Farm finance and conservation

How stewardship generates value for farmers, lenders, insurers and landowners

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Farm finance and conservation: How stewardship generates value for farmers, lenders, insurers and landowners

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EDF ENVIRONMENTAL DEFENSE FUND
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About EDF

Environmental Defense Fund (edf.org), a leading international nonprofit organization, creates transformational solutions to the most serious environmental problems. EDF links science, economics, law and innovative private-sector partnerships.

K·COE ISOM

About K·Coe Isom

K·Coe Isom (kcoe.com) is a leading national firm of consultants and certified public accountants in the food and agriculture industry. AgKnowledge is a service that gives farmers and ranchers access to financial and farm management knowledge to inform decision-making.

Acknowledgements

Research contributors

Amy Dickie, Max Levine and Sydney Sanders, California Environmental Associates

Larry Band, sustainable finance consultant

Scott Walsh, sustainable business consultant

Case study participants

We are especially grateful to farmers **Scott Henry, Justin Knopf** and **Joshua Yoder** for their generous contributions of expertise and data.

Expert reviewers

Mollie Aronowitz, Peoples Company

Sam Bunz, CropPro Insurance

Jennifer Filipiak, American Farmland Trust

Clay Mitchell, Fall Line Capital

Interview participants

We would also like to thank the many interview participants for generously sharing their time and perspectives.

Foreword

Keith Alverson, farmer and National Corn Growers Association board member

About this report

This report is the result of a collaboration between Environmental Defense Fund (EDF), the agriculture managerial accounting firm K·Coe Isom AgKnowledge and three Midwestern grain farmers – Scott Henry, Justin Knopf and Joshua Yoder. It analyzes the impact of conservation on farm budgets with three in-depth case studies that combine the farmers' own records with their experience adopting conservation practices. The cases show how these farmers have made conservation work financially and share lessons they have learned in the process of adopting conservation practices.

AgKnowledge also pulled data from its own client database to perform a comparative analysis of 10 additional farmers, including farmers who practice no-till, farmers who practice no-till and cover crops, and farmers who have not adopted conservation practices. The report combines this analysis with expertise from AgKnowledge on how farmers can maximize cost savings from conservation adoption.

It is important to note that this analysis is based on farmer records and expertise and therefore does not prove a causal relationship between conservation adoption and the cost and yield impacts. Many factors affect costs and yields in any agricultural operation. However, the farmers who participated in this analysis attribute their cost savings and yield impacts to conservation adoption. Their stories show how conservation can be incorporated successfully into a profitable farming enterprise. Additional efforts to build a robust financial case for conservation are needed to show the value to the farm and beyond.

The report also incorporates a study of the farm financial system conducted by EDF, California Environmental Associates and environmental finance and business consultants Larry Band and Scott Walsh. We examine the financial implications of agricultural conservation to the broader set of businesses, agencies and individuals with financial ties to farmers. We contend that these entities should consider conservation to be a material issue to their own businesses, and that the failure to recognize conservation in their decision-making poses significant financial risk.

Last, we offer ideas on how those businesses, agencies and individuals with financial ties to farmers can monetize the value of conservation. Capturing the true financial value of conservation and incorporating it into the decision-making of farmers and their business partners presents opportunities to share the benefits, costs and risks of conservation adoption more equitably across the farm financial system and to generate more financial and environmental value for all.

Contents

Foreword

“If you take care of the land, the land will take care of you.” I’ve heard this throughout my life, and it’s more than just words to my parents, aunts, uncles and grandparents. To my family, and many other farm families, stewardship is a way of life – and it’s integral to our livelihoods.

Farmers consider the economic viability of conservation practices in the short and long term before deciding whether to implement them. Only those practices that demonstrate positive return on investment will achieve widespread adoption, especially during times of tight farm economics when farmers keep an even more watchful eye on the bottom line. Finding practices that can perform the double duty of improving stewardship and maintaining profitability is critical.

Conservation and stewardship take many forms on the farm, including reduced tillage, cover crops, precision technology and advanced nutrient management. All have different return on investment timelines, influenced by a range of variables unique to each farm, such as weather, soil, labor and land ownership conditions. More than half of U.S. cropland is rented, and uncertainty over the length of land tenure can impact farmers’ approach to long-term conservation investments.

Many conservation practices require a farmer to change their farm management systems. This transition process can bring growing pains, for example, determining when to terminate cover crops or adapting to new equipment needs for conservation tillage. When conservation practices enhance profitability, however, increases in management costs are more than offset.

Returns come from reduced monetary and time costs, higher or more stable yields, and increased resiliency to weather variability. Adapting management practices allows farmers to take advantage of the uniqueness of individual farms, while also capitalizing on the conservation practices that work universally across farms. When we manage to the environment around us, we can identify practices that will not only increase profitability but also benefit the land and water we steward.

As a member of the National Corn Growers Association (NCGA) board of directors, I’ve chaired NCGA’s Climate Task Force, served as liaison to our Stewardship Action Team and sat on the Finance Committee. NCGA’s mission is to create opportunities for its 40,000 members while sustainably feeding and fueling a growing world. In efforts toward achieving that mission, we’ve studied the practice changes that will help farmers improve stewardship, resilience and economic viability.

Farm finance and conservation: How stewardship generates value for farmers, lenders, insurers and landowners shows how those practices translate to real-world farming operations. It provides three case studies that explore how growers in Iowa, Kansas and Ohio manage the complexities of adopting conservation practices and find solutions that strengthen farm finances and stewardship.

This report takes an honest look at the economic viability of on-farm conservation, and it demonstrates that conservation and profitability can, and should, go hand in hand. Taking care of the land does in fact allow it to take care of your family now and for generations to come.

– Keith Alverson, sixth-generation South Dakota farmer and National Corn Growers Association board member

Executive summary

The farm economy is under stress. Low commodity prices have caused a 52 percent drop in net farm income over the past five years.[1] Across the country, farmers are sitting down with their financial advisers to figure out where they can cut costs. At the same time, farmers face continued calls to reduce the environmental impacts of agriculture. Water pollution and greenhouse gas emissions associated with nutrient loss are a major challenge, and documented adoption rates of conservation practices remain low.[2]

In lean years, even farmers who are deeply committed to conservation must take a second look at whether any costs required to implement practices are worth it. Farmers who have not yet adopted conservation activities are less likely to experiment with new ones. Thin farm margins make it even more important to show the impacts of conservation adoption on farm budgets. Agricultural sustainability advocates need to be invested in the overall financial success of farmers and change course when conservation adoption doesn't help farms remain viable.

This analysis of the impact of conservation adoption on farm budgets offers reason to be optimistic. The farmers found that conservation management systems can produce lower costs than conventional management and, in some cases, increased or more resilient yields. Despite these benefits, our examination of the broader farm financial system shows that crop insurers, lenders, landowners and others largely ignore the financial value of conservation. The final section of the report offers ideas on how the farm financial system can monetize the value of conservation and incorporate it into decision-making, resulting in greater conservation and financial value for all.

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[1] Chairman K. Michael Conaway, 18 Apr. 2018. "Opening Statement: Chairman K. Michael Conaway." House Committee on Agriculture, https://agriculture.house.gov/news/documentsingle.aspx?DocumentID=4296.

[2] Wade, Tara, et al. 2015. "Conservation-Practice Adoption Rates Vary Widely by Crop and Region." US Department of Agriculture Economic Research Service, www.ers.usda.gov/publications/pub-details/?pubid=44030.

Key findings include:

Conservation practices *can* pay. Farmers who adopted conservation practices – combinations of no-till, cover crops, nutrient optimization and crop rotation – reported a cascade of cost savings throughout their budgets, including lower fertilizer, labor, fuel and equipment costs. They also saw an increase in their farms' soil structure and health, which in some cases resulted in increased or more resilient yields, losing less yield in bad weather years. Some costs did increase, such as cover crop seed and herbicides, but in each of the cases studied, the benefits of conservation practices outweighed the costs.

Payoffs come at the farm level. The farmers emphasized that conservation often requires a total management change, and the whole of that change is greater than the sum of its individual parts. The farm budgets bear out that perspective. The farmers experienced cost increases in a couple of budget categories, but found cost savings in multiple budget categories. This analysis shows that the farm enterprise scale may be more likely to show the financial value of conservation because it captures the holistic conservation management system.

Getting it right takes time and effort. It can take time to determine the right mix of practices or the necessary adjustments to fit conservation practices into the specific farm and rotation. It also takes time for the benefits of the practices to outweigh the initial costs of implementing them. Once the farmers figured out the right combination of practices for their operations, the benefits were substantial.

Conservation benefits are often unrecognized and unrewarded. In addition to the direct benefits of conservation to farmers, there are significant benefits to the broader farm financial system that often go unrecognized and unrewarded. Farmers who adopt conservation practices provide significant benefits to landowners, lenders and insurers by lowering costs and increasing profits and asset values. Unfortunately, many of the current practices and policies of these business partners do not recognize these benefits and even discourage farmers from conservation adoption. Such practices and policies should be modified to recognize and encourage opportunities for conservation to add financial value.

Conservation is a material issue. Materiality is a concept from corporate financial and sustainability reporting that proposes a threshold for reporting on issues that may affect the company and its investors and other stakeholders. The financial impacts of conservation matter for farmers' budgets, as well as those of the businesses and individuals in the broader farm financial system. Recognizing conservation as a material issue to landowners, lenders, crop insurers and others presents opportunities to increase the environmental and financial value generated by farmers who adopt conservation practices, while avoiding the risk associated with sticking to the status quo.

Creating incentives for conservation is in the financial interest of businesses and individuals with financial ties to farmers. There are a number of ways the farm finance sector can encourage farmers to adopt conservation practices that benefit the entire value chain. Lease terms, land appraisal practices, crop insurance policies and other financial instruments could all be adjusted to provide incentives for farmers to adopt conservation practices. These innovations offer the opportunity to share the costs and risks of conservation adoption more equitably across the farm financial system, as well as generate more financial value and risk reduction for farmers and their business partners.

Introduction

This report began as a conversation in the summer of 2017 among a group of farmers and conservationists gathered around a table at LongView Farms in Iowa. This was not the first time this group had met. A group of farmers and staff of Environmental Defense Fund (EDF) have been meeting for the past six years to discuss the challenge of feeding a growing population while protecting our natural resources. At EDF, we view this group – most of whom farm thousands of acres and employ a variety of conservation practices such as no-till and cover crops – as the most important sounding board for our ideas. But that July day, the farmers brought a problem to us: How can we better demonstrate the impact of conservation on farm budgets?

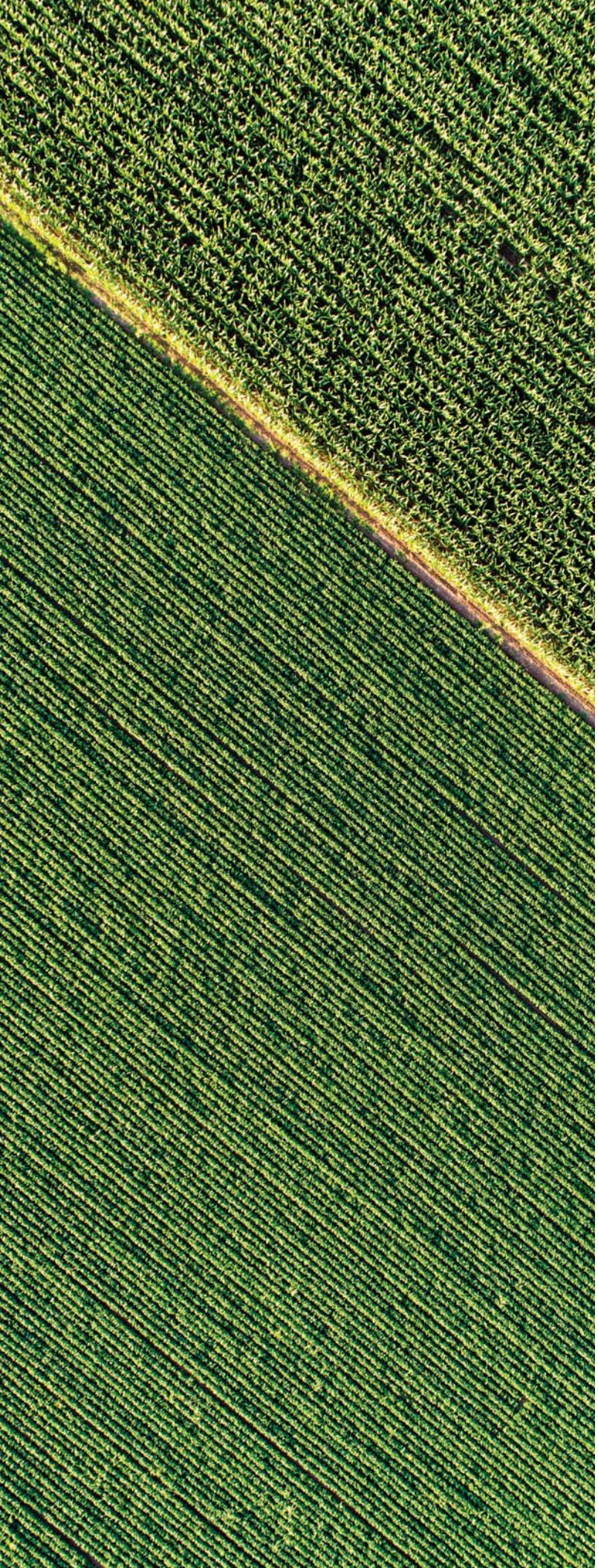
This was a particularly pressing question as corn prices had plunged following the highs of 2012. Even these farmers, who are deeply committed to conservation, were taking a second look at whether the investment in conservation was worth it.

