

CLIMATE-SMART AGRICULTURE

De-risking and scaling a regenerative future for the American farm



EXECUTIVE

SUMMARY

Agriculture is on the forefront of the climate change discussion. Farmers and ranchers are uniquely positioned as both firsthand witnesses of its impacts and a key part of the solution. Understanding this, AgAmerica gathered a collection of insights from economists, farmers, ranchers, and industry experts to create a holistic report on what climate-smart agriculture is, why it matters, and—perhaps most importantly—how government programs, lenders, and private companies can support farmers without hindering their ability to continue feeding a growing global population.



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PART ONE

WHY CLIMATE-SMART AGRICULTURE?

Understanding the “why” behind the “what”

Climate change is defined as shifts in climate characteristics that last for an extended period of time. Typically, this change is brought on by significant changes in temperatures, precipitation, and other weather patterns.

Over the last century, the global average surface temperature has risen by an average 0.14° F (0.08° C) each decade. This number has doubled in the last several decades.

According to the National Oceanic and Atmospheric Administration (NOAA), the ten warmest years on record all occurred after 2005. Because of the mounting scientific evidence that temperatures will continue to rise, it’s becoming increasingly important to consider how changing climates will shape the way our food system operates.

In an industry like agriculture, climate change can create disruptive and costly consequences for:

-  Soil health
-  Livestock health
-  Water availability
-  Food crop nutrients
-  Crop yields
-  Profit margins

Global warming is a major contributor to severe weather patterns, which have gradually increased in frequency over the last several decades.

Losses from severe weather events in the U.S. in 2021 totaled over \$145 billion, the third-highest total annual loss in history.

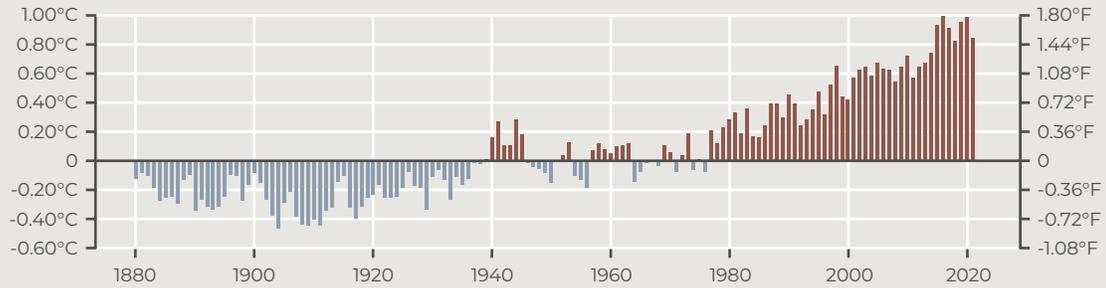
If it continues on the same trajectory, climate stress can create environments that are no longer sustainable for crops historically grown in specific regions, resulting in a phenomenon known as crop migration. Not only will crops be grown in different regions to adapt to a warming climate, but studies indicate that crop yields could shift as soon as 2030. One [2021 NASA study](#) concluded that corn crop yields could decline as much as 24 percent, while wheat—a more heat-tolerant crop—could see growth in production of about 17 percent.

IMPORTANT NOTE

Severe weather events, such as hurricanes or tornadoes, typically drive losses in the central and southeastern region of the U.S. In contrast, losses in the western region are typically driven by drought and heat events.

GLOBAL AVERAGE SURFACE TEMPERATURE⁽¹⁾

(January-December temperature anomalies, difference from 1901-2000 average (°C), global land and ocean surface)



