full conventional tillage, conservation tillage requires fewer trips across each field resulting in less labor, fuel and machinery wear and tear. The USDA NRCS estimates that conventional row crop tillage requires about six gallons of diesel fuel per acre, compared to about two gallons per acre for continuous no-till.

However, no-till and strip-till do require modern guidance and planting equipment. Conservation tillage has grown in tandem with advances in GPS and biotechnology that have enabled the easier adoption of large-scale and precision conservation tillage. Modern planters are now able to plant into crop residue and untilled dirt at high speeds.

Conservation tillage may in some cases and for some crops have negative impacts on crop yields. For example, soils with a large proportion of clay retain water, and the lack of tillage may slow the movement of air through these soils and impede drying. Conservation tillage is used on about 70 percent of soybean acres, 67 percent of wheat acres, 65 percent of corn acres and 40 percent of cotton acres. Conventional and conservation tillage are less of a factor in permanent crop production, such as orchard and vineyards, where tillage is not a major practice. While not applicable for all farms, the continued adoption of the practice is an excellent indicator that it is making positive contributions to financial performance while improving the value of the underlying farmland by minimizing soil disturbance and boosting soil quality.

Cover Cropping
Cover cropping refers to planting a crop that is not targeted for sale. The typical approach in agriculture is to plant and cultivate only a primary crop for sale. Cover cropping provides benefits to soils and can enhance conservation tillage by establishing crop organic matter on top of the soil. Cover crops can reduce erosion, enhance soil structure and biology, provide nutrients, help suppress weeds, improve soil water availability and interrupt pest cycles. Cover crops involve additional upfront costs, for planting and terminating the cover crops prior to planting the primary crop, however these costs may be offset by input costs savings or yield enhancements due to enhanced soil carbon and physical properties.

In the management of permanent crops, such as tree-nuts, apples or grapes, cover crops can have a combination of negative and positive impacts, depending on the crop and site conditions. In the case of almonds and pistachios, cover cropping will add organic material back into the soil, but excessive amounts of organic material in the soil can impede growth of the trees. Cover crops also compete with the trees for water in the soil, so almond and pistachio growers will not use any cover crops in drought conditions.

### Share of Harvested Cropland with Cover Crops by County

Cover crops can also help with pest control. For example, mustard grass releases natural toxins in the soil helping prevent nematode infestation. Natural toxins will not always be sufficient in all areas, and orchards using mustard grass as a cover crop may still need to fumigate. One challenge for permanent crops compared to row crops is that during cover crop termination insects both beneficial and damaging can move up into the trees after mowing the cover crop, bringing diseases from the orchard floor up into the trees, and potentially damaging the trees and the nut or fruit crop.

Vineyards and apple orchards plant grass or other mixes as cover crops, especially in areas with high erosion issues.

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Cover crops help with absorbing the excess water, keep soil structure in place and replace nutrients back into the soil. Growers still need to be cautious with managing cover crops as can lead to disease issues and needs to be mowed prior to any frost event. Cover crops will keep the orchard or vineyard cooler at nights during frost events, increasing chances of frost damage.  

**Market and policy initiatives drive regenerative agriculture practices forward**

Food companies and consumers are increasingly asking and ensuring that their supply chains are sustainable. Two major consumer food industry giants, General Mills and PepsiCo, illustrate the scale and depth of commitment to sustainable supply chains through their financial investment in regenerative agricultural practices. General Mills’ regenerative agriculture standard identifies four measurement areas: economic resilience in farm communities, soil health, water and above-ground biodiversity. To pursue the soil health goal, General Mills began pilot programs directly with farmers in 2019 and has invested in university research and cost-sharing with farmers. PepsiCo’s standard similarly identifies regenerating soil and reducing carbon emission as key goals. PepsiCo’s program works with over 40,000 farmers in 38 countries, and the company provides specific calculator tools to help farmers quantify and evaluate how management practices can increase carbon soil sequestration. Federal financial incentives have actively promoted the wider deployment of conservation tillage and cover cropping. The USDA Agriculture Innovation Agenda announced in February 2020 set a national goal of increasing food production 40% while halving agriculture environmental impact by 2050. One of the four sustainability benchmarks is achieving a net reduction of the agricultural sector’s carbon footprint, including by enhancing carbon sequestration. The second sustainability goal is enhancing water quality by reducing nutrient loss by 30 percent by 2050. Both goals can be advanced by conservation tillage and cover crops. The federal government provides financial incentives to help farmers overcome start-up costs and tighter cash flow that can result from implementation of conservation tillage or cover cropping. The Environmental Quality Incentives Program (EQIP) provides matching grants for conservation tillage and cover crops as well as for other regenerative farming practices such as crop rotation, nutrient management and terraces. For cover crops in 2019, the USDA NRCS provided cover crop payment rates that likely covered initial costs for many producers. For example, the 2019 payment rates of $51-$76 per acre in Illinois compared to estimated annual cover crop costs of $15-$78 per acre.

