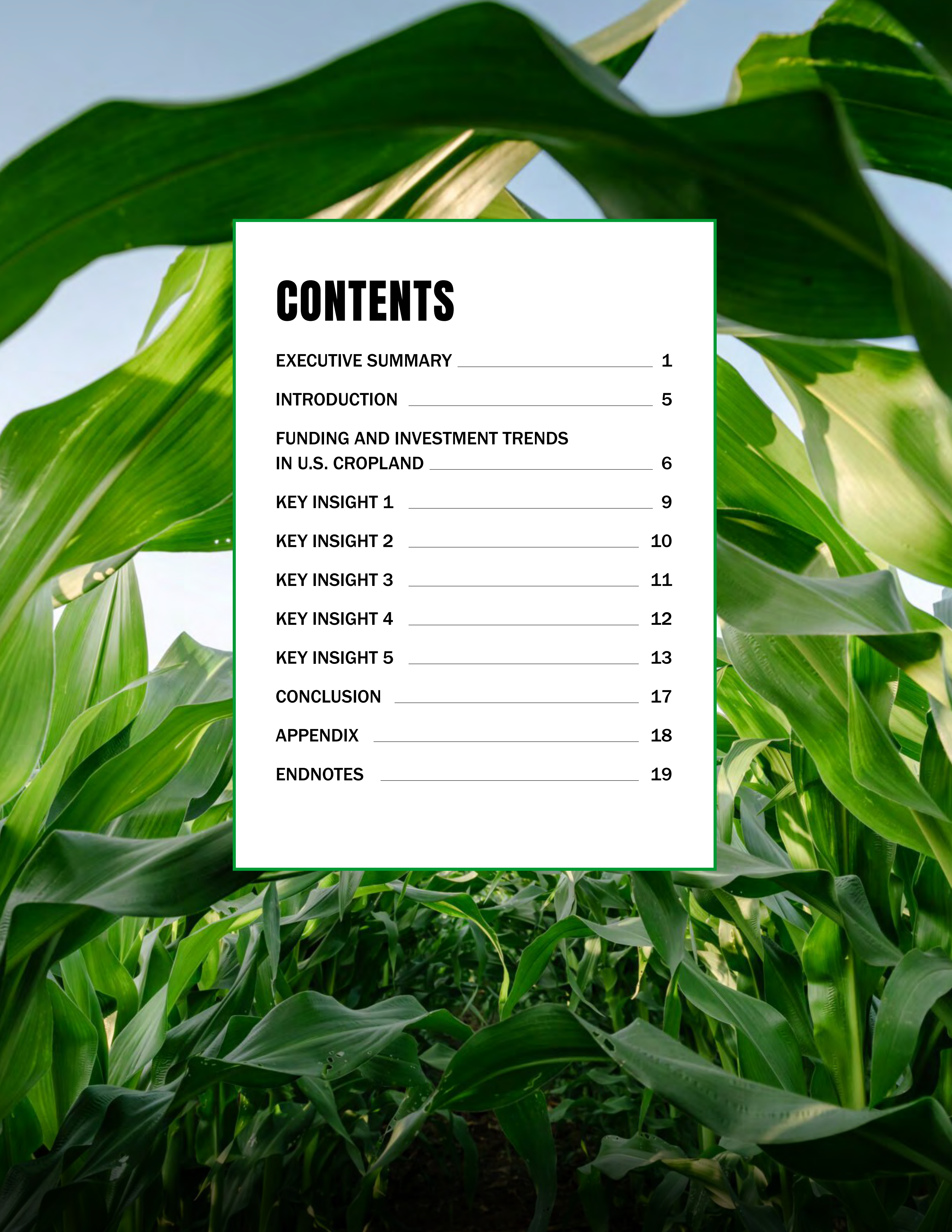
FUNDING THE FUTURE

Evaluating public & private investments in climate-smart row crop agriculture

Environmental Defense Fund | BUSINESS

Anthesis



CONTENTS

EXECUTIVE SUMMARY

With only six harvests remaining until 2030, the food and agriculture sector is feeling the urgency to advance a climate-smart future more clearly than ever before. With America's Midwest contending with drought during critical planting windows of corn, soy and wheat this past spring before grappling with flooding and increasingly erratic weather this summer, farmers are on the frontlines of the impacts of extreme weather on crop output and quality.

Agriculture accounts for more than 10% of the United States' greenhouse gas emissions and is the country's largest source of methane and nitrous oxide emissions. At the same time, agriculture can play a pivotal role in helping the U.S. achieve economy-wide net zero greenhouse gas (GHG) emissions by 2050 and meet its Nationally Determined Contribution to the Paris Agreement.

With leading companies, scientists, policymakers, and farmers alike eager to accelerate a transition to a more resilient and climate-secure future, the sector faces a knowledge gap: Are current financial incentive programs enough to achieve those goals, and if not, what is needed to accelerate progress?

Environmental Defense Fund and **Anthesis Group** partnered together to conduct research to answer these urgent questions and more clearly understand the resources and strategic climate action needed to enable U.S. agriculture to reduce emissions by nearly 25% by 2030, critical to delivering on the Paris Agreement.[1]

The research evaluated key questions, including:

- *Is current funding from public and corporate investment in climate smart interventions on U.S. cropland enough to achieve the reductions required to deliver 2030 climate goals of the food and agriculture sector?*
- *Is the funding targeting the right climate-smart interventions to move the needle?*
- *Given the urgency to draw down emissions, where could public and private funding drive the most impact?*

OUR ANALYSIS UNLOCKED

FIVE KEY FINDINGS TO INFORM COLLECTIVE ACTION FOR THE SECTOR, INCLUDING:

1. While good builders of resilience and soil health, **climate-smart practices like cover cropping and no till have high uncertainty in the estimated atmospheric carbon dioxide (CO_2) removal, are reversible, and insufficient on their own** to deliver U.S. climate goals and align with corporate net zero goals.
2. **Any efforts to increase soil organic carbon (SOC) must complement, not come at the expense of deep emissions reductions** in nitrous oxide (N_2O) and carbon dioxide (CO_2).
3. **On-farm and fossil carbon reductions remain a gap** in how climate-smart agriculture funds are being deployed.
4. **Companies need clearer land sector-specific guidance on accounting for emissions reductions** to invest in solutions with confidence.
5. **Current financial incentive strategies are missing the mark** to match the variable financial impacts of farmers transitioning to climate-smart practices.