MAJOR NATURAL DISASTERS AROUND THE WORLD⁽²⁾⁽³⁾

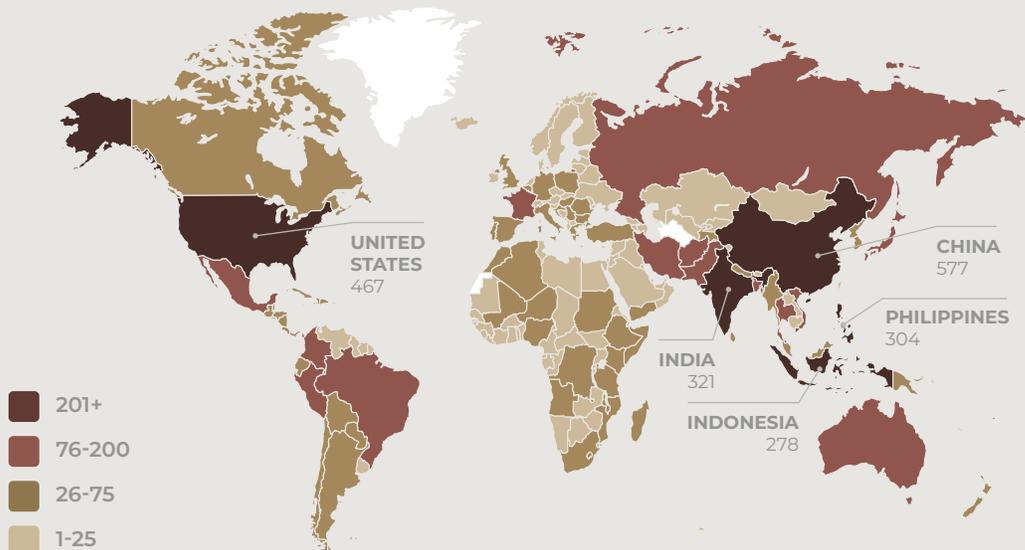


DIRECT GLOBAL ECONOMIC LOSSES^{(2)(3)*}



NUMBER OF NATURAL DISASTERS REPORTED⁽³⁾

(per country/territory, 2000-2019)



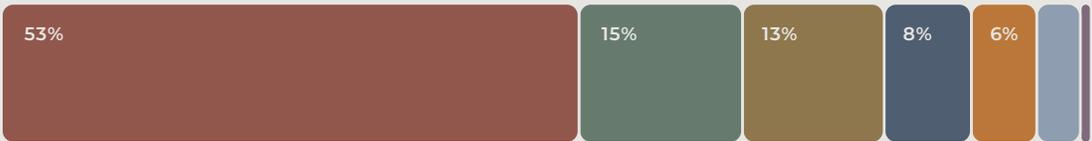
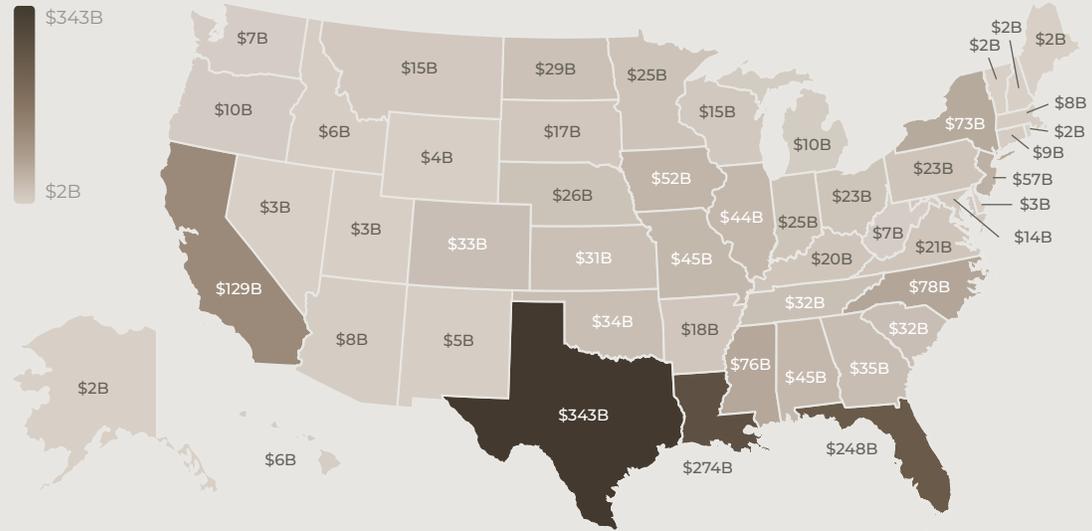
Sources: (1) NOAA National Centers for Environmental Information, Climate at a Glance: Global Time Series, published March 2022;