> "Narrow margins are putting a pinch on peoples' willingness to experiment with things that might not pencil out. We still have to prove to the banker that we're not going to go broke in the next few years."
>
> – **Cori Wittman,** Idaho

In addition, the benefits of conservation often take at least a few years to materialize. Those farmers who do take the leap to change their management often do so out of their desire to steward the land, without knowing whether it will pay off.

> "Making those choices not knowing the economic outcomes has to do with science… If it's scientifically the right answer, I assume the economics will work over time."
>
> – **Justin Knopf,** Kansas

> "I expect zero return in the short term. My goal for conservation is to not have a loss. With faith, I can make an economic benefit long term."
>
> – **Dave Nelson,** Iowa



The farmers emphasized that conservation agriculture is a total management change, and that the whole of that change is much greater than the sum of its individual practices. This led us to look at the farm enterprise budget, so we could capture the interactions between practices and their total impact on the farm's bottom line. We also wanted to present the costs and value associated with conservation management to farmers in the way that they are typically accustomed to receiving financial information about their farms.

For this reason, we decided to enlist the help of farm budgeting experts at K·Coe Isom AgKnowledge, a managerial accounting service for farmers and ranchers. Three of the farmers in EDF's advisory group agreed to open their books to AgKnowledge so they could assess the impacts of conservation adoption on their finances. These farmers – Justin Knopf from Kansas, Scott Henry from Iowa and Joshua Yoder from Ohio – were incredibly generous with their time and financial information so that AgKnowledge could analyze the cost increases, cost savings and yield impacts of conservation management across their budgets. AgKnowledge also pulled from its own client records to conduct a comparative analysis of the budgets of conservation adopters and non-adopters.

The bottom line of this report is that conservation *can* pay. Furthermore, farmers who practice conservation management also create value that goes far beyond their own fields. That insight mirrors the initial conversation around the table at LongView Farms, which extended beyond the farmers' own operations to the wider system of organizations and individuals with whom farmers do business – lenders, insurers, grain buyers, seed companies, landowners and governments. The farm financial system does little to support farmers who want to adopt conservation management, yet they benefit from the value created by farmers like Scott, Justin and Joshua. The mainstream farm financial system faces the opportunity to benefit from recognizing and monetizing the value of conservation agriculture, as well as the financial risks of sticking with the status quo.

The challenges of a volatile farm economy, growing global population and changing climate require a resilient agricultural system. That starts with the soil and extends to the global financial and commodity markets that affect, and are affected by, daily life on the farm. We believe that lasting solutions to these challenges are good business for farmers, landowners, investors and farm financial services providers. Our hope is that those who read this report gain insight into the financial value of conservation and ways that we can collaborate to encourage conservation agriculture more broadly.

– **Maggie Monast,** Environmental Defense Fund

Conservation practices adopted

Nutrient optimization

Managing the amount, source, placement and timing of plant nutrients such as nitrogen fertilizer to optimize yield without applying in excess. This reduces the potential for nutrients to go unused and result in water pollution or greenhouse gas emissions.[3] This is often accomplished through the use of precision technology.

Crop rotation

Growing different crops on the same piece of land season after season in a planned, recurring sequence. This could involve a rotation from corn to a legume, small grain or both. The environmental benefits of crop rotation include reduced soil erosion, reduced fertilizer needs when legumes are included in the rotation, reduced pesticide costs, added soil biological diversity and improved water quality.[4]

Conservation tillage

In conventional farming systems, the soil is turned to prepare the seedbed and control for weeds. No-till and reduced till are management approaches where the soil is not turned or only minimally turned, leaving plant material on the surface of the soil. The seed is then directly drilled for planting. Conservation tillage reduces soil erosion and improves the quality of the soil, for example by increasing water-holding capacity.[5]

Cover crops

In a conventional system, nothing is planted in a field after harvest. Cover crops are grasses, legumes or forbs planted to provide seasonal soil cover on cropland when the soil would otherwise be bare. Cover crops are generally not intended for harvest or sale, although some growers earn revenue by integrating livestock into their cover crop systems or planting an overwintering cash crop such as winter wheat. Cover crops can prevent soil erosion, improve soil health, suppress weeds and disrupt pest cycles. Depending on the crop, they may also supply nutrients.[6]

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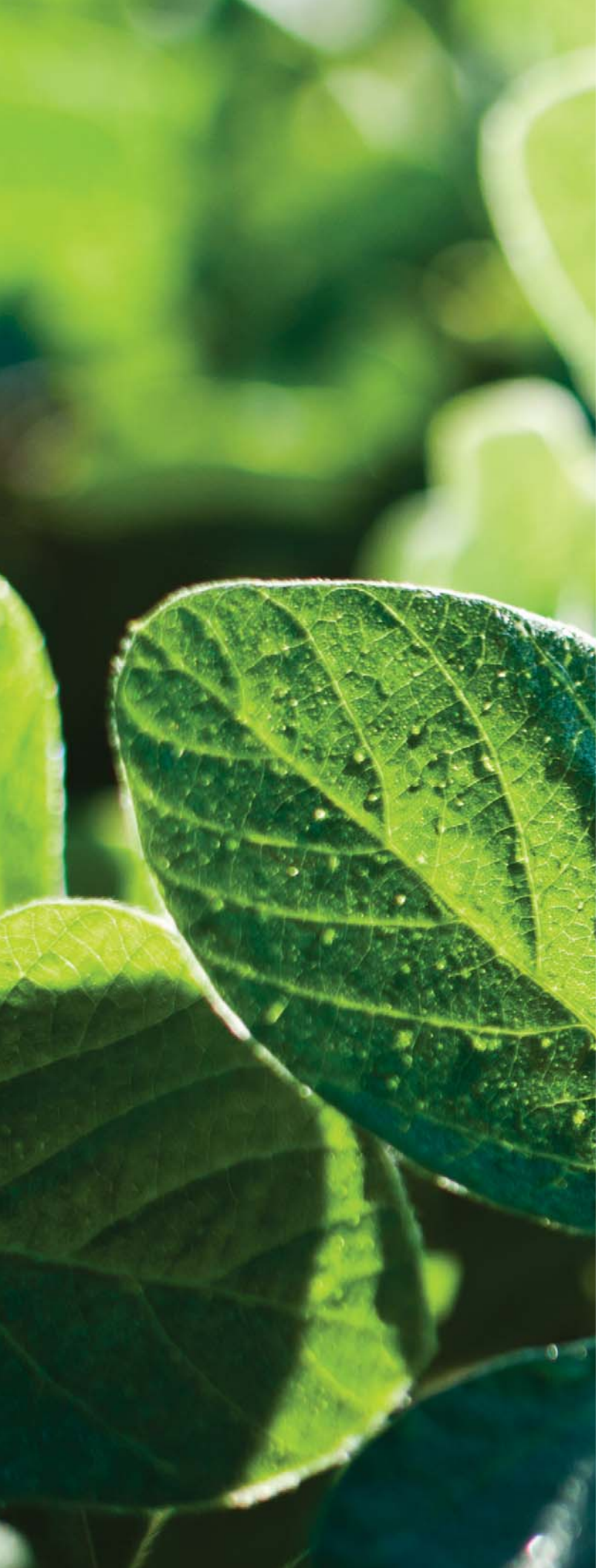
[3] US Department of Agriculture Natural Resources Conservation Service. 2017. "CONSERVATION CHOICES: Soil Health Practices." https://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcseprd1318196.pdf.

[4] Ibid.

[5] Wade, Tara, et al. 2015. "Conservation-Practice Adoption Rates Vary Widely by Crop and Region." US Department of Agriculture Economic Research Service, www.ers.usda.gov/publications/pub-details/?pubid=44030.

[6] Ibid.



Conservation in practice: farm enterprise case studies

The three case studies summarize the finances of three farming operations that each adopted a suite of conservation practices. The farmers – Scott Henry from Iowa, Justin Knopf from Kansas and Joshua Yoder from Ohio – allowed AgKnowledge to review their financial records and interview them about their experience with conservation adoption. Each case contains information about the farm and the farmer's history of conservation adoption, a table of key financial variables and a farm budget.

These analyses are valuable to farmers interested in the financial impacts of conservation for several reasons:

- **Accessible methods:** The crop budgets in this analysis should look familiar to any farmer. Good recordkeeping is the only requirement to replicate this analysis on any farm.
- **Focus on the whole farm enterprise:** The budgets show how relatively small savings in multiple cost categories across the budget add up. The holistic view of the farm enterprise and conservation practices allows farmers to see the bottom line impact.
- **Emphasis on profits rather than yields:** To understand the true financial health of their operations, farmers must consider crop yields, crop prices and production costs. This analysis shows that conservation adoption can lower costs and increase farms' net returns. Even in some cases where yields and revenues decreased, profits still increased because of greater cost savings.
- **Shared lessons learned:** The farmers' stories that accompany their budgets allow other farmers to learn from their experiences and understand potential tradeoffs and management considerations that can be the difference between making a profit or not.

AgKnowledge compiled a budget using 2016 data from each farmer's recordkeeping system and interviews with the farmer. AgKnowledge standardized the budgets to the extent possible, but different farm recordkeeping systems led to some variety in the budget categories. The budgets highlight the costs that, in the farmers' experiences, increased or decreased due to conservation adoption. Each case also includes a table of key financial variables, which summarize the farmers' estimates of the magnitude of the cost and yield impacts from conservation adoption.

To enable comparison across the three budgets, AgKnowledge normalized the price of corn and soybeans, assuming a price of $3.50 per bushel for corn and $9.50 per bushel for soy. This approach to normalizing prices was not applicable to wheat, sorghum and alfalfa, so those prices were calculated using the farmers' revenue and yield.

AgKnowledge also excluded the cost of land from the analysis. When farmers own their own land, renting it out can generate revenue or be used to pay land debt. If they farm on rented land, that adds to their production costs. The bottom line for each budget is therefore net return before land costs.

Farm budget categories

Revenue

Farm revenue is a function of crop yield multiplied by the commodity price. This analysis uses farmer yield data but assumes a commodity price for corn and soy. For this reason, actual farm revenue for those crops will be different from the figures in this analysis depending on the farmer's crop marketing strategy. The analysis also does not include any government conservation payments.

Input costs

This includes fertilizer, chemical and seed costs.

Variable costs

Costs such as fuel, labor and repairs that vary with the level of production.

Fixed costs

This includes the costs of running the operation that do not vary with yield or productivity. We exclude rent and term debt interest.

Finally, these budgets represent one year of each farm's operations and do not show investments in technology or learning that allowed them to successfully adopt their conservation practices. Payments from conservation programs are also excluded but can be an important consideration for farmers interested in adopting conservation practices. Conservation cost-share programs can often improve the profitability of the system, particularly in the first few years of adoption when farmers are learning how to integrate new practices into their farming operation.

It is important to note that these analyses are based on farmer records and expertise and therefore do not prove a causal relationship between conservation adoption and the cost and yield impacts. Many factors affect costs and yields in any agricultural operation. However, the farmers who participated in this analysis attribute their cost savings and yield impacts to conservation adoption. Their stories show how conservation can be incorporated successfully into a profitable farming enterprise.

LongView Farms

About the farmer

Scott Henry is a partner and business development manager for LongView Farms, a grain operation in central Iowa that specializes in seed production. As part of a family farm, Scott helps manage production operations and is responsible for business growth, strategy and the implementation of precision technology.

Farm size: 4,600 acres.

Crops grown: Corn, soybeans and sorghum.