**Case studies indicate potential costs and benefits across a range of crops, soils and climates**

The American Farmland Trust, a farmland conservation non-profit, partnered with the USDA Natural Resources Conservation Service and worked with eight farmers to test soil health practices costs and impacts (Table 1). The farms in California, Illinois, New York and Ohio measured economic, water quality and climate outcomes, and in general, the practices were positive across a range of metrics.

With long-term capital and perspective, these case studies illustrate the potential continued expansion of conservation tillage to contribute to enhanced farm sustainability, both economic and environmental, in service to consumers and supply chains that demand it.

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**Table 1: Production Costs and Benefits of Conservation Tillage**

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<thead>
<tr>
<th>Yield and Income</th>
<th>Inputs and Costs</th>
<th>Environmental Benefits</th>
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<tbody>
<tr>
<td>Yield, after accounting for enhanced seeds and other technologies, improved due to soil health 2-22%</td>
<td>Five of the six row crop farms reported fertilizer savings, averaging $36 per acre, mainly due to reduced phosphors and potassium applications.</td>
<td>All eight farms saw reduced soil and water runoff, with average reductions of 43% for nitrogen, 74% for phosphorus and 81% for sediment loss.</td>
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<td>The six row crop farms increased their net income by an average of $41 per acre</td>
<td>Five of the six row crop farms reported an average reduction of $35 per acre in machinery, fuel and labor costs.</td>
<td>Using USDA’s COMET-Farm tool, seven of the farms reduced greenhouse gas emissions.</td>
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<td>The two almond farms improved net income $841 per acre</td>
<td>Fertilizer costs increased for one almond farm and increased for another due to switching to fertigation.</td>
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14Hancock Natural Resource Group, Hancock Farmland Services April 2020
18USDA SARE, accessed May 2020 https://www.sare.org/Learning-Center/Bulletins/Cover-Crop-Economics
Looking forward

Conservation tillage and cover cropping are the two leading regenerative agriculture practices that have an established role in sustainable agriculture practices suitable for large-scale institutional investors. Understanding the costs and returns and opportunities associated with implementing these regenerative agricultural practices have become increasingly important in the processes of investment selection, valuation and management of commercial farmland. Going forward, we believe that agricultural markets will increasingly recognize the importance of soil health, and that properties that take this into account in formulating their management strategies will deliver more consistent productivity and profitability as well as operating in a more sensitive manner, which will be recognized in enhanced farmland value while delivering higher environmental quality to communities.
A widespread health crisis such as a global pandemic could cause substantial market volatility, exchange trading suspensions and closures, and affect portfolio performance. For example, the novel coronavirus disease (COVID-19) has resulted in significant disruptions to global business activity. The impact of a health crisis and other epidemics and pandemics that may arise in the future, could affect the global economy in ways that cannot necessarily be foreseen at the present time. A health crisis may exacerbate other pre-existing political, social and economic risks. Any such impact could adversely affect the portfolio’s performance, resulting in losses to your investment.

Investing involves risks, including the potential loss of principal. Financial markets are volatile and can fluctuate significantly in response to company, industry, political, regulatory, market, or economic developments. These risks are magnified for investments made in emerging markets. Currency risk is the risk that fluctuations in exchange rates may adversely affect the value of a portfolio’s investments.

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