(2) Centre for Research on the Epidemiology of Disasters; (3) United Nations Office for Disaster Risk Reduction;

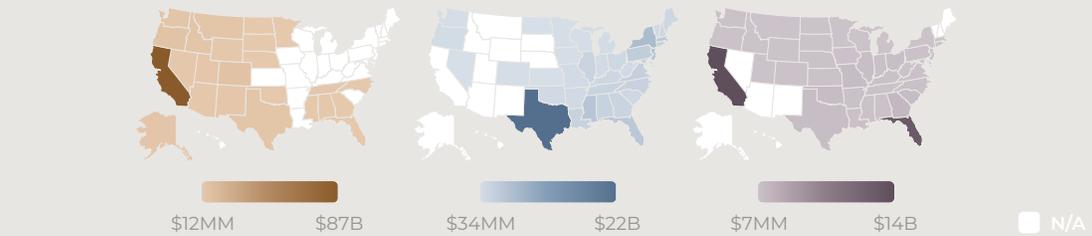
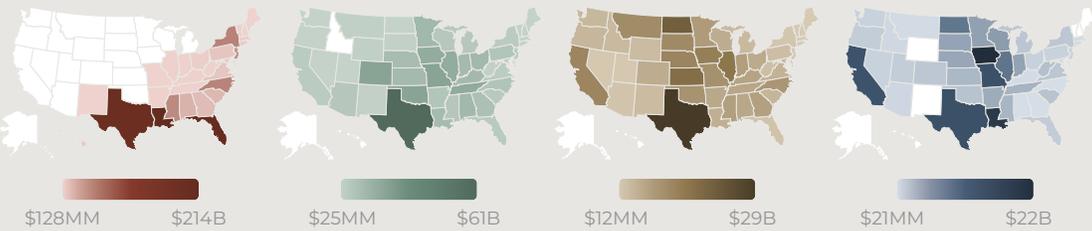
*The economic loss estimate excludes indirect and long-term effects on productivity and loss of income.

BILLION-DOLLAR WEATHER AND CLIMATE DISASTER COSTS

(cost amount for each state and type rounded by nearest billion dollar, CPI-Adjusted, from 1980-2021 by NOAA)



■ **TROPICAL CYCLONE** \$1,148B
■ **SEVERE STORM** \$331B
■ **DROUGHT** \$285B
■ **FLOODING** \$164B
■ **WILDFIRE** \$120B
■ **WINTER STORM** \$78B
■ **FREEZING STORM** \$33B



WHAT IS CLIMATE-SMART AGRICULTURE?

According to the Food and Agriculture Organization of the United Nations (FAO), climate-smart agriculture aims to tackle three fundamental issues:

1. Sustainably increase ag productivity and income streams;
2. Adapt to and build resilience against the impacts of climate change; and
3. Reduce and remove greenhouse gas (GHG) emissions as much as possible.

While global agriculture is a significant contributor to GHG emissions, it is one of the few industries capable of contributing to both climate mitigation and adaptation practices.

CLIMATE MITIGATION

Mitigation is an offensive human intervention that seeks to reduce the extent of climate change by limiting activities that contribute to GHG emissions or enhancing activities that promote sinking GHGs. For example, the term “regenerative agriculture” is more of an offensive approach, as its goal is to not only slow the course of climate change but neutralize it.

CLIMATE ADAPTATION

Adaptation is a defensive human reaction that primarily seeks to avoid harm brought on by climate change or exploit opportunities that arise from climate change. It does not try to change the extent of climate change but instead focuses on change that keeps the system’s integrity intact. The term “sustainable agriculture” focuses more on the defensive response to climate change by adapting your operation in response to its effects.



“Climate-smart agriculture (CSA) is an approach that helps guide actions to transform agri-food systems towards green and climate-resilient practices.”

FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS

RISKS, REWARDS, AND ROADBLOCKS

Understanding the opportunity and uncertainty in regenerative farming and ranching

Advocates of [regenerative agriculture](#) stress that the total system includes both crop and livestock production. Considerable research has found that integrating animals into crop production through grazing cover crops:

- ▲ Improves soil health
- ▲ Increases carbon sequestration potential
- ▼ Reduces labor and machinery costs
- ▼ Reduces fertilizer input and animal feed costs



WHAT IS CARBON SEQUESTRATION?

Carbon sequestration occurs through increased photosynthesis. It is the process of capturing and storing carbon dioxide in a solid or dissolved form so that it doesn't contribute to atmospheric warming. This occurs both on land and in the ocean.

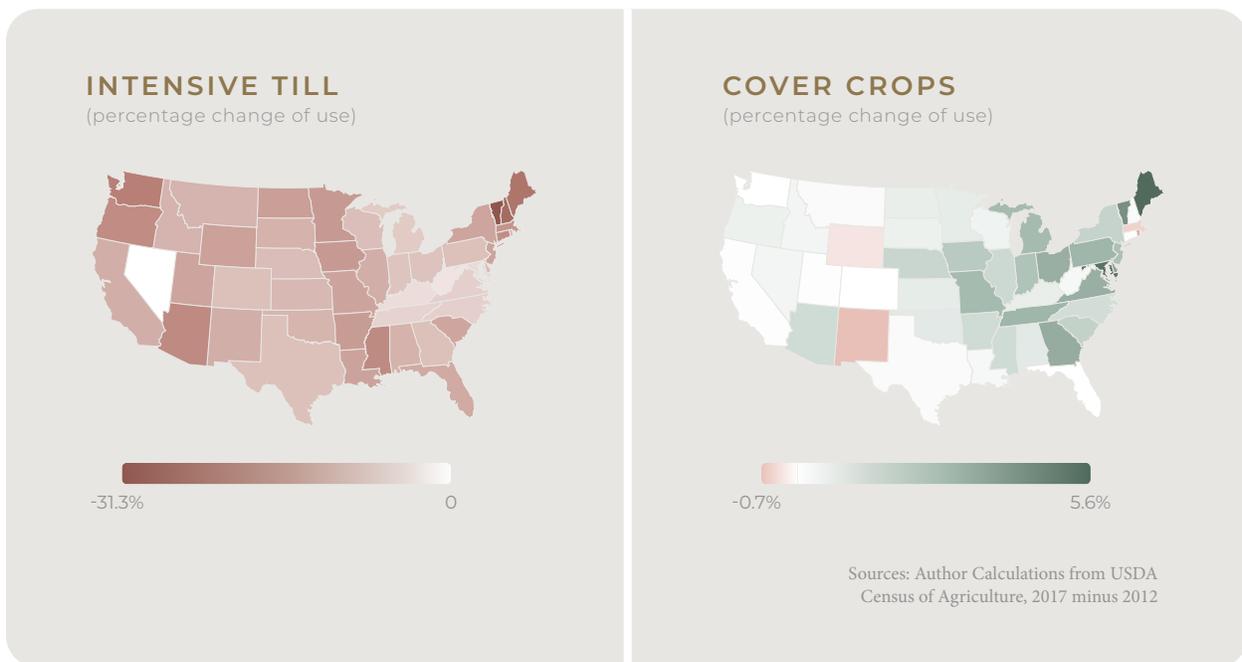
IMPORTANT TO NOTE

For the purposes of this whitepaper, we have separated the discussion into crop production and livestock production. However, many regenerative farmers and ranchers integrate regenerative practices in both types of production to maximize carbon capture capacity.

CROP PRODUCTION

One of the most straightforward practices crop producers can adopt is no-till or conservation till farming. Conventional tillage loosens and removes plant matter in the soil, reducing soil coverage and releasing GHGs stored in the affected layer of the soil.

From 2012 to 2017, use of intensive (conventional) till practices declined across the board, while cover crop adoption rates have showed steady signs of increasing—particularly in the eastern part of the U.S. due to differences in climate and state incentive programs. **According to the USDA, more than one-third of U.S. farmers are using no-till.**



Another sequestration-based regenerative practice is to plant cover crops. Cover crops act as a barrier for the soil, increasing resilience to intense rainfall and erosion. On the opposite end of the rainfall spectrum, water availability and storage enhancements increase resilience to drought conditions.