Conservation practices: Precision agriculture using GPS technology, nutrient management, cover crops on all 1,900+ acres of the farm's seed and commercial corn, no-till where applicable, split nitrogen application, slow-release nitrogen products and conservation waterways.

Conservation program and research participation: U.S. Department of Agriculture Conservation Reserve Program, Unilever/ADM Sustainable Soy Continuous Improvement Program, Land O'Lakes SUSTAIN, research with Iowa State University and the Iowa Soybean Association.

Approach to conservation

LongView Farms embraces precision agriculture technology in order to most efficiently use fuel and crop inputs. The information generated by this technology measures the cost and efficiency of production practices and allows Scott to adapt those practices to maximize profits. Scott monitors climate data across all of the acres that he and his family manage. Every field has records of product used, field operations, yield and other pertinent data to provide feedback to farm managers and landowners.

With the introduction of GPS technology to LongView Farms, Scott is now able to improve seed placement, tillage, input application and harvest, in addition to reducing soil compaction, operator fatigue, and chemical and fertilizer overlap. This has resulted in increased yields, reduced costs and better stewardship of the farm's natural resources. Scott also carefully selects crop varieties to respond to disease and insect pressure.

LongView Farms' approach to fertilizer management is to focus on the 4Rs of nutrient stewardship: the right source, rate, timing and amount of nutrients.[7] Scott works to reduce the total number of nitrogen fertilizer units applied, and most importantly, to avoid fertilizer loss and runoff. LongView Farms uses forms of nitrogen coming from NH3, liquid (30 percent), urea, and sometimes ESN® SMART NITROGEN, a form of urea with a polymer coating that slows the release of nitrogen to the crop.[8] Fertilizer is applied in a variety of ways, including ground incorporation, broadcast, side-dressed or with drop tubes/Y-drops.

LongView Farms practices no-till where applicable, depending on topography, soil type and crop rotation. The farm has also focused on cover crops, testing several different mixes and programs. Currently the farm uses a mix of oats and rye, which costs less than other cover crop options. Scott's target for cover crop seed costs is currently $8-10 an acre. Terminating the cover crop with herbicides costs an additional $8-12 per acre.

2017 was the first drought year since LongView Farms started using cover crops, and Scott reported that fields with cover crops had higher water retention, which boosted yields in those fields. According to Scott, the benefit of cover crops extends beyond soil erosion and is a vital tactic in the fight against herbicide-resistant weeds. Scott has found that cover crops provide better weed control on some acres than herbicides. In Scott's experience, this correlates to a yield increase of 1-2 bushels per acre in soybeans for increased revenue of $10-20 per acre, and a yield increase of 2-4 bushels per acre in corn for an increased revenue of $7-14 per acre.

LongView Farms participates in several research efforts and conservation programs. They also participate in the Conservation Reserve Program (CRP), in which land is removed from production and planted with species that will improve environmental health and habitat in exchange for an annual payment.[9] CRP and the creation and maintenance of waterways helps filter water and reduce siltation. Scott also provides acres for research trials performed by Iowa State University and the Iowa Soybean Association.

LongView Farms participates in conservation programs developed by grain buyers and agricultural retailers. The farm takes part in the Land O'Lakes SUSTAIN platform, which trains local agricultural cooperatives to assist farmer customers in adopting land stewardship practices. Longview Farms also participated in the Unilever/ADM Sustainable Soy Continuous Improvement Program, which offered cost-share funding, technical assistance and sustainability benchmarking for enrolled farmers.[10]

For LongView Farms, stewardship is more than tillage and production practices. Scott and his family make collecting data, and tracking and understanding the growing process, a priority. They invest heavily in technologies and software to help better understand how every practice impacts their farm's productivity and profitability.

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[7] The Fertilizer Institute. 2017. "What Are the 4Rs." 4Rs Nutrient Stewardship, www.nutrientstewardship.com/4rs/.

[8] Nutrien Ltd. 2018. "How ESN Works." www.smartnitrogen.com/what-esn/how-esn-works.

[9] US Department of Agriculture Farm Service Agency. "Conservation Reserve Program." www.fsa.usda.gov/programs-and-services/conservation-programs/conservation-reserve-program/.

[10] ADM and Unilever. "Sustainable Soy Continuous Improvement Program." Iowa State University Extension, https://www.extension.iastate.edu/marshall/sites/www.extension.iastate.edu/files/marshall/15-2640%20ADM%20Unilever%20Brochure-6%20(00000002).pdf.

"We believe that the greater insights into our operation provided by new data and monitoring technologies will help unlock further advantages for our farm and the environment."

– Scott Henry

Key financial variables

The table of key financial variables summarizes Scott's estimates of the magnitude of the cost and yield impacts from the farm's conservation adoption. This table is based on a scenario of acres rotating from corn to soybeans, in which Scott plants cover crops for fall/spring growth and then no-till plants soybeans into the cover the following spring. All data is from 2016, so the corn and soy acres are not additive on a per acre basis. To calculate net impact, we summed the low and high end cost savings and yield impacts for each crop and then subtracted the high and low end increased costs. For example, for the low end corn estimate, we added the low end cost savings and yield increase ($24+$7) and then subtracted the high end cost increase ($22) for a net impact of $9 per acre.

Table A: LongView Farms, key financial variables ($/acre)

Numbers are based on farmer estimates.

	Cost savings	Increased costs	Yield impact
Seed (cover crop)		$8-10	
Fertilizer	$6-14		
Chemicals (cover crop burndown*)		$8-12	
Labor	$4		
Fuel and oil	$4		
Equipment rent/leases	$10-12		
Yield change (corn)			$7-14
Yield change (soybeans)			$10-20
Total	$24-34	$16-22	
Net impact	$9 to $32 (corn), $12 to $38 (soy)		

Rows in **green** are areas of reduced costs when using conservation tillage and/or cover crops.
Rows in **red** are increased costs.
* Not always applicable if they are able to do the burndown with their pre-emerge application pass on soybeans.

Crop budget

This table summarizes LongView Farms' 2016 crop budget. To enable comparison to other farms, it excludes the acres on which LongView Farms performs custom farming operations. All figures are dollars per acre unless otherwise indicated. Rows in green are areas of reduced costs due to conservation adoption. Rows in red are increased costs. The assessments of increased or decreased costs are based on Scott's experience. Net return before land cost represents the gross income minus total expenses for each crop, divided by the acres of each crop.

Table B: LongView Farms, 2016 crop budget

Crop	Corn following corn	Corn following soy	Soybeans	Seed soybeans
Acres	920	1,840	1,380	460
Yield (bu/acre)*	**210**	**210**	**55**	**55**
Commodity price ($/bu)	3.50	3.50	9.50	9.50
Gross income	**735**	**735**	**523**	**523**
Gross income (total $)	**676,200**	**1,352,400**	**721,050**	**240,350**
Seed	**113**	**80**	**59**	**41**
Fertilizer	**121**	**116**	**30**	**30**
Pesticides	**61**	**62**	**49**	**38**
Total input costs	**295**	**258**	**138**	**109**
Other variable costs	17	17	15	21
Grain dry and storage	21	21	6	6
Total input + variable costs	**333**	**296**	**159**	**136**
Crop consultant/soil test	3	3	3	3
Hired labor	**30**	**30**	**30**	**30**
Machinery	**60**	**60**	**60**	**60**
Equipment depreciation	12	12	12	12
Other fixed costs	47	47	47	47
Interest charge	21	21	21	21
Total fixed costs	**173**	**173**	**173**	**173**
Total expenses	**506**	**469**	**332**	**309**
Total expenses (total $)	**465,520**	**862,960**	**458,160**	**142,140**
Net return before land costs	**229**	**266**	**191**	**214**

All figures are $/acre unless otherwise indicated. Rows in **green** are areas of reduced costs when using conservation tillage and/or cover crops. Rows in **red** are increased costs.
* Scott provided average crop yields across all acres in 2016.

Knopf Farms

About the farmer

Justin Knopf farms with his father and brother raising wheat, alfalfa, soybeans, grain sorghum and corn in a dryland, no-till environment. Justin graduated from Kansas State University with a degree in agronomy. He still maintains a close working relationship with the college and department and each year hosts and participates in several on-farm research trials. On the farm, Justin enjoys learning, observing and studying the relationships between their cropping system and the soil. He endeavors to build resilience and profitability throughout the system.

Farm size: 4,750 acres. (The budget is for the 1,200 acres that Justin farms.)

Crops grown: Alfalfa, wheat, grain sorghum, soybeans and corn. (Justin did not plant corn in 2016, so it is not included in his budget.)

Conservation practices: No-till, cover crops, diverse crop rotation, nutrient management and precision agriculture.

Research participation: U.S. Department of Agriculture Conservation Reserve Program and Conservation Stewardship Program, Kansas State University research trials, his own on-farm research trials, a research collaboration with No-Till on the Plains made possible by a Sustainable Agriculture Research and Education grant, and the Southern Plains Hard Wheat project with General Mills, ADM and Agrible.

Approach to conservation

Justin's farm transitioned to a complete no-till system in 2003, a change that he made to reverse the degradation of his soils, lower the costs of his operation and make his crop yields more resilient. The farm's no-till system requires a smaller fleet of tractors, fewer implements and lower horsepower equipment. However, the replacement seeder and sprayer were more expensive, so his equipment costs remain near even. The change in equipment does create savings in fuel and labor because of the lower horsepower and reduction in tillage trips, requiring less fuel and creating less wear and tear on equipment. No-till systems also require fewer trips out to the field. Justin estimates that he does three to four fewer trips per crop.

Justin utilizes a diverse cropping system and rotation on his farm to improve his soils and reduce financial risk. By planting multiple crops in the same crop year, he reduces the vulnerability of his full operation to volatile weather and price changes. It is not uncommon after fixed costs for Justin to have a negative net return on a few crops each year, but the diverse rotation makes up for crops that don't do well. In addition, a diverse system allows him to balance the work load of the farm and maintain less seeding and harvest capacity in his equipment because all of the farm's acres do not need to be harvested and planted at the same time. He also benefits from including a perennial (alfalfa) in his crop mix. Alfalfa is often the most profitable cropping enterprise in his operation because its yearly variable costs are much lower, and it is resilient to poor weather.

Justin has observed soil and yield improvements since the farm's transition to no-till and a diverse cropping system. This is especially true for those fields that are more prone to erosion or have a higher clay content when planted with summer annual crops. Justin measured improvements in the soil organic matter of his fields from an average of 1.8-2 percent prior to adopting no-till to an average of 3-3.5 percent after adopting no-till, 15 years later. While Justin attributes some of the yield benefits to the improved genetics in crop varieties, he believes that improved soil health from reduced tillage and his diverse cropping system also contribute to improved yields. In particular, he notes that yields are more stable during drought conditions – a major economic benefit in a region with little rain. In a drought, he has observed his fields looking healthy for two to three weeks beyond those of conventionally tilled farms, lengthening the window in which a rain can save his crop. In the future, he hopes to improve the biological activity of his soil by building up fungi that deliver phosphorus to the roots, thereby reducing his phosphorus applications.

Justin is utilizing cover crop mixes on a portion of the farm's acres, and he is still learning and fine-tuning where this practice makes the most sense within his cropping system. Justin consistently seeds cover crops after the corn or grain sorghum rotation, ahead of planting soybeans. He typically uses winter cereal combined with rapeseed or canola. After winter wheat, he also uses a mixture of millet, flax, sunflower, radish and turnip. In selecting this mix, Justin follows the theory that "diversity trumps quantity," selecting a variety of species for their different benefits but applying them at a lower seeding rate to make the mix financially feasible. Justin worked with his seed provider to come up with a multi-species cover crop seed mix that costs less than $15 per acre. He also sets goals for the benefits of his cover crops, such as testing whether his cover crop can allow him to eliminate an herbicide pass.

Justin's participation in the U.S. Department of Agriculture's Conservation Stewardship Program (CSP) assisted him in adopting cover crops by reducing some of the risk in his early experiments. The CSP funds offset the costs of cover crop seed and seeding, which helps to absorb the financial impact of any errors as he fine-tunes his system.

Justin has documented some added costs that have come along with the conservation practices. For a no-till system, Justin estimates that he needs an average of two more herbicide applications per crop than in a conventional till system. However, if he plants a cover crop, his herbicide requirements go back down to just one extra application. This example shows the importance of considering the interactions between conservation practices and their potential to reduce costs.

Knopf Farms' experience with conservation adoption has improved yield resiliency and decreased certain costs. From a financial standpoint, Justin believes the next big opportunity is to incorporate the value of improved soils into higher land values – and thus an improved balance sheet.

