



Financing Resilient Agriculture

How agricultural lenders can reduce climate risk and help farmers build resilience



September 2020

Authors and acknowledgements

Author: Maggie Monast, Environmental Defense Fund

Environmental Defense Fund, a leading international nonprofit organization, creates transformational solutions to the most serious environmental challenges. EDF links science, economics, law and innovative private-sector partnerships. EDF's agricultural finance work includes farm budget analyses, financial solutions and agricultural finance policy. To learn more, visit www.edf.org/farm-finance.

Major contributors:



The Nature Conservancy, with thanks to Greg Fishbein for his partnership and expertise in agricultural lending.



K•Coe Isom, with thanks to Laura Sands, Kala Jenkins and Brad Mohrmann for their research on the Farm Credit System.



Scott Marlow of Long Rows Consulting, for his guidance on the intersection of equity and agriculture finance.



The AGree Economic and Environmental Risk Coalition, with thanks to Deborah Atwood, Heather Lair and Rex Raimond of Meridian Institute, as well as Jonathan Coppess and Bruce Sherrick of the University of Illinois, for their extensive research on crop insurance and agricultural lending.

In addition to the major contributors above, we would like to thank the following individuals who reviewed the report and provided important feedback:

- Farmers Dick Wittman of Idaho, Kristin Weeks Duncanson of Minnesota, and Scott Henry of Iowa.
- Marcia DeLonge, Union of Concerned Scientists.
- David Beck, Self-Help Credit Union.
- Kavita Koppa, agricultural finance and equity consultant.
- Vincent Gauthier, Environmental Defense Fund.
- Agricultural lenders who prefer to remain anonymous.



About this report

This report is for agricultural lenders and lending institutions, as well as others interested in understanding the climate risks faced by the agricultural lending sector and the role of agricultural lenders in financing resilient agriculture.

The report is based on extensive research and interviews with a variety of food and agricultural lenders, including Farm Credit and commercial lenders, as well as multiple other relevant experts. Many of the agricultural lenders who contributed their perspectives wish not to be identified. They are cited using initials.

This report provides a path forward for lenders to mitigate climate risks and finance resilient agriculture. Our hope is that it is useful to all those who are invested in the future of U.S. farms.

Contents

Authors and acknowledgements	1
About this report	2
Foreword	4
Executive summary	5
Introduction: The need for resilient agriculture	8
Agriculture is on the front lines of climate change.....	8
Building climate resilience in agriculture	9
Agricultural lenders are exposed to climate risk	11
An overview of agricultural lending in the U.S.....	11
Agricultural lenders face growing risks from climate-related shocks	16
Common considerations of agricultural lenders in risk assessment	17
Crop insurance is not sufficient to protect farmers or lenders from climate risk	19
Agricultural lending institutions must assess their climate risk	22
The role of agricultural lenders in supporting resilient agriculture	24
The financial case for resilient agricultural practices	24
Disconnects between current loan offerings and resilient agriculture	29
Existing lender initiatives can inform efforts to build resilience	30
Lessons for financing resilient agriculture.....	32
Recommendations for financing resilient agriculture	35
1. Assess climate risk at the lending institution level.....	35
2. Understand the role of resilient agriculture in managing climate risk.....	35
3. Design lending programs or products that support farmers in building climate resilience.....	36
Conclusion	37
Appendix A: Resource list on climate risk assessment for financial institutions	38
Appendix B: Resource list on farm budget analyses of conservation adoption	39
References	41

Foreword

Farmers and their lenders must look at both risks and opportunities in order to survive in a globally competitive and constantly changing industry. Climate change impacts are already making production harder and threatening livelihoods. Together, farmers and their lenders have an opportunity to mitigate this risk, enhance operational resilience and ensure agriculture remains economically and environmentally sustainable.

Farmers need a wide variety of tools and support to adopt conservation practices like no-till, cover crops and diverse crop rotations that can boost climate resilience and reduce production risk. Programs that reduce the costs of adopting new practices can help, but agricultural lenders can and should play a stronger role in addressing this challenge.

As a farmer who produces grain, cattle and timber in Idaho and as a business consultant with an early career in banking — working for the Farm Credit System and the Farm Credit Administration — I have witnessed how collaborations with agricultural lenders and environmental organizations help farmers implement better conservation strategies.

For years, Farm Credit has supported conservation and soil health in my region, the Pacific Northwest, by sponsoring conferences and peer breakfast groups for farmers interested in no-till and direct seed cropping systems. Through participation in those breakfast groups, my fellow farmers and I were able to share ideas and learn from each other's experiences as we implemented conservation practices on our farm.

Environmental Defense Fund, which I've advised for over 20 years, has collaborated with farmers to help them better understand how conservation practices improve soil and water quality and deliver positive returns on investment.

Historically, lenders have placed the heaviest weight on farmers' financial strength and repayment ability. Little consideration has been given in credit scoring models to farmers' conservation strategies or exposure to climate risk. That needs to change.



In the future, climate impacts will challenge lenders to change their thinking and give increased weight to how their customers farm, mitigate climate risk, and position themselves to be resilient and sustainable for the long term.

Financing Resilient Agriculture offers fresh thinking about how the agricultural finance sector can better understand and mitigate climate risks and be a partner in advancing conservation. The sector needs innovation in lending products and program delivery to better understand the relationships between conservation and financial success. This will in turn affect how lenders price credit and reward risk mitigation.

This report makes a clear and compelling case that long-term farm profitability is not undermined by near-term investments in conservation and climate resilience — it depends on it.

Dick Wittman, farmer, business consultant and member of EDF farmer advisory board

Executive summary

The agriculture sector is on the front lines of climate change. Production depends on access to healthy soil, adequate water supplies and predictable weather conditions, all of which are more difficult to access and manage as the climate changes.

Farmers already experience higher temperatures, increasingly variable rainfall and more frequent droughts, storms, fires and floods that threaten crop and livestock production across the United States.¹ These climate-related challenges compound other severe challenges posed by poor economic conditions and disruptions from the COVID-19 pandemic. While these risks are felt by all farmers, they are particularly challenging for small farms, farmers of color and low-income farming communities.

“Concerns about climate change are now a permanent part of the operating environment for rural America; they are here to stay regardless of which political party happens to be in power at state or federal levels.”

— Tom Halverson, president and chief executive officer of CoBank⁵

Climate change also threatens farmers’ financial partners, including agricultural lenders. Nearly half of all agricultural loans are held by lenders with at least one-quarter of their portfolio concentrated in farm operating or real estate loans, and many of those lenders also have correlated risks because of concentrations of loans in particular geographies or related agricultural businesses.^{2,3} This contributes to lending sector vulnerability to climate-related disruptions.

Following severe flooding in the spring of 2019, lenders in the Midwest reported to the Federal Reserve Bank of Chicago that 70% of their borrowers were moderately or severely affected by extreme weather events. That year, the portion of the region’s agricultural loan portfolio reported as having “major” or “severe” repayment problems hit the highest level in 20 years.⁴

Fortunately, agriculture has the capacity to build resilience and protect long-term productivity and profitability.

Building resilience is a complex undertaking that crosses multiple scales, from individual farms to global markets, and requires economic, social, environmental and cultural considerations. This report focuses on a critical piece of puzzle — farm-level management strategies for soil health, water use and crop diversification that enhance climate resilience.

Risk and opportunity for agricultural lenders

As farmers’ closest financial partners, agricultural lenders have a critical role to play in supporting climate-resilient agriculture, but U.S. lenders currently lag the broader financial sector in assessing climate risk and incorporating it into risk mitigation strategies.

A 2019 survey of 20 banks and seven other financial institutions found that more than half of major financial institutions now take a strategic approach to climate risk.⁶ However, research and interviews with agricultural lending institutions indicate that they view the largest risks as commodity prices, production costs, farmland values and global market issues.⁷ Most agricultural lenders have not specifically assessed climate risk. The longer the agricultural lending sector fails to prepare for climate risks, the greater the likely severity of economic consequences — both for lenders and their farmer clients.

Crop insurance is an important shock absorber for farmers and their lenders, but it is not sufficient to protect farmers, lenders or the broader agricultural economy from climate risk over the long term. The U.S. Department of Agriculture's Economic Research Service estimates that without farmer adaptation to climate change, the cost of the Federal Crop Insurance Program could increase by over a third in the second half of this century.⁸ In addition, while insurance coverage is high for the major field crops, only one-quarter of U.S. agriculture's total production value is covered by crop insurance.⁹ This means that the vast majority of U.S. agricultural production value is left unprotected by crop insurance and vulnerable to weather shocks.

Given the severity of weather events already affecting farmers across the country, a major shift in the agricultural lending sector's approach to climate risk and resilience is overdue.

Well-known conservation practices, including no-till, cover crops and extended crop rotations, contribute to improved resilience.¹⁰ EDF and many other organizations are collaborating with farmers to quantify the financial value of these practices. These analyses show that resilient farm management practices support risk reduction and farm financial viability by stabilizing crop yields, lowering costs of production, diversifying revenue streams and preserving the long-term value of the land.¹¹ This value is particularly evident when viewing farm budgets over multiple years.¹² These practices can also generate benefits for water quality and quantity, biodiversity, greenhouse gas emissions reductions and carbon sequestration.¹³

Despite these benefits, short-term costs and risks during the transition period may deter many farmers from adopting new conservation practices, especially in economically challenging times. In addition, there are several ways in which agricultural loans currently create disincentives for farmer borrowers who want to adopt conservation practices. They include information gaps or lender unfamiliarity with the return profiles of the practices, the short-term focus on annual operating loan repayment to the detriment of long-term profitability and financial stability, and loan terms that do not align with the transition to conservation practices or accord value to them.

Fortunately, several existing agricultural lender initiatives can inform the development of lending programs or products for resilient agriculture, such as programs developed for young, beginning and small farmers, the Farm Service Agency's conservation loan program and organic transition loans. This report derives five key lessons from these initiatives, including the need to understand the financial benefits of and barriers to resilient agricultural practices, design loan structures and requirements that correspond with the financial characteristics of those practices, utilize loan support to launch initial products, collect data on financial and environmental performance to show results and adjust credit rating processes, and consider other forms of support farmers may need to ensure successful practice adoption. The recommendations below are informed by these insights.



Recommendations

This report offers agricultural lenders and lending institutions a path forward to engage in understanding climate risk and improving resilience. It contains three main recommendations:

- 1. Assess climate risk at the lending institution level.** This will require buy-in from senior leadership, and it could utilize or modify existing climate risk assessment tools developed for the finance sector. Smaller lenders may be able to collaborate with each other or get external support to develop this capacity.
- 2. Understand the role of resilient agriculture in managing climate risk.** Lenders should familiarize themselves with locally-relevant climate risks and resilience strategies, collaborate with other organizations in assessing the farm budget impacts of conservation practices, and identify data blind spots — including for small farmers and farmers of color.
- 3. Design lending programs or products that support farmers in building climate resilience.** Products could include transition loans that align with return projections of resilient farming practices. Such products can also be utilized to collect data that can be incorporated into credit ratings. This will allow the value of resilient agriculture to be accurately reflected in credit structures and pricing. As new lending programs or products are developed, they should avoid doubling down on existing inequities in the agriculture system and seek to mitigate disparities in access to opportunities to build resilience for all farmers.

For lenders interested in pursuing these recommendations, the report also contains two resource guides — one on climate risk assessment for financial institutions and one on farm budget analyses of conservation adoption.

This report provides a path forward for agricultural lenders to mitigate climate risks and finance resilient agriculture. Our hope is that it is useful to all those who are invested in the future of U.S. farms.

Introduction:

The need for resilient agriculture

The challenges facing the U.S. agriculture sector in 2020 are dire. They include extreme weather related to climate change, a poor farm economy and supply chain disruptions from the COVID-19 pandemic. The farm economy is currently in the middle of its worst downturn since 2001.¹⁴ Net farm income dropped by nearly half between 2013 and 2016, from \$123 billion to \$63 billion.¹⁵ In 2019, the combination of a trade war with China, the continuation of depressed crop prices, and incessant rain and subsequent wide-scale flooding that prevented planting in much of the Midwest compounded farmers' economic distress.¹⁶ In 2020, the added shock of the COVID-19 pandemic massively disrupted agricultural supply chains, including closures of major meat processing plants, loss of demand from food service and restaurants, food waste, depressed ethanol demand, and illness outbreaks in processing plants and among farmworkers.^{17,18,19}

The need for resilience in agriculture has never been this clear.

“Weather and climate present the greatest, consistent — yet uncertain — risks to the agricultural economy and rural communities. More frequent and more severe extreme weather events have presented a growing set of longer-term challenges that require a different way of assessing long-term risk management and the policies to support it.”
— U.S. Commodity Futures Trading Commission Commissioner Rostin Behnam²²

Building a more resilient agricultural system is a complex undertaking that requires many different considerations, including farming practices and crop choices, farm ownership structures, net returns for farm products, diversity of markets and value chains, farmer health and personal capacity, farm and supply chain labor, rural communities and more. While these considerations all deserve inquiry, the focus of this report is on three farm-level management strategies that improve climate resilience.

One of the foundational steps in boosting farms' climate resilience is the improvement of soil health by using conservation practices such as cover crops and conservation tillage. Two other core strategies known to build climate resilience in agriculture are water management and crop diversification.

Despite the well-known and researched benefits of these practices, low implementation rates reveal a disconnect between the benefits of these practices and the overall financial framework in which agriculture operates, including risk management and agricultural credit.^{20,21} This disconnect has significant impacts on farm viability, rural communities, and the role of agriculture in addressing and weathering climate change. As farmers' closest financial partners, agricultural lenders have a critical role to play in building agricultural resilience.

Agriculture is on the front lines of climate change

Agriculture is a “front-line sector” in terms of both its dependence and impacts on natural resources, which means that the economic and environmental challenges facing farmers and the agricultural system are closely connected.²³ Agriculture will be affected by a wide range of shocks and stresses, which vary by type of production and growing region. Climate-related stresses include soil erosion and crop damage from extreme precipitation and drought,²⁴ heat stress impacting livestock²⁵ and farmworkers,^{26,27} increased pest damage²⁸ and increased

disruptions to processing infrastructure from extreme weather.²⁹ These stresses have an increased impact on lower-wealth farming communities and farmers of color.³⁰

The Fourth National Climate Assessment, a congressionally mandated report by the U.S. Global Change Research Program, describes how increased temperatures and more frequent droughts and extreme precipitation events threaten crop productivity across the United States.³¹ These weather changes are expected to affect crop yields, growing season durations and geographical suitability of major crops. The impacts will be either detrimental or beneficial to yields depending on the crop, region and irrigation system.^{32,33,34}

For example, irrigation can buffer crops against drought, but excess irrigation may hasten water shortages in some regions.^{35,36} In the Midwest, corn, sorghum and soybean yields are projected to be affected differently from increased temperatures and precipitation, and will vary significantly across subregions.³⁷ Corn is particularly heat-sensitive, and the Midwest's specialization in that crop increases the region's vulnerability to higher temperatures.³⁸ Changing temperatures will also shift the optimal geographic growing range for some of these grains northward.³⁹ Fruit crops in the Northeast such as apples may bloom earlier due to milder winters, but may also be damaged by frost if the crops bloom too early.⁴⁰ In California, perennial crops such as grapes, avocados and almonds may also be substantially impacted by increasing temperatures and higher intensity droughts influenced by climate change.⁴¹

Building climate resilience in agriculture

Mitigating the financial risks of climate change to the U.S. agriculture system requires resilience, which is the ability of system function to recover from a disturbance. Experts describe three different capacities of resilient agricultural systems:⁴²

- **Response capacity:** the ability of a farm to cope with climate-related challenges in order to avoid or reduce potential damages and to capture new opportunities.
- **Recovery capacity:** having the reserves needed to swiftly and efficiently return to full function after a disruption.
- **Transformation capacity:** the ability to make fundamental changes to farms and the broader agricultural system that enhance its response and recovery capacity in the face of changing conditions now and into the future.

Resilience can be considered across multiple scales, from individual fields to agricultural landscapes and beyond, and also has environmental, economic and social components.⁴³ Recognizing that complexity, the focus of this report is on some of the foundational building blocks of climate-resilient farm management: soil health, water management and crop diversification.