Contrary to the more widespread adoption of conservation till practices, it's estimated that less than five percent of U.S. farmers are currently using cover crops. A number of [case studies show that improvements to soil health](#) from planting cover crops result in increased yields and a reduction in costly inputs, like fertilizer, over time. So, why the lagging adoption rate?

One roadblock is the upfront capital needed for cover crop adoption since many cover crop adopters don't see immediate results. Another is a lack of technical assistance for managing soil health, planting cover crops, and measuring success. Fortunately, soil health companies like [Continuum Ag](#) are stepping up to the plate to provide farmers with logistical and analytical support to ensure a successful transition.

SUMMARY

From [conservation tillage to cover crops](#), transitioning to more regenerative practices can do wonders for your soil's health.

- ▲ Increases moisture-retaining properties
- ▲ Increases carbon sequestration capacity
- ▼ Reduces water and wind erosion
- ▼ Reduces reliance on commercial fertilizers and chemicals

However, it must be acknowledged that this transition carries risk. Adopting regenerative cropping practices may result in operating losses and stress in serving existing debt in the first few years. This is often due to a lack of experience and resources to support successful cover crops and no-till integration. The success rate of regenerative practices also depends on locale and topography. That's why it's critical to work with local agronomists, soil health experts, or university extension personnel to build out a transitional game plan to ensure long-term sustainability.



REGENERATIVE FARMING CHECKLIST

A roadmap for integrating regenerative practices on your farm.

[DOWNLOAD NOW](#)



“Using the Haney Test, we’re able to see not only the inorganic nutrients, but also the organic nutrients of the soil because we’re quantifying its biology. Because of this, we were able to save our customers an average of \$106.24 per acre in fertilizer last fall as fertilizer prices shot through the roof.”

MITCHELL HORA, FOUNDER AND CEO OF CONTINUUM AG

LIVESTOCK PRODUCTION

In livestock production, climate change can negatively affect the quality and quantity of feeds available, promote livestock diseases, and place heat stress on the animals. This ultimately impacts livestock reproduction, growth, and milk production.

Improvements to animal nutrition practices can help to reduce methane emissions in livestock production. For example, enhancing the protein and dietary fat content of feeds decreases enteric methane emissions. Higher quality forages increase digestibility while also contributing to the decline in methane production. While feed additives that inhibit methane-producing microorganisms in the rumen offer the opportunity to reduce emissions at the source, the fat content increases in the diet of ruminants should be limited to avoid negative impacts on livestock performance. There is also a cost factor to consider—feed additives lower emissions, but there is a price to pay that doesn't necessarily translate into lower input costs as it does with soil health practices.

Manure from [grazing animals improves soil fertility](#) by increasing soil microbial density and organic matter. Their hooves help integrate manure into the soil. Rotational grazing practices help avoid over-compaction of the soil, leading to healthier soil and, in time, a reduced need for synthetic fertilizer.

Anaerobic digesters also show promise by extracting and converting methane into biogas, a renewable fuel created through the decomposition of food scraps and livestock manure. Digesters range from covered anaerobic lagoons to plug flow digesters and upright tank digesters that can also incorporate dry matter in the process. The type of digester used on farms is typically determined by the manure management practices in place and the type of animal manure that is fed into the digester.

The biogas (RNG) produced by the anaerobic digester is a low carbon-based fuel. RNG can be sold to electricity grids or companies operating a fleet of semi-trailer trucks. The owner of the digester may qualify for state tax credits, renewable energy certificates (RECs), and low carbon fuel standard (LCFS) credits. Nutrients from digested material such as nitrogen and phosphorus, can also be applied to the farm's crops. Finally, a farm-based digester can create an additional revenue stream through [tipping fees](#). Other byproducts, such as fertilizer and bedding, offer cost-saving opportunities as well.



“The main thing is to focus on soil health—increase soil health, increase plant health, increase animal health. It all goes hand in hand. When you focus on soil health, you can cut out a lot of unnecessary evils. We run about a 1,000-acre operation, and I don't have a fertilizer bill.”