IGNITING COLLECTIVE ACTION TO REALIZE A NET ZERO FUTURE FOR U.S. AGRICULTURE:

There are three sets of actions that we believe can offer significant points of leverage to accelerating a climate-secure future for U.S. croplands:

1. **De-risk the transition and build farmer confidence to reduce nitrogen from fertilizer.** Nitrogen fertilizer is the predominant source of new anthropogenic nitrogen in U.S. landscapes, resulting in estimated ecosystem and health damages of $157 billion per year.[2] Yet, fertilizer reduction continues to be a challenge on the ground. We must reinforce the opportunities for cost savings to farmers and ecosystem harm reduction paired with supportive financial incentives for nutrient management, particularly looking at geographies of over-application of fertilizer.

2. **Reduce embedded and on-farm fossil carbon:** The agribusiness sector needs to pre-competitively invest in solutions that will enable the entire industry to rapidly scale alternative energy sources from fossil fuels to deliver net zero. Fertilizer manufacturers can support the transition to a net zero future for agriculture by utilizing electricity sourced from renewables. In the same way, equipment manufacturers need to invest in a shift away from dependence on fossil fuels.

3. **Transform business models:** Crop input providers can explore ways to transform business models from outmoded approaches of volume of sales to strategies focused on delivering services that accelerate sustainable outcomes. Food and agriculture companies could partner with agriculture technology companies to promote education on supplier-wide adoption of nutrient management programs and precision technologies. In addition, seed manufacturers can pre-competitively pursue advanced crop genetics that reduce N_2O.

MIND THE FINANCING GAP

While the public and private sector are increasing recent investments into climate-smart agriculture, a growing body of research indicates that the magnitude of the funding and financing gap to support widespread global adoption is massive. Several studies have estimated the financial needs for the climate transition in the agriculture sector, ranging from $200 billion per year to $1.2 trillion per year.[3] Unfortunately, current climate funding to agrifood systems is very low, with an annual average of about $28.5 billion in 2019/2020.[4]

EXTREME WEATHER INTENSIFIES CLIMATE IMPACTS, THREATENING ROW CROP OUTPUT, FARMER LIVELIHOODS AND U.S. ECONOMY

The window of opportunity for reversing the course of runaway climate change is rapidly narrowing, and the food and agriculture sector is already on the frontlines of a hotter planet. According to the U.S. National Oceanic and Atmospheric Administration (NOAA), natural disasters and severe weather caused over $21 billion[5] in crop losses in 2023.

And across the U.S., the 2024 production season looks much the same:

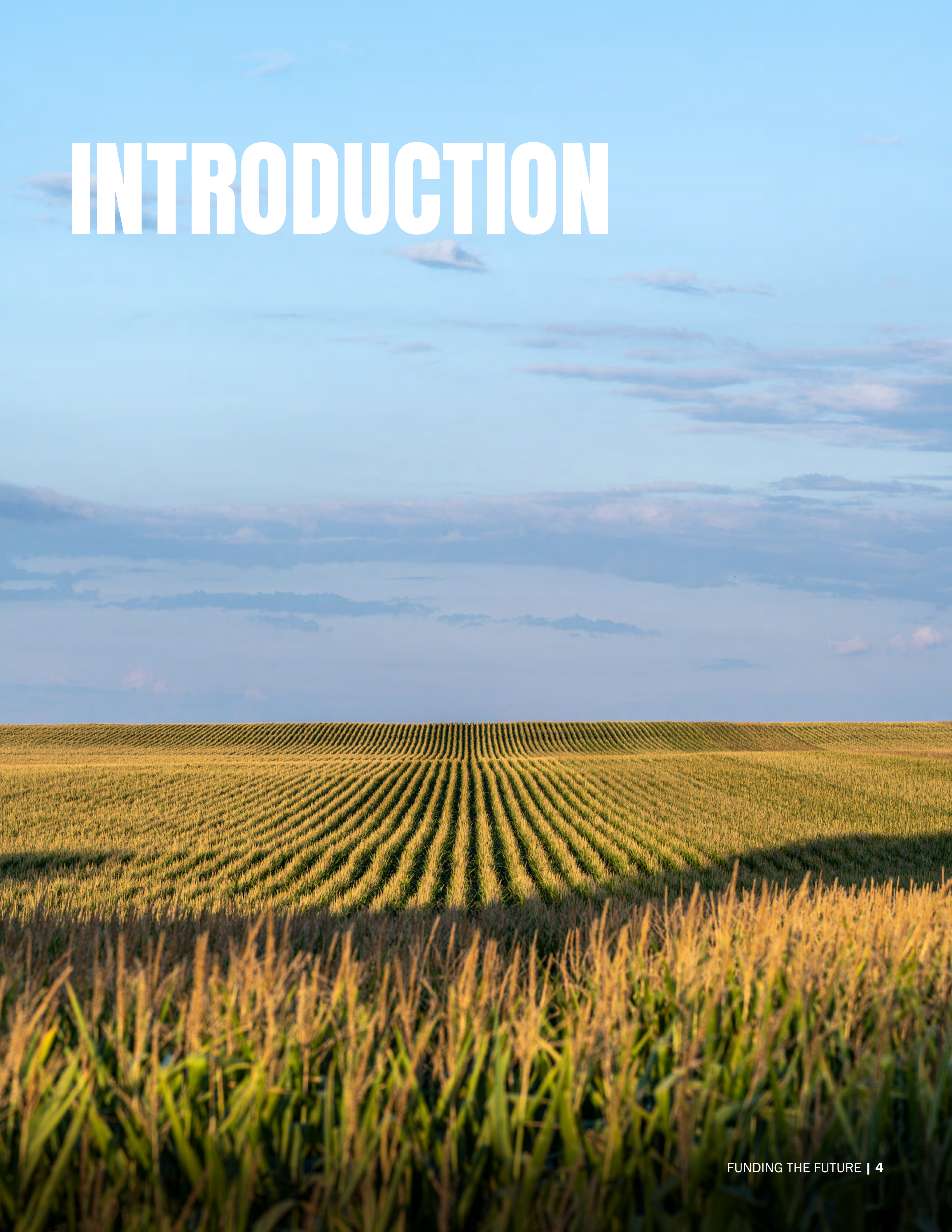
- **IOWA**: As the top corn producing state, widespread flooding in northwest Iowa pushed river levels to levels not seen in the past 30 years. Cropland that has been flooded two to three times already is once again flooding, with farmers managing what acres remain viable.[6]
- **KANSAS:** As a major wheat producing state, less than 3% of the state was free from drought stress as farmers began planting in spring 2024, with limited stores of soil moisture threatening a crucial window in a crop's lifecycle.[7]
- **TEXAS:** Hurricane Beryl posed significant challenges for corn and sorghum producers in the state, damaging crops as farmers were looking to rebound from years of drought. Texas A&M estimates between 20 to 40% losses in corn and 50% of the sorghum crop in impacted counties.[8]

Our findings indicate a shortcoming of private and public funding and inadequate support systems for U.S. row crop farmers to implement the right climate-smart practices to drive down emissions. Without addressing this shortfall, the sector risks failing to achieve the necessary reductions required to meet its contribution to the goals of the Paris Agreement.