Resilient agriculture should be considered holistically as a management system — the whole is greater than the sum of its parts, or practices. The farming practices and management shifts that improve resilience are not new and continue to be used by many farmers. However, predominant agricultural production systems emphasize efficiency and specialization, which are goals that can conflict with resilience. Resilient farm management emphasizes risk reduction and farm financial viability through crop yield stability, reduced costs of production, diverse revenue streams and preserving the long-term value of the land.^{76,77,78}

Farm management strategies to improve resilience

Build soil health

Farming practices and cropping changes including no-till and cover crops, extended crop rotations and perennial crops can help prevent erosion, improve the soil's physical and biological properties, supply nutrients, suppress weeds, improve soil water holding capacity and break pest cycles.^{44,45} Implementing these practices can reduce input costs by allowing farmers to decrease fertilizer and herbicide use.⁴⁶ Healthy soils can function as sponges. They are better able to absorb rainfall and can also hold onto moisture in times of insufficient rain.^{47,48,49} This can improve the resilience of crop yields to variable rainfall and lower the use of irrigation, and therefore contribute to stabilizing farm income.^{50,51,52} The practices that build soil health also have the potential to generate multiple environmental benefits, including reduced erosion, water use and greenhouse gas emissions, and improved water quality, biodiversity and carbon sequestration.^{53,54,55,56,57} The 2017 U.S. Department of Agriculture Census of Agriculture found that cover crops were implemented on 15.4 million acres in 2017, just under 4% of total U.S. cropland.^{58,59} The census reported 104 million acres of no-till in 2017, which is approximately 25% of total U.S. cropland.⁶⁰ No-till adoption is more widespread than cover crops, though adoption varies widely across crops and regions.⁶¹

Manage water efficiently

Climate projections show that different agricultural regions will face different changes to rainfall patterns, requiring a variety of water management responses to reduce climate risk from drought or excess rain.⁶² In some regions such as the arid West, the frequency and intensity of drought will increase and water availability will be the greatest concern. Continuing or expanding existing levels of irrigation will be limited by the availability of water.⁶³ In these areas, it will be necessary to embrace efficient irrigation practices and systems, and switch to crops that make the most of scarce water.⁶⁴ Other regions may experience the same or increased overall rainfall, but rains will increasingly come in sudden bursts, which can increase erosion and runoff and prevent crops from accessing the water they need at the right time.⁶⁵ Drainage water management can provide farmers the ability to hold back water when fields need it and release water when they do not. Drainage water management can improve crop yield resilience by smoothing out water availability in fields.^{66,67} Drainage water management has also been found to reduce nitrogen losses from agriculture to surface water by as much as 75%.⁶⁸

Diversify crop rotations

In regions dominated by just a few crops, increasing the diversity of crops and rotations can help reduce risks associated with weather variability due to climate change in several complementary ways.^{69,70} Crop diversity also helps reduce economic and production risks due to the "portfolio effect," whereby different crops respond differently to stress.⁷¹ Extended crop rotations (three or more crops over a five year period) have been found to lower farm input costs due to decreased pest pressure and reduced soil-borne diseases.^{72,73} A diversity of crops also shields farms from the negative impacts of fluctuations in market prices and the costs of production.⁷⁴ Diversification has also been found to generate yield benefits for crops that are already in the rotation, such as corn. An analysis of long-term crop yield datasets in North America showed that more diverse rotations increased corn yields over time and across all growing conditions, including both favorable and unfavorable weather conditions.⁷⁵

Agricultural lenders are exposed to climate risk

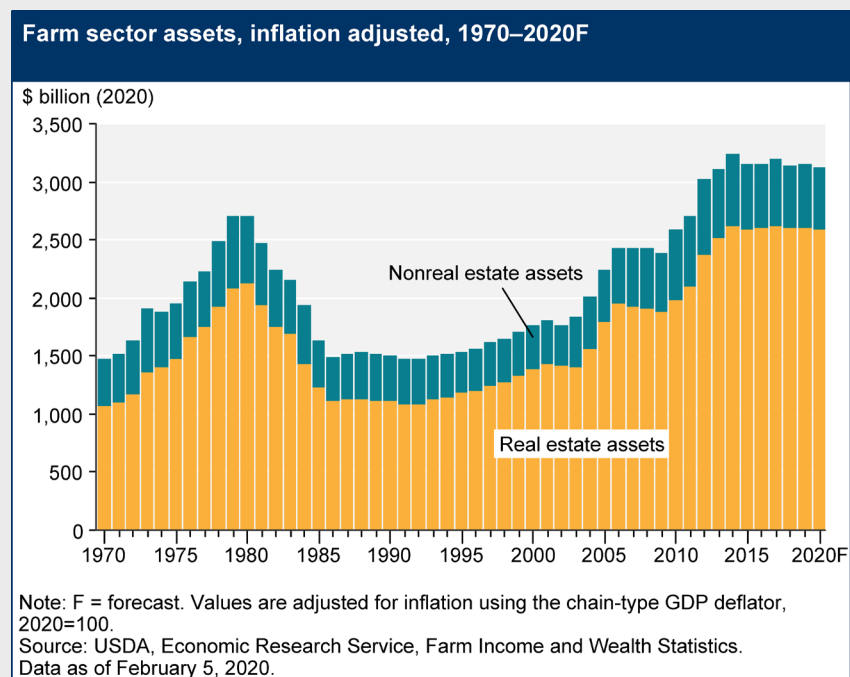
Building climate resilience is an urgent task that requires the involvement of the entire agricultural sector. Research suggests that climate risk is currently underpriced and that climate-exposed financial assets may be overvalued.⁷⁹ Because the agricultural sector faces substantial climate risk, its financial assets are also vulnerable. Lenders could both suffer losses from impaired loans and perhaps be less able to provide credit to borrowers in the future.⁸⁰ Despite these risks, there is little evidence of proactive climate risk assessment by U.S. agricultural lenders.

Inaction on climate risks within the agricultural lending sector stands in contrast to the broader finance sector, in which there is a growing push to assess and mitigate financial market risks from climate change. The following section provides an overview of the agricultural lending sector in the U.S., how lenders currently relate to their farmer clients and assess risk, the role of crop insurance as a shock absorber for agricultural lenders and ways that lenders can assess their climate risk.

An overview of agricultural lending in the U.S.

Farm debt is on the rise, reaching levels unseen since the 1980s. Figure 1 shows trends in U.S. farm real estate and non-real estate debt from 1970 to the present.

Figure 1: Trends in farm real estate and non-real estate debt



Agricultural lending in the U.S. is conducted by two main segments: commercial banks and the Farm Credit System. Farm Credit holds a greater percentage of farm real estate debt, while commercial banks hold a larger percentage of agricultural non-real estate debt, such as equipment and operating loans. Figures 2 and 3 show the distribution of farm real estate and non-real estate debt by type of lender.

Figure 2: Non-real estate debt by lender, 2018

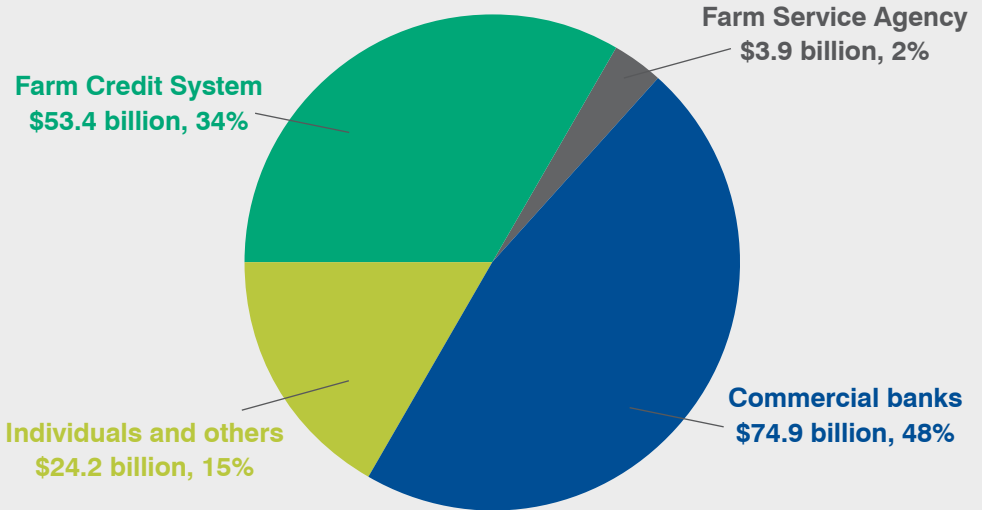
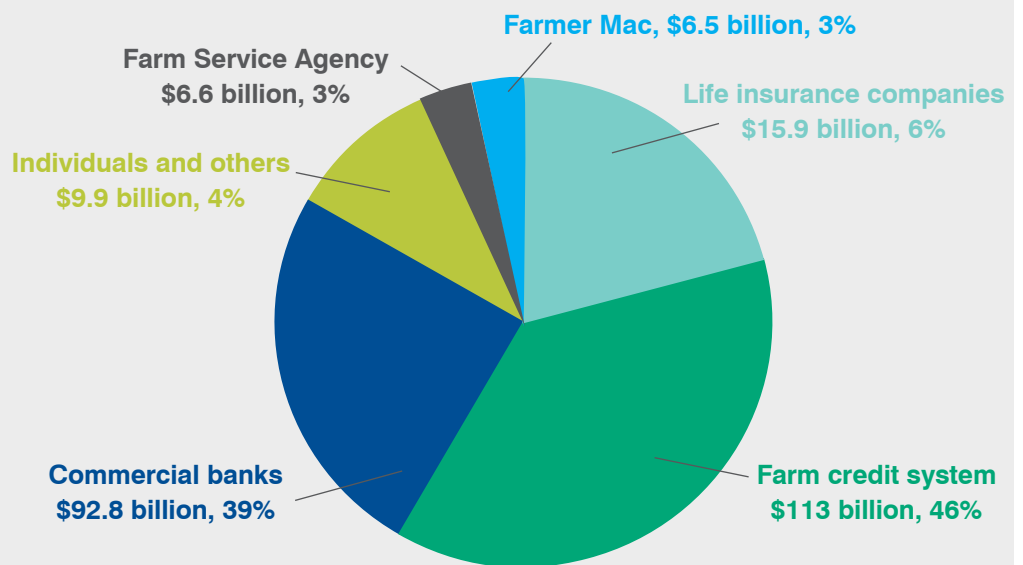


Figure 3: Real estate debt by lender, 2018



Source: U.S. Department of Agriculture, Economic Research Service. (2020, February 05). Charts and Maps of U.S. Farm Balance Sheet Data. Farm Debt: By Lender. Retrieved August 19, 2020, from <https://www.ers.usda.gov/data-products/farm-income-and-wealth-statistics/charts-and-maps-of-us-farm-balance-sheet-data/>



Types of agricultural lenders

Farm Credit

The Farm Credit System is a government-sponsored enterprise, a quasi-governmental entity established to enhance the flow of credit to specific sectors of the U.S. economy — in this case, agriculture.⁸¹ The Farm Credit Administration is an independent agency in the executive branch and is the regulator of the Farm Credit System and the Federal Agricultural Mortgage Corporation (Farmer Mac).⁸² The U.S. Senate Committee on Agriculture, Nutrition and Forestry and the U.S. House of Representatives Committee on Agriculture oversee the Farm Credit Administration and the Farm Credit System. The Farm Credit System raises funds by selling debt securities in the capital markets. For investors who buy Farm Credit bonds on Wall Street, the interest earned is exempt from state, municipal and local taxes.⁸³ This lower cost of capital can result in lower interest rates for farmer clients. The debt securities fund the 72 individual Farm Credit associations that offer loans to farmers, ranchers and rural homebuyers.⁸⁴ Farm Credit associations are cooperatives, so farmer borrowers purchase stock and receive dividends as part of their loan.⁸⁵ The Farm Credit System accounts for 41% of farm debt and is the largest lender for farm real estate.⁸⁶

Commercial lenders

Commercial banks are the other primary agricultural lender, holding slightly more than the Farm Credit System with 42% of total farm debt. Commercial banks are the largest lender for farm operating loans.⁸⁷ This segment includes large, diversified banks such as Wells Fargo and Bank of America, financial divisions of major agriculture companies such as John Deere Financial, as well as many regional and community banks.

Farm Service Agency

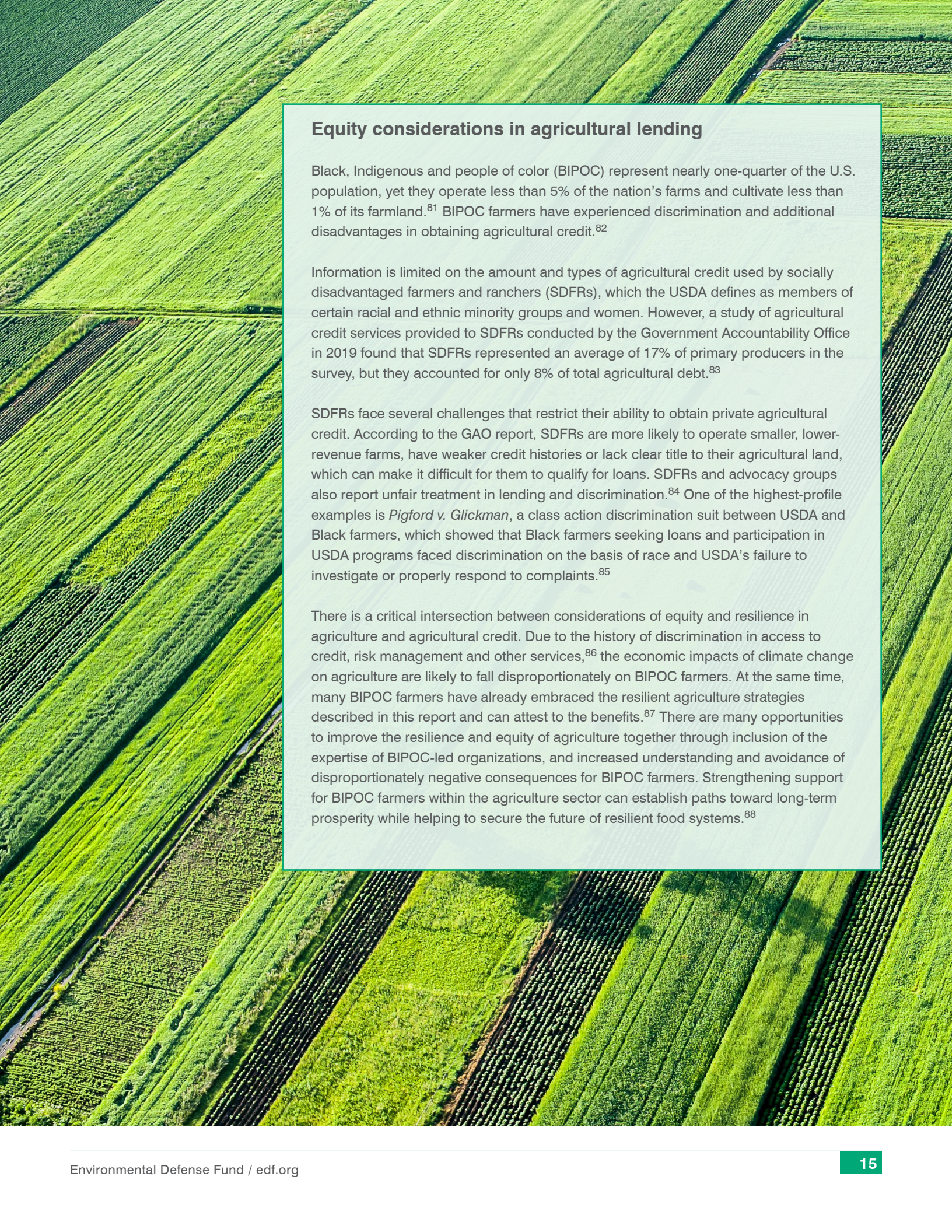
The Farm Service Agency issues direct loans to farmers who cannot qualify for other sources of credit and guarantees the repayment of loans made by other lenders. The Farm Service Agency receives direct appropriations from Congress. Of approximately \$374 billion in total farm debt, the Farm Service Agency provides approximately 2.6% through direct loans and guarantees another 4% to 5% of loans. The Farm Service Agency is considered a lender of last resort because it lends to farmers who cannot meet the credit standards of other agricultural lenders, but it is also a lender of first opportunity because it targets loans or reserves funds for farmers defined as “socially disadvantaged” due to their race, gender and/or ethnicity.⁸⁸ Therefore, while the Farm Service Agency represents a small portion of overall farm debt, it has a critical role in supporting equitable access to agricultural credit.



Farmers go to agricultural lenders for a variety of lending products, including real estate loans, equipment loans and operating loans. Farmer and lender relationships often span many years and are rooted in a shared community. Aside from the farmer him- or herself, the agricultural lender has the most holistic view of a farm's financial health.