"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

Key financial variables

The table of key financial variables summarizes Justin's estimates of the magnitude of the cost and yield impacts from the farm's conservation adoption. All data is from 2016, so the wheat, soy and sorghum acres are not additive on a per acre basis. To calculate net impact, we summed the low and high end cost savings and yield impacts for each crop and then subtracted the high and low end increased costs. For example, for the low end soybeans estimate, we added the low end cost savings and yield increase ($25+$45) and then subtracted the high end cost increase ($30) for a net impact of $40 per acre.

Table C: Knopf Farms, key financial variables ($/acre)

Numbers are based on farmer estimates.

	Cost savings	Increased costs	Yield impact
Seed (cover crop)		$15	
Fertilizer	$5-10	$5	
Chemicals		$5-10	
Labor	$15		
Fuel and oil	$5		
Yield change (wheat)			$0
Yield change (soybeans)			$45
Yield change (sorghum)			$15
Total	$25-30	$25-30	
Net impact	$-5 to $5 (wheat), $40 to $50 (soy), $10 to $20 (sorghum)		

Rows in **green** are areas of reduced costs when using conservation tillage and/or cover crops.
Rows in **red** are increased costs.

Crop budget

This table summarizes Knopf Farms' 2016 crop budget. All figures are dollars per acre unless otherwise indicated. Rows in green are areas of reduced costs due to conservation adoption. Rows in red are increased costs. The assessments of increased or decreased costs are based on Justin's experience. Net return before land cost represents the gross income minus total expenses for each crop, divided by the acres of each crop.

Table D: Knopf Farms, 2016 crop budget

Crop	No-till grain sorghum	Double crop grain sorghum	No-till wheat	No-till soybeans	Double crop soybeans	Alfalfa
Acres	93	71	358	528	115	235
Yield (bu/acre)	71	61	62	53	35	4 tons/acre
Commodity price ($/bu)	2.70	2.70	3.50	9.50	9.50	109 $/ton
Gross income	**192**	**165**	**217**	**504**	**333**	**436**
Gross income (total $)	**17,828**	**11,694**	**77,686**	**265,848**	**38,238**	**102,460**
Seed	11	13	12	57	30	20*
Fertilizer	36	59	55	7	0	28
Herbicide-insecticide	35	21	18	49	19	17
Total input costs	**82**	**93**	**85**	**113**	**49**	**65**
Other variable expenses	17	6	14	15	7	12
Total input + variable costs	**99**	**99**	**99**	**128**	**56**	**77**
Machinery	10	8	14	12	8	15
Hired labor	2	1	2	2	1	5
Equipment depreciation	51	41	48	62	44	78
Unpaid operator labor	20	12	19	21	13	59
Interest charge	21	18	22	28	17	31
Total fixed costs	**104**	**80**	**105**	**125**	**83**	**188**
Total expenses	**203**	**179**	**204**	**253**	**139**	**265**
Total expenses (total $)	**18,879**	**12,709**	**73,032**	**133,584**	**15,985**	**62,275**
Net return before land costs	**(11)**	**(14)**	**13**	**251**	**194**	**171**

All figures are $/acre unless otherwise indicated. Rows in **green** are areas of reduced costs when using conservation tillage and/or cover crops. Rows in **red** are increased costs.
*Alfalfa is a perennial. It costs approximately $100/acre in a planting year, and then grows for 5-6 years.

Yoder Farms

About the farmer

Joshua (Josh) Yoder farms 1,800 acres of corn and soybeans with his father Fred. He also serves as president of Yoder Ag Services, which sells seed and precision technology to farmers and provides agronomic expertise to customers.

Farm size: 1,800 acres.

Crops grown: Corn and soybeans.

Conservation practices: No-till, cover crops, crop rotation, nutrient management and precision technology.

Approach to conservation

Yoder Farms is a 100 percent no-till and minimum till operation. The only tilling the farm does is 1.5-inches deep with a vertical tillage bar in order to chop up corn stalks for residue management. Over the last seven years, they have converted the bar into a cover crop seeder.

Josh Yoder and his dad started experimenting with cover crops by planting a three-way mix of tillage radish, winter pea and crimson clover behind wheat in the mid-August time frame to get enough growth before the first frost. Through that experience, they saw a 2-5 bushel advantage in soybeans the year following implementation. Despite the positive yield impacts, the costs were substantial. The cost of the seed mix was approximately $35 per acre, and the application cost was $10-12 per acre. This meant that most or all of the yield advantages seen from the fields with cover crops were absorbed by the costs. Another challenge was time. Cover crops worked when planted after wheat in August, but in the Yoder's region, the growing season was too short for this to work with corn and soybeans. When Josh stopped planting wheat, they no longer used the original mix of cover crops.

After his initial experience with cover crops, Josh decided to switch to a cereal rye cover crop that could be planted behind harvested soybeans, as well as behind corn, depending on the timing of harvest completion. Josh selected cereal rye because it is the most winter-hardy crop he could find for their location. Josh plants the rye directly after the combine is out of the field, and allows it to grow through the spring until it reaches 12-18 inches. He applies the herbicide glyphosate in April to ready the field for spring planting. Burning down the cover crop at this stage allows the planter to get through the field efficiently, and preempts the growth of pests such as army worms and slugs that could damage the following crop.

In addition to the logistical advantages of rye, the cost is much lower. Josh estimates that he spends $5 per acre in seed, another $10 per acre in application costs and $7 per acre in added herbicide costs from burndown. In total, Josh has cut the cost of his cover crop program in half. He estimates that he invests $22 per acre in his cereal rye cover crop program, as compared to the $45 per acre for his original cover crop program.

Josh has also observed improvements in soil health and structure from his cover crop program. He generally applies phosphorus and potassium applications in the fall. This starts the cover crop, which takes up and holds the fertilizer and pulls other nutrients in the soil up from the lower soil profile. The cover crop also reduced soil erosion. He has observed that crop residue breaks down at a faster rate due to greater microbial activity. These benefits all keep the soil healthy and nutrients available for uptake by the crop in the spring.

Finally, Josh was surprised by the seed bed created by the cover crops. By spring, the upward movement of the soil created a good planting environment, which helped improve the emergence of the crop seedlings and, ultimately, crop yields. Josh expects that over time these practices will improve soil tilth, structure and porosity while holding additional nutrients in the residue. He believes these improvements in soil health will increase water and nutrient holding capacity for the long-term benefit of his farm.

In the future, Josh plans to only apply fertilizer in the spring to minimize the risk of nutrient loss. At that time, the cover crop will primarily scavenge nutrients from the previous crop and prevent late winter erosion.

Josh is happy with the results of his cover crop program and estimates it is saving him at least $9 per acre in weed control. He also estimates yield benefits of 6-8 bushels for corn and 2-3 for soybeans, resulting in a $21-28 per acre revenue increase for corn and a $19-29 per acre revenue increase for soy. With cost savings and yield benefits combined, Josh has experienced a $40-47 per acre benefit for corn and a $38-48 per acre revenue increase for soy. These benefits significantly exceed the $22 per acre cost of his rye cover crop program. He also attributes cost savings in fertilizer, labor and fuel to conservation management.

Josh's experience shows how conservation management must be fine-tuned to each farming operation in order to maximize financial benefits. It also shows that trial and error can lead to big increases in profits.

"When my dad took over the farm, Grandpa said his hope for him was that he 'leave the farm in better shape than when he started with it.' That has been a guiding principle for us. We first discovered that no-till production helped improve our soil structure year over year. With the addition of cover crops, those benefits seem to be accelerating fairly significantly. We still have a bit to figure out but feel that we are on the right track."

– Josh Yoder

Key financial variables

The table of key financial variables summarizes Josh's estimates of the magnitude of the cost and yield impacts from the farm's conservation adoption. All data is from 2016, so the corn and soy acres are not additive on a per acre basis. To calculate net impact, we summed the cost savings and high and low yield impacts for each crop and then subtracted the increased costs. For example, for the low end corn estimate, we added the cost savings and low end yield increase ($41+$21) and then subtracted the cost increase ($22) for a net impact of $40 per acre.

Table E: Yoder Farms, key financial variables ($/acre)

Numbers are based on farmer estimates.

	Cost savings	Increased costs	Yield impact
Cover crop seed		$5	
Cover crop application		$10	
Fertilizer	$2		
Chemicals	$9 (weed control)	$7	
Labor	$15		
Fuel and oil	$15		
Yield change (corn)			$21-28
Yield change (soybeans)			$19-29
Total	$41	$22	
Net impact	$40 to $47 (corn), $38 to $48 (soy)		

Rows in **green** are areas of reduced costs when using conservation tillage and/or cover crops.
Rows in **red** are increased costs.

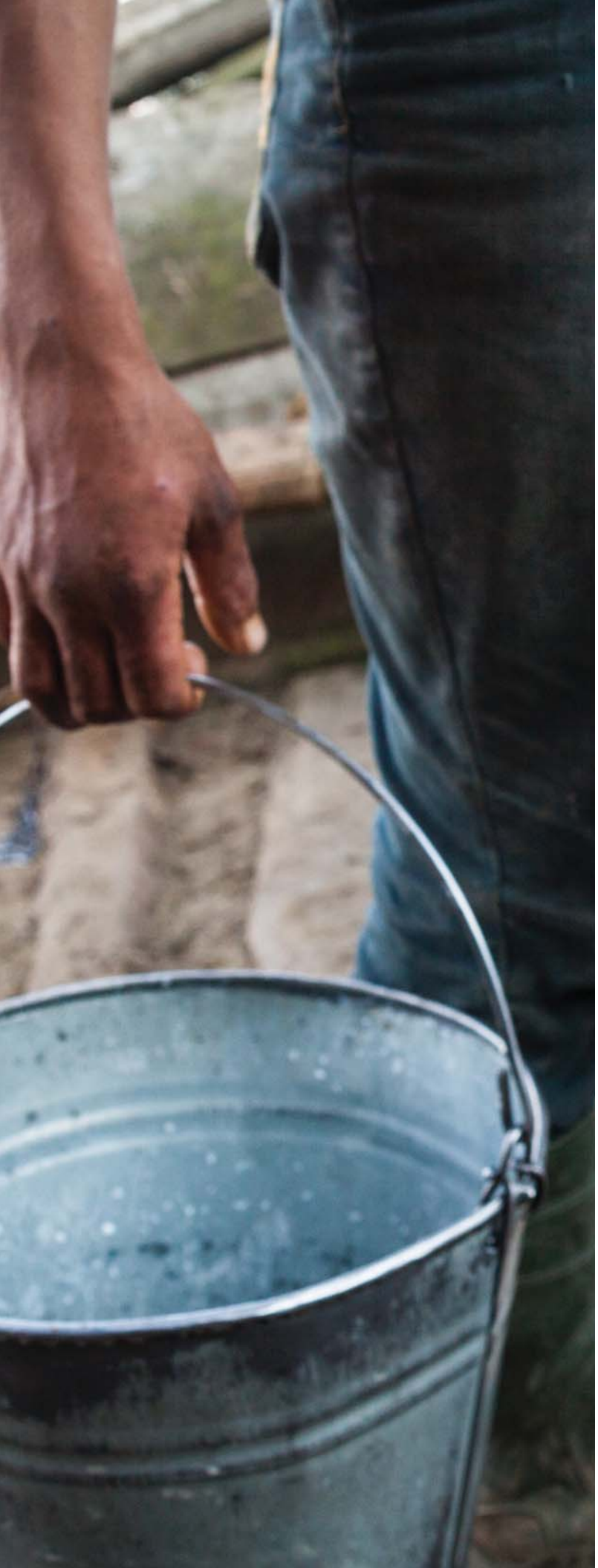
Crop budget

This table summarizes Yoder Farms' 2016 crop budget. All figures are dollars per acre unless otherwise indicated. Rows in green are areas of reduced costs due to conservation adoption. Rows in red are increased costs. The assessments of increased or decreased costs are based on Josh's experience. Net return before land cost represents the gross income minus total expenses for each crop, divided by the acres of each crop.

Table F: Yoder Farms, 2016 crop budget

Crop	Corn	Soybeans
Acres	610	700
Yield (bu/acre)	**183**	**54**
Commodity price ($/bu)	3.50	9.50
Gross income	**641**	**513**
Gross income (total $)	**390,705**	**359,100**
Seed	108	81
Fertilizer	**149**	**40**
Herbicide-insecticide	**42**	**41**
Total input costs	**299**	**162**
Hauling	28	8
Grain dry and storage	16	1
Total input + variable costs	**343**	**171**
Fuel	**12**	**10**
Repairs	**10**	**10**
Insurance	25	25
Total fixed costs	**47**	**45**
Total expenses	**390**	**216**
Total expenses (total $)	**237,900**	**151,200**
Net return before land costs	**251**	**297**

All figures are $/acre unless otherwise indicated. Rows in **green** are areas of reduced costs when using conservation tillage and/or cover crops. Rows in **red** are increased costs.