As climate change intensifies, how can food companies partner with farmers to better protect against these rising challenges?

Companies have a critical opportunity to invest in innovative solutions to provide the tools needed to mitigate agricultural emissions. Leveraging technology and research of on-farm equipment electrification and decarbonizing fertilizer production are two of the major opportunities for companies to invest in impactful solutions to drive change within their value chain emissions and across industries.

INTRODUCTION



INTRODUCTION

Agriculture, forestry and other land use contributes approximately 21% to global warming and 10.6% to the U.S. GHG emissions alone, and without major changes to how food and animal feed is produced, business as usual within the agricultural system would make it impossible to limit global warming to well below 2°C.[9, 10]

At the same time, climate-smart agriculture practices have increased in adoption over the years and in many cases have helped farmers realize the environmental co-benefits of soil health practices in building climate resilience and in some cases, soil carbon. Historically, the costs associated with climate-smart practice adoption have been subsidized by federal, state, and other funding mechanisms. Over the last decade or so, however, leading retailers, food and beverage brands and agribusinesses have begun to build a business case for addressing the greenhouse gas emissions in their supply chains (Scope 3 emissions), which largely consist of emissions from agriculture.

Companies have invested in cost-share programs with farmers in their supply chain to proliferate certain climate smart agriculture practices. In other cases, incentives payments for conservation practices have generated carbon credits which are sold to offset GHG emissions unrelated to agriculture in a voluntary carbon market (VCM).

While the public and private sector are increasing recent investments into climate-smart agriculture, a growing body of research indicates that the magnitude of the funding and financing gap to support widespread global adoption is massive. Several studies have estimated the financial needs for the climate transition in the agriculture sector, ranging from $200 billion per year to $1.2 trillion per year. Unfortunately, current global climate funding to agrifood systems is very low, with an annual average of about $28.5 billion in 2019/2020.[11]

Our analysis indicates there is potentially available an additional $6.3 billion in total collective investments in climate-smart agriculture from 2018 to 2030 in the U.S. if current trends in public and private sector investment continue.[12] **However, this level of funding is likely insufficient unless it is highly targeted on interventions that are most likely to move the needle on row crop emissions reductions to align with a well below 2°C pathway.**

INCREASED AND ONGOING INVESTMENT will be needed from the public and private sectors to incentivize the holistic agricultural land management practices required to drive emissions reductions.

FUNDING AND INVESTMENT TRENDS IN U.S. CROPLAND

The federal government is historically and currently responsible for most investments in commodity crop-focused incentive programs to drive climate smart agriculture practices, though private sector investments play a growing role.

Analysis of publicly available information on private sector investments in climate-smart agriculture programs indicates a sizeable increase over the last decade from just over $2 million in 2018 to over $10 million in 2023 in corporate funding. While substantial public sector funding has been allocated in the Inflation Reduction Act,[13] Growing Climate Solutions Act,[14] and Partnerships for Climate Smart Commodities[15] over the remainder of the decade (totaling $22.6 billion invested between 2022 and 2031), it remains unclear whether public funding is driving uptake of the suite of climate-smart practices needed to drawdown emissions and ensure a resilient and climate-secure future for American farmers.[16] Some scientists worry that current funding rewards carbon sequestration over preventing emissions from being released in the first place. Targeting nutrient management and fertilizer use efficiency, for example, would prevent emissions rather than offset them.[17]

The fact remains that increased and ongoing investment will be needed from the public and private sectors to incentivize the holistic agricultural land management practices required to drive emissions reductions.

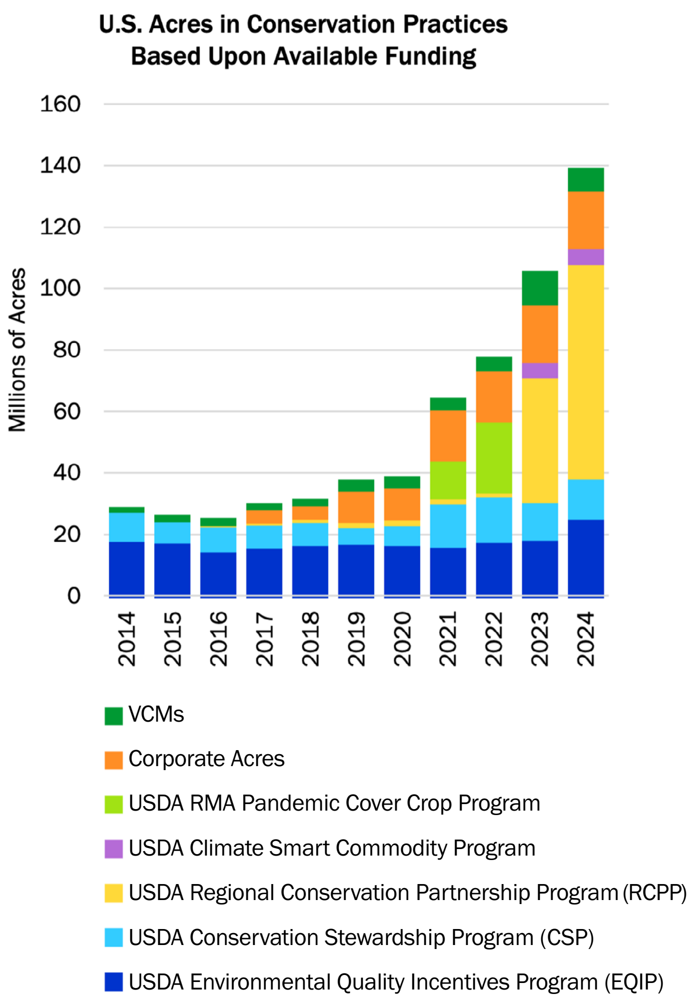


Figure 1: This graph highlights the acres in conservation practices based on available information on funding across private and public sectors from 2014-2024. A key assumption of this graph is that funding and acreage are dependent (i.e., funding drives acreage adoption). Funding obligations as allocated under the Inflation Reduction Act are built into specific USDA programs and expected to continue through 2030. Corporate and VCM acres for 2024 may be incomplete as they were compiled prior to the end of the year.

Utilizing conservative projections under the assumption that funding drives practice adoption, we estimate that continued federal and corporate funding could increase the uptake of conservation practices on 271 million additional acres between 2018 and 2030.[18, 19] Yet, when modelling the potential GHG mitigation impact (this study conducted a life cycle analysis and leveraged EPA National Inventory data), even if all 271 million acres implemented cover crops and no till consistently through 2030, it would be insufficient to meet climate mitigation needs unless paired with significant fossil fuel CO_2 and programs to reduce soil N_2O emissions.[20, 21]

The picture is clear: To advance climate action, the business community needs to prioritize investment in the right kinds of climate-smart interventions. The research community must also support the private sector with roadmaps that illustrate for corporate leadership what interventions will drive the most impact based on our knowledge of the science, technology and high integrity innovation opportunities for addressing emissions from agriculture.