Lenders seek to understand the factors that impact loan repayment capacity, including cost of production, a variety of risk factors, financial metrics such as solvency and liquidity, and off-farm income sources. While all lenders seek to understand their clients' repayment capacity, some lenders also seek a more in-depth understanding of the many factors that influence the overall profitability of the farming operation.⁸⁹ They also are considered trusted advisers and encourage good financial practices, such as risk management and the use of recordkeeping and accounting systems that enable farmers to better understand their farms' profitability.⁹⁰

Lenders take care not to make farming decisions for borrowers or exercise control over farm operations because that would trigger lender liability concerns.⁹¹ While agricultural lenders cannot advise farmers to adopt specific management practices because of liability restrictions, they often share information among their clients on what different farmers are trying and what results they are seeing. Some lenders conduct financial benchmarking of their clients, allowing them to identify and share success factors among their client base.⁹²



Equity considerations in agricultural lending

Black, Indigenous and people of color (BIPOC) represent nearly one-quarter of the U.S. population, yet they operate less than 5% of the nation's farms and cultivate less than 1% of its farmland.⁸¹ BIPOC farmers have experienced discrimination and additional disadvantages in obtaining agricultural credit.⁸²

Information is limited on the amount and types of agricultural credit used by socially disadvantaged farmers and ranchers (SDFRs), which the USDA defines as members of certain racial and ethnic minority groups and women. However, a study of agricultural credit services provided to SDFRs conducted by the Government Accountability Office in 2019 found that SDFRs represented an average of 17% of primary producers in the survey, but they accounted for only 8% of total agricultural debt.⁸³

SDFRs face several challenges that restrict their ability to obtain private agricultural credit. According to the GAO report, SDFRs are more likely to operate smaller, lower-revenue farms, have weaker credit histories or lack clear title to their agricultural land, which can make it difficult for them to qualify for loans. SDFRs and advocacy groups also report unfair treatment in lending and discrimination.⁸⁴ One of the highest-profile examples is *Pigford v. Glickman*, a class action discrimination suit between USDA and Black farmers, which showed that Black farmers seeking loans and participation in USDA programs faced discrimination on the basis of race and USDA's failure to investigate or properly respond to complaints.⁸⁵

There is a critical intersection between considerations of equity and resilience in agriculture and agricultural credit. Due to the history of discrimination in access to credit, risk management and other services,⁸⁶ the economic impacts of climate change on agriculture are likely to fall disproportionately on BIPOC farmers. At the same time, many BIPOC farmers have already embraced the resilient agriculture strategies described in this report and can attest to the benefits.⁸⁷ There are many opportunities to improve the resilience and equity of agriculture together through inclusion of the expertise of BIPOC-led organizations, and increased understanding and avoidance of disproportionately negative consequences for BIPOC farmers. Strengthening support for BIPOC farmers within the agriculture sector can establish paths toward long-term prosperity while helping to secure the future of resilient food systems.⁸⁸

Agricultural lenders face growing risks from climate-related shocks

Weather extremes and disruptions associated with climate change impact farmers' financial partners, including agricultural lenders. Following severe flooding in the spring of 2019, bankers lending in the Midwest reported to the Federal Reserve Bank of Chicago that approximately 70% of their borrowers were at least moderately affected by extreme weather events in the first half of the year. At the same time, the portion of the region's agricultural loan portfolio reported as having "major" or "severe" repayment problems hit the highest level in 20 years.¹⁰¹

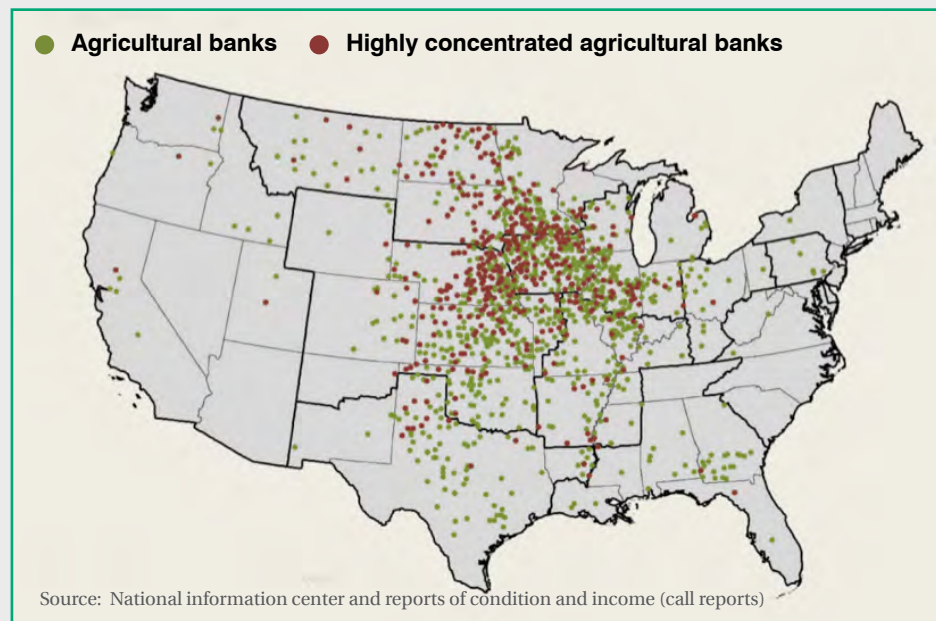
“Extreme weather conditions can substantially impact harvest volume and prices of agricultural products and, ultimately, impact the credit quality of some of our agribusiness borrowers and our Associations’ borrowers as their earnings are affected.”

— CoBank 2018 annual report¹⁰²

Agricultural banks are defined by the Federal Reserve as those where combined agricultural production and farmland loans account for at least a quarter of total loans in their portfolio. Banks that meet this criterion hold nearly half of all agricultural loans (see Figure 4). About one-third of those agricultural banks are considered “highly concentrated,” meaning total agricultural lending is more than 300% of their total risk-based capital, the minimum capital requirements for banks set by regulators to act as a cushion from insolvency.^{103,104}

Many agricultural banks are highly exposed to impacts that reduce farmers' ability to service their debts, including climate-exacerbated extreme weather events. This is due in part to their concentration in agricultural loans, their geographic concentration and correlated risks. Their portfolios often include multiple types of agricultural businesses or other businesses dependent on farmer customers, all of which are affected by agricultural production shocks and economic downturns.¹⁰⁵ Many agricultural banks are also small, another potential risk factor. As of 2019, more than 70% of non-performing agricultural loans in the Midwest were at banks with less than \$10 billion in total assets.¹⁰⁶

Figure 4: Half of all agricultural loans are held by banks with at least 25% of their portfolio concentrated in agricultural production or farmland¹⁰⁷



Large banks are not immune to climate stress, especially chronic risks such as prolonged drought.¹⁰⁸ In 2017, nine major international banks with combined assets of more than \$10 trillion voluntarily conducted a modelling exercise to assess how drought might affect creditworthiness among a sample of their borrowers.¹⁰⁹ The exercise showed that agriculture was among the most affected sectors, and most borrowers experienced some level of credit downgrade.¹¹⁰

Credit-stressed agricultural lenders can reduce access to affordable credit for farmers, making it more difficult for them to recover from climate-related shocks. Credit supply constrictions are particularly likely to impact farmers who are historically underserved by lending institutions, including small farmers and farmers of color. This dynamic can then contribute to greater consolidation in the agriculture sector, which may further reduce diversification and resilience to future shocks.¹¹¹

Common considerations of agricultural lenders in risk assessment

A common framework that lenders use in evaluating credit applications is called the “Five C’s of Credit” (see box). This framework shows that lenders value both tangible financial indicators of repayment ability (collateral), as well as less tangible relationship factors (character).

The Five C’s of Credit

- **Capacity** refers to the borrower’s ability to repay debt obligations.
- **Capital** relates to a borrower’s ability to meet obligations, continue business operations, and protect against adversity and unexpected losses.
- **Collateral** is the security pledged on the loan. Guarantees and crop insurance also add strength to the collateral position.
- **Character** refers to the borrower’s integrity and management ability, including considerable emphasis on the institution’s past relationship with the borrower.
- **Conditions** are items that help the lender control risk in loans. Conditions should be commensurate with the loan type, purpose and overall risk in the account.

Source: Farm Credit Administration. Classifying Assets Using the UCS. Retrieved July 2020 from: <https://www3.fca.gov/readingrm/exammanual/General%20Guidance/Classifying%20Assets%20Using%20the%20UCS.pdf>

Farm operating loans are typically renewed annually, and the renewal process requires that the farmer provide financial information and discuss the farm's performance and plans with their lender. Farmers are asked to provide their lender with financial records, including tax returns, profit and loss statements, balance sheets and a plan of future operations that shows financial impacts. The lender uses this information to project a cash flow, rate the risk of the loan, and seek to understand the financial strengths and weaknesses of the farm operation.¹¹²

Lenders determine loan terms using several factors captured in the Five C's, the most important of which is typically collateral and the capacity to repay.¹¹³ Lenders use basic financial measures, as well as working capital assessments, financial statements and loan repayment calculations, to evaluate a farm's probability of default. If a farm has significant equity, crop insurance or a loan guarantee, that will improve its score.¹¹⁴ The Farm Credit Administration regards repayment capacity as the most important quantitative credit factor, but it also notes that negative character assessments can be significant enough to outweigh strengths in the other C's.¹¹⁵ This subjective character component can be used to support farmers who have a constructive relationship with their lender, but it also is a source of risk for farmers of color and others who may diverge from conventional farming methods.¹¹⁶

Lending institutions identify, measure and report credit risk through several different methods. Risk ratings support numerous lending institution processes (e.g., hold limits, underwriting, loan pricing, allowance for losses methodology, capital planning and other risk management functions).¹¹⁷ For example, Rabo AgriFinance identifies and quantifies probability of default and loss given default ratings for each client, along with other ratings prescribed in the Basel Accord.¹¹⁸ Individual ratings then roll up to portfolio and business analyses.¹¹⁹ The Farm Credit System uses the Uniform Classification System based on thorough analysis of a borrower's Five C's, which then inform the Uniform Classification System ratings of acceptable, special mention, substandard, doubtful and loss.¹²⁰ Farm Credit also develops probability of default and loss given default ratings for farmers and portfolio analysis.¹²¹

Lenders can establish differential interest rates for loans based on a variety of factors that may include loan type, purpose, amount, quality, funding or operating costs, or similar factors or combinations of factors. In the adoption of differential interest rate programs, lenders also consider the special credit needs of classes of farmers with positive attributes that they want to protect, advance or manage (such as young, beginning and small farmers, which are described in more detail later in the report).¹²² While conversations with agricultural lenders indicate that they may qualitatively consider conservation practice adoption as a testament to the farmer's management prowess and character, they typically do not consider or collect financial information on the quantitative connection between conservation adoption, financial performance and risk in their loan underwriting practices.¹²³ Lenders have a blind spot when it comes to understanding the connections between conservation adoption and farm finances, and incorporating that information into lending decisions.

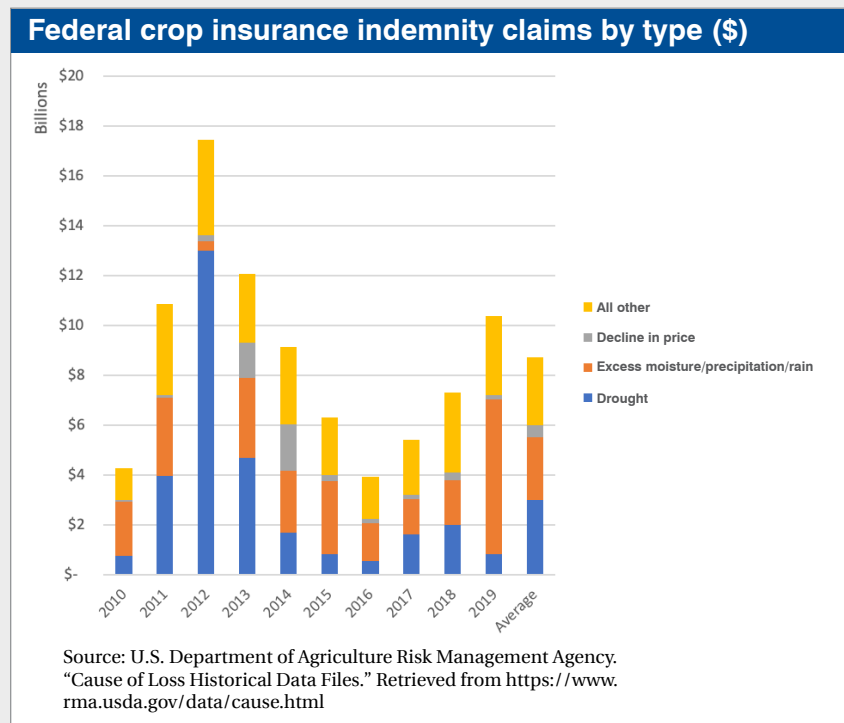
Lenders have a blind spot when it comes to understanding the connections between conservation adoption and farm finances, and incorporating that information into lending decisions.

Crop insurance is not sufficient to protect farmers or lenders from climate risk

Crop insurance helps to shield both farmers and their lenders from the financial impacts of weather-induced crop yield and quality losses, and is frequently described as agriculture’s most important risk management tool.¹²⁴ Total crop insurance liability represents nearly 70% of all non-real estate agricultural debt in the U.S.^{125,126} Insurance can be critical from a lending perspective since it guarantees a minimum revenue or yield, which affects the farmer’s ability to repay the loan. Agricultural lenders typically require their borrowers to hold crop insurance (or require significant collateral in its absence) because loans backed by insurance are lower risk.¹²⁷ Often, the amount of crop insurance that a farmer selects sets the amount that they can borrow as operating capital. Crop insurance also allows farm loans to maintain relatively low interest rates by absorbing much of the risk of yield loss and market swings from farmers, and therefore their lenders.¹²⁸

The federal government is heavily involved in the crop insurance industry through USDA’s Risk Management Agency, which subsidizes between 50% of farmers’ insurance premiums.¹²⁹ In 2017, federal crop insurance policies covered 311 million acres, protecting nearly 90% of the nation’s insurable cropland.¹³⁰ Insurers backed more than \$106 billion worth of crops in 2017, and farmers paid \$3.7 billion in premiums for insurance protection.¹³¹ Crop insurance is the second most volatile insurance category after flood insurance, as measured by the range of loss ratios (incurred losses divided by earned premiums).¹³² Figure 5 shows federal crop insurance indemnity claims over the 2010-2019 period.

Figure 5: Droughts and excess precipitation drive the variability in crop insurance indemnities



The close relationship between crop insurance and agricultural lending has important implications for climate-resilient agriculture and conservation adoption. First, while lenders cannot require specific farming practices, crop insurers do — and when lenders require crop insurance to receive a loan, they are de facto requiring farmers to utilize the “Good Farming Practices” designated by USDA’s Risk Management Agency. These Good Farming Practices have created barriers to some key conservation practices, including cover crops. Many organizations have pushed to incorporate conservation practices in the Good Farming Practices definition, and while significant progress has been made, some producers still find their conservation efforts hindered by crop insurance requirements.¹³⁴

In addition, crop insurance is used mainly by farmers who grow a select group of major field crops — feed grains (corn, sorghum, barley and oats), cotton, wheat, rice, soybeans and peanuts. Since 1980, the Federal Crop Insurance Commission has paid over \$80 billion in premium subsidies to support federal crop insurance policies. The major field crops have received over 85% of federal crop insurance premium subsidies.¹³⁵ Given the importance of crop insurance in lending decisions and the value of crop insurance as a safety net for farmers, the emphasis on a small group of crops creates a disincentive to crop diversification.

On the other hand, the close linkage between lending and crop insurance also means that efforts to incorporate the risk reduction benefits of resilient agricultural practices into the way that crop insurance is rated will also flow through to lending, potentially creating a positive feedback loop between both financial products. Members of the AGree Economic and Environmental Risk Coalition have conducted significant research on the connections between agricultural conservation, crop yield risk reduction and crop insurance.¹³⁶ The coalition advocates for federal risk management programs that encourage farmers to implement practices that reduce producers’ long-term risk, in addition to improving soil health and water quality.¹³⁷

Crop insurance does not protect farmers or lenders completely from the financial impacts of weather shocks.

Crop insurance will continue to be an important risk management tool for farmers and lenders, and opportunities to integrate the risk reduction benefits of resilient agriculture into crop insurance methodologies is a key area for continued work. However, there are several reasons why crop insurance does not protect farmers or lenders completely from the financial impacts of weather shocks:

- Crop insurance is not designed to make farmers “whole” after a disaster. The maximum crop insurance coverage is 85% of farm losses.¹³⁸ In the face of more frequent extreme weather events, a farm’s financial position will degrade over time as crop insurance does not completely make up for losses.
- Many agricultural lenders finance not only farmers, but also local processors and agricultural businesses. Those entities are also negatively affected when crop yields suffer, and they are not buffered by crop insurance. Therefore, a regional agricultural lender could have correlated risks in its portfolio.¹³⁹
- There are also significant barriers to small farmer participation in crop insurance: 75% of large farms participate in federal crop insurance, compared with just 15% of all U.S. farms.¹⁴⁰ While insurance coverage is high for the major field crops, only one-quarter of U.S. agriculture’s total production value is covered by crop insurance.¹⁴¹ This means that the vast majority of U.S. agricultural production is left unprotected by crop insurance and vulnerable to weather shocks.



An exclusive reliance on crop insurance to absorb the impacts of weather shocks without considering opportunities to build resilience in the underlying agricultural system is a strategy that will ultimately increase overall risk and losses in the agricultural economy.

Looking to the future, the continuation of crop insurance in its current form depends on the willingness of legislators and taxpayers to subsidize agricultural risk. A study by USDA's Economic Research Service found that crop yield volatility increases under most climate scenarios and for most crops, increasing the frequency and/or depth of losses, and thus increasing premiums and subsidies. Under different greenhouse gas emissions and farmer adaptation scenarios, the cost of today's federal crop insurance program in the second half of this century is projected to range from a 3.5% increase under moderate emissions with farmer adaptation, to a 37% increase under severe emissions and no adaptation.¹³¹

In sum, an exclusive reliance on crop insurance to absorb the impacts of weather shocks without considering opportunities to build resilience in the underlying agricultural system is a strategy that will ultimately increase overall risk and losses in the agricultural economy. Agricultural lenders must expand their view of risk mitigation beyond crop insurance to include farm management strategies that reduce risk — in other words, agricultural resilience.

Agricultural lending institutions must assess their climate risk

Major financial institutions around the globe are increasingly recognizing their role in assessing and mitigating climate risk to financial markets. In early 2020, Larry Fink, the chairman and CEO of the world's largest asset management firm BlackRock, wrote a letter in which he asserted that climate change is causing a fundamentally reshaping of finance. Fink emphasized the need to focus on long-term profitability and to make sustainability integral to portfolio construction and risk management.¹⁴⁴ Continued pressure from asset managers, including BlackRock, has mobilized banks to build climate risk strategies. A 2019 survey of 20 banks and seven other financial institutions found that 55% of mainstream financial institutions are currently taking a strategic approach to climate risk, and 95% aim to implement a strategic approach in the future.¹⁴⁵

Despite this trend, most U.S. agricultural lending institutions have not yet integrated climate risk into their risk management frameworks. The Federal Reserve outlines the four major categories of risk facing agricultural lenders as agricultural commodity prices, production costs, farmland values and global market issues, which includes weather events as a sub-category but does not include a specific focus on climate change.¹⁴⁶ In 2010, the Farm Credit Administration released a statement expressing its intent to adequately plan for the effects of climate change so that it can continue its mission of ensuring a safe, sound and dependable source of credit,¹⁴⁷ yet interviews with Farm Credit lenders and system experts indicated that lenders have not examined climate risk. Interviews indicated that Farm Credit views its largest risks as interest rate risks and general farm economy risks, especially land values.¹⁴⁸

A more comprehensive approach to assessing and mitigating climate risk is needed for agricultural lenders of all types and sizes. There are several different types of climate risks¹⁴⁹ that may affect agricultural lenders. They include physical risks to assets such as crops,¹⁵⁰ correlated risks when lenders finance multiple related businesses, regulatory risks and reputational risks.¹⁵¹

In 2019, the U.S. Commodity Futures Trading Commission formed a subcommittee focused on climate-related market risk. Founded by CFTC Commissioner Rostin Behnam, the subcommittee includes experts from financial markets, the banking and insurance sectors, the agriculture and energy markets, data and intelligence service providers, environmental and sustainability public interest sector (including EDF), and academics.¹⁵³ The work of this subcommittee is likely to significantly influence U.S. financial institutions' approach to climate risk.