Insights from case studies

AgKnowledge developed the following insights based on the farmer cases and interviews, as well as their expertise working with farmers who employ conservation management systems.

Conservation is a management system – the whole is greater than the sum of its parts.

All of the farmers interviewed described conservation adoption as a transition to a new management system, rather than the implementation of isolated practices. The farmers were able to maximize the benefits of conservation adoption by focusing on how the different practices interact with each other. For example, no-till often requires increased herbicide use, but integration of cover crops can assist with weed suppression and also provide nutrients back to the crop, which allows for decreased fertilizer application. The farm budgets bear out that perspective. The farmers experienced cost increases in a couple of budget categories but found cost savings in multiple budget categories. These savings add up across the farm enterprise and result in a positive return overall.

Technology and data provide feedback to fine-tune management

All three farmers experimented with different ways to implement conservation practices on their farms to maximize the benefits to their operations. Precision technology helped target the application of farm inputs like fertilizer and herbicides to reduce waste while maintaining or increasing production. The farmers also participated in on-farm research with university experts. Whether information on the performance of conservation practices on their farms was gathered by university experts, cutting-edge technology or their own observations, the farmers all adapted their management in response to that data. This feedback loop allows them to constantly improve their farming operations.

Net cost of production decreased

The producers interviewed for this report typically use a combination of no-till, nutrient optimization, cover crops and crop rotation on some or all of their fields. Table G provides a directional overview of how the costs of production were impacted by conservation adoption. These impacts are explained in greater detail below and in tables H and I.

Fuel and labor ▼

Acres under conservation tillage generally have lower fuel and labor costs, which benefits the entire operation. This is due to three factors: fewer trips across the field, less intense usage of equipment and the ability to transition to lower horsepower machinery. The producers interviewed report anywhere from 3-5 fewer trips across the field, reduced from the typical number of 10-12 trips. This results in lower fuel costs, reduced labor needs and reduced risk of soil compaction. In addition, fields in a conservation tillage operation require less intense usage, and therefore less fuel. Finally, as opposed to conventional full tillage operations, the machinery in no-till requires lower horsepower. This results in an additional reduction in fuel consumption.

Table G: Directional impact of conservation adoption on production costs

Cost	Impact	Cost	Impact
Fuel	▼	Fertilizer	▲ then ▼
Labor	▼	Herbicides	= or ▲
Equipment	▼	Seed (cover crops)	▲

Equipment ▼

Operations using conservation tillage – no-till or minimum till – are often able to invest less in machinery over time. Lower horsepower equipment is less expensive. In addition, conservation tillage requires fewer passes over the field, which increases the equipment lifespan and requires fewer repairs. AgKnowledge calculated the financial impacts of exchanging a high-power tractor for a lower-power tractor. Table H shows the average costs of tractors with different horsepower and the potential cost savings for farmers who shift to using a lower-horsepower tractor. Over time, farmers utilizing conservation tillage are often able to retire one or more tractors. However, some operations choose to keep their conventional equipment such as plows in case they need to address a persistent weed or other management issue. Table I shows the estimated savings per acre for operations that choose to retire a tractor.

Table H: Tractor costs by horsepower (HP)

Tractor horsepower	Cost of tractor	Savings	Cost per HP
345 hp	$307,000	Baseline	$890
290 hp	$271,000	$36,000	$934
280 hp	$238,000	$33,000	$850
195 hp	$145,000	$93,000	$744

Table I: Estimated savings due to removing one tractor from production

Average cost of a tractor	# of acres farmed	Savings per acre
$272,000	1000	$54
	2000	$27
Cost per year (Average equipment life: 5 years)	3000	$18
$54,000	4000	$14
	5000	$11

Fertilizer ▲ then ▼

All of the farmers were able to increase the precision of fertilizer application through the use of new technology, which could result in reduced application or more even crop yields with the same amount of fertilizer. Either scenario should reduce the amount of fertilizer that is ultimately lost to the water or air. The farmers reported that fertilizer requirements may be consistent or greater during the initial years of adoption of conservation tillage. However, as organic matter builds up in the soil, fertilizer needs can decrease. In regions where they can be grown, leguminous cover crops that add nitrogen to the soil can also reduce fertilizer costs.

Chemicals = or ▲

The need for herbicides and other chemicals increased or remained neutral overall. In no-till or minimum till systems, chemicals are the primary tool for handling weed pressure. Cover crop termination is also often achieved through chemical burndown. However, cover crops can also be used to suppress weeds. The three farmers in the case studies were able to offset some increases in chemical use with weed suppression provided by cover crops.

Seed (cover crops) ▲

Crop seed costs remained neutral, but the addition of cover crops represents an additional cost. There is also a wide range of cover crop seed costs. These farmers reported a range from $5-35 per acre, which does not include the additional costs of planting and cover crop termination. The farmer cases highlight the tradeoffs between a more diverse, expensive cover crop seed mix as opposed to a simple, winter-kill cover crop.

Reducing the costs of cover crops

The annual costs of cover crop seed, planting and termination remain a barrier to farmers scaling adoption of this practice. The farmer-led organization Practical Farmers of Iowa (PFI) has developed several strategies to assist corn and soybean farmers in minimizing those costs while retaining the production and environmental benefits of cover crops.

PFI PRACTICAL farmers of Iowa
working together, always learning

Control seed costs
Single-species cover crops are less expensive than seed mixes, and there is little difference between the two approaches in the amount of biomass produced when cover cropping in a corn and soybean system. PFI recommends that farmers starting out with cover crops consider an inexpensive small grain such as rye or oats before trying more expensive mixes. As seen in the Yoder Farms case study, the shift from a multi-species cover crop to rye made the difference between a profitable and unprofitable practice. In a small grains rotation, the Knopf Farms case shows that a multi-species cover crop can pencil out.

Control herbicide costs
Cover crops provide weed suppression, and PFI experiments with termination timing show that many farmers can reduce herbicide applications without impacting the following crop. Other opportunities to control herbicide costs include reducing a pass or changing the farm's residual herbicide package.

Avoid cover crop failure
Some studies show that farm application of post-emergence herbicides in May or June can carry over to impact the cover crop planted into standing crops. Farmers can consult with their agronomists to select an herbicide package that will not impact their planned cover crop.

Avoid redundant expenses
Cover crops are very effective at taking up nitrogen from the soil in the spring and fall. Farmers who apply nitrogen stabilizers to reduce nitrogen loss may not need the extra expense of the stabilizer if they use a cover crop. Eliminating this expense can save approximately $10-17 per acre.

Protect crop yields
PFI research with partner Iowa Learning Farms on cover crops' effect on corn and soybean yields shows little to no impact on corn yields when managed correctly, and sometimes soybean yields increase. However, some farmers experience yield decreases due to the failure to terminate the cover crop, poor fertilizer timing after the cover crop or an incorrect planter set-up. These factors can be managed to reduce risk to crop yields.

Feed cover crops to livestock
PFI research with Iowa State University shows that the addition of cattle to a cover crop system consistently results in a positive return on the investment in the cover crop.[11]

[11] Plastina, A, and Carlson, S. 9 Mar. 2018. "Economics of Cover Crops Webinar." Iowa State University Extension and Outreach, https://connect.extension.iastate.edu/pyvwfb3etusy/?launcher=false&fcsContent=true&pbMode=normal.

Conservation benefits soil health and crop yields

All three farmers described improved soil structure and health from conservation adoption, including reduced wind and water erosion, increased soil organic matter and improved water holding capacity. They also observed evidence of increased microbial activity such as crop residue breaking down more quickly. The farmers attributed yield benefits – either yield increases or yield resiliency during adverse weather years – to the improved health of their soil. For example, during drought conditions, they noted more consistent yields or fewer yield losses compared to neighboring farms that were not employing conservation practices.

This analysis is based on farmer records and experience and does not prove a causal relationship between yield benefits and conservation. However, similar results have been found in other studies, such as case studies published by Datu Research and the National Association of Conservation Districts.[12] The connection between conservation practices, soil health improvements and crop yields is a topic that is the focus of significant continued research. Leading efforts on this topic include the work of the Soil Health Institute,[13] which is working to fill critical research gaps, and the Soil Health Partnership, which is conducting on-farm trials through a national network of farmer participants.[14] These efforts and others, including the work of this report, are critical contributions to the scientific and financial case for conservation.

Conservation management brings new challenges

To better understand what prevents farmers from embracing conservation practices, we also asked about the challenges associated with conservation management. Among the barriers:

- **Pests and disease:** The farmers reported concerns with crop disease when using conservation tillage, especially in wetter climates. Some plant diseases survive in the remaining crop residue. Additionally, because there is more soil water retention in a conservation tillage system, there is more moisture, which helps fungi and insects persist.[15] Conversely, pathogens that favor drier soils and higher soil temperatures may create challenges in other drier regions. Concerns with pests like slugs were also reported but could be managed.
- **Time and potential for management error:** The farmers reported that it took three or four years of using conservation practices before they began to see a soil health benefit capable of producing agronomic and yield benefits. During this transition period, the farmers were learning new agronomic and managerial systems that can create additional costs, as well as the potential for error and yield losses. This process of trial and error can be discouraging, particularly in years when commodity prices are low. The farmers noted that they worked to maximize the learning and value from conservation practice adoption through good recordkeeping and using technology to continue adjusting their management.

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[12] National Association of Conservation Districts. 2017. "Case Studies Show Big Economic Benefits of Soil Health Practices." www.nacdnet.org/newsroom/case-studies-show-big-economic-benefits-soil-health-practices/.

[13] Soil Health Institute. 2017. Enriching Soil, Enhancing Life: An Action Plan for Soil Health. https://soilhealthinstitute.org/wp-content/uploads/2017/05/Action-Plan-FINAL-for-flipbook-3.pdf.

[14] National Corn Growers Association. Soil Health Partnership. http://soilhealthpartnership.org/.

[15] Doug Jardine and Erick De Wolf, *Disease Factors to Consider in No-till*, Kansas State University, October 2009. https://www.bookstore.ksre.ksu.edu/pubs/MF2909.pdf.

Conservation adopters and non-adopters: comparative analysis

AgKnowledge used data from its existing clients to evaluate the per acre cost and yield differences between conservation practice adopters and non-adopters. The sample of 36 different farm records from 10 farmers represents non-irrigated corn, soy and wheat. The analysis uses average yield data from 2016 by crop and adoption category – non-adopter, conservation tillage, and conservation tillage with cover crops – and actual farm revenues. The use of actual farm revenues means no assumptions were made about crop price. The actual crop price received is included in the revenue. For cover crop adopters, AgKnowledge assumed an $8-35 per acre cost for cover crop seed.

AgKnowledge selected comparable farming operations to enable comparison across production practices (locations of the farms are marked in black on the map on the next page). However, it is important to note that geographic differences often impact crop yields and other management decisions. Non-adopters in this study are concentrated more heavily in the Corn Belt region, whereas conservation adopters are drawn more often from outside the Corn Belt. This has implications for the comparison, as crop yields are typically higher in the Corn Belt. For example, within the group of corn growers, the four non-adopters were in Kansas, Missouri and Illinois, whereas the conservation adopters were all in Kansas and Colorado.

Another complicating variable is that farmers with poor soils often adopt conservation practices with the goal of protecting and building their soils. This means that lower yields on a conservation adopter's farm may be an indication of initially poorer soils rather than a yield decrease due to conservation adoption. Finally, it is important to note that we do not have information on the length of time that the conservation practice adopters have employed those practices, which affects the likelihood that those farmers would be experiencing yield improvements.