CORPORATE BARRIERS TO INCREASING INVESTMENT

1. **Uncertain outcomes:** We heard from several food companies surveyed that there are still significant barriers to getting internal buy-in from the C-suite for investing in programs where the science is uncertain about the emissions reduction outcomes.

2. **Supply chain engagement:** There are also challenges in identifying effective incentives together with suppliers to drive on-the-ground changes in farming that will result in positive outcomes.

3. **Lack of standardization:** A lack of finalized standards for greenhouse gas accounting has instilled a sense of confusion and frustration among sustainability practitioners within companies about how to proceed towards their 2030 goals, including how to partner effectively in ways that allow for appropriate claiming of emissions reductions.

"Our theory of change is that growers need multiple levels of support, not just $/acre for practice changes."

—

Agribusiness company

IMPLICATIONS & RECOMMENDATIONS

KEY INSIGHT

1

Climate-smart practices like cover cropping and no till, while meaningful from a resilience and soil health perspective, have high uncertainty in the estimated atmospheric CO_2 removal and are reversible.

Despite setting emissions reduction targets, a recent study of 50 of the highest-emitting companies in the North American food and agriculture sector finds that the sector is still lagging in achieving net zero progress.[22] As they engage upstream, many companies are targeting practices like cover crop adoption as a method for reducing on-farm emissions and improving soil health. However, climate-smart practices like cover cropping and no till, while meaningful, have high levels of uncertainty in the estimated atmospheric CO_2 removal and are reversible, leading to reduced confidence in the ability of these practices to deliver climate mitigation.

Practices like cover cropping and no till that improve soil health may reduce the need for nitrogen fertilizer application, but without additional support to overcome farmers' concerns about potential negative impacts on yield, these practices alone are unlikely to lead to a reduction in overapplication of nitrogen application rates which now occurs on many U.S. farms.[23] The optimization of nitrogen (N) fertilizer application relative to crop N needs is important to reduce the direct and indirect emissions of N_2O.[24]

While building soil health is essential, such action must be coupled with a holistic approach that addresses the key GHGs emitted by row crop agricultural activities – CO_2, N_2O – to deliver a climate-secure future.

Current science indicates significant uncertainty around carbon sequestration due to variability of soil and climate conditions and concerns around permanence.[25] For U.S. agriculture to reduce emissions in line with limiting global warming to well below 2°C, an approach to scaling adoption of sustainable agriculture practices that includes targeted efforts to reduce N_2O emissions and replace fossil fuels with renewable energy are essential.

It is critical that companies not only engage and encourage direct suppliers to reduce GHG emissions, but that adequate financial and technical assistance to achieve nitrogen balance (between fertilizer application rates and crop needs) and enable a just transition away from fossil fuels is available.[26]

At present, only ten of the 50 highest-emitting food and agriculture companies disclose provision of financial and technical assistance to farmers in their supply chain, signifying a lack of investment from companies and slower progress on permanent reductions in N_2O and fossil fuel CO_2 emissions.[27]

Decarbonizing fertilizer production, while desirable, is less well understood. Ammonia-based products have been widely used as a fertilizer for the last century. According to Yale 360, experts are championing "green" ammonia, whose production eliminates the use of natural gas by utilizing renewable energy, which will help decarbonize agriculture while also becoming a significant clean fuel source for generating electricity and shipping.[28]

Research by the University of Cambridge shows that the most effective mitigation pathway at the production stage would be for the fertilizer industry to decarbonize heating and hydrogen production associated with ammonia.[29] In addition, the study examined benefits of combining fertilizers at the point of production with nitrification inhibitors, keeping nitrogen in the soil longer and preventing bacteria from forming N_2O. A similar study from the University of Minnesota has found that green ammonia could reduce farming's carbon footprint by as much as 90 percent for corn and small grain crops.[30]

KEY INSIGHT

2

Soil carbon sequestration must complement, not come at the expense of deep emissions reductions in CO_2 and N_2O emissions.

Lack of consensus on what is known and unknown about natural climate solutions and the broader array of other carbon dioxide removal strategies is a key barrier to progress toward the broad deployment of these strategies. This variation is compounded by the different scales of impact associated with different practices. Further, there is less confidence in the understanding of the magnitude of the climate benefit of practice adoption, particularly at smaller farm-scales.[31] While magnitudes are uncertain, some researchers find that practices such as cover cropping, reduced tillage, and crop system diversification all have the potential to increase surface (0-30 cm) soil carbon relative to business-as-usual practices on average, across broad geographical contexts. However, others indicate much more variation in that potential.[32, 33, 34] These practices also have important co-benefits for agricultural productivity, erosion reduction, preventing soil nutrient losses, and resilience against both drought and excess moisture.[35]

However, context matters when it comes to GHG reductions from agriculture, and there is currently a lot of uncertainty around what combination of management interventions, soil types, cropping systems and climates will lead to increases in soil carbon versus negligible gains or even losses. When it comes to GHG mitigation opportunities in row crop agriculture and their climate mitigation potential, an important distinction should be made between removals and reductions. As a removals strategy, soil carbon sequestration has received substantial attention and investment as evidenced by corporate carbon programs and the voluntary carbon market, while reduction strategies (e.g., reducing N_2O emissions through fertilizer management) have received less attention.[36]

Reducing N_2O emissions, however, represents a strategy that can have an immediate impact on reducing GHG because most N_2O emissions occur the same year fertilizer is applied. The climate benefit derived from removals through soil carbon sequestration, on the other hand, takes years to develop, requires continued maintenance of carbon building agricultural practices well into the future and is prone to reversal. As such, soil carbon sequestration must complement strategies to reduce agricultural GHGs and not come at the expense of direct emission reductions of CO_2 and N_2O.

Research shows that optimizing fertilizer application rates on acres with the highest surplus nitrogen being applied relative to crop needs have the greatest prospect to reduce nitrous oxide emissions. One study indicates that for many Midwestern states, farmers can reduce nitrogen fertilizer application rates by 14-21% and still be within an economically profitable N rate range. This could result in an N_2O emissions reduction range of 19-29%, which presents a significant opportunity.[37, 38]

Research on the use of metrics such as N balance – the difference between N inputs and outputs – can help approximate on-farm N losses and help overcome some of the challenges associated with measuring N_2O.[39] Targeting farms or larger areas such as counties or regions where N balance is high represents an opportunity to substantially reduce GHG emissions with little risk of yield impacts.[40] N balance recognizes nitrogen is essential for agricultural productivity and is not focused on eliminating N fertilizer inputs but on targeting a “safe zone” where farmers can optimize yields, minimize excess N and help protect soil health.[41, 42]

Better data, measurement, and verification will be essential for knowing that agricultural emissions are decreasing, and resilience is increasing. With recent historic investments in climate-smart agriculture, it is essential to direct funding to practices and strategies that address N_2O, expand long-term financing solutions for farmers, and foster collaboration between farmers and the value chain to share in the risks and the reward equally across the agri-food value chain.