Agricultural lenders in the U.S. can learn from progress in the banking sector more broadly. For example, global consulting firm McKinsey published five principles for banks to manage climate risk:¹⁵⁴

- 1. Establish strong climate-risk governance.** Nominating a senior leader to be responsible for climate risk can ensure that the process is taken seriously and that there is a clear path for oversight from the board. The Task Force on Climate-Related Financial Disclosures recommends assigning climate risk responsibilities to management or the board, regular updates to the board, and a formal structure for climate risk considerations to imbed into strategy, risk management policies and capital allocation.¹⁵⁵



2. Tailor business and credit strategy. Climate considerations should be deeply embedded in risk frameworks and capital-allocation processes. Boards should regularly identify potential threats to strategic plans and business models.¹⁵⁶


3. Align risk processes. To align climate-risk exposure with risk appetite and the business and credit strategy, risk managers should inject climate-risk considerations into all risk-management processes, including capital allocations, loan approvals, portfolio monitoring and reporting.¹⁵⁷

4. Utilize tools including scenario analyses and stress tests. Reliable data and methodologies must be utilized to adequately understand, assess and price environmental risks to inform financial decision making.¹⁵⁸ Currently, few banks use environmental stress testing, and those that do employ a range of different techniques, data sources and analytical processes, which leads to inconsistencies of reporting between and even within institutions.¹⁵⁹ However, new developments such as the stress tests conducted in 2020 by the European Banking Authority provide new standardized tools that banks can use (See Appendix A to access the stress test template).¹⁶⁰

5. Create a strong enabling environment through partnerships. Banks taking their first steps address climate risks should not expect to do it on their own. Partnerships with climate risk experts and organizations focused on developing climate risk assessment tools can help banks assess and mitigate risks efficiently and effectively.¹⁶¹

The International Finance Corporation and Sustainable Banking Network describe sustainable banking as spanning two important aspects of banks' business operations — risk management that integrates environmental and social risks into lending considerations, and loan origination that supports lending to businesses that are environmentally and socially responsible.¹⁴⁷ In the case of agricultural lending in the U.S., neither is occurring at a level that matches the scale or urgency of the threat of climate change. Given the severity of weather events already affecting agriculture across the country, a major shift in the agricultural lending sector's approach to climate risk and resilience is overdue. The longer the agricultural lending sector fails to prepare for climate risks, the greater the likely severity of economic consequences — both for lenders and their farmer clients.

[For a resource list on climate risk assessment for financial institutions, see Appendix A.](#)



Other trends supporting agricultural lender engagement in conservation

Climate risk is not the only reason why lenders should take a more active role in understanding the benefits of resilient farming practices and supporting their farmer clients who wish to adopt them. There are several other trends or risks lenders should consider, including:

- **Supply chain sustainability initiatives.** Major companies including Walmart, Tyson Foods, Smithfield Foods, Unilever, Cargill and others set sustainability targets and have launched programs to engage farmers in their supply chains to adopt conservation practices.¹⁶³
- **Regulatory risks.** Related to water quality, these risks include federal Clean Water Act nutrient limits¹⁶⁴ and state nutrient reduction plans and regulations.^{165,166} Areas reliant on irrigation that are not proactively managing for variable water supplies are likely to face increased regulations, such as California's Sustainable Groundwater Management Act, which will likely require the retirement of 500,000 to 780,000 acres of irrigated agriculture in order to curb unsustainable groundwater extraction and resulting community and economic impacts.¹⁶⁷
- **Litigation risks.** Environmental litigation is also a rising risk, as exemplified by the Des Moines Water Works' lawsuit against three drainage districts in northern Iowa due to high levels of nitrates in the Raccoon River, a source of drinking water for central Iowa residents.¹⁶⁸
- **Reputational opportunities and risks.** Consumers and citizens are increasingly interested in where their food comes from, how it is made and its impacts, which offers both new market opportunities for some farmers,¹⁶⁹ as well as reputational risks and opposition for others.¹⁷⁰

The role of agricultural lenders in supporting resilient agriculture

Agricultural leaders interviewed for this report expressed a strong interest in improving their understanding of the farm budget impacts of conservation practices. Such information can be translated to lender decision-making, lending programs and products that better serve farmers who adopt, or want to adopt, practices that build resilience. While lenders cannot require their clients to adopt specific practices, there are still multiple ways that they can pursue strategic objectives that benefit the agriculture sector and farmer clients, and there are several existing examples of lender programs or products that support farmers in navigating similar financial barriers or transitions. Where such programs and products do not meet current credit standards, loan support from partners can help bridge the gap, de-risking initial programs and offering the opportunity to collect data that prove new or modified lending products for resilient agriculture can stand on their own.

Ultimately, the objective is to accurately reflect the value of resilient agriculture in credit pricing and structures.

The objective of developing new lending programs to finance resilient agriculture is not to create new agricultural subsidies through lenders, but rather to realign lending structures to better match the needs of farmers who adopt practices that improve resilience, and in doing so realign the overall risk of a lender' portfolio. Ultimately, the objective is to accurately reflect the value of resilient agriculture in credit pricing and structures.

The financial case for resilient agricultural practices

A frequently cited reason for the limited adoption for agricultural conservation practices is the perception of a poor or negative return on investment, or short-term financial obstacles to change.¹⁷¹ However, when evaluated as a long-term investment, resilient agricultural practices can generate significant financial benefits to farming operations. Organizations working to better understand the farm budget impacts of conservation adoption include EDF, American Farmland Trust, Precision Conservation Management, Soil Health Partnership, Sustainable Agriculture Research and Education (SARE), Soil Health Institute and land-grant universities such as the University of Illinois.

To date, this body of work shows that there are several ways in which resilient practices impact farm budgets, including:

- **Production costs.** Practices that build soil health can allow farmers to reduce input costs over time, as biological processes replace some synthetic nutrients, herbicides and pesticides. Financial analyses of cover crops by the Iowa Soybean Association, EDF and SARE found cover crops can serve as a nutrient source or stabilizer and suppress weeds, reducing fertilizer and herbicide costs.^{172,173,174} Analysis from the Precision Conservation Management program in Illinois shows that between 2015 and 2018, 66% of fields received applied nitrogen over the university-recommended “Maximum Return to Nitrogen” rate.¹⁷⁵ Precision Conservation Management determined that farmers can save \$5 per acre for every 10 pounds of excess nitrogen reduced.¹⁷⁶

No-till also reduces the number of trips across the field and can allow farmers to downsize their equipment, reducing machinery, fuel and labor costs.¹⁷⁷ Extended crop rotations have been found to lower farm input costs due to decreased pest pressure and reduced soil-borne diseases.^{178,179}

“Conservation agriculture isn’t just stopping tilling or planting cover crops — it’s a complete systems change. That systems change requires a mindset change that embraces the benefits of diversity and building resiliency over time.”

— Justin Knopf,
Knopf Farms, Kansas



There are also cost increases associated with some conservation practices. Cover crop seed and application increased costs for farmers in studies from Iowa Soybean Association and EDF.^{180,181} SARE found that cover crop seed and application cost an average of \$37 per acre, though they also identified multiple strategies to compensate for those costs.¹⁸² In the case of water management improvements, there may be upfront capital costs of new technology or drainage water management systems.¹⁸³ Opportunity costs are another consideration for farmers, particularly when some of the management operations related to conservation conflict with the timing of other farm management operations.¹⁸⁴

- **Crop yields.** Analysis by SARE identified that for many farmers, implementing cover crops minimized drought-related losses. According to an analysis of yield data collected in a national cover crop survey, grain farmers experienced a 3% increase in their corn yield and a 5% increase in soybeans after five consecutive years of cover crop use. In the drought year of 2012, farmers reported even greater yield increases when they used cover crops: nearly 10% in corn and 12% in soybeans.¹⁸⁵ Grain farmers in EDF case studies also described benefits of yield resilience in poor weather years.¹⁸⁶ Cover crops also can allow earlier planting in a wet spring and improve field trafficability.¹⁸⁷

Almond farmers in California found yield benefits from mulching, nutrient management and compost application.^{188,189} Drainage water management can improve crop yield resilience by smoothing out water availability in fields.¹⁹⁰

Diversification can also have benefits for crops that are currently the focus of specialization, such as corn. An analysis of long-term crop yield datasets in North America showed that more diverse rotations increased corn yields over time and across all growing conditions, including both favorable and unfavorable weather conditions.¹⁹¹

- **Farm revenue.** While resilient farming practices do not currently receive a premium price like organic production, there are opportunities for farmers to increase or smooth revenue associated with these practices. Federal and state cost-share programs are the most significant source of potential revenue for farmers who are newly adopting conservation practices.¹⁹² Extended crop rotations shield farms from the negative revenue impacts of fluctuations in market prices and the costs of production.¹⁹³ Farmers who graze or harvest products from their cover crops have also been found to consistently make a positive return on investment.¹⁹⁴

In addition, there is a growing number of supply chain sustainability programs that offer farmers a financial incentive to adopt conservation practices. For example, Unilever and PepsiCo offer \$40 per acre for up to 40 acres to farmers new to using cover crops, or \$10 per acre for up to 160 acres or 10% of acres farmed (whichever is larger) to existing cover crop users.¹⁹⁵ There are also numerous efforts to develop markets for ecosystem services and carbon credits generated by farmers.^{196,197} As these opportunities expand, there will be more opportunities for farmers to generate revenue from resilient practices.

- **Farmland asset value.** Farmland buyers typically consider location, soil type and soil class. Appraisers seldom place a value on soil health, and there is no standard method to incorporate the value of healthy soils into farmland appraisal. However, it is intuitive that farmland that has been managed well, without erosion or nutrient mining, has greater production value than farmland with degraded soils. While there is anecdotal evidence that farmland with healthy, well managed soils can receive a premium price, there is little information currently available on this connection at scale.¹⁹⁸



Farm Finance Report

Farm finance and conservation: How stewardship generates value for farmers, lenders, insurers and landowners, a 2018 report by Environmental Defense Fund and agriculture accounting firm K-Coe Isom AgKnowledge, details the financial impacts of conservation for three Midwestern grain farmers and provides a comparative sample of conservation adopters and non-adopters. The three farmers profiled adopted a variety of conservation and precision farming practices and were able to reduce their costs and improve their soils, which they observed to increase the resilience of their crop yields to adverse weather events. Their stories and budget information combine to show how they were able to improve both financial and environmental performance on their farms.

Farm budget analyses of conservation adoption reveal key themes that are essential to understand the unique financial profile of conservation practices that improve resilience:

- 1. Cost savings come from practice interactions.** Resilient agriculture is a management system — the whole is greater than the sum of its parts, or practices. There are significant cost savings that can be achieved, but it requires a focus on the interaction between practices in order to achieve those savings. For example, no-till often requires a different regime of herbicide use, but integration of cover crops can assist with weed suppression and provide nutrients back to the crop, which may allow for decreased fertilizer and chemical application.¹⁹⁹ This dynamic can add to the challenge of quantifying benefits, because costs often occur in one or two budget categories while the benefits occur over multiple categories.²⁰⁰
- 2. Benefits can take several years to materialize.** Practices that build soil health can take several years (for example, three to five years for cover crops) to generate a financial benefit. In a cost-benefit analysis of cover crops in California almond orchards, researchers found long-term financial benefits that could not be quantified in an annual analysis.²⁰¹ Adjusting farm management to improve resilience requires a process of trial and error, recording results and making further adjustments. There are both biochemical and farmer learning components to this transition. Each farm has its own unique mixture of soils, water, climate and topography that impact the integration of new crops and practices.

Farmers often incur transitional risk in the form of reduced yields and exposures to new types of weeds or pests until the new system can normalize.²⁰² American Farmland Trust case studies identified significant learning costs to implementing new conservation practices.²⁰³ Recognizing and planning financially for this transition period and taking a multi-year view of the investment are both critical to success.

“Without good numbers, you can’t have trends and you can’t understand where you’ve been, where you are, and where you’re going.”

— Jim Knuth,
senior vice president of
Farm Credit Services
of America²⁰⁶

3. Risk reduction is a key benefit. The relationship between healthy soils, water management and crop yield resilience is important, as is the opportunity to reduce financial risk overall through crop diversification and cost savings. However, it can be challenging to measure financial benefits that only appear in certain years or under poor weather conditions. While many farmers have stories of their investments in soil health paying off in bad weather years,²⁰⁴ it is difficult to proactively incorporate that experience into a return projection. In addition, while crop diversity helps reduce economic and production risks due to the “portfolio effect” and helps foster long-term financial stability,²⁰⁵ extended crop rotations may also cause variability in revenue in the short-term.

4. Strong farm management — including accurate recordkeeping — is essential. Farm recordkeeping allows farmers to track practice interactions and potential cost savings, and to effectively manage the many variables involved on each farm to achieve the best results. However, comprehensive recordkeeping often is not at the top of farmers’ priorities, especially for those under financial stress or who have less capacity around the farm.

One opportunity to improve recordkeeping and quantification of the financial impacts of practice adoption is agricultural technology and data collection. While farm data collection capabilities have expanded drastically over the past decade, there are still many gaps in farmer access to technology and the ability of farmers to manage and analyze data.²⁰⁷ There are also integration gaps with key types of software, such as farm management and financial accounting software.²⁰⁸ Despite these challenges, there are signs that integration of farm management and financial software is now occurring, with lenders playing a significant role in the transition. For example, Rabo AgriFinance, a subsidiary of Rabobank, announced a partnership with farm management software Conservis focused on co-developing technology to help farmers connect real-time field and management data with financial results and analysis.²⁰⁹ These software integrations could allow lenders to better understand the connections between conservation adoption and farm profitability, risk and resilience at a much more granular level.

At the same time, it is important to note that such software is much more commonly available to and used by large-scale farmers.²¹⁰ An exclusive reliance on technology-heavy solutions to understand opportunities to build resilience creates a significant blind spot in leaving out smaller and more diverse operations, many of which may already be utilizing more resilient practices. The path forward will require methods to assess the financial performance and resilience of farms of all types and sizes, and an openness to learn from a variety of different operations. This will also require clear protections for farmers in terms of how their data will be used and protected.²¹¹ Opportunities to support farm recordkeeping for farms of all sizes would help overall farm management, as well as the assessment of resilient practices.²¹²

In summary, the core financial attributes of resilient farming systems are reduced costs and risk. These benefits are particularly evident when farm budgets are viewed over multiple years. While some costs increase, in many cases they can be offset by other cost savings and yield benefits. When farmers are able to attract additional revenue, the financial case is even stronger. However, despite the long-term benefits, the transition period may deter many farmers from adopting these practices — especially in economically challenging times.

[For a resource list on farm budget analyses of conservation adoption, see Appendix B.](#)

Disconnects between current loan offerings and resilient agriculture

There are several ways in which current loan offerings do not align with the financial attributes of resilient farming practices, and therefore create challenges for farmer clients that use or are considering adopting more resilient practices, including:

- **Information gaps.** First, there is less data available to lenders on the return proposition of resilient practices than conventional farming practices, and many lenders are unaware of the data that does exist. This information gap disadvantages both farmers and lenders in developing reasonable projections of the financial impacts of the transition to resilient practices. Continued efforts to create locally relevant analyses of the finances of farms that use resilient practices can help fill that gap, as can lender efforts to educate themselves on the information that is available (see Appendix B for a resource list).
- **Short-term focus.** The annual nature of many crop cycles and associated business practices, including annual operating loans, compel farmers and their financial partners to focus on short-term cash flow rather than longer-term profitability and value.²¹³ This has the potential to create significant blind spots. For example, soil degradation or mining for nutrients can produce high yields in the short term, but over the long term such practices undermine crop productivity and the value of the land asset.²¹⁴ Similarly, excess water consumption for irrigation can lead to future water scarcity and the risk of crop failure.²¹⁵ Lastly, extended crop rotations may also cause variability in revenue in the short term, but greater stability over the long-term.²¹⁶ With risk and loan assessment conducted on a single-year basis, short-term risk is given more weight than long-term stability.²¹⁷
- **Loan terms do not value resilience.** While farmers who use crop insurance are able to access significantly better loan terms, farmers who utilize a production-system risk reduction strategy receive little or no benefits. In addition, lenders do not provide short-term accommodations in loan terms for farmers who are transitioning to more resilient practices. Some lenders contend that if farmers increase their financial health and stability by using resilient practices, ultimately their lending terms will improve along with the farm's improved financial performance. However, this is a lagging indicator and does not support farmers in navigating the transition so that they can arrive at the better outcome. Farmers face an additional barrier to conservation adoption when they cannot partner with their lenders to plan for the transition period and take a multi-year view of conservation investments.

If success is only defined as the farmer's ability to repay his or her annual operating loan, farmers and lenders will miss opportunities to reduce risk and maximize long-term profitability.

Agricultural lenders in the U.S. do not currently collect financial data specific to resilient practices, incorporate the risk-reduction potential of resilient farming practices into their risk ratings, or design programs or products to support farmers in managing the transition to practices that improve resilience. Some in the lending sector may ask why such changes are needed when many farmers are currently able to finance conservation expenses using existing lending products. While this is true, it is also true that existing products were developed with conventional farming practices in mind, and are not designed to support farmers in overcoming the unique financial characteristics of the adoption of resilient farming practices. As such, this places the onus of navigating the existing loan products and structures on the farmer who desires to increase resilience. This disconnect creates a structural disincentive to change, and contributes to persistent low adoption levels. Ultimately, this results in sub-optimal outcomes both for farmers and for lenders seeking the best risk-adjusted return.

On the other hand, there are market opportunities for lenders who engage with their farmer clients who are interested in resilient practices and seek to meet their needs. There are several examples of existing lender initiatives and programs that can inform efforts to develop programming or products that support farmer adoption of resilient farming practices.