Location of farms studied

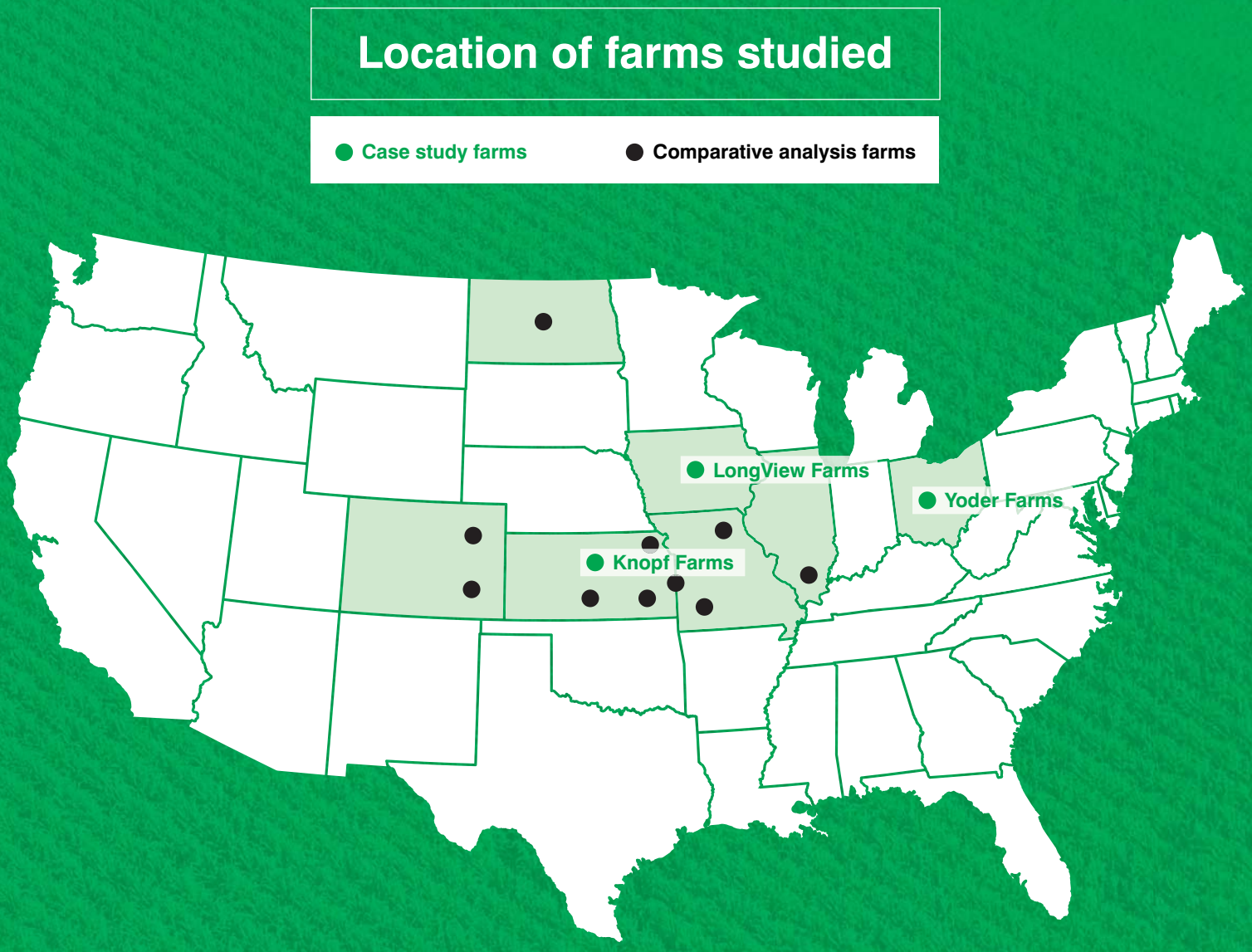

Table J: Comparative analysis for corn, conservation adopters and non-adopters

Practices adopted	Non-adopter	Conservation tillage	Conservation tillage and cover crop
Number of farmers	4	5	3
Yield (bu/acre)	133	111	95
Revenue	**533**	**444**	**381**
Fertilizer	122	78	93
Chemical	58	43	65
Seed	85	57	82
Cover crops	N/A	N/A	8-35
Total input costs	**265**	**178**	**248-275**
Fuel	13	8	8
Labor	44	20	8
Repairs	37	19	15
Other variable	41	58	32
Total variable	**135**	**105**	**63**
Total fixed costs	**36**	**36**	**36**
Total costs	**436**	**319**	**347-374**
Net returns	**97**	**125**	**7-34**

All figures are $/bushel unless otherwise indicated. Rows in **green** are areas of reduced costs when using conservation tillage and/or cover crops. Rows in **red** are increased costs.

Table K: Comparative analysis for soybeans, conservation adopters and non-adopters

Practices adopted	Non-adopter	Conservation tillage	Conservation tillage and cover crop
Number of farmers	5	6	3
Yield (bu/acre)	47	39	51
Revenue	**474**	**392**	**510**
Fertilizer	12	13	0
Chemical	54	47	49
Seed	54	41	56
Cover crops	N/A	N/A	8-35
Total input costs	**120**	**101**	**113-140**
Fuel	15	6	9
Labor	47	12	8
Repairs	38	17	13
Other variable	38	28	14
Total variable	**138**	**63**	**44**
Total fixed costs	**34**	**34**	**34**
Total costs	**292**	**197**	**191-218**
Net returns	**182**	**194**	**292-319**

All figures are $/bushel unless otherwise indicated. Rows in **green** are areas of reduced costs when using conservation tillage and/or cover crops. Rows in **red** are increased costs.

Table L: Comparative analysis for wheat, conservation adopters and non-adopters

Practices adopted	Non-adopter	Conservation tillage	Conservation tillage and cover crop
Number of farmers	2	5	3
Yield (bu/acre)	67	49	45
Revenue	**302**	**222**	**203**
Fertilizer	63	35	30
Chemical	53	24	32
Seed	26	20	22
Cover crops	N/A	N/A	8-35
Total input costs	**142**	**79**	**92-119**
Fuel	15	9	8
Labor	51	20	13
Repairs	44	17	14
Other variable	46	38	23
Total variable	**156**	**84**	**58**
Total fixed costs	**34**	**34**	**34**
Total costs	**332**	**197**	**184-211**
Estimated net returns	**(30)**	**25**	**(8)-19**

All figures are $/bushel unless otherwise indicated. Rows in **green** are areas of reduced costs when using conservation tillage and/or cover crops. Rows in **red** are increased costs.

The difference for conservation adopters

The comparative analysis shows significant differences in cost savings between the studied conservation non-adopters and adopters:

- **Fuel, labor and repairs** are lower for conservation adopters. Essentially, conservation tillage users cover more acres with less equipment and labor, thereby reducing costs per acre.
- **Fertilizer costs** on corn and wheat are lower for conservation adopters. This could be partially due to the agronomic benefits of conservation tillage, and partially due to geographic differences – the non-adopter farms are more heavily located in the Corn Belt where crop seeding rates and associated fertilizer application rates tend to be higher. Fertilizer is often not needed for soybeans because the plants fix nitrogen, and the cover crop adopters did not use any fertilizer on their soy crops.
- **Chemical costs** are lower for conservation tillage users on all three crops. Chemical use slightly increased for cover crop adopters on soy and wheat and exceeded the chemical use for non-adopters on corn. This is likely due to chemical use for cover crop termination.
- **Seed costs** are typically higher for cover crop users. These budgets show lower seed costs in the conservation tillage-only group, but that is likely a result of geographic differences because seeding rates in the Corn Belt tend to be higher than in other regions.

Yields in this comparison varied, which may be due largely to geography. For corn and wheat, most of the non-adopter farms were located in areas that had higher average crop yields in 2016 than the locations of the farms adopting cover crops and/or conservation tillage.[16] For soy, there were minimal regional yield differences among the groups.[17] Despite varying crop yields, in all but one case, the cost savings in conservation adopters' budgets outweighed yield differences to result in higher net returns.

Analysis of financial data from many more farms is needed to build the evidence for the financial value of conservation adoption to farmers, as well as to the businesses and individuals that make up the broader farm financial system. In that effort, it is important to identify the type and quantity of financial data that is needed by each of those entities to show how agricultural conservation matters to their own bottom lines. The remainder of the report turns to the farm financial system to explore the opportunity to recognize and monetize the value of conservation.

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[16] USDA 2016 corn yields were pulled for each comparative analysis farm's region, then applied to the farms in each practice group and averaged across them, resulting in: USDA average corn yield for farmers practicing conservation tillage 114 bushels/acre, USDA average yield for farmers practicing conservation tillage and cover crops 124 bu/ac, USDA average yield for non-adopting farmers 152 bu/ac. USDA average wheat yield for farmers practicing conservation tillage 53 bushels/acre, USDA average yield for farmers practicing conservation tillage and cover crops 54 bu/ac, USDA average yield for non-adopting farmers 72 bu/ac. Note that these calculations have no relation to the actual crop yields of the comparative analysis farms, but rather are a way to display baseline regional yield differences. See: U.S Department of Agriculture, National Agriculture Statistics Service. https://quickstats.nass.usda.gov.

[17] Using the same methodology and source as above, USDA average soy yield for farmers practicing conservation tillage 43 bushels/acre, USDA average yield for farmers practicing conservation tillage and cover crops 48 bu/ac, USDA average yield for non-adopting farmers 49 bu/ac.

Materiality to the farm financial system

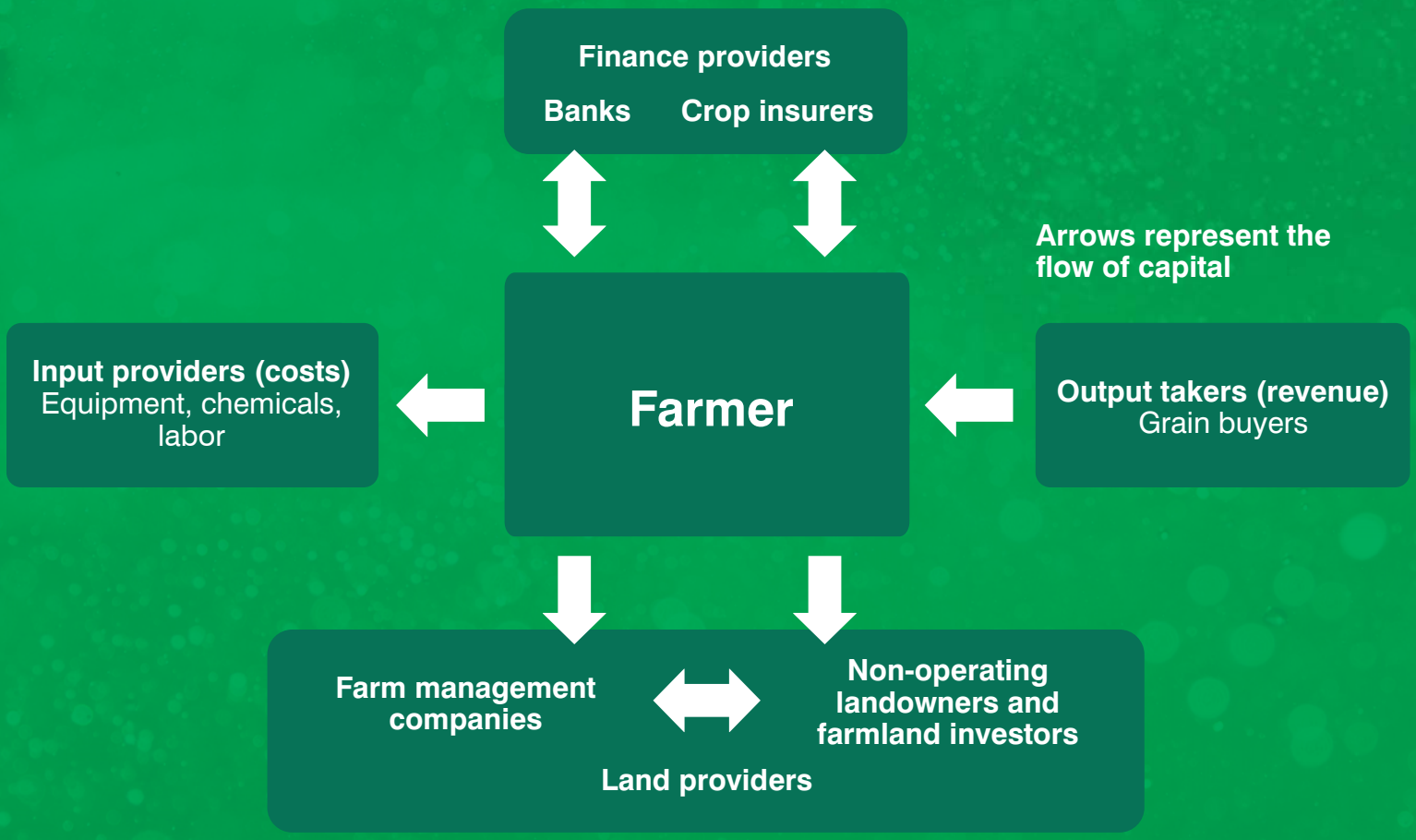
This report contributes to the growing body of evidence that conservation management can provide financial benefits to farmers in the form of cost savings, more resilient or increased crop yields, and more profitable farms. In addition to the value accrued to the farmer, conservation management also creates value for the individuals and businesses that have financial ties to the farmer. Despite the broader financial value generated by conservation adopters, this value is rarely recognized by the farm financial system. This section of the report identifies some of the key businesses and individuals in the farm financial system, explains the financial benefits they gain from conservation agriculture, and proposes ways to encourage and support farmers to adopt conservation practices in order to generate more value for all.