KEY INSIGHT

3

On-farm and embedded fossil carbon emissions reductions remain a blind spot.

U.S. cropland agriculture relies heavily on fossil fuels to produce crops — from energy-intensive synthetic fertilizer production to heavy-duty diesel equipment used on-farm to the transportation activities in between and beyond the farm gate. Lifecycle assessment studies of cropland agriculture consistently show a very high contribution, often 50% or more, of fossil fuel-based emissions to the GHG footprint of producing corn, soy, and wheat.[43]

With a global goal of phasing out fossil fuels to as close to zero as possible by 2050, incentive programs should consider placing more focus towards a just transition away from fossil fuels for farmers and agriculture. This will undoubtedly require significant partnerships and collaboration around resource use efficiency, new technologies, renewable energy, and the requisite funding mechanisms to make this shift possible.

Electric and hybrid farm equipment are one example of how innovation is making progress on phasing out agricultural fossil fuels. For instance, John Deere has an electric commitment to “deliver an autonomous, battery-powered electric utility tractor to the ag market” and CNH Industrial has a prototype electric tractor.[44, 45] In addition to reducing fossil carbon emissions, the co-benefits for electrification are clear and can include reduced noise, and reduced cost to operate.[46] However, for combines and larger pieces of equipment, battery power may reach its limit with regards to the power density and cost of batteries; hybrid options that include combustion of biofuel and biogas may provide an alternative.[47] Collectively, we need holistic solutions that can advance circularity within our food system.

Additionally, while financing for on-farm electrification remains a significant barrier due to upfront costs, risks, uncertainties, and market frictions, examples like the Total Cost of Electrification framework and New Holland’s electric tractor demonstrate successful opportunities to finance on-farm electrification.[48] The Inflation Reduction Act in the U.S. could soften some of these barriers with the allocation of over $10 billion for rural electrification efforts.[49]

As a recent World Business Council for Sustainable Development report describes, the current financing landscape in the U.S. is fragmented, but greater collaboration across the value chain can provide relief to farmers by stacking financial support mechanisms that share in the risks and burdens of transitioning to climate-smart practices.[50]

KEY INSIGHT

4

Companies need greater clarity of land sector-specific guidance on accounting for emissions reductions to invest with confidence.

Stronger clarity is also needed in corporate carbon accounting guidance to drive commensurate action within agriculture to limit warming to well below 2°C. At present, there is a lack of consistency in how to account for emissions from forest, land use, and agriculture (FLAG) when compared to industrial or non-FLAG emissions. As of publication, the Science-Based Targets initiative (SBTi) FLAG Guidance makes it clear that FLAG emissions abatement, such as through biogenic removals, cannot be used to achieve an energy/industry target for emissions reduction, though changes may ensue after the GHG Protocol Land Sector and Removals guidance is published in Q1 2025.[51]

However, the FLAG guidance also provides companies with the option to voluntarily elect whether to include fossil-based emissions sources from machinery and energy emissions embedded in fertilizer inputs either within a FLAG target boundary or to instead include them within their energy/industry target.[52]

Clearer guidance around the importance for agri-food companies to phase out fossil-fuel based emissions within agriculture, rather than partial reductions or offsets, is needed to encourage focus and investment to transition agricultural supply chains away from fossil fuels.

KEY INSIGHT 5

Current incentive strategies are missing the mark to match the variable financial impacts of row crop farmers transitioning to climate-smart practices.

When adopting new practices, farmers face both financial barriers and technical barriers. These are closely linked, as appropriate technical support that enables farmers to successfully transition to new practices can enable them to minimize costs and risks in the transition and maximize the benefits of their new practices.

Our analysis of current approaches indicates that cost-share payments and technical assistance are the most common incentives offered to farmers to encourage adoption of climate-smart practices. In interviews with agri-food companies, all respondents noted that financial incentives are a critical priority with recognition that technical assistance is valuable to support farmers as they transition to new practices.

We found wide variability in cost-share payments across practices implemented, ranging from $10 to $60 per acre. While cost-sharing may reduce practice implementation costs for farmers in the short-term, this approach may be insufficient to spur adoption because it does not fully address barriers identified by farmers, such as potential crop yield risk in the transition years. The interview discussions revealed that consideration of solutions focused on going beyond sharing in costs to de-risk the adoption of new practices is a nascent tool under consideration by agri-food companies.

Critically, any incentive strategy should be based on a thorough understanding of the financial and technical barriers to change that farmers experience in a given sourcing region and for a specific transition under consideration. Climate-smart agriculture practices can have a variety of financial impacts on the farm that present opportunities, costs and risks.

Key insight

5

EXAMPLES OF FINANCIAL COSTS AND RISKS

of implementing cover crops, reduced tillage and efficient nitrogen management found in farm financial data research and analyses:

COVER CROPS: Planting a cover crop between growing seasons includes direct expenses for seed, fuel, equipment repair, and in some cases, chemical termination. Data from 141 farms in Minnesota and Wisconsin shows that all these cover crop direct expenses averaged $60/acre with a median of $48/acre in 2023. These costs differ significantly based on the end use of the cover crop, such as whether the cover crop is used purely for soil health and erosion control purposes or used as livestock feed in the spring.[53]

REDUCED TILLAGE: Changing from conventional tillage to reduced, no- or strip-till can involve changes in tillage equipment that sometimes require farmers to buy new equipment that require capital investments and ongoing interest payments. Once the equipment is updated, reduced tillage typically reduces per acre direct expenses for the row crop operations. Reducing tillage, especially using no-till, can reduce yield in the first few years of implementation.

Data from thousands of fields participating in the Illinois Corn Growers' Precision Conservation Management program found that tillage costs were lower for no-till, strip-till and one light tillage pass compared to more intensive tillage systems. The data also shows that greater tillage intensity fields are less profitable than no-till and minimum tillage fields.[54]

EFFICIENT NITROGEN APPLICATION: Applying just enough nitrogen, no more, no less, for row crops to meet their full yield potential reduces fertilizer costs and improves per acre profitability. Data from the Precision Conservation Management program clearly shows that applying the University of Illinois-recommended Maximum Return to Nitrogen rate is the most profitable rate. Farmers applying the recommended rate (151-175 lbs/acre) had net returns of $371/acre while farmers applying more than 225 lbs/acre had net returns of $346 per acre.[55]

Understanding these financial impacts from implementing climate-smart practices is critical to design effective financial incentives that solve the actual financial challenges farmers face. Such incentives could require tackling not only the upfront costs a farmer faces, but also the technical know-how and risk management solutions farmers need to feel confident and capable of changing management practices from niche to norm.