Existing lender initiatives can inform efforts to build resilience

The following examples are useful in understanding the ways in which lenders can expand or adjust their existing loan offerings to meet farmer client needs.

Young, beginning and small farmer programs

Farm Credit, as well as several commercial lenders, have developed programs to support young, beginning and small (YBS) farmers and ranchers. This market segment may be considered risky or have insufficient collateral, equity or working capital to get a traditional agricultural loan.²¹⁸ However, most agricultural lenders recognize the importance of supporting YBS farmers to maintain a vibrant farming population into the future.

In the case of Farm Credit, Section 4.19 of the Farm Credit Act requires credit associations to establish programs for furnishing “sound and constructive credit and related services to young, beginning, and small farmers and ranchers.” The YBS regulation, which implements the Act’s YBS provision, requires minimum components to successfully fulfill the YBS mission. Farm Credit’s Bookletter 040 provides guidance on how Farm Credit associations can implement this requirement, including the following provisions:

- **Credit enhancements for YBS farmers.** Credit enhancements could include applying more flexible interest rates or fees, underwriting standards, and collateral requirements on such loans, as well as obtaining guarantees, such as Farm Service Agency guarantees.
- **Setting aside capital for the YBS mission.** Institutions should consider setting aside capital that they are willing to put at risk to support programs that meet the credit needs of these YBS farmers.
- **Sharing best practices.** This sharing of best practices is important to ensure that the Farm Credit System as a whole provides all YBS farmers the credit they need to begin, grow or remain in agricultural production.²¹⁹

In addition to these benefits, some Farm Credit YBS programs also offer financial planning assistance to their clients to qualify for the credit enhancements.²²⁰ Other agricultural lenders also have programs to target beginning farmers, such as Rabo AgriFinance’s Rising Stars program, which provides advantages in pricing and structure for young and beginning farmers, and provides opportunities for learning and networking.²²¹ The Farm Service Agency also targets loans or reserves funds for farmers defined as “socially disadvantaged” due to their race, gender and/or ethnicity, in part through a microloan program.^{222,223}

Conservation loan programs

The Farm Service Agency administers a conservation loan program, which makes loans available through agricultural lenders (e.g. Farm Credit or commercial lenders) that participate in the Farm Service Agency’s guaranteed loan program. Conservation loans are made to eligible borrowers to cover the costs of qualified conservation projects. A conservation project is “qualified” for a loan if it is included in a conservation plan that is approved by USDA’s Natural Resources Conservation Service.²²⁴

Currently, farmers are only able to obtain guaranteed conservation loans from a commercial lender, and these loans are capped at \$1.75 million. While the farm bill authorizes both direct and guaranteed loans, in recent years Congress has only provided funding for guaranteed loans. Since 2008, the Farm Service Agency has provided more than \$16 million in loan funding to farmers through its direct conservation loan program and guaranteed more than \$3.5 million in additional loan capital. This translates to over 230 loans made to farmers and ranchers to help them finance conservation efforts on their farms.²²⁵ Given the small volume of loans made under this program, further assessment is warranted to better understand its current uses and how this program or similar programs could enhance their reach.

Transition products

Several new lending products have been launched recently to address the three-year transition period to USDA's organic certification and the premium prices that accompany that certification. Announced in 2019, Rabobank's organic transition product, developed in partnership with Pipeline Foods, includes a financial framework that gives farmers the flexibility to receive the capital needed for upfront costs associated with changing production practices. Farmers then schedule repayments when they receive the additional revenue from selling certified organic goods. Rabobank developed the product in collaboration with Pipeline Foods, a supply chain solutions company focused exclusively on organic, non-GMO and regenerative food and feed.²²⁶ Pipeline offers offtake agreements for farmers' organic grain along with other support through the transition period, which gives both the farmer and Rabobank more confidence in navigating the organic transition.²²⁷

Another example of an organic bridge loan was developed by Compeer Financial, a Farm Credit cooperative based in the Upper Midwest. With Compeer's organic bridge loan, clients only pay interest on their loan for the first two to three years, with a declining balance operating loan while they are working toward organic certification. The loan converts to a standard five-year intermediate term loan with fully amortized principal and interest payments after the farmer achieves organic certification.²²⁸

Innovative agriculture finance in Brazil

In Brazil, one of the largest global soy producers along with the U.S., several preferential lending products have been developed to support farmers in adopting sustainable practices. The public credit system includes a multi-billion dollar "low-carbon agriculture program" which offers below-market interest rates, multi-year loans, and grace periods for farmers who adopt low-carbon practices such as recovery of degraded pasture, farm-livestock integration and no-till planting.

Traders and input companies, along with banks, are the primary lenders to Brazilian farmers for their annual crop finance needs. These private lenders have recently developed long-term lending products for farmers who expand agricultural production without deforestation. For example, Bunge, Santander and The Nature Conservancy created a \$50 million lending program to acquire and convert land from pasture to soy production with no deforestation, with lengths of up to 10 years — well beyond the typical annual lending term of farm loans in Brazil. Dreyfus has offered a similar product, and several other traders and input companies are planning to launch similar products by 2021.

Sources: Lopes, Desiree, & Lowery, Sarah. (2015, November.) Rural Credit in Brazil: Challenges and Opportunities for Promoting Sustainable Agriculture. Retrieved from: https://www.forest-trends.org/wp-content/uploads/imported/fit-mapping-rural-credit-in-brazil_v19_final-rev-pdf.pdf. Parker, Mario & Freitas, Tatiana. (2018, August 29.) Crop giant out to save Brazil's savannas from soy takeover. Bloomberg. Retrieved from: <https://www.bloomberg.com/news/articles/2018-08-29/crop-giant-sets-out-to-save-brazil-s-savannas-from-soy-takeover>.

Lessons for financing resilient agriculture

The examples in the previous section, combined with extensive discussion and collaboration with agricultural lenders, offer several lessons that can help guide lender efforts to finance resilient agriculture. These lessons are also useful for the broader universe of organizations and companies that hope to collaborate with agricultural lenders in the development of lending programs and products.

- **Lesson 1: Understand the financial benefits of and barriers to resilient agricultural practices.** First, lenders should better understand the benefits of resilient agriculture so that they can effectively serve their current borrowers and not let unfamiliarity with conservation practices discourage farmers or increase barriers to lending. Second, lenders should improve their understanding of the return profile of transitions to resilient agriculture, including the benefits, barriers and the transition timeframe in order to identify farmer needs or market gaps that could be addressed with new or modified loan products. Agricultural lenders do not currently collect information from farmer clients that gives them the level of detail needed to assess this, but organizations working to quantify the financial impact of conservation adoption on farm budgets can provide useful information on the type and magnitude of potential costs, savings and crop yield impacts (See Appendix B for resources). Lenders can collaborate with those organizations to provide feedback on the type of information needed to inform their decision-making.
- **Lesson 2: Design loan structures and requirements to correspond with the financial characteristics of the resilience practice(s).** Lenders may select a subset of resilient farming practices particularly suited to their region or desired by local farmers. Based on their understanding of the financial shift that is taking place (e.g., any upfront costs or yield impacts, how cost savings and yield benefits occur over time), they should consider how to adjust the requirements of the loan to accommodate those expected changes. For example, lenders could consider modifying the length of the loan or utilizing a longer planning horizon with streamlined loan renewals, relaxing some credit standards in the first few years of the transition or reducing the interest rate to encourage farmer uptake. The organic transition products exemplify this, as lenders gathered information on farmers' experience with the costs and risks in the three-year transition period, and could also project the increased earnings from premium organic prices after the transition. This allowed them to match the product offering to the financial profile of the farm management change.
- **Lesson 3: Loan support may be needed to launch initial products and should be used to prove the financial case.** If it is difficult to make a loan product acceptable for the lender and meet the needs of the farmer at the outset due to insufficient data on the return proposition, then loan support can be used to bridge the gap. Loan support is when a partner (corporate partner, investor, philanthropic or public source) provides additional financial risk-sharing to make the overall loan package work for both the lender and the farmer. An important role for loan support is to support sufficient data collection in a product pilot phase in order to prove the financial hypothesis for the product to stand on its own. Loan support can take many different forms. Figure 6 on the next page summarizes several common structures.

Figure 6: Common loan support structures²²⁹

Loan support type	Description	Example
Full guarantee	<ul style="list-style-type: none"> • Full guarantee of loan repayment. 	<ul style="list-style-type: none"> • \$50 MM guarantee. • Loan offered by bank at borrowing rate of entity providing guarantee.
Partial guarantee	<ul style="list-style-type: none"> • Guarantee of a portion of loan principal and interest, such as first loss guarantee for up to 20% of the initial losses. 	<ul style="list-style-type: none"> • Guarantee of the first \$10 MM of losses. • Loans offered at lower rate than commercial terms.
Subordinated loan	<ul style="list-style-type: none"> • A loan where the principal and interest are paid only after the senior loan is paid. • Can also offer lower interest rates than the senior loan. 	<ul style="list-style-type: none"> • Two “tranches”: - \$40 MM in senior loans (paid first). - \$10 MM sub. loans (paid after senior) at low rate (e.g. 2%). • “Blended” rate reduced to farmer.
Interest buy-down	<ul style="list-style-type: none"> • Payments made to a bank to reduce the interest rate of a loan to farmers. 	<ul style="list-style-type: none"> • Payments to bank equivalent to 2% interest (e.g. \$1 million for one-year on \$50 MM in loans). • Bank reduces interest rate to farmer by 2%.
Offtake agreement	<ul style="list-style-type: none"> • Buyer contract to purchase production: - Can be one year or multi-year. - Price can fluctuate with market. - Direct or through an intermediary. 	<ul style="list-style-type: none"> • Buyer enters offtake agreement with farmer. • Term of agreement matches loan term. • Bank feels more secure and offers improved lending rate to the farmer.

• **Lesson 4: Collect data on financial and environmental performance to show results, fine-tune loans and adjust credit rating processes.** While external financial support may be necessary to launch new or modified loan programs for resilient agriculture, such support should be utilized to test a loan product that can ultimately stand on its own from a financial standpoint. For this to occur, data collection on both the financial and environmental performance of the farm and the loan is essential. This is another area where collaboration can prove useful to the lender, whether it is with an environmental or agricultural organization that can advise on appropriate environmental metrics, or an agriculture technology provider that can assist in data collection and analysis. This data can enable a positive feedback loop for continuous improvement, both for individual farmers as well as the lenders’ overall view of its portfolio and products. As lenders build a knowledge base from empirical data around resilient practices and results, they can modify credit rating processes to incorporate this data. Ultimately, the objective is to accurately demonstrate the value of resilient farming practices and integrate these results into lender policies and pricing for farmers who implement practices that build resilience in their operations.

Agricultural lending associations

Agricultural lending associations can serve as important partners in identifying appropriate tools and resources for lenders. Associations include:

- Farm Credit Council <https://farmcredit.com/farm-credit-council>
- American Bankers Association <https://www.aba.com/banking-topics/commercial-banking/agricultural-banking>
- Independent Community Bankers of America <https://www.icba.org/>
- National Rural Lenders Association <http://nrla-usda.org/>

- **Lesson 5: Consider other forms of support farmers may need to ensure successful practice adoption** — and avoid creating new burdens. Additional support could take the form of financial arrangements, such as grain offtake agreements or cost-share for conservation expenses, or educational support, such as agronomic advice on how to incorporate new practices into farms' existing management systems. Some of these forms of support can be offered by lenders, while others may need to be part of a broader program with partners. For example, while some degree of trial and error will nearly always be required to integrate new practices into a farming operation, technical assistance and education can support farmers in moving up the learning curve. In addition, creating a financial plan for the transition can help both parties set realistic expectations and then continue to check in on whether changes to the farm's finances are occurring as planned. Finally, for a new or modified lending product to be used, it should avoid creating burdensome new requirements for farmers and should have terms that are competitive with other offerings in the market.

There are substantial opportunities for agricultural lenders to support their farmer clients in building the resilience of their farms. At scale, this could also reduce climate risk to the agricultural lending sector. A proactive approach to managing climate risk includes both programs designed to support farmer adoption of resilient practices, as well as comprehensive climate risk planning, such as scenario analyses and stress testing by lending institutions. It is the combination of these two approaches — supporting agriculture to become more resilient, while assessing and mitigating climate risk at the lending institution level — that will be required to successfully navigate the challenges posed to agriculture and agricultural lending institutions by climate change.

Recommendations for financing resilient agriculture

The following recommendations are for agricultural lenders and lending institutions to assess their exposure to climate risk and seek to mitigate that risk by supporting increased resilience among their farmer clients. The first recommendation is targeted to lending institutions, because climate risk analysis needs buy-in from senior leadership and should provide a holistic view of risk for the lending institution. For smaller lenders that do not have the capacity to undertake climate risk analysis on their own, the recommendation for lending institutions could be accomplished through collaboration with other lenders or with external support. The second and third recommendations are for farmer-facing lenders. While support from leadership is still needed, it is critical that those recommendations are implemented in the context of lender and farmer relationships.

1. Assess climate risk at the lending institution level.

- **Get up to speed on best practices for climate risk assessment for agricultural lenders.** This could include partnering with institutions leading in climate-risk management and supporting efforts to develop climate risk datasets and tools to effectively quantify climate risks to agricultural lending institutions.
- **Assess the exposure and implications of climate-related risks for lending portfolios.** For example, large lending institutions and the Farm Credit System should pilot climate stress testing, and a climate stress testing pilot program should be considered for groups of smaller agricultural lenders.
- **Integrate climate risk assessment into lending institution structures.** This should include developing strong climate risk governance by assigning the responsibility to senior management and the board, and building internal capacity through strategic planning, organizational structure and additional resourcing.
- **Integrate climate risk assessment into lending institution risk management frameworks and processes.** This should include integration of climate risk management to existing risk management practices, policies, capital allocations, portfolio monitoring and reporting. As climate risk assessments are translated into strategy and decision-making, include a screen for equity to make sure that small farmers or farmers of color are not disproportionately disadvantaged by climate risk mitigation plans.

2. Understand the role of resilient agriculture in managing climate risk.

- **Understand relevant climate risks and resilience strategies for farmer clients.** This should include climate change impacts and predictions by region, the types of risks most likely to impact clients (e.g., water scarcity, flooding, drought, etc.), and the actions farmers in the region can take to build resilience to those risks (e.g., improving soil health, installing efficient irrigation, switching crops, etc.).

- **Become familiar with locally relevant assessments of the financial impacts of conservation adoption.** This should include learning about strategies to minimize costs and maximize benefits of conservation adoption. Lenders should consider collaborating with organizations working to quantify the financial impacts of conservation adoption, and sharing the lender perspective on the data needed to support modified lending programs, policies or products.
- **Use lender relationships and capabilities to improve financial assessment of resilience strategies.** Lenders could also use banking system database capabilities to build comparative assessments of producer financial performance based on the adoption of resilient farming practices and management systems, and collaborate with farmer clients who have adopted resilient practices or management systems to examine the relationship between those changes and their long-term profitability and risk.
- **Identify data blind spots, including for small farmers and farmers of color.** Identify methods to assess and learn from the financial performance and resilience of farms of all types and sizes.

3. Design lending programs or products that support farmers in building climate resilience.

- **Develop lending programs that are designed to support farmers who adopt farming practices that increase resilience.** Offer lending programs or products with features that are tailored to meet the needs of farmers who are transitioning to these practices. For example, a transition product for the adoption of soil health practices could offer underwriting or interest rate benefits in the first few years of adoption. Other potential attributes could include financial assistance for budget planning, as well as technical assistance to support farmers in the transition to new practices. In addition to new, standalone programs, a focus on resilient farming practices could be integrated to existing YBS programs.
- **Incorporate data on the benefits of resilient farming practices to credit rating processes.** Utilize lending program for resilient agriculture to collect data that can be incorporated into credit review in order to accurately value the risk reduction benefits of resilient farming systems. Include the adoption of resilient practices and management systems as a more explicit consideration among the Five C's of Credit.
- **Consider the financing needs of farmers who are historically underserved by agricultural credit.** In any new program or product for resilient agriculture, assess opportunities to improve access to loans for small farmers and farmers of color. Consider low-interest loans and microloans, as well as loans not requiring collateral or other alternative financing options.
- **Explore lending solutions that can support both farmers and food companies.** For lending institutions that have both farmer and corporate supply chain clients, develop lending solutions that can support corporate clients in achieving sustainability goals while simultaneously offering farmer clients opportunities to enhance the resilience of their operations.

Conclusion

Improving climate resilience is essential to protect U.S. agriculture's long-term productivity and profitability. As finance providers, agricultural lenders have an important role to play in this transition. In assessing and mitigating the risks of climate change to their own businesses, lenders also have the opportunity to serve their farmer clients in new ways and optimize their own risk-adjusted returns.

Agricultural resilience can deliver measurable economic value in terms of cost-savings and risk reduction to farmers and their lenders. This value must be recognized, assessed and incorporated into lending decision-making and products. By offering loans designed to help farmers navigate the transition to build soil health, manage water efficiently and diversify crop production, lenders can improve the financial stability of their clients and lending portfolios. By incorporating data on the financial performance of resilient agriculture into risk assessment, lenders can improve the accuracy of their risk assessment processes and mitigate their overall climate risk.

Farmers and agricultural lenders across the U.S. are facing immense pressure from multiple different sources. In the face of such challenges, it is even more important to proactively address those risks that can be mitigated. This report provides a path forward for lenders to mitigate climate risks and finance resilient agriculture. Our hope is that it is useful to all those who are invested in the future of U.S. farms.

Appendix A:

Resource list on climate risk assessment for financial institutions

Climate Financial Risk Forum. 2020. Climate Financial Risk Forum Guide 2020. Accessed at: <https://www.fca.org.uk/publication/corporate/climate-financial-risk-forum-guide-2020-summary.pdf>

European Banking Authority. 2019.