AUGUST HORSTMANN, OWNER AND OPERATOR OF [HORSTMANN CATTLE CO.](#)

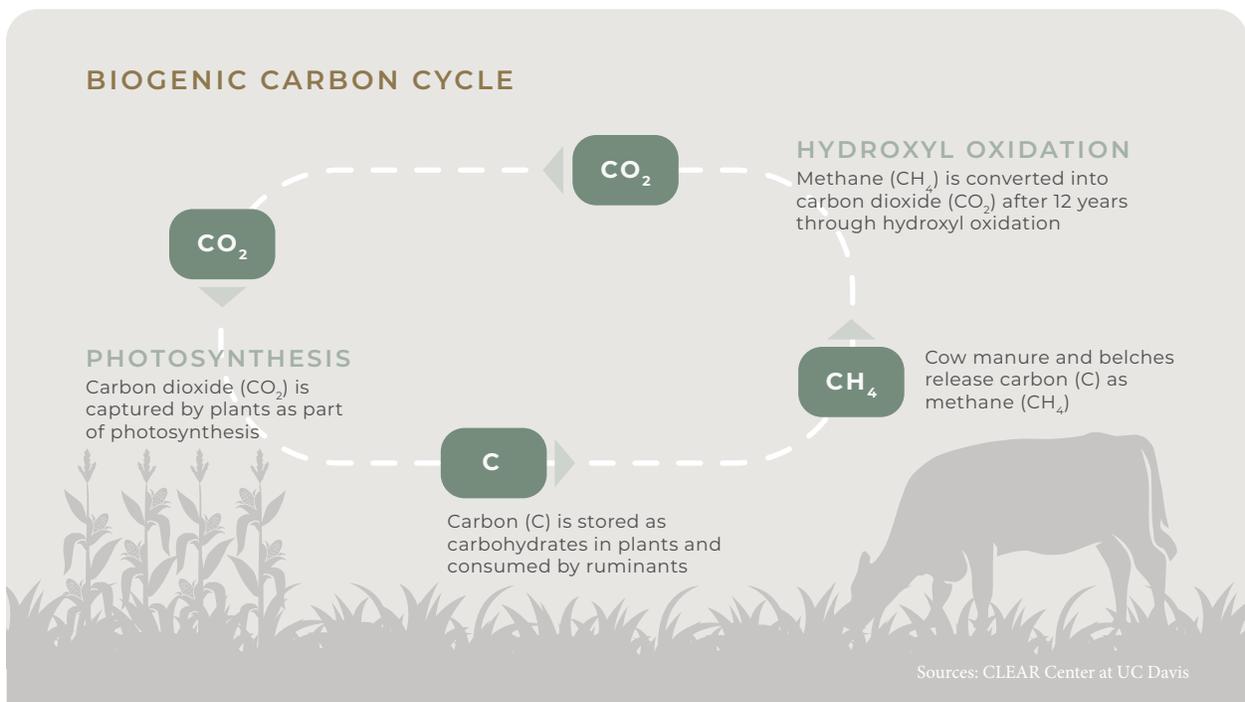
ANIMAL AGRICULTURE: ENVIRONMENTAL FRIEND OR FOE?

As meat consumption increases around the world, the biogenic methane emitted by ruminant animals from belching and waste has received increased negative attention. The reality is **animal agriculture is an important ally in climate mitigation.**

Dr. Frank Mitloehner, professor and air quality specialist at the University of California-Davis, has extensive research on the impact of livestock production on GHG emissions. One key finding from his research is the distinction between carbon dioxide emissions from fossil fuels and methane emissions from ruminant animals.

- **Methane** gas emissions are a flow gas that is destroyed in the atmosphere through oxidation, usually over a period of ten to twelve years.
- **Carbon dioxide** is a stock gas that remains in the atmosphere virtually forever.

This distinction is important because methane is a part of the **biogenic carbon cycle**. This means it is an essential part of the same cycle that converts carbon into cellulose—a carbohydrate that is one of the main building blocks for growing plants.



DEBUNKING AG AND CLIMATE MISCONCEPTIONS

Visit AgAmerica's blog to learn more facts behind this symbiotic, but often misunderstood, relationship.