A simplified diagram of the farm financial system is presented in Figure A. The businesses and individuals with direct financial ties to farmers are divided into four categories:

- **Input providers:** Agricultural retailers and equipment companies that sell farmers the inputs they need to grow their crops, such as equipment, chemicals and seed.
- **Output takers:** Grain buyers that provide revenue to the farmer, such as grain aggregators, food companies and ethanol companies.
- **Land providers:** Many farmers rent some or all of the land in their operation. Land providers include non-operating landowners, other farmers and farmland investors, as well as the farmland management companies that sometimes act as intermediaries between the landowner and farmer.
- **Finance providers:** Agricultural lenders and crop insurers. While this report does not focus on state and federal providers of cost-share grants for conservation, they could also be included in this category.

It is important to note that there are myriad other individuals, government agencies and businesses with direct and indirect financial ties to farmers – investors, taxing agencies and more – that are not included in the scope of this report.

Figure A: Diagram of the farm financial system



As the chart above suggests, agriculture involves many sectors of the economy. A 2014 report by Ceres estimated that the U.S. corn industry produces $65 billion per year in revenue, and that the top 45 public companies in the corn value chain had a market capitalization of $1.7 trillion.[18] For all of these companies, how the farms in their value chain address conservation is a material – that is, significant – issue.

[18] Barton, Brooke, and Sarah Elizabeth Clark. 2014. Water & Climate Risks Facing U.S. Corn Production. Ceres. http://www.ourenergypolicy.org/wp-content/uploads/2014/06/ceres-corn.pdf.

Materiality is a concept from corporate financial and sustainability reporting that proposes a threshold for reporting on various results, actions, conditions and risks that may affect the company, its investors and other stakeholders. Materiality for sustainability reporting also includes considering the economic, environmental and social impacts that affect the ability to meet the needs of the present without compromising the needs of future generations.[19] These material aspects often have a significant financial impact on an organization in the short term or long term. Therefore they are also considered relevant for stakeholders who focus strictly on the financial condition of an organization.[20] While it is left to companies themselves to ultimately decide what issues they consider material or not, a growing number of financial organizations, investor organizations, regulatory agencies and courts have made it clear that they consider conservation and sustainability issues – especially those that involve climate change – to be material.[21]

Even from a strictly financial perspective, conservation practices should be considered material to all of the entities in the farm financial system. This report suggest that conservation practices can reduce costs and improve the profitability, productivity and resilience of a farm's operations. This in turn affects the farm's financial partners in many ways. Farms with lower costs and/or higher profits are better able to service loans and pay landowners and management companies. As described by the farmers interviewed for this report, conservation practices can lower insurance claims by making crop yields more resilient to harsh weather such as droughts and excess precipitation. More profitable farms are better able to afford inputs from their suppliers. Productive and resilient farms are better able to supply their downstream customers.

To the extent that conservation agriculture practices may help farmers avoid some of the worst effects of harsh weather, they may in turn shield farms' downstream customers from supply chain disruptions. The severe flooding of 2011 and severe drought of 2012 provided a number of unfortunate examples of the risks companies face when harsh weather disrupts agriculture. As detailed in Ceres' 2014 report, these extreme weather events forced companies to close ethanol plants and cull beef herds, reducing profits for food and beverage companies including Tyson, Pilgrim's Pride, Sanderson Farms and Coca Cola.[22]

In addition to avoiding supply chain risks, consumer goods companies that support conservation in their grain supply chains may see resulting increases in sales, profits and growth. Research shows that customers want more sustainable food, and they are willing to pay for it. Fifty-five percent of consumers globally would pay more for a brand with a positive social or environmental impact.[23] In 2015, sales from brands committed to sustainability grew more than four percent compared to one-percent growth for other companies, as consumers increasingly consider sustainability when purchasing food products.[24]

A number of the entities in the farm financial system already recognize agricultural conservation as material. Major food retailers and companies such as Walmart, Smithfield Foods, Unilever, General Mills and Tyson recognize that agricultural sustainability is a core issue for their businesses, and they have established sustainability commitments and programs to expand adoption of conservation practices by farmers in their supply chains.[25] Progress is also occurring in the farm inputs sector. The Land O'Lakes SUSTAIN platform, for example, seeks to expand conservation through agricultural retailers.[26] All of these companies are pursuing sustainability initiatives that go beyond regulatory compliance to expand voluntary conservation activities.

In contrast to some grain buyers and input providers, the land and finance provider segments have lagged in addressing the materiality of agricultural conservation, beyond regulatory compliance, to their own bottom lines. However, opportunity awaits those who recognize the potential financial and risk reduction value of agricultural conservation and seek ways to incorporate that value into their decision-making.

The final section of this report describes how landowners, lenders and insurers currently engage with conservation agriculture, the financial implications of that engagement or lack of engagement, and how they might better recognize and reward conservation management – resulting in greater benefits for themselves, farmers and the environment.

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[19] Global Reporting Initiative. "Materiality: What Topics Should Organizations Include in Their Reports?" https://www.globalreporting.org/resourcelibrary/Materiality.pdf.

[20] Global Reporting Initiative. 2013. G4 Online: Materiality. https://g4.globalreporting.org/how-you-should-report/reporting-principles/principles-for-defining-report-content/materiality/Pages/default.aspx.

[21] See, for example: The Task Force on Climate-Related Financial Disclosures. June 2017. https://www.fsb-tcfd.org/publications/final-recommendations-report/#. Eccles, Bob, and Lois Guthrie. March 2017. "Defining 'Material' Climate Risks." MIT Sloan Management Review. https://sloanreview.mit.edu/article/defining-material-climate-risks/. Crowell & Moring LLP. 2016. "Are Climate Change-Related Risks Becoming a Material Concern or Public Companies?" https://www.crowell.com/NewsEvents/AlertsNewsletters/all/Are-Climate-Change-Related-Risks-Becoming-a-Material-Concern-For-Public-Companies.

[22] Barton, Brooke, and Sarah Elizabeth Clark. 2014. Water & Climate Risks Facing U.S. Corn Production. Our Energy Policy, http://www.ourenergypolicy.org/wp-content/uploads/2014/06/ceres-corn.pdf (p. 8, p. 21)

[23] Nielsen. 2014. "Global Consumers Are Willing to Put Their Money Where Their Heart Is When It Comes to Goods and Services from Companies Committed to Social Responsibility." www.nielsen.com/us/en/press-room/2014/global-consumers-are-willing-to-put-their-money-where-their-heart-is.html.

[24] Nielsen. 12 Nov. 2015. "The Sustainability Imperative." www.nielsen.com/us/en/insights/reports/2015/the-sustainability-imperative.html.

[25] Walmart. 19 Apr. 2017. "Walmart Launches Project Gigaton to Reduce Emissions in Company's Supply Chain." https://news.walmart.com/2017/04/19/walmart-launches-project-gigaton-to-reduce-emissions-in-companys-supply-chain, https://www.environmentalleader.com/2018/04/smithfield-foods-bill-gill/.

[26] Land O'Lakes. 2018. SUSTAIN. http://www.landolakessustain.com/.

Land providers:

Landowners, farmland investors and farm management companies

Landowners

More than half of U.S. cropland, 207 million acres, is rented.[27] The percentage of rented land varies by region and crop. Grains such as rice, corn, soybeans and wheat are commonly grown in areas with high rental percentages. The vast majority of rented land is owned by non-operator landlords, those who own land used in agricultural production but are not actively involved in farming.[28] Table M shows the distribution of ownership for rented agricultural land in the three case study states.

Table M: Land ownership in Iowa, Ohio and Kansas

State	Iowa	Ohio	Kansas
Total rented land (%)	53	44	51
Total rented land (million acres)	16.2	6.2	23.5

Source: Bigelow et al. USDA ERS, 2016

The large proportion of rented land and predominance of non-operator ownership has significant implications for conservation. As noted previously, any cost-savings from implementing conservation management may take several years to materialize, and the potential yield improvements due to building soils can occur over an even longer timeframe. Farmer uncertainty with regard to his or her control over the land presents a major disincentive to long-term investments in conservation.

Compounding this challenge is the fact that 57 percent of rented land is farmed under an annual fixed-cash rent.[29] Annual cash rent minimizes the managerial burden on the landowner and the potential for disagreements over divisions in the crop. However, it also places 100 percent of the costs and risks of conservation practice adoption onto the farmer.[30] Alternative leasing arrangements exist. For example, under a crop-share arrangement, the landowner and farmer share both the costs of production and the costs and benefits of the harvest.[31]

The predominance of non-operating landowners and annual cash rent is frequently cited as a disincentive to long-term investments in conservation by farmers.[32] When these circumstances prevent farmers from adopting conservation management, the ultimate result is a negative impact on the landowner's asset – the land. This disincentive can even promote soil "mining" in which farmers deliberately underinvest in soil fertility to minimize costs and maximize profits in the short-term.

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[27] National Agriculture Statistics Service, U.S. Department of Agriculture. Farms and Farmland, ACH12-13, September 2014. https://www.agcensus.usda.gov/Publications/2012/Online_Resources/Highlights/Farms_and_Farmland/Highlights_Farms_and_Farmland.pdf

[28] Bigelow, Daniel, Allison Borchers, and Todd Hubbs. U.S. Farmland Ownership, Tenure, and Transfer, EIB-161, U.S. Department of Agriculture, Economic Research Service, August 2016. Available at: https://www.ers.usda.gov/webdocs/publications/74672/60298_eib161.pdf?v=42607

[29] Ibid.

[30] Personal communication, Jennifer Filipiak, American Farmland Trust.

[31] North Central Regional Cooperative Extension. 2011. "Fixed and Flexible Cash Rental Arrangements for your Farm." https://www.agmanager.info/sites/default/files/NCFMEC-01.pdf

[32] Hoag, D., A. E. Luloff, and D. L. Osmond. 2012. Lessons Learned from the NIFA-CEAP: How Farmers and Ranchers Make Decisions on Conservation Practices. NC State University, Raleigh, NC. http://www.soil.ncsu.edu/publications/NIFACEAP/Factsheet_3.pdf

"The current cash rent arrangement many landowners utilize for return on their investment has allowed both owners and operators to take their eye off the ball when it comes to managing land in a socially responsible manner. When the focus of the owner becomes maximizing rent, it creates a misalignment of goals between the farmer and the landowner. Both are thinking short-term, and that misses the big picture.

Superior appreciation will provide a greater portion of total return for the owner than the portion from higher cash rents. And superior appreciation comes from long-term strategies addressing conservation, soil protection, water quality improvement, fertility increases and other practices associated with sustainability.

While the farmer is a benefactor from these practices, the biggest winner is clearly the landowner. By incorporating these practices into their expectations and lease terms, the owner and operator can become better aligned."[33]

– Steve Bruere

President, Peoples Company. Peoples Company, a U.S. Midwest company, provides client services in the areas of farmland brokerage, management, appraisal and investment.

Correcting these disincentives requires two complementary efforts – education of landowners and farmers on how to communicate with each other about their values and the costs and benefits of conservation, and improved financial structures that more equitably distribute cost and risk and reflect the true value of conservation.

There are a variety of financial structures that can help overcome disincentives to conservation on rented land. They include:

- **Lease modifications:** Landowners with fixed-cash rental agreements with their tenants can include additional stipulations in the lease or agree to pay for some or all of the costs of conservation adoption. It is common to include a soil test requirement in leases to show that the farmer is maintaining soil fertility, but that makes no distinction between organic and synthetic forms of fertility. Landowners who are concerned about soil health can add to this stipulation by asking for measurements of organic matter too. Similarly, landowners can agree to cover the costs of conservation practice implementation or share the costs with the farmer.
- **Lease length:** While an annual lease is standard, in practice landowner and tenant relationships often last for many years. Any type of lease can be executed for a longer time period, allowing the farmer greater certainty that he or she will have the opportunity to experience the benefits of investments in conservation.
- **Lease type:** As noted above, annual fixed-cash rent is the most common form of lease, which places all of the costs and risks of practice adoption on the farmer. Crop-share leases, in which farmers and landowners split both the costs of production and the harvest, provide an equitable distribution of those costs and risks. There are also several other types of leases that distribute these costs and risks in different proportions and can be tailored to the goals of the landowner and farmer.
- **Land appraisal methodologies:** Current farmland appraisal methodologies incorporate soil type, a static classification, but do not incorporate soil management or site-specific measurements of soil quality. If these methodologies were modified to incorporate a dynamic measurement of soil quality, then landowners would see a direct benefit to the appraised value of their land from investments in conservation. This would create a greater incentive for landowners to encourage conservation on their land through any of the above leasing arrangements. For further discussion of this idea, see page 40.