EBA publishes 2020 EU-wide stress test templates after testing them with banks. Accessed at: <https://eba.europa.eu/eba-publishes-2020-eu-wide-stress-test-templates-after-testing-them-banks>

Federal Deposit Insurance Corporation. 2012. Stress testing credit risk at community banks. Accessed at: https://www.ffc.org/wps/wcm/connect/fe18be47-a0cc-4b5d-a134-078a995ce8bd/ClimateRisk_FinancialInstitutions.pdf?MOD=AJPERES&CVID=n48iBMz

International Finance Corporation. Climate Risk and Financial Institutions: Challenges and opportunities. Accessed at: https://www.ifc.org/wps/wcm/connect/fe18be47-a0cc-4b5d-a134-078a995ce8bd/ClimateRisk_FinancialInstitutions.pdf?MOD=AJPERES&CVID=n48iBMz

McKinsey & Company. Eceiza, J., Harreis, H., Härtl, D., Viscardi, S. 2020. Banking imperatives for managing climate risk. Accessed at: <https://www.mckinsey.com/business-functions/risk/our-insights/banking-imperatives-for-managing-climate-risk>

Network for Greening the Financial System. 2020. NGFS climate scenarios. Accessed at: <https://www.ngfs.net/en/publications/ngfs-climate-scenarios>

Standard and Poors (S&P). 2019. Navigating the ESG Risk Atlas. Accessed at: <https://www.spglobal.com/en/research-insights/articles/navigating-the-esg-risk-atlas>

Task Force on Climate-Related Financial Disclosures. 2017. Implementing the Recommendations of the Task Force on Climate-related Financial Disclosures. Accessed at: <https://www.fsb-tcfd.org/wp-content/uploads/2017/12/FINAL-TCFD-Annex-Amended-121517.pdf>

- Supplemental Guidance for the Financial Sector: <https://www.tcfhub.org/Downloads/pdfs/E20%20More%20information%20on%20supplemental%20guidance%20for%20the%20financial%20sector.pdf>

United Nations Environment Program Finance Initiative. Pilot project on implementing the TCFD recommendations for banks: <https://www.unepfi.org/banking/tcfd/>

- Extending our horizons: Assessing credit risk and opportunity in a changing climate: <https://www.unepfi.org/news/themes/climate-change/extending-our-horizons/>
- Navigating a New Climate: Assessing Credit Risk and Opportunity in a changing climate: <https://www.unepfi.org/publications/banking-publications/navigating-a-new-climate-assessing-credit-risk-and-opportunity-in-a-changing-climate/>

Appendix B:

Resource list on farm budget analyses of conservation adoption

American Farmland Trust. 2020. “Quantifying Economic and Environmental Benefits of Soil Health.” <https://farmland.org/project/quantifying-economic-and-environmental-benefits-of-soil-health/>

Datu Research. Upper Mississippi River Basin. <https://www.daturesearch.com/upper-mississippi-river-basin/>

Environmental Defense Fund & KCoe Isom. 2018. “Farm finance and conservation: how stewardship generates value for farmers, lenders, insurers and landowners.” <https://www.edf.org/ecosystems/how-farm-conservation-can-generate-financial-value>

The Fertilizer Institute. 4R Farming.org. Case studies. <https://www.4rfarming.org/case-studies/>

Iowa Soybean Association. 2019. “Estimation of financial implications resulting from the implementation of farm conservation practices.” https://www.iasoybeans.com/upl/downloads/library/Conservation_Profitability_White_Paper.pdf

Iowa State University. Plastina, A., Liu, F., Sawadgo, W., Miguez, F. E., Carlson, S. 2018. Partial budgets for cover crops in Midwest row crop farming. https://lib.dr.iastate.edu/econ_ias_pubs/621/

USDA NRCS. Technical resources: Data & Analysis. <https://www.nrcs.usda.gov/wps/portal/nrcs/main/national/technical/econ/data/>

Precision Conservation Management. 2019. “The Business Case for Conservation: Cost-Benefit Analysis of Conservation Practices.” https://www.precisionconservation.org/wp-content/uploads/2019/12/Illinois-Corn-PCM-Booklet_single-pages_no-bleed_hires.pdf

Sustainable Agriculture Research and Education (SARE). 2019. Cover Crop Economics: Opportunities to improve your bottom line in row crops. <https://www.sare.org/Learning-Center/Bulletins/Cover-Crop-Economics>

Soil Health Partnership. Benefits of cover crops: Mike Buis, Indiana. <https://www.soilhealthpartnership.org/shp-business-cases/>

References

- ¹USGCRP, 2018: Impacts, Risks, and Adaptation in the United States: Fourth National Climate Assessment, Volume II [Reidmiller, D.R., C.W. Avery, D.R. Easterling, K.E. Kunkel, K.L.M. Lewis, T.K. Maycock, and B.C. Stewart (eds.)]. U.S. Global Change Research Program, Washington, DC, USA, 1515 pp. doi: 10.7930/NCA4.2018.
- ²Humston, T. L. (2019). Slowing Agricultural Markets Highlight the Importance of Sound Risk Management Principles. Retrieved from <https://www.communitybankingconnections.org/articles/2019/11/slowing-agricultural-markets>
- ³Personal communication, agricultural lender BE, July 2020.
- ⁴Oppedahl, D. (2019). AgLetter: August 2019. Chicago, Illinois: Federal Reserve Bank of Chicago. Retrieved April 26, 2020, from <https://www.chicagofed.org/publications/agletter/2015-2019/august-2019>
- ⁵CoBank. (2019.) Rural Industries and Climate Change. Retrieved from: <https://www.cobank.com/-/media/files/ged/general/rural-industries-climate-change.pdf?la=en&hash=234B62A18E2E279D82C84222C1E62DB343E9F816>
- ⁶GARP Risk Institute. (2019.) Climate Risk Management At Financial Firms: A good start, but more work to do. Results from a global survey. Retrieved from: https://www.garp.org/newmedia/gri/climate-risk-management-survey/AGoodStart_052919_PDF.pdf
- ⁷Board of Governors of the Federal Reserve System. (2011, October 26.) SR 11-14: Supervisory Expectations for Risk Management of Agricultural Credit Risk <https://www.federalreserve.gov/supervisionreg/srletters/sr1114.htm>
- ⁸Crane-Droesch, Andrew et al. (2019, July.) Climate change and agricultural risk management into the 21st century. U.S. Department of Agriculture Economic Research Service. Retrieved from: <https://www.ers.usda.gov/webdocs/publications/93547/err-266.pdf?v=9932.1>
- ⁹Calculated as the total crop insurance liability for 2017 (106,088,501,298) as a percentage of the value of agricultural production from the 2017 U.S. census of agriculture, (\$388,522,695,000), which is 27.3%. Sources: Federal Crop Insurance Corporation. Commodity Year Statistics for 2017. Retrieved from: https://www3.rma.usda.gov/apps/sob/current_week/crop2017.pdf and U.S. Department of Agriculture National Agriculture Statistics Service. U.S. Agriculture Census, Table 2. Market Value of Agricultural Products Sold. Retrieved from: https://www.nass.usda.gov/Publications/AgCensus/2017/Full_Report/Volume_1_Chapter_1_US/st99_1_0002_0002.pdf
- ¹⁰Basche, A.D. and M.S. DeLonge. 2019. Comparing infiltration rates in soils managed with conventional and alternative farming methods: A meta-analysis. PLOS ONE 14(9):e0215702. doi:10.1371/journal.pone.0215702.
- ¹¹Monast, Maggie and KCoe Isom AgKnowledge. (2018.) Farm Finance and Conservation: How stewardship generates value for farmers, lenders, insurers and landowners. Retrieved from: <https://edf.org/farm-finance>
- ¹²Ibid.
- ¹³U.S. Department of Agriculture Natural Resources Conservation Service. Environmental Quality Incentives Program. Retrieved from: <https://www.nrcs.usda.gov/wps/portal/nrcs/main/?ss=16&navid=100120310000000&p>
- ¹⁴U.S. Department of Agriculture Economic Research Service. 2020 Farm Sector Income Forecast. (2020, February 05). Retrieved July 2020, from <https://www.ers.usda.gov/topics/farm-economy/farm-sector-income-finances/farm-sector-income-forecast/>
- ¹⁵Net farm income rebounded to \$93 billion in 2019, including an increase of government direct farm program payments from \$13b in 2016 to nearly \$24b in 2019. U.S. Department of Agriculture Economic Research Service. (2020, February 05). Data Files: U.S. and State-Level Farm Income and Wealth Statistics. U.S. farm sector financial indicators, 2013-20F. (downloadable excel spreadsheet). Retrieved July 2020, from <https://www.ers.usda.gov/data-products/farm-income-and-wealth-statistics/data-files-us-and-state-level-farm-income-and-wealth-statistics/>
- ¹⁶Latzke, J. M. (2019, November 06). Warning signs abound in today's farm economy. High Plains Journal. Retrieved from https://www.hpj.com/ag_news/warning-signs-abound-in-today-s-farm-economy/article_3bae09c4-ff0d-11e9-b68b-47de5ef2180e.html
- ¹⁷Duvall, Z. (2020, April 01). Yes, There are COVID-19 Impacts on Agriculture. Retrieved June 2020 from <https://www.fb.org/viewpoints/yes-there-are-covid-19-impacts-on-agriculture1>
- ¹⁸Yaffe-Bellany, D., & Corkery, M. (2020, April 11). Dumped Milk, Smashed Eggs, Plowed Vegetables: Food Waste of the Pandemic. New York Times. Retrieved June 2020, from <https://www.nytimes.com/2020/04/11/business/coronavirus-destroying-food.html>
- ¹⁹Thompson, D. (2020, July 07). COVID-19 outbreaks at meat processing plants are hitting minorities hard. HealthDay News. Retrieved June 2020, from https://www.upi.com/Health_News/2020/07/07/COVID-19-outbreaks-at-meat-processing-plants-are-hitting-minorities-hard/1781594153956/
- ²⁰Woodard, J. D. (2016). Integrating high resolution soil data into federal crop insurance policy: Implications for policy and conservation. Environmental Science & Policy, 66, 93-100. doi:10.1016/j.envsci.2016.08.011

- ²¹The AGree Economic and Environmental Risk Coalition. (2020). Exploring the Regulatory and Policy Aspects of Agricultural Credit and Finance for Conservation Investments. Retrieved from: <https://foodandagpolicy.org/wp-content/uploads/sites/4/2020/05/AGree-E2-Banking-Policy-White-Paper.pdf>
- ²²“Changing Weather Patterns: Risk Management for Certain Uncertain Change” Remarks of CFTC Commissioner Rostin Behnam at the 56th Crop Insurance and Reinsurance Bureau Annual Meeting, Bonita Springs, Florida. February 14, 2020.
- ²³Ascui, Francisco and Cojoianu, Theodor (2019). Natural Capital Credit Risk Assessment in Agricultural Lending: An Approach Based on the Natural Capital Protocol, Oxford: Natural Capital Finance Alliance. Retrieved from: <https://www.unepfi.org/wordpress/wp-content/uploads/2019/04/Natural-Capital-Credit-Risk-Assessment-2019.pdf>
- ²⁴USGCRP, (2018.)
- ²⁵Rojas-Downing, M. M., Nejadhashemi, A. P., Harrigan, T., & Woznicki, S. A. (2017). Climate change and livestock: Impacts, adaptation, and mitigation. *Climate Risk Management*, 16, 145-37 163.
- ²⁶Lundgren, K., Kuklane, K., Gao, C., & Holmer, I. (2013). Effects of heat stress on working populations when facing climate change. *Industrial Health*, 51(1), 3-15.
- ²⁷Gubernot, D. M., Anderson, G. B., & Hunting, K. L. (2014). The epidemiology of occupational heat exposure in the United States: a review of the literature and assessment of research needs in a changing climate. *International Journal of Biometeorology*, 58(8), 1779-1788.
- ²⁸Taylor, R. A. J., Herms, D. A., Cardina, J., & Moore, R. H. (2018). Climate change and pest management: unanticipated consequences of trophic dislocation. *Agronomy*, 8(1), 7. doi: 10.3390/agronomy8010007
- ²⁹Bakker, C., Zaitchik, B. F., Siddiqui, S., Hobbs, B. F., Broaddus, E., Neff, R. A., & Parker, C. L. (2018). Shocks, seasonality, and disaggregation: Modelling food security through the integration of agricultural, transportation, and economic systems. *Agricultural Systems*, 164(1), 165-184. doi: 10.1016/j.agsy.2018.04.005
- ³⁰Gutierrez, K. & LePrevost, C. Climate Justice in Rural Southeastern United States: A Review of Climate Change Impacts and Effects on Human Health. *International Journal of Environmental Research and Public Health*. 2016, 13, 189; doi:10.3390/ijerph13020189
- ³¹USGCRP, (2018.)
- ³²Kukul, M. S., Irmak, S. 2018. Climate-driven crop yield and yield variability and climate change impacts on the U.S. Great Plains agricultural production. *Scientific Reports*. 8:3450. <https://doi.org/10.1038/s41598-018-21848-2>
- ³³Zhu, X., Troy, T. J., Devineni, N. 2019. Stochastically modeling the projected impacts of climate change on rainfed and irrigated US crop yields. *Env. Res. Letters*. <https://iopscience.iop.org/article/10.1088/1748-9326/ab25a1>
- ³⁴Xie, L., Lewis, S. M., Aughammer, M. et al. 2019. Heat in the heartland: crop yield and coverage response to climate change along the Mississippi River. *Env and Res Econ*. 73(2). <https://doi.org/10.1007/s10640-018-0271-7>
- ³⁵Zhu, X., Troy, T. J., Devineni, N. 2019.
- ³⁶USGCRP, (2018.)
- ³⁷Kukul, M. S., Irmak, S. 2018. Climate-driven crop yield and yield variability and climate change impacts on the U.S. Great Plains agricultural production. *Scientific Reports*. 8:3450.
- ³⁸Ortiz-Bobea, Ariel et al. “Growing climatic sensitivity of U.S. agriculture linked to technological change and regional specialization.” *Science Advances* 12 Dec 2018: Vol. 4, no. 12. DOI: 10.1126/sciadv.aat4343
- ³⁹Xie, L., Lewis, S. M., Aughammer, M. et al. 2019. Heat in the heartland: crop yield and coverage response to climate change along the Mississippi River. *Env and Res Econ*. 73(2). <https://doi.org/10.1007/s10640-018-0271-7>
- ⁴⁰Wolfe, D.W., DeGaetano, A.T., Peck, G.M. et al. (2018) Unique challenges and opportunities for northeastern US crop production in a changing climate. *Climatic Change* 146, 231–245 (2018). <https://doi.org/10.1007/s10584-017-2109-7>
- ⁴¹Lobell, D B., Field, C B., Cahill, K N., Bonfils, C. (2006). Impacts of future climate change on California perennial crop yields: model projections with climate and crop uncertainties. *Ag and Forest Meteorology*. Vol 141, issues 2-4, pg. 208-218. <https://doi.org/10.1016/j.agrformet.2006.10.006>
- ⁴²Lengnick, Laura. (2018). “Cultivating Climate Resilience on Farms and Ranches.” Sustainable Agriculture Research and Education. Accessed at: <https://www.sare.org/Learning-Center/Bulletins/Cultivating-Climate-Resilience-on-Farms-and-Ranches/Climate-Risk-Management-and-Resilience-on-Farms-and-Ranches/Understanding-Climate-Resilience>
- ⁴³Walker, B., & Salt, D. (2006). Resilience thinking: Sustaining ecosystems and people in a changing world. Island Press; Washington DC
- ⁴⁴U.S. Department of Agriculture, Natural Resources Conservation Service. Cover Crops and Soil Health. Retrieved from: <https://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/climatechange/?cid=stelprdb1077238>
- ⁴⁵Iowa State University. Science-Based Trials of Rowcrops Integrated with Prairie Strips. Retrieved from <https://www.nrem.iastate.edu/research/STRIPS/>
- ⁴⁶Rob Myers, Alan Weber, and Sami Tellatin. (2019). Cover Crop Economics: Opportunities to Improve Your Bottom Line in Row Crops. Sustainable Agriculture Research & Education. Retrieved from: <https://www.sare.org/Learning-Center/Bulletins/Cover-Crop-Economics>
- ⁴⁷Basche, A.D. and M.S. DeLonge. 2019.
- ⁴⁸Zibilske, L.M. and J.M. Bradford. 2007. Soil Aggregation, Aggregate Carbon and Nitrogen, and Moisture Retention Induced by Conservation Tillage. *Soil Science Society of America Journal* 71(3):793-802. doi: 10.2136/sssaj2006.0217.