Key insight

5

A 2022 report by Field to Market, "Financial Innovations to Accelerate Sustainable Agriculture: Blueprints for the Value Chain," offers a starting place for companies seeking to understand financing innovations that can help them achieve their goals.[56] The report connects the variety of financial barriers identified by farmers who seek to adopt sustainable practices in row crop systems and matches them with financial solutions. It includes models such as sustainability-linked loans and crop yield warranties.

Several of these financial innovations are now being expanded through Field to Market's Climate-Smart Agriculture Innovative Finance Initiative as part of the U.S. Department of Agriculture's Partnerships for Climate-Smart Commodities Program.[57] This initiative is providing producers with holistic financial support by matching up financial innovations with technical assistance from on-the-ground organizations and supply chain demand from PepsiCo, Mondelez, and more.

Aside from finance, agronomists often play a valuable role in educating farmers through direct relationships and knowledge of sustainable farming methods. Agri-food companies recognize the importance of non-financial incentives by providing farmers with technical assistance. For example, a pre-competitive collaboration among Walmart, Unilever, PepsiCo, King Arthur Baking Company, Hershey, General Mills and Anheuser-Busch is working to scale practice adoption through North Dakota's Trusted Advisor Partnership that establishes a network and training on the landscape of sustainable agriculture in the state.[58] By engaging and incentivizing agronomists, programs can accelerate practice adoption and expand the scale of acreage enrollment.

By matching financial and technical support to farmers' needs for a given transition, companies can provide more holistic solutions to farmers and enable greater adoption of the right practices. A combination of financial mechanisms, such as cost-sharing, crop warranties and premiums, crop insurance, and government subsidy programs offer a powerful toolbox to create a more flexible and secure system for farmers. A fusion of corporate and government support remains an important catalyst for scaling these efforts and offers the potential to bring in other critical partners such as agronomists and financial institutions. More pre-competitive collaboration is needed to support farmers in overcoming the financial barriers they face in decarbonizing agriculture, moving beyond cost-share incentives to de-risk the transition.

CONCLUSION

CONCLUSION

Climate-smart practices like cover cropping and reducing tillage on farmland acres are seen as key levers in USDA's strategy to significantly reduce agriculture's 10% contribution to U.S. greenhouse gas emissions as the nation pursues net zero by 2050. However, the predicted atmospheric CO_2 removal expected from these practices is not supported by the current science. Rather, a focus on reducing N_2O emissions from excess fertilizer application and reducing fossil fuel CO_2 emissions is vital to decarbonize agricultural emissions.

Ensuring that farmers are rewarded for delivering low carbon commodities is a position that has nearly universal alignment across policymakers, companies and farmers alike. The challenge that remains is figuring out the right mix of incentives and deciding who bears the cost to support farmers and the industry at large in grappling with the urgent transition needed to ensure the resilience and long-term productivity of America's farmland.

> A focus on reducing N_2O emissions from excess fertilizer application and reducing fossil fuel CO_2 emissions is vital to decarbonize agricultural emissions.

With current public and private funding focused on increasing soil carbon storage rather than reducing emissions in row crop systems to fight climate change, there is still a funding gap and mismatch in investment of certain practices needed to achieve climate mitigation at scale. Even if optimistic estimates of soil carbon sequestration, acres of practice adoption and financial incentives were realized, the sector will not meet climate mitigation goals. While substantial public sector funding has been investing in scaling climate-smart agriculture, it remains unclear whether this funding is resulting in the emissions reductions required to ensure a resilient and climate-secure future for American farmers. Our analysis of trends in historic funding and scale of acreage points to a need for an ambitious, verifiable program to reduce emissions from fossil fuel and fertilizer production and use to reduce agriculture's climate impact.

This means that the food and agriculture industry must identify innovative approaches to financing the transition to a low carbon economy. That includes adding to the current toolbox of cost-share programs to support farmers in sharing in the perceived yield risk of changing nitrogen management and advancing an array of financial incentives that directly address the barriers faced by farmers.

> Even if optimistic estimates of soil carbon sequestration, acres of practice adoption and financial incentives were realized, the sector will not meet climate mitigation goals.

Unlocking barriers to pre-competitive collaboration across the entire food and agriculture value chain to support farmers and the industry at large in rapidly decarbonizing is mission critical. The business case to scale this funding for the private sector remains a challenge as business functions across a company must see a viable reason to incorporate sustainability into their operating contexts. Further, the research and sustainability community must be able to demonstrate proof of concept by promoting a more transparent industry where data insights can give everyone a clearer sense of the agricultural landscape we need to shift as each geography requires a different suite of solutions.

With significant environmental benefits including preventing soil erosion, retaining soil moisture, and increasing biodiversity, the agriculture sector needs to continue incentivizing farmers to pursue cover crops and no-till for their resilience benefits, but from a climate mitigation perspective, the agricultural sector must elevate its efforts to reduce N_2O and fossil CO_2 emissions into their climate-smart incentive strategies.

> **WITH ONLY FIVE YEARS REMAINING UNTIL 2030,**
> **the food and agriculture sector has no time to lose — and every reason to step up now.**

APPENDIX

Research Design & Methodologies, Acknowledgements & Contributors, References

RESEARCH DESIGN

The goal of this research was to understand at a high-level what impact financial incentives have had in terms of scaling row crop acreage dedicated to climate smart agriculture practices. The analysis also sought to evaluate how current funding is driving uptake of conservation practices across cropland acres and assess whether this sufficient uptake of the types of climate-smart practices to drive the required climate mitigation and adaptation solutions to align with the world's goal of a safer climate.

The research methodology included a landscape assessment of public and private sector climate-smart agriculture incentive programs, followed by 10 in-depth interviews with leading food, beverage, and agriculture companies, and a horizon scan to assess trends in acreage and funding driven by USDA cost-share programs, VCM programs, and corporate commitments and programs to advance climate-smart outcomes from agriculture. Analysis was projected out to 2030, to align with the target year of most corporate sustainability programs and guidelines/commitments and included evaluation of different scenarios based on potential growth and the strength of the relationship between acreage and funding (i.e., historic trends indicate that funding drives acreage adoption).