[READ MORE](#)

THE COST OF ANAEROBIC DIGESTERS

The capital investment required to start an anaerobic digester can be prohibitive. Smaller systems may require an upfront investment of \$500,000, while larger systems can require an investment of \$5 million or more. Annual operating expenses and debt service requirements also need to be compared to the revenue opportunities when assessing the financial feasibility of a farm-based digester. Depending on the digester system's scale and complexity, private lenders may be concerned about the farmer diverting too much time and financial resources away from current crop and livestock operations.

An alternative approach would involve a third-party owning and operating the digester on the farm. Contracting with a third party to operate the digester and arrange for the sale of energy and byproducts may be more feasible, leaving the farmer to focus on existing livestock and cropping operations. Under this arrangement, the farmer would receive a share of the digester project's net income. Smaller-sized livestock operations may consider pooling with four to five other farmers to contract for the delivery of manure to a third-party owned and operated anaerobic digester.

[The EPA's AgSTAR website offers a handbook addressing these and other considerations regarding digesters.](#)

SUMMARY

Regenerative approaches to mitigating methane gases from livestock production include feed additives, rotational grazing, and anaerobic digestion. Alternative feed additives are currently under development and will eventually be available on a commercial scale. While more research is needed in this area, the science is pointing to feed additives and digesters working together to drastically [reduce the carbon footprint of livestock production](#) while also providing a renewable energy source and fertilizer alternative at a time when costs for both are skyrocketing.



REGENERATIVE RANCHING CHECKLIST

A roadmap for integrating regenerative practices on your ranch.

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PART THREE

FINANCIAL SUPPORT FOR CLIMATE-SMART AGRICULTURE

Transitioning your operation to more regenerative farming and ranching practices often requires upfront capital to invest in equipment or inputs. Those currently practicing conventional tillage will need new equipment if they want to implement conservation tillage methods to improve soil health. Buying cover crop seeds may cause some financial stress at the start of the transition period before operators can wean off synthetic inputs.

Fortunately, there are several ways farmers, ranchers, and landowners can offset the cost and reduce the risk that comes with transitioning to a more climate-smart operation.

CORPORATIONS

A number of large corporations such as General Mills, Unilever, Cargill, and other nongovernmental organizations (NGO) are involved in programs that provide incentives for adopting cover crop practices.

Another approach to offsetting the costs of transitioning to regenerative cropping practices is to sell carbon credits to large nonfarm corporations needing to meet emission standards. Two types of carbon markets are driving demand in the U.S.:

- **Compliance markets** based on the government-imposed emission curbs like California's cap-and-trade program, which promotes healthy soils and forests.
- **Voluntary incentive-based markets** like corporate sustainability reporting programs where companies can buy carbon credits from the farmer through third-party aggregators who connect buyers with sellers.

These credits are based on a per-acre basis and range from \$20 to \$30 per ton of carbon captured. Often, there are verification issues and other challenges associated with transactions. Therefore, farmers should carefully examine these contracts for potential risk exposure.

IMPORTANT TO NOTE

The USDA's new [Partnerships for Climate-Smart Commodities](#) program is designed to create market opportunities for farmers that use climate-smart practices. This may lead to the development of a national carbon bank that would purchase carbon credits.



“We utilized the NRCS and EQIP to help implement grazing systems and with fence and water development.”

AUGUST HORSTMANN, OWNER AND OPERATOR OF [HORSTMANN CATTLE CO.](#)

FEDERAL AND STATE GOVERNMENT

The Alternative Farming Systems Information Center (AFSIC), founded in 1985, was one of the first U.S. Department of Agriculture (USDA) programs to focus on sustainable and organic agriculture.

Now, at least 29 states administer programs that provide cost-share or incentive payments for the adoption of cover crops. These programs can partially defray cover crop expenses, including seedbed preparation and cost of seed usually over a multi-year contract. Some states offer low interest loans and credits against state income tax. Basic payment rates per acre can range from \$25-\$100 or more depending on the state and nature of the program.