- ⁴⁹Basche, A.D. 2017. Turning Soils into Sponges. Union of Concerned Scientists, Washington, DC. <https://www.ucsusa.org/sites/default/files/attach/2017/08/turning-soils-into-sponges-full-report-august-2017.pdf>.
- ⁵⁰Williams, A., N.R. Jordan, R.G. Smith, M.C. Hunter, M. Kammerer, D.A. Kane, R.T. Koide and A.S. Davis. 2018. A regionally-adapted implementation of conservation agriculture delivers rapid improvements to soil properties associated with crop yield stability. *Scientific reports* 8(1):8467-8467. doi: 10.1038/s41598-018-26896-2.
- ⁵¹CTIC. 2017. Report of the 2016-17 National Cover Crop Survey. Joint publication of the Conservation Technology Information Center, the North Central Region Sustainable Agriculture Research and Education Program, and the American Seed Trade Association, West Lafayette, IN. Retrieved from: www.sare.org/covercropsurvey.
- ⁵²Kane, D., Wood, S., Bradford, M. A., Oldfield, E., & Fuller, E. (n.d.). Soil organic matter effects on US maize production and crop insurance payouts under drought. Retrieved from eartharxiv.org/wk7yz
- ⁵³Hunt, N.D., J.D. Hill and M. Liebman. 2019. Cropping System Diversity Effects on Nutrient Discharge, Soil Erosion, and Agronomic Performance. *Environmental Science & Technology* 53(3):1344-1352. doi: 10.1021/acs.est.8b02193
- ⁵⁴Mhazo, N., P. Chivenge and V. Chaplot. 2016. Tillage impact on soil erosion by water: Discrepancies due to climate and soil characteristics. *Agriculture, Ecosystems & Environment* 230:231-241. doi: <https://doi.org/10.1016/j.agee.2016.04.033>.
- ⁵⁵Morton, L.W., J. Hobbs, J.G. Arbuckle and A. Loy. 2015. Upper Midwest Climate Variations: Farmer Responses to Excess Water Risks. *Journal of Environmental Quality* 44(3):810-822. doi: 10.2134/jeq2014.08.0352.
- ⁵⁶Eagle, A.J. and L.P. Olander. 2012. Greenhouse gas mitigation with agricultural land management activities in the United States—A side-by-side comparison of biophysical potential. *Advances in Agronomy* 115:79–179.
- ⁵⁷Kim, N., Zabaloy, M. C., Guan, K., & Villamil, M. B. (2020). Do cover crops benefit soil microbiome? A meta-analysis of current research. *Soil Biology and Biochemistry*, 142, 107701.
- ⁵⁸U.S. Department of Agriculture, National Agriculture Statistics Service. 2017 Census of Agriculture, Table 47: Land Use Practices by Size of Farm. Retrieved from: https://www.nass.usda.gov/Publications/AgCensus/2017/Full_Report/Volume_1_Chapter_1_US/st99_1_0047_0047.pdf
- ⁵⁹Total 2017 U.S. cropland is 396,433,817 acres. U.S. Department of Agriculture, National Agriculture Statistics Service. 2017 Census of Agriculture, Table 1. Historical Highlights: 2017 and Earlier Census Years. Retrieved from: https://www.nass.usda.gov/Publications/AgCensus/2017/Full_Report/Volume_1_Chapter_1_US/st99_1_0001_0001.pdf
- ⁶⁰Rotational no-till refers to using no tillage after one crop, such as soybeans, but tilling after another crop in the rotation, such as corn. U.S. Department of Agriculture, National Agriculture Statistics Service. 2017 Census of Agriculture,
- Table 47: Land Use Practices by Size of Farm. Accessed at: https://www.nass.usda.gov/Publications/AgCensus/2017/Full_Report/Volume_1_Chapter_1_US/st99_1_0047_0047.pdf
- ⁶¹Classen, Roger et al. 2018. Tillage Intensity and Conservation Cropping in the United States. US Department of Agriculture, Economic Research Service. Accessed at: https://www.ers.usda.gov/webdocs/publications/90201/eib197_summary.pdf?v=1783.8
- ⁶²Zhu, X., Troy, T. J., Devineni, N. 2019.
- ⁶³Elliott, J., Deryng, D., Müller, C., Frieler, K., Konzmann, M., Gerten, D., Glotter, M., Flörke, M., Wada, Y., Best, N. and Eisner, S., 2014. Constraints and potentials of future irrigation water availability on agricultural production under climate change. *Proceedings of the National Academy of Sciences*, 111(9), pp.3239-3244.
- ⁶⁴Cho, S. J., & McCarl, B. A. (2017). Climate change influences on crop mix shifts in the United States. *Scientific reports*, 7, 40845.
- ⁶⁵USGCRP, (2018.)
- ⁶⁶Skaggs, R. Wayne, Fausey, Norman R., and Robert O. Evans. 2012. Drainage Water Management. *Journal of Soil and Water Conservation* 67(6):167A-172A. doi:10.2489/jswc.67.6.167A
- ⁶⁷Williams, M. R., King, K. W., & Fausey, N. R. (2015). Drainage water management effects on tile discharge and water quality. *Agricultural Water Management*, 148, 43-51.
- ⁶⁸Skaggs, R. Wayne, Fausey, Norman R., and Robert O. Evans. 2012.
- ⁶⁹Ortiz-Bobea, Ariel et al. “Growing climatic sensitivity of U.S. agriculture linked to technological change and regional specialization.” *Science Advances* 12 Dec 2018: Vol. 4, no. 12. DOI: 10.1126/sciadv.aat4343
- ⁷⁰Gaudin, A. C., Tolhurst, T. N., Ker, A. P., Janovicek, K., Tortora, C., Martin, R. C., & Deen, W. (2015). Increasing crop diversity mitigates weather variations and improves yield stability. *PLoS one*, 10(2), e0113261.
- ⁷¹Bowles et al. “Long-Term Evidence Shows that Crop-Rotation Diversification Increases Agricultural Resilience to Adverse Growing Conditions in North America.” *One Earth* 2, 284–293, March 20, 2020
- ⁷²Lin, B.B. 2011. Resilience in Agriculture through Crop Diversification: Adaptive Management for Environmental Change. *BioScience* 61(3):183-193. doi: 10.1525/bio.2011.61.3.4
- ⁷³Abawi, G. S., & Widmer, T. L. (2000). Impact of soil health management practices on soilborne pathogens, nematodes and root diseases of vegetable crops. *Applied soil ecology*, 15(1), 37-47.
- ⁷⁴Roesch-McNally, Gabrielle, Arbuckle, J., and Tyndall, John. “Barriers to implementing climate resilient agricultural strategies: The case of crop diversification in the U.S. Corn Belt.” *Global Environmental Change* 48 (2018) 206–215.
- ⁷⁵Bowles et al. (2020.)
- ⁷⁶Ibid.

- ⁷⁷LaPorte, Jonathan and Mark Longstroth. (2020, May 09). Farm resilience starts with a solid financial foundation. Retrieved from <https://www.canr.msu.edu/news/farm-resilience-starts-with-a-solid-financial-foundation>
- ⁷⁸Spiegel, B. (2016, March 22). Investing In Soil Health Pays. Retrieved from https://www.agriculture.com/crops/tillage/no-till/investing-in-soil-health-pays_188-ar52662
- ⁷⁹International Monetary Fund (IMF) (2020). Global Financial Stability Report. Washington, D.C.: International Monetary Fund. Retrieved from <https://www.imf.org/en/Publications/GFSR/Issues/2020/04/14/Global-Financial-Stability-31-Report-April-2020-49020>
- ⁸⁰Tariq, Z., & Duren, C. (2019). Flooding may cause credit problems at Midwest banks. Retrieved from <https://www.spglobal.com/marketintelligence/en/news-insights/latest-news-28-headlines/51102824>
- ⁸¹Segal, T. (2020, August 01). How a Government-Sponsored Enterprise (GSE) Works. Retrieved July 2020, from <https://www.investopedia.com/terms/g/gse.asp>
- ⁸²Monke, Jim. (2018, March 26.) Agricultural Credit: Institutions and Issues. Congressional Research Service. Retrieved July 2020 from: <https://fas.org/sgp/crs/misc/RS21977.pdf>
- ⁸³Ibid.
- ⁸⁴Farm Credit. (n.d.). Our Structure. Retrieved July 2020, from <https://farmcredit.com/our-structure>
- ⁸⁵Ibid.
- ⁸⁶Monke 2018.
- ⁸⁷Ibid.
- ⁸⁸Ibid.
- ⁸⁹Personal communication, agricultural lender RH, September 2019.
- ⁹⁰Personal communication, agricultural lender RH, September 2019.
- ⁹¹Iowa Bankers Association. (2017.) Challenges Lenders Face in Today's Ag Economy. Retrieved from: <https://www.iowafarmbureau.com/Article/File/get?path=Files%2Farticle-99185%2Fs3.pdf>
- ⁹²Personal communication, agricultural lender RH, May 2019.
- ⁹³Union of Concerned Scientists and HEAL Food Alliance. (2020.) Leveling the Fields: Creating Farming Opportunities for Black People, Indigenous People, and Other People of Color. Retrieved July 2020 from: <https://www.ucsusa.org/sites/default/files/2020-06/leveling-the-fields.pdf>
- ⁹⁴Miller, E.; Griffin, T. (2019, August 27). Trends in and Barriers to Lending to Farmers of Color and Women. National Sustainable Agriculture Coalition. Retrieved July 2020, from <https://sustainableagriculture.net/blog/gao-report-lending-sdfr/>
- ⁹⁵U.S. Government Accountability Office. (July 2019). Agricultural Lending: Information on Credit and Outreach to Socially Disadvantaged Farmers and Ranchers is Limited. Retrieved July 2020 from <https://www.gao.gov/assets/710/700218.pdf>
- ⁹⁶Ibid.
- ⁹⁷Cowan, T. and Feder, J. (2013, May 29). The Pigford Cases: USDA Settlement of Discrimination Suits by Black Farmers. Congressional Research Service. Retrieved July 2020 from: <https://nationalaglawcenter.org/wp-content/uploads/assets/crs/RS20430.pdf>
- ⁹⁸Tyler, Shakara S. and Moore, Eddie A. (2013) "Plight of Black Farmers in the Context of USDA Farm Loan Programs: A Research Agenda for the Future," Professional Agricultural Workers Journal: Vol. 1: No. 1, 6. Available at: <http://tuspubs.tuskegee.edu/pawj/vol1/iss1/6>
- ⁹⁹Personal communication, Scott Marlow, August 2020.
- ¹⁰⁰Union of Concerned Scientists and HEAL Food Alliance 2020.
- ¹⁰¹Oppedahl, D. (2019).
- ¹⁰²CoBank. 2019. Forward together: 2019 annual report. Retrieved from: <https://www.cobank.com/-/media/files/financials/2019/cobank-2019-annual-report.pdf?la=en&hash=DDAD226893F20E21C43B7DE275CB1AAA85C82CE3>
- ¹⁰³Humston, T. L. (2019).
- ¹⁰⁴Chen, James. (2020, March 31.) Risk-Based Capital Requirement. Investopedia. Retrieved from: <https://www.investopedia.com/terms/r/risk-based-capital-requirement.asp>
- ¹⁰⁵Personal communication, agricultural lender BE, July 2020.
- ¹⁰⁶Tariq, Z., & Duren, C. (2019).
- ¹⁰⁷Humston, T. L. (2019).
- ¹⁰⁸Carter, L. & Moss, S. (2017, March). Drought Stress Testing: Making Financial Institutions More Resilient to Environmental Risks. Retrieved July 2020 from: <https://naturalcapital.finance/wp-content/uploads/2018/11/Drought-Stress-Testing-Tool-FULL-REPORT.pdf>
- ¹⁰⁹Ibid.
- ¹¹⁰Ibid.
- ¹¹¹Tyler, Shakara S. and Moore, Eddie A. (2013)
- ¹¹²AgWeb.com. (29 May 2013.) Ag Finance 101: What will your banker need from you? Retrieved from: https://www.agweb.com/article/ag_finance_101_what_will_your_bank_need_from_you/
- ¹¹³Personal communication, Bruce Sherrick, August 2020.
- ¹¹⁴Ibid.
- ¹¹⁵Farm Credit Administration. Classifying Assets Using the UCS. Retrieved July 2020 from: <https://www3.fca.gov/readingrm/exammanual/General%20Guidance/Classifying%20Assets%20Using%20the%20UCS.pdf>
- ¹¹⁶Personal communication, Scott Marlow, August 2020.
- ¹¹⁷Farm Credit Administration. Classifying Assets Using the UCS.
- ¹¹⁸Chen, J. (2019, July 22). Basel Accord. Retrieved July 2020 from https://www.investopedia.com/terms/b/basel_accord.asp
- ¹¹⁹Personal communication, agricultural lender BE, July 2020.

- ¹²⁰Ibid.
- ¹²¹Farm Credit Administration. (2016, August 11). Examination Manual- Loan Portfolio Management: Risk Identification. Retrieved from: <https://www3.fca.gov/readingrm/exammanual/New%20Exam%20Manual/22.2.pdf>
- ¹²²Raimond, R., Sherrick, B. and Coppess, J. (2020.) Exploring the Regulatory and Policy Aspects of Agricultural Credit and Finance for Conservation Investments. The AGree Economic and Environmental Risk Coalition. Retrieved from: <https://s31207.pcdn.co/wp-content/uploads/sites/4/2020/05/AGree-E2-Banking-Policy-White-Paper.pdf>
- ¹²³Personal communication, ag lender PD, September 2019.
- ¹²⁴National Association of Wheat Growers. (n.d.). Risk Management. Retrieved from <https://www.wheatworld.org/policy-action/issues/risk-management/>
- ¹²⁵Federal Crop Insurance Corporation. Commodity Year Statistics for 2017. Retrieved from: https://www3.rma.usda.gov/apps/sob/current_week/crop2017.pdf
- ¹²⁶U.S. Department of Agriculture Economic Research Service. (2020, February 5). Non-real estate debt: Farm Sector Indicators. Retrieved from: <https://www.ers.usda.gov/data-products/farm-income-and-wealth-statistics/data-files-us-and-state-level-farm-income-and-wealth-statistics/>
- ¹²⁷Woodard, J. & Marlow, S. (2017, April). Crop Insurance, Credit, and Conservation. The AGree Economic and Environmental Risk Coalition. Retrieved From: <https://foodandagpolicy.org/wp-content/uploads/sites/4/2019/09/2017-April-Crop-Insurance-Credit-and-Conservation.pdf>
- ¹²⁸U.S. Department of Agriculture Farm Service Agency. (2020, August 1.) Farm Loan Programs: Current FSA Loan Interest Rates. Retrieved from: <https://www.fsa.usda.gov/programs-and-services/farm-loan-programs/>
- ¹²⁹Zulauf, C. (2016, May 5). Crop Insurance Premium Subsidy Rates: A Proposed Objective Metric Based on Systemic Risk. farmdoc daily. Retrieved August 2020, from <https://farmdocdaily.illinois.edu/2016/05/crop-insurance-premium-subsidy-rates.html>
- ¹³⁰Farm Press Staff. (2018, February 7.) Crop insurance acreage, farmers' expense for it up in 2017. Southeast Farm Press. Retrieved from: <http://www.southeastfarmpress.com/insurance/crop-insurance-acreage-farmers-expense-it-2017>
- ¹³¹Ibid.
- ¹³²National Association of Insurance Commissioners. 2017. "2016 Market Share Reports for Property/Casualty Groups and Companies by State and Countrywide." Retrieved from: http://www.naic.org/prod_serv/MSR-PB-17.pdf
- ¹³³U.S. Department of Agriculture Risk Management Agency. "Cause of Loss Historical Data Files." Retrieved from <https://www.rma.usda.gov/data/cause.html>
- ¹³⁴National Sustainable Agriculture Coalition. (2014, November 11). What Does "Good Farming Practices" Really Mean? Retrieved from <https://sustainableagriculture.net/blog/good-farming-practices-hndbok/>
- ¹³⁵Schnepf, Randy. (2017, August 11). Farm Safety Net Payments Under the 2014 Farm Bill: Comparison by Program Crop. Congressional Research Service. Retrieved from: <https://fas.org/spp/crs/misc/R44914.pdf>
- ¹³⁶The AGree Economic and Environmental Risk Coalition. AGree Research Publications. Retrieved from: <https://foodandagpolicy.org/research/>
- ¹³⁷The AGree Economic and Environmental Risk Coalition. Our Work. Retrieved from: <https://foodandagpolicy.org/our-work/>
- ¹³⁸U.S. Department of Agriculture Economic Research Service. (2020, May 06). Crop Insurance Program Provisions-Title XI. Retrieved from <https://www.ers.usda.gov/topics/farm-economy/farm-commodity-policy/crop-insurance-program-provisions-title-xi/>
- ¹³⁹Personal communication, agricultural lender BE, August 2020.
- ¹⁴⁰U.S. Department of Agriculture Economic Research Service. (2017, December.) America's Diverse Family Farms. Retrieved from: <https://www.ers.usda.gov/webdocs/publications/86198/eib-185.pdf>
- ¹⁴¹Calculated as the total crop insurance liability for 2017 (106,088,501,298) as a percentage of the value of agricultural production from the 2017 U.S. census of agriculture, (\$388,522,695,000), which is 27.3%. Sources: Federal Crop Insurance Corporation. Commodity Year Statistics for 2017. Retrieved from: https://www3.rma.usda.gov/apps/sob/current_week/crop2017.pdf. and U.S. Department of Agriculture National Agriculture Statistics Service. U.S. Agriculture Census, Table 2. Market Value of Agricultural Products Sold. Retrieved from: https://www.nass.usda.gov/Publications/AgCensus/2017/Full_Report/Volume_1_Chapter_1_US/st99_1_0002_0002.pdf
- ¹⁴²CoBank. 2019. Forward together: 2019 annual report. Retrieved from: <https://www.cobank.com/-/media/files/financials/2019/cobank-2019-annual-report.pdf?la=en&hash=DDAD226893F20E21C43B7DE275CB1AAA85C82CE3>
- ¹⁴³Crane-Droesch, Andrew et al. (2019, July.)
- ¹⁴⁴Fink, Larry. (2020, January.) A Fundamental Reshaping of Finance. Retrieved from: <https://www.blackrock.com/corporate/investor-relations/larry-fink-ceo-letter>
- ¹⁴⁵GARP Risk Institute. (2019.)
- ¹⁴⁶Board of Governors of the Federal Reserve System. (2011, October 26.) SR 11-14: Supervisory Expectations for Risk Management of Agricultural Credit Risk <https://www.federalreserve.gov/supervisionreg/srletters/sr1114.htm>
- ¹⁴⁷Strom, Leland. (2010.) Statement on Farm Credit Administration's Climate Adaptation Policy. Retrieved from: <https://www.fca.gov/template-fca/download/ClimateChangeAdaptationPolicy.pdf>