CONTRIBUTORS & ACKNOWLEDGEMENTS

LEAD AUTHORS:

- Simone Schenkel, Environmental Defense Fund
- Betsy Hickman, Anthesis Group

CONTRIBUTORS:

Environmental Defense Fund

- Joe Rudek
- Emily Oldfield
- Doria Gordon
- Maggie Monast
- Vincent Gauthier
- Nika Beauchamp

Anthesis Group

- Katie Bartel
- Mariko Thorbecke
- Anirban Kundu
- Meri Mullins
- Dawn Mancini Moyer

ENDNOTES

1 Eagle, A.J., A.L. Hughes, N.A. Randazzo, C.L. Schneider, C.H. Melikov, E. Puritz, K. Jaglo, and B. Hurley. 2022. Ambitious Climate Mitigation Pathways for U.S. Agriculture and Forestry: Vision for 2030. Environmental Defense Fund (New York, NY) and ICF (Washington, DC). https://www.edf.org/sites/default/files/documents/climate-mitigation-pathways-us-agriculture-forestry.pdf

2 Daniel J Sobota et al 2015 Environ. Res. Lett. 10 025006. DOI 10.1088/1748-9326/10/2/025006

3 Food and Land Use Coalition, the World Business Council for Sustainable Development, and the We Mean Business Coalition. 2024. Future Fit Food and Agriculture: The financial implications of mitigating agriculture and land use change emissions for businesses. Accessed: https://www.foodandlandusecoalition.org/wp-content/uploads/2024/03/FOLU-Future-Fit-paper-2_compressed.pdf

4 CPI [Daniela Chiriac, Harsha Vishnumolakala, Paul Rosane], 2023. Landscape of Climate Finance for Agrifood Systems. Climate Policy Initiative. Available at: https://www.climatepolicyinitiative.org/publication/landscape-of-climate-finance-for-agrifood-systems/

5 American Farm Bureau Federation. "Major Disasters and Severe Weather Caused Over $21 Billion in Crop Losses in 2023." February 29, 2024. https://www.fb.org/market-intel/major-disasters-and-severe-weather-caused-over-21-billion-in-crop-losses-in-2023

6 Farm Progress. Wallaces Farmer. "What's known so far about western Iowa flooding." June 24, 2024. https://www.farmprogress.com/crops/what-s-known-so-far-about-western-iowa-flooding

7 Successful Farming. "'Substantial drought expansion' impacts Kansas as planting begin." April 22, 2024. https://www.agriculture.com/substantial-drought-expansion-impacts-kansas-as-planting-begins-8637295

8 Texas A&M Today. "Hurricane Beryl Winds Damage Some Crops, Others Benefit From Rain: Texas A&M AgriLife Extension agents report post-storm crop damage." July 19, 2024. https://today.tamu.edu/2024/07/19/hurricane-beryl-winds-damage-some-crops-others-benefit-from-rain/

9 U.S. EPA. "Global Greenhouse Gas Overview". Accessed: https://www.epa.gov/ghgemissions/global-greenhouse-gas-overview#:~:text=However%2C%20changes%20in%20land%20use,total%20global%20greenhouse%20gas%20emissions

10 USDA ERS. "Climate Change". Accessed: https://www.ers.usda.gov/topics/natural-resources-environment/climate-change/

11 CPI [Daniela Chiriac, Harsha Vishnumolakala, Paul Rosane], 2023. Landscape of Climate Finance for Agrifood Systems. Climate Policy Initiative. Available at: https://www.climatepolicyinitiative.org/publication/landscape-of-climate-finance-for-agrifood-systems/

12 The analysis of private sector investment evaluated 28 U.S. companies benchmarked in the Ceres Food Emissions 50 report of the highest-emitting food companies in North America. Funding and acreage data are based on publicly available information related to these companies' efforts in the U.S. Of the companies researched, 14 provided sufficient acreage and funding data to include in the analysis

13 USDA Natural Resource Conservation Service, "FAQs: Climate-Smart Agriculture and Forestry Mitigation Activities and Inflation Reduction Act Funding." Accessed: https://www.nrcs.usda.gov/group/143/faqs-climate-smart-agriculture-and-forestry-mitigation-activities-and-inflation-reduction

14 U.S. Senate - Agriculture, Nutrition, and Forestry. "S.1251 - Growing Climate Solutions Act of 2021." https://www.congress.gov/bill/117th-congress/senate-bill/1251/text

15 USDA. "Partnership for Climate Smart Commodities." https://www.usda.gov/climate-solutions/climate-smart-commodities/projects

16 The question of whether funding is driving the adoption of the most effective practices is uncertain and is out of scope for this particular study

17 Reuters. "US bets on climate friendly farming; experts doubt it is climate friendly enough". April 11, 2024. Accessed: https://www.reuters.com/business/environment/us-bets-climate-friendly-farming-experts-doubt-it-is-climate-friendly-enough-2024-04-11/

18 Lack of transparency into consistent and clearly reported data led to significant gaps in publicly available information resulted in several key assumptions to the acreage data, including: Data likely consists of acres that are enrolled in more than one federal and corporate program; Committed acres receiving technical assistance are included in acreage estimations

19 Acreage forecasted under federal programs assumed continuation of historic funding and a uniform $300 million per year for RCPP

20 Research conducted by EDF demonstrates that mitigation potential of cover crops and no-till agriculture practices are overestimated by the existing process models. See Uludere Aragon, N., Xie, Y., Bigelow, D., Lark, T. J., & Eagle, A. J. (2024). The realistic potential of soil carbon sequestration in U.S. croplands for climate mitigation. Earth's Future, 12, e2023EF003866. https://doi.org/10.1029/2023EF003866

21 Additional GHG modelling performed by Anthesis Group affirmed the mitigation potential for cover crops and no-till is overestimated by the process models

22 Ceres. Food Emissions 50 Benchmark, February 2024. Available at: https://www.ceres.org/resources/assessments/food-emissions-50

23 Coppess, J., S. Ruppert and M. Skidmore. "A Menace Reconsidered, Part 4: Losing Nitrogen." farmdoc daily (14):74, Department of Agricultural and Consumer Economics, University of Illinois at Urbana-Champaign, April 18, 2024. Available at: https://farmdocdaily.illinois.edu/2024/04/a-menace-reconsidered-part-4-losing-nitrogen.html

24 Simone Schenkel. Environmental Defense Fund Business Insights. October 2022. Accessed: https://business.edf.org/insights/how-companies-can-reduce-nitrogen-pollution-and-measure-progress-toward-climate-goals/

25 Oldfield, E. E., Lavallee, J. M., Blesh, J., Bradford, M. A., Cameron-Harp, M., Cotrufo, M. F., ... Gordon, D. R. (2024). Greenhouse gas mitigation on croplands: clarifying the debate on knowns, unknowns and risks to move forward with effective management interventions. *Carbon Management, 15(1).* https://doi.org/10.1080/17583004.2024.2365896