At the federal level, the USDA's Natural Resource Conservation Service (NRCS) administers the Environmental Quality Incentives Program (EQIP) as well as the Conservation Stewardship Program (CSP). These are voluntary programs designed to provide financial and technical assistance to promote sustainable natural resource management. EQIP is a short-term program more targeted to a specific part of the farmer's operation. It provides funding once the cover crop is planted. CSP is a longer-term program that deals with the farmer's entire operation. It provides funding while conservation improvements are being implemented, as well as an additional payment once the project is completed.

PRO TIP

Contact a local NRCS office or [visit the NRCS website](#) to learn more about the programs available to you. If you need assistance for the application process, there are free resources available online—like this [plain language guide from Sustainable Agriculture Research and Education \(SARE\)](#)— and private companies that offer resources and technical support to facilitate the application to the EQIP, CSP, and other programs for a fee.

PRIVATE LENDERS

Cost-sharing and other incentives afforded by various federal, state, and private sources may not fully offset the potential financial stress in the short run. That's why private lenders have an important role to play in the adoption of regenerative ag practices by providing transitional financing that is consistent with the farmer's long-term goals. Short-term, interest-only loans that are asset-backed can be a great source of fast and flexible funding. Then, once the upfront cost is covered, having a lender who is capable of transitioning your loan into more conventional terms could save you even more money down the road.

PRO TIP

When working with a private lender, choose one who can adapt loan terms to meet the upfront investment of implementing new practices with the option to convert to more conventional loan terms in subsequent years.

CASE STUDY HIGHLIGHT

SOUTHEAST FARMER USES AGAMERICA'S TRANSITIONAL FINANCING TO REDUCE FOOD WASTE

A first-generation farmer worked with AgAmerica to invest in innovative technology that allowed them to launch new business lines and develop their family operation into a beacon of sustainability, reducing food waste from 30 percent to less than ten percent. As their needs evolved, AgAmerica was able to transition its short-term, interest-only loan structure into a blend of long-term conventional term debt and a revolving line of credit sized to meet working capital needs and the capital investment necessary to sustain the operation. Through this debt restructuring, the borrower was able to extend the term of their loans and lower their cost of borrowing in under two years.

[READ FULL SUCCESS STORY](#)



“Agriculture is not the foe. Agriculture is one of the most important solution-providers in this sphere along with forestry.”

DR. FRANK MITLOEHNER, PROFESSOR AND AIR QUALITY SPECIALIST AT THE UNIVERSITY OF CALIFORNIA-DAVIS

CONCLUSION

CREATING A MORE SUSTAINABLE FUTURE TOGETHER

Agriculture and forestry are unique in that they can both emit and sequester greenhouse gas emissions. No one cares more about the health of their land than the farmer, rancher, and landowner who rely on it for their livelihoods. That being said, responsibility shouldn't fall solely on their shoulders. Nonfarm corporations, federal and state agencies, and private lenders are all in positions to help lower the risk of transition and provide technical assistance to ensure its success. At AgAmerica, we make it our mission to be a champion and advocate for the future of American agriculture. By providing resources, counsel, and flexible financing, we can support you in building a more resilient operation.

Because when farmers thrive—everyone wins.

AGAMERICA NEWSLETTER

Sign up for AgAmerica's newsletter to stay informed on the latest financial programs and developments in the U.S. ag sector.

GET STARTED

ACKNOWLEDGEMENTS

This report was a collaborative effort with contributions from a range of farmers, ranchers, economists, and industry experts. The AgAmerica team would like to thank our economists [Dr. John Penson](#) and Dr. Cliff Shelton for their insightful contributions to this whitepaper. Other notable contributors include:

- Dr. Frank Mitloehner, Professor and Air Quality Specialist for the [CLEAR Center at UC Davis](#).
- Mitchell Hora, Founder and CEO of [Continuum Ag](#).
- August Horstmann, Owner and Operator of [Horstmann Cattle Co.](#)
- Brandon Howley, Managing Partner at [Happy Hollow Ranch](#).

Thank you to all who shared their insights and time with us for this report and for your ongoing dedication to a brighter and more sustainable future for American agriculture. These efforts are seen, appreciated, and of the utmost importance.



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