- ¹⁴⁸Personal communication, agricultural lender interviews conducted by KCoe Isom, April 2020.
- ¹⁴⁹Task Force on Climate-Related Financial Disclosures. 2017. Recommendations of the Task Force on Climate-Related Financial Disclosures. Table 1: Examples of climate-related risks and potential financial impacts. Accessed at: <https://www.fsb-tcfd.org/wp-content/uploads/2017/06/FINAL-TCFD-Report-062817.pdf>
- ¹⁵⁰McKinsey Global Institute. 2020. Climate risk and response: physical hazards and socioeconomic impacts. Accessed at: <https://www.mckinsey.com/business-functions/sustainability/our-insights/climate-risk-and-response-physical-hazards-and-socioeconomic-impacts>
- ¹⁵¹Ceres. 2020. Addressing climate as a systemic risk: a call to action for U.S. financial regulators. Accessed at: <https://www.ceres.org/resources/reports/addressing-climate-systemic-risk>
- ¹⁵²CoBank. (2019.) Rural Industries and Climate Change. Retrieved from: <https://www.cobank.com/-/media/files/ked/general/rural-industries-climate-change.pdf?ja=en&hash=234B62A18E2E279D82C84222C1E62DB343E9F816>
- ¹⁵³Commodity Futures Trading Commission. (2020.) Climate-Related Market Risk Subcommittee. Retrieved from: https://www.cftc.gov/About/CFTCCommittees/MarketRiskAdvisoryCommittee/mrac_subcommitteemembers.html
- ¹⁵⁴Eceiza, J., Harreis, H., Härtle, D., Viscardi, S. (2020.) Banking imperatives for managing climate risk. McKinsey & Company. Retrieved from: <https://www.mckinsey.com/business-functions/risk/our-insights/banking-imperatives-for-managing-climate-risk>
- ¹⁵⁵Task Force on Climate-related Financial Disclosures. (2017.) Implementing the recommendations of the Task Force on Climate-Related Financial Disclosures. Retrieved from: <https://www.fsb-tcfd.org/wp-content/uploads/2017/12/FINAL-TCFD-Annex-Amended-121517.pdf>
- ¹⁵⁶Eceiza, J., Harreis, H., Härtle, D., Viscardi, S. (2020.)
- ¹⁵⁷Eceiza, J., Harreis, H., Härtle, D., Viscardi, S. (2020.)
- ¹⁵⁸Beinker, Natascha. Foreword to U.N. Environment Programme Finance Initiative (UNEP FI) (2017). Drought Stress Testing: Making Financial Institutions More Resilient to Environmental Risks. Frankfurt, GR.: U.N. Environment Programme. Retrieved from: <https://naturalcapital.finance/wp-content/uploads/2018/11/Drought-Stress-Testing-Tool-FULL-REPORT.pdf>
- ¹⁵⁹U.N. Environment Programme Finance Initiative (UNEP FI) (2017). Drought Stress Testing: Making Financial Institutions More Resilient to Environmental Risks. Frankfurt, GR.: U.N. Environment Programme. Retrieved from <https://naturalcapital.finance/wp-content/uploads/2018/11/Drought-Stress-Testing-Tool-FULL-REPORT.pdf>
- ¹⁶⁰European Banking Authority. (2019.) EBA publishes 2020 EU-wide stress test templates after testing them with banks. Retrieved from: <https://eba.europa.eu/eba-publishes-2020-eu-wide-stress-test-templates-after-testing-them-banks>
- ¹⁶¹Eceiza, J., Harreis, H., Härtle, D., Viscardi, S. (2020.)
- ¹⁶²International Finance Corporation and Sustainable Banking Network. (2017.) Greening the banking system – experiences from the sustainable banking network. Retrieved from: https://www.ifc.org/wps/wcm/connect/5962a2da-1f59-4140-a091-12bb7acef40f/SBN_PAPER_G20_02102017.pdf?MOD=AJPERES&CVID=IHehxyG
- ¹⁶³Ellis, Jonathan. (2014, March 16). Wal-Mart pushes plan to reduce fertilizer. USA Today. Retrieved from: <https://www.usatoday.com/story/money/business/2014/03/16/wal-mart-has-fertilizer-plan/6428637/>
- ¹⁶⁴Mueller, Jon. (2018, January 1.) The Chesapeake Bay TMDL seven years out: Status, lessons, and the future. American Bar Association Trends. Retrieved from: https://www.americanbar.org/groups/environment_energy_resources/publications/trends/2017-2018/january-february-2018/the-chesapeake-bay-tmdl-seven-years-out/
- ¹⁶⁵Iowa State University. Iowa Nutrient Reduction Strategy. Retrieved from: <http://www.nutrientstrategy.iastate.edu/>
- ¹⁶⁶Ohio State University. Ohio Fertilizer Laws. Retrieved from: <https://nutrienteducation.osu.edu/FertilizerLaws>
- ¹⁶⁷Cagle, S. (2020, February 27). 'Without water we can't grow anything': Can small farms survive California's landmark water law? The Guardian. Retrieved from <https://www.theguardian.com/environment/2020/feb/27/california-groundwater-sigma-law-farmers>
- ¹⁶⁸Eller, Donnelle. (2017, March 20.) Water Works lawsuit was dismissed. Des Moines Register. Retrieved from: <https://www.desmoinesregister.com/story/money/agriculture/2017/03/17/judge-dismisses-water-works-nitrates-lawsuit/99327928/>
- ¹⁶⁹Neutral. <https://www.eatneutral.com/>
- ¹⁷⁰Houser Conzemius, Maria. (2014, June 15.) Dozens of Johnson & Cedar County Residents Oppose New Factory Farm Expansion Proposal. Patch. Accessed at: <https://patch.com/iowa/iowacity/want-a-huge-hog-factory-farm-on-oasis-road-in-johnson-county>
- ¹⁷¹House Select Committee on the Climate Crisis. (2020, June.) Solving the Climate Crisis: The Congressional Action Plan for a Clean Energy Economy and a Healthy, Resilient, and Just America. Page 340. Retrieved from: <https://climatecrisis.house.gov/sites/climatecrisis.house.gov/files/Climate%20Crisis%20Action%20Plan.pdf>
- ¹⁷²Iowa Soybean Association. (2019.) Estimations of financial implications resulting from implementation of farm conservation practices. Retrieved from: https://www.iasoybeans.com/upl/downloads/library/Conservation_Profitability_White_Paper.pdf
- ¹⁷³Monast, Maggie and KCoe Isom AgKnowledge. (2018.)
- ¹⁷⁴Sustainable Agriculture and Education. (2019.) Cover crop economics: opportunities to improve your bottom line in row crops. Retrieved from: <https://www.sare.org/Learning-Center/Bulletins/Cover-Crop-Economics>

- ¹⁷⁵Precision Conservation Management. (2019.) The Business Case for Conservation: Cost-Benefit Analysis of Conservation Practices. Retrieved from: https://www.precisionconservation.org/wp-content/uploads/2019/12/Illinois-Corn-PCM-Booklet_single-pages_no-bleed_hires.pdf
- ¹⁷⁶Schnitkey, G. and L. Gentry. (2019, March 19.) The Economic Advisability of Lowering 2019 Nitrogen Application Rates on Corn." *farmdoc daily* (9):48, Department of Agricultural and Consumer Economics, University of Illinois at Urbana-Champaign. Retrieved from: <https://farmdocdaily.illinois.edu/2019/03/the-economic-advisability-of-lowering-2019-nitrogen-application-rates-on-corn.html>
- ¹⁷⁷Monast, Maggie and KCoe Isom AgKnowledge. (2018.)
- ¹⁷⁸Lin, B.B. (2011.) Resilience in Agriculture through Crop Diversification: Adaptive Management for Environmental Change. *BioScience* 61(3):183-193. doi: 10.1525/bio.2011.61.3.4
- ¹⁷⁹Abawi, G. S., & Widmer, T. L. (2000).
- ¹⁸⁰Iowa Soybean Association. (2019.) Estimations of financial implications resulting from implementation of farm conservation practices. Retrieved from: https://www.iasoybeans.com/upl/downloads/library/Conservation_Profitability_White_Paper.pdf
- ¹⁸¹Monast, Maggie and KCoe Isom AgKnowledge. 2018.
- ¹⁸²Sustainable Agriculture and Education. (2019.)
- ¹⁸³California Ag Water Stewardship Initiative. Irrigation Management. Retrieved from: http://agwaterstewards.org/practices/irrigation_management/
- ¹⁸⁴Personal communication with Scott Marlow, August 2020.
- ¹⁸⁵Ibid.
- ¹⁸⁶Monast, Maggie and KCoe Isom AgKnowledge. (2018.)
- ¹⁸⁷Alverson, Keith. (2020, April 1). How Congress can help farmers reduce loss and risk in uncertain times. <http://blogs.edf.org/growingreturns/2020/04/01/congress-farmers-crop-insurance-reduce-risk/>
- ¹⁸⁸American Farmland Trust and USDA Natural Resources Conservation Service. (2020). Soil health case study: Tom and Dan Rogers, CA. Retrieved from https://s30428.pcdn.co/wp-content/uploads/sites/2/2020/02/CA_RogersFarm_Soil_Health_Case_Study_AFT_NRCS.pdf
- ¹⁸⁹American Farmland Trust and USDA Natural Resources Conservation Service. (2020). Soil health case study: Ralf Sauter, Okuye Farm, CA. Retrieved from https://s30428.pcdn.co/wp-content/uploads/sites/2/2020/02/CA_OkuyeFarms_Soil_Health_Case_Study_AFT_NRCS.pdf
- ¹⁹⁰Skaggs, R. Wayne, Fausey, Norman R., and Robert O. Evans. 2012. Drainage Water Management. *Journal of Soil and Water Conservation* 67(6)167A-172A. doi:10.2489/jswc.67.6.167A
- ¹⁹¹Bowles et al. (2020.)
- ¹⁹²U.S. Department of Agriculture Natural Resources Conservation Service. (n.d.). NRCS Funding Opportunities. Retrieved from <https://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/programs/>
- ¹⁹³Roesch-McNally, Gabrielle, Arbuckle, J., and Tyndall, John. (2018.)
- ¹⁹⁴Sustainable Agriculture and Education. (2019.)
- ¹⁹⁵Partnership for Ag Resource Management. (2019, May 10). Unilever and PepsiCo Offer Cover Crop Incentives. Retrieved from <https://partnershipfarm.org/2019/05/unilever-and-pepsico-offer-cover-crop-incentives/>
- ¹⁹⁶Ecosystem Services Market Consortium. Retrieved from <https://ecosystemservicesmarket.org/>
- ¹⁹⁷Senator Mike Braun. (2020, June 4.) Growing Climate Solutions Act set to be introduced in U.S. Senate. Retrieved from: <https://www.braun.senate.gov/growing-climate-solutions-act-set-be-introduced-us-senate>
- ¹⁹⁸Spiegel, Bill. (2016, March 18). Investing in Soil Health Pays. Successful Farming. https://www.agriculture.com/crops/tillage/no-till/investing-in-soil-health-pays_188-ar52662
- ¹⁹⁹Monast, Maggie and KCoe Isom AgKnowledge. 2018.
- ²⁰⁰Ibid.
- ²⁰¹DeVincents, A J., et al. (2020). Using cost-benefit analysis to understand adoption of winter cover cropping in California's specialty crop systems. *J. of Env. Manage.* | <https://reader.elsevier.com/reader/sd/pii/S0301479720301407?token=10B8C97E9551336E380D264D90380687BB73FEE3598651DFE79D6F0BACB1C60BF4345835AECEA3657D448EAD1800E627>
- ²⁰²Personal communication, Dick Wittman, August 2020.
- ²⁰³American Farmland Trust. Soil health case studies findings. Farmland.org. Retrieved from: <https://farmland.org/soil-health-case-studies-findings/>
- ²⁰⁴Alverson, Keith. (2020, April 1).
- ²⁰⁵Bowles et al. (2020.)
- ²⁰⁶Ibid.
- ²⁰⁷Farm Management. (2019, January 12). Modern agricultural technology adoption and its importance. Retrieved from <https://www.farmmanagement.pro/modern-agricultural-technology-adoption-and-its-importance/>
- ²⁰⁸Brown, N. (2019, January 15). Integrating Ag Technology Data with Financial and Managerial Accounting. FBS Systems. Retrieved from <https://www.fbssystems.com/farm-management-software-blog/integrating-ag-technology-data-with-financial-and-managerial-accounting>
- ²⁰⁹Bedord, Laurie. (2018, December 5.) "Rabo AgriFinance, Conservis partnership turns farm data into financial management." Successful Farming. Accessed at: <https://www.agriculture.com/news/technology/rabo-agrifinance-conservis-partnership-turns-farm-data-into-financial-management>

- ²¹⁰McDonald, J., Korb, P., Hoppe, R. (2013, August.) Farm Size and the Organization of U.S. Crop Farming. U.S. Department of Agriculture Economic Research Service. Retrieved from: https://www.ers.usda.gov/webdocs/publications/45108/39359_err152.pdf
- ²¹¹U.S. Congressional Research Service. (2013, February 22.) Garcia v. Vilsack: A Policy and Legal Analysis of a USDA Discrimination Case. Retrieved from https://www.everycrsreport.com/files/20130222_R40988_853acfce8ee52a3da3a49162d1a9fc578b7b5dfc.pdf
- ²¹²Baratta, Bethany. (2020, June 18). Why recordkeeping is “one of the most essential pieces of farming today.” Growing Returns. Retrieved from: <http://blogs.edf.org/growingreturns/2020/06/18/recordkeeping-farm-success-sustainability/>
- ²¹³Personal communication, agricultural lender PD, October 2019
- ²¹⁴Eswaran, H., R. Lal and P.F. Reich. 2001. Land degradation: an overview. In: Bridges, E.M., I.D. Hannam, L.R. Oldeman, F.W.T. Pening de Vries, S.J. Scherr, and S. Sompatpanit (eds.). Responses to Land Degradation. Proc. 2nd. International Conference on Land Degradation and Desertification, Khon Kaen, Thailand. Oxford Press, New Delhi, India. Accessed at: https://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/use/?cid=nrcs142p2_054028
- ²¹⁵Council for Agricultural Science and Technology (CAST). (2019.) Aquifer Depletion and Potential Impacts on Long-term Irrigated Agricultural Productivity. Issue Paper 63. CAST, Ames, Iowa. Retrieved from <https://www.cast-science.org/wp-content/uploads/2019/02/CAST-IP63-Aquifer-Depletion.pdf>
- ²¹⁶Bowles et al. (2020.)
- ²¹⁷Personal communication, Scott Marlow, July 2020.
- ²¹⁸Personal communication, Scott Marlow, July 2020.
- ²¹⁹Pellett, Nancy. (2007, August 10.) Revised Bookletter 040 - Providing Sound and Constructive Credit to Young, Beginning, and Small Farmers, Ranchers, and Producers or Harvesters of Aquatic Products. Retrieved from: https://www3.fca.gov/readingrm/Handbook/_layouts/15/WopiFrame.aspx?sourcedoc={788991C0-7E8B-43AC-ADB4-55C500B85A94}&file=BL-040%20REVISED.docx&action=default
- ²²⁰Personal communication ag lender RH, May 2019.
- ²²¹Personal communication ag lender BE, July 2020.
- ²²²Monke (2018.)
- ²²³National Sustainable Agriculture Coalition. (2019, September.) Microloans. Retrieved from: <https://sustainableagriculture.net/publications/grassrootsguide/credit-crop-insurance/microloans/>
- ²²⁴National Sustainable Agriculture Coalition. (2019, June.) Conservation Loans. Retrieved from: <https://sustainableagriculture.net/publications/grassrootsguide/credit-crop-insurance/conservation-loans/>
- ²²⁵Ibid.
- ²²⁶Rabo AgriFinance. (2019, October 24.)“Rabo AgriFinance Designs Industry’s First Organic Transition Loan Offering.” Retrieved from: <https://www.raboag.com/news/rabo-agrifinance-designs-industrys-first-organic-transition-loan-offering-54>
- ²²⁷Personal communication, Erin Heitkamp, Pipeline Foods, August 2020.
- ²²⁸Compeer Financial. (2020, February). New Organic Bridge Loan. Retrieved from: <https://www.compeer.com/Utility/Support/About/Newsroom/Press-Releases/February-2020/New-Organic-Bridge-Loan>
- ²²⁹Personal communication, Greg Fishbein, The Nature Conservancy, 2020.



Headquarters

257 Park Avenue South
New York, NY 10010
T 212 505 2100
F 212 505 2375

Austin, TX

301 Congress Avenue
Austin, TX 78701
T 512 478 5161
F 512 478 8140

Bentonville, AR

1116 South Walton Boulevard
Bentonville, AR 72712
T 479 845 3816
F 479 845 3815

Boston, MA

18 Tremont Street
Boston, MA 02108
T 617 723 2996
F 617 723 2999

Boulder, CO

2060 Broadway
Boulder, CO 80302
T 303 440 4901
F 303 440 8052

Raleigh, NC

4000 Westchase Boulevard
Raleigh, NC 27607
T 919 881 2601
F 919 881 2607

Sacramento, CA

1107 9th Street
Sacramento, CA 95814
T 916 492 7070
F 916 441 3142

San Francisco, CA

123 Mission Street
San Francisco, CA 94105
T 415 293 6050
F 415 293 6051

Washington, DC

1875 Connecticut Avenue, NW
Washington, DC 20009
T 202 387 3500
F 202 234 6049

Beijing, China

C-501, Yonghe Plaza
28 East Andingmen East Road
Dongcheng District
Beijing 100007, China
T +86 10 6409 7088
F +86 10 6409 7097

La Paz, Mexico

Revolución No. 345
E/5 de Mayo y Constitución
Col. Centro, CP 23000
La Paz, Baja California Sur, Mexico
T +52 612 123 2029

London, UK

6-10 Borough High Street
London, SE1 9QQ, UK
T +44 203 310 5909