26 McLellan, E.L., Cassman, K.G., Eagle, A.J., Woodbury, P.B., Sela, S., Tonitto, C., Marjerison, R.D. and Van Es, H.M., 2018. The nitrogen balancing act: tracking the environmental performance of food production. BioScience, 68(3), pp.194-203. https://academic.oup.com/bioscience/article/68/3/194/4831124

27 Ceres. Analysis: Food Emissions 50 Benchmark Update(February 2024)

28 Jones, Nicola. "From Fertilizer to Fuel: Can Green Ammonia Be a Climate Fix?". Yale E360. January 2022. https://e360.yale.edu/features/from-fertilizer-to-fuel-can-green-ammonia-be-a-climate-fix

29 Gao, Y., Cabrera Serrenho, A. Greenhouse gas emissions from nitrogen fertilizers could be reduced by up to one-fifth of current levels by 2050 with combined interventions. *Nature Food* **4**, 170–178 (2023). https://doi.org/10.1038/s43016-023-00698-w

30 University of Minnesota. "Fueling Sustainable Energy and Agriculture: Putting Wind in a Bottle." March 2020. https://wcroc.cfans.umn.edu/research/renewable-energy/bottling-wind

31 Buma et al. 2024. Expert review of the science underlying nature-based climate solutions. Nature. Available at: https://www.nature.com/articles/s41558-024-01960-0

32 Lessmann, M., Ros, G. H., Young, M. D., & de Vries, W. 2021. Global variation in soil carbon sequestration potential through improved cropland management. Global Change Biology. Available at: https://onlinelibrary.wiley.com/doi/full/10.1111/gcb.15954

33 Prairie, A. M., Green, R., Marklein, A., & Cotrufo, M. F. 2023. Restoring particulate and mineral-associated organic carbon through regenerative agriculture. Proceedings of the National Academy of Sciences of the United States of America. Available at: https://www.pnas.org/doi/full/10.1073/pnas.2217481120

34 Uludere Aragon, N., Xie, Y., Bigelow, D., Lark, T. J., & Eagle, A. J. (2024). The realistic potential of soil carbon sequestration in U.S. croplands for climate mitigation. *Earth's Future*, 12, e2023EF003866. https://doi.org/10.1029/2023EF003866

35 Lehmann, J., Bossio, D.A., Kögel-Knabner, I. et al. The concept and future prospects of soil health. *Nat Rev Earth Environ* **1**, 544–553 (2020). https://doi.org/10.1038/s43017-020-0080-8

36 DeFries et al. 2022. Land management can contribute to net zero. Science. Available at: https://www.science.org/doi/10.1126/science.abo0613

37 Millar et al. 2010. Nitrogen fertilizer management for nitrous oxide (N_2O) mitigation in intensive corn (Maize) production: an emissions reduction protocol for US Midwest agriculture. Available at: https://link.springer.com/article/10.1007/s11027-010-9212-7

38 As we don't have acres focusing on nutrient management specifically broken out for this GHG exercise, we have taken the average of 17% reduction in absolute nitrogen fertilizer application reduction for any acres forecasted to be under climate smart practices, and a 24% resulting reduction in N_2O emissions

39 Eagle, A. J., McLellan, E. L., Brawner, E. M., Chantigny, M. H., Davidson, E. A., Dickey, J. B., et al. 2020. Quantifying on farm nitrous oxide emission reductions in food supply chains. Earth's Future, 8, e2020EF001504. doi:10.1029/2020EF001504

40 McLellan et al. 2018. The Nitrogen Balancing Act: Tracking the Environmental Performance of Food Production. BioScience. Available at: https://academic.oup.com/bioscience/article/68/3/194/4831124

41 Ibid.

42 Ibid.

43 EDF. Strategic Roadmaps for SBTi Forest, Land, & Agriculture Targets, Prioritizing Action for Impact. April 2024. Page 30, 33, 35. Available at: https://business.edf.org/wp-content/blogs.dir/90/files/EDF-SBTi-FLAG-Report-2024.pdf

44 John Deere. Electrification. Available at: https://about.deere.com/en-us/our-company-and-purpose/technology-and-innovation/electrification

45 Triple Pundit. Electrifying Agriculture and Construction, One Machine at a Time. July 2023. Available at: https://www.triplepundit.com/story/2023/electrification-agriculture-construction-equipment/778526

46 NRECA. Farm Beneficial Electrification: Opportunities and Strategies for Rural Electric Cooperatives. October 2018. Available at: https://www.cooperative.com/programs-services/bts/documents/techsurveillance/surveillance-article-farm-beneficial-electrification-october-2018.pdf

47 DTN Progressive Farmer. New Holland's T7 Methane Tractor Is Key in System to Turn Livestock Waste Into Fuel. May 2023. Available at: https://www.dtnpf.com/agriculture/web/ag/equipment/article/2023/05/16/new-hollands-t7-methane-tractor-key

48 Triple Pundit. Electrifying Agriculture and Construction, One Machine at a Time. July 2023. Available at: https://www.triplepundit.com/story/2023/electrification-agriculture-construction-equipment/778526

49 Jayce Jimenez. Inflation Reduction Act, U.S. Department of Agriculture, and Rural Clean Energy Investment. April 5, 2024. Farm Bill Law Enterprise. Accessed: https://www.farmbilllaw.org/2024/04/05/inflation-reduction-act-u-s-department-of-agriculture-and-rural-clean-energy-investment/

50 WBCSD. "Cultivating farmer prosperity". May 24, 2023. Available at: https://www.wbcsd.org/resources/cultivating-farmer-prosperity/

51 Science-Based Targets initiative. FLAG Science-Based Target-Setting Guidance. December 2023. Section 3.1.4 Carbon removals and storage." Page 34. Available at: https://sciencebasedtargets.org/resources/files/SBTiFLAGGuidance.pdf

52 Ibid. Page 32

53 EDF. Financial impacts of cover crops in Minnesota and Wisconsin. Accessed: https://business.edf.org/insights/financial-impacts-of-cover-crops-in-minnesota-and-wisconsin/

54 Precision Conservation Management. "The Business Case for Conservation: Cost-Benefit Analysis of Conservation Practices, 2015-2023 Summary". 2024. Accessed: https://www.precisionconservation.org/wp-content/uploads/2024/06/2024_PCM_Booklet_WEB2_FINAL.pdf

55 Ibid

56 Field to Market. Financial Innovations to Accelerate Sustainable Agriculture: Blueprints for the Value Chain. 2022. https://fieldtomarket.org/finance-innovations-to-accelerate-sustainable-agriculture/

57 Field to Market. Climate-Smart Agriculture Innovative Finance Initiative. 2024. https://fieldtomarket.org/climate-smart-agriculture-innovative-finance-initiative/

58 Trusted Advisor Partnership. What is the Trusted Advisor Partnership? Available at: https://trustedadvisorpartnership.com

Environmental Defense Fund | BUSINESS

Anthesis