[33] Bruere, Steve, and Michael Duffy. 2015. Socially Responsible Farmland Investment. Peoples Company, www.card.iastate.edu/land-value/history/Duffy-and-Bruere-2014-Socially-Responsible-Farmland-Investment.pdf

Farmland investors and farmland management companies

Institutional and foreign investment is a small, but potentially growing, sector of landownership in the U.S. Estimates put ownership of U.S. farmland by institutional investors – including hedge funds, private equity, pension funds and university endowments – at approximately one percent.[34] Major institutional investors in farmland include Hancock Agricultural Investment Group, UBS Agrivest and the Teachers Insurance and Annuity Association-College Retirement Equities Fund, or TIAA-CREF, one of the largest pension funds in the world.[35] Some farmland investors own their own management companies, while others have contractual relationships with farmland management companies.

U.S. farmland is an appealing investment, yielding an annual return of 12 percent over the past two decades. Farmland has outperformed most major asset classes over the past decade and has enjoyed relatively low volatility during that period. Farmland value has also been uncorrelated with stock and bond markets, resistant to inflation, and less sensitive to economic shocks and interest hikes than other investments types.[36] By some estimates, $10 billion in institutional capital is looking for access to U.S. farmland.[37] At the average U.S. price of farmland of $4,000 per acre, that would purchase 2.5 million acres.[38]

The interest in farmland investing may have increasing opportunity, as farmland owners are an aging population. Senior principal landlords and operators, ages 65 and older, own 371 million acres of farmland.[39] In the coming decades, a significant portion of American farmland will transition ownership, which may lead to increased non-operator ownership and an increased proportion of investor-held farmland.[40]

Farmland investors face the same set of trade-offs as other non-operating landowners – deciding whether to prioritize short-term rents or longer-term appreciation in the value of the land. However, institutional investors face additional scrutiny from their investors, many of whom are state employees and teachers, as well as advocacy organizations concerned about corporate ownership of farmland.

In contrast to individual family farmland owners, farmland investors and managers have the ability to dedicate resources and staff to understanding agricultural conservation's importance to their investment strategy.[41] The lease structures mentioned previously are equally applicable to farmland investors. In addition, farmland investors can apply sustainability standards to their owned land and work with farmland management companies that practice agricultural conservation.

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[34] Oakland Institute. 2014. "Down on the Farm. Wall Street: America's New Farmer." https://www.oaklandinstitute.org/down-on-the-farm

[35] Ibid.

[36] The Economist. 30 Dec. 2014. "Barbarians at the Farm Gate." https://www.economist.com/finance-and-economics/2014/12/30/barbarians-at-the-farm-gate

[37] Oakland Institute 2014.

[38] U.S. Department of Agriculture National Agriculture Statistics Service. 2017. Land Values 2017 Summary. https://www.usda.gov/nass/PUBS/TODAYRPT/land0817.pdf

[39] Farmland Information Center. 2018. 2014 Tenure, Ownership, and Transition of Agricultural Land Survey Talking Points. https://www.farmlandinfo.org/2014-tenure-ownership-and-transition-agricultural-land-survey-talking-points

[40] Oakland Institute 2014.

[41] TIAA. 2016. "Responsible Investment in Farmland." https://www.tiaa.org/public/pdf/C26304_2015_Farmland_Report.pdf

Incorporating soil quality into farmland value

A major goal of agricultural conservation is to preserve the soil, both by preventing soil loss through erosion and by building up its productive potential by increasing organic matter, microbial activity, water infiltration rates and other aspects of soil health. These improvements directly affect the land's ability to grow crops, and are therefore integral to the value of the land. However, none of the management activities required to achieve these outcomes or any measurement of soil health is currently included in farmland valuation methodologies.

Farmland valuation varies by state, but the majority of states use a system developed by the U.S. Department of Agriculture's Natural Resources Conservation Service called the National Commodity Crop Productivity Index (NCCPI).[42] Other states have modified the NCCPI or developed their own methods, notably including Iowa's Corn Suitability Rating, Illinois' Optimal Productivity Index and Minnesota's Crop Productivity Index.[43] All of these methodologies incorporate soil types from U.S. Department of Agriculture soil surveys and some assumptions about the average characteristics of those soils.[44]

As noted in the NCCPI user guide, short-term soil variations caused by differences in land management are not yet in the database.[45] This means that land is appraised largely based on average characteristics of the soil and not whether the soil has been improved – or degraded – through its management. Some would argue that historical yield data is a sufficient proxy for good management because poor farm management would result in lower yields. However, that does not take into account the lag time between when soils are either improved or degraded and crop yield responses. Furthermore, historical yield data is rarely included in farmland sales. According to one farmland investor and manager operating in Iowa, in his experience only five percent of farmland sales include historical yield data.[46]

The prices at which farmland is ultimately sold depend on a variety of factors in addition to the appraised value. These include commodity prices, proximity to urban areas, local competition for land, water availability and price, historical yields, and soil productivity indices, such as those included in the appraised value.[47] The full impact of incorporating a measure of soil health, such as soil organic matter, in appraised farmland values is speculative at this time. However, the modification of the appraised value would have implications for several entities in the farm financial system:

- **Landowners** would see a direct benefit to the appraised value of their land from investments in conservation. This would create a greater incentive for landowners to encourage conservation on their land by their tenant farmers.
- **Farmers** who own their land would also experience that increase, which would increase the amount of collateral available to them for lending.
- **Farmland investors, managers and agricultural lenders** would have a concrete financial metric to indicate how soils are being managed.
- **Local tax authorities** may also see an impact on local property tax revenues.

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[42] U.S. Department of Agriculture Natural Resources Conservation Service. 2012. User Guide for the National Commodity Crop Productivity Index. https://www.nrcs.usda.gov/wps/PA_NRCSConsumption/download?cid=nrcs142p2_050734&ext=pdf

[43] AcreValue. "Frequently Asked Questions." https://www.acrevalue.com/faq/

[44] Miller, Gerald, and Lee Burras. 2015. "Corn Suitability Rating 2 Equation Upgrade." https://crops.extension.iastate.edu/cropnews/2015/04/corn-suitability-rating-2-equation-updated

[45] U.S. Department of Agriculture Natural Resources Conservation Service. 2012. User Guide for the National Commodity Crop Productivity Index. https://www.nrcs.usda.gov/wps/PA_NRCSConsumption/download?cid=nrcs142p2_050734&ext=pdf

[46] Personal communication, Clay Mitchell, Fall Line Capital

[47] Sherrick, Bruce. 29 Jan. 2016. "Components of Cropland Value in the Cornbelt." Farmdoc Daily, University of Illinois at Urbana-Champaign. http://farmdocdaily.illinois.edu/2016/01/components-of-cropland-value-in-the-cornbelt.html

Finance providers:
Agricultural lenders and crop insurers

Agricultural lenders

Large-scale grain agriculture runs on credit. Farmers bring in revenue when they sell their crop, but they must borrow to finance the inputs, land and equipment to produce that crop. It is typical for a large grain farmer to borrow $1 million or more each year, which means paying tens of thousands in interest.[48] Lenders have an obvious interest in the financial health of their farmer clients, as financially sound farmers are able to repay their loans.

Farmers typically take on three major kinds of debt: mortgages for land, equipment loans and operating loans. Equipment loans are often financed through the equipment dealer, but mortgages and operating loans are made through agricultural lenders. Operating loans are annual lines of credit that the farmer uses to finance the inputs needed to grow their crops, such as chemicals and seed. Figure B shows farmers' use of debt financing.

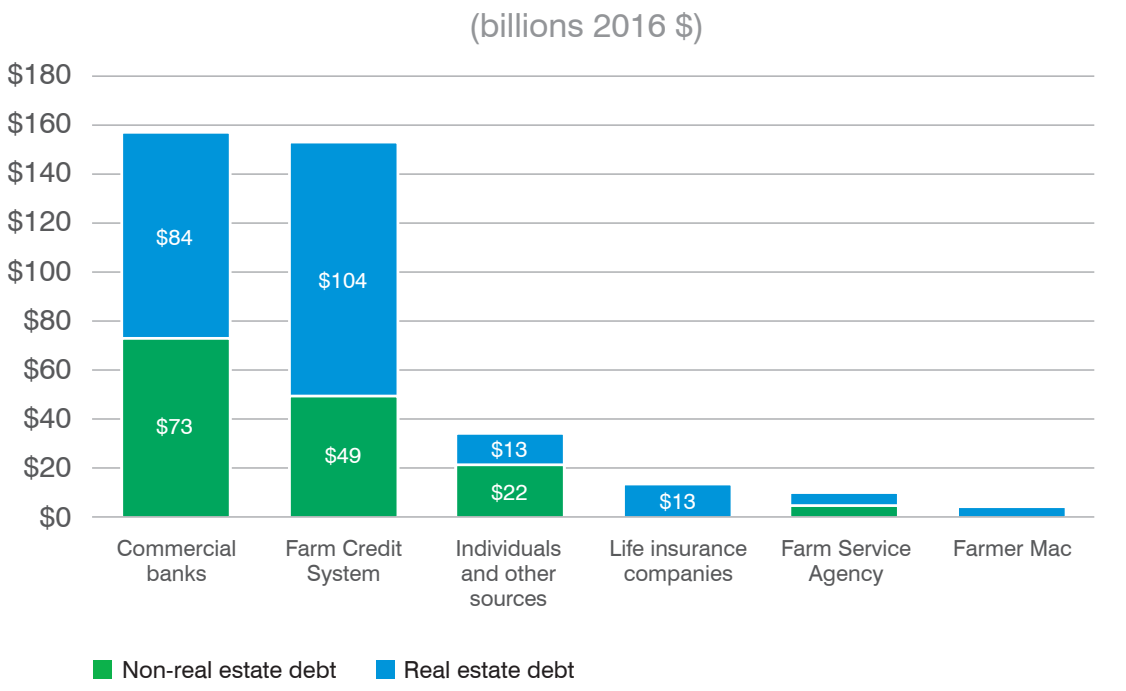
Figure B: Farmers' use of debt financing

	Types of financing	Financing partner	Terms
Land	Mortgage	Bank (loans)	Long-term loans (10-30 yr) fixed or adjustable rate, 3-5%
Equipment	Seller finance loans	Bank or credit union Ag retailer or direct through manufacturer Self-financed	Mid-term loans (3-5 yr) fixed rate, 3-5-6.5%
Operations	Short-term loans	Bank or credit union	Short-term loans (1 yr) 3.5-9.5%

[48] Long, Heather. 1 June 2018, "The Latest Blow to Struggling Family Farms: Rising Interest Rates." The Washington Post, https://www.washingtonpost.com/business/economy/the-latest-blow-to-struggling-family-farms-rising-interest-rates/2018/06/01/ec4d192a-5aac-11e8-b656-a5f8c2a9295d_story.html?noredirect=on&utm_term=.7a25155416db

Commercial banks and the Farm Credit System both hold approximately 40 percent of U.S. agriculture sector debt.[49] Figure C shows the farm sector debt by lender.[50]

Figure C: Farm sector debt by lender



The market share of commercial banks is relatively diffuse. Wells Fargo has the largest concentration of U.S. farm loans at 10 percent, followed by Rabobank with 6 percent.[51] The Farm Credit System is a nationwide network of cooperative lending institutions, which are backed by Farm Credit Banks and the Farm Credit Insurance Corporation.[52]

Lenders cannot directly prescribe conservation management practices to their farmer clients, because that would incur lender liability. This legal restriction is intended to prevent lenders from exercising inappropriate control over their borrowers.[53] Despite these restrictions, there are several ways in which the lending industry is integrating sustainability into its business practices, including assessing the materiality of sustainability issues to their business, making sustainable financing commitments, reporting on sustainability metrics and integrating sustainability into their governance.[54]

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[49] U.S. Department of Agriculture Economic Research Service. 2016. "U.S. and State-Level Farm Income and Wealth Statistics." www.ers.usda.gov/data-products/farm-income-and-wealth-statistics/data-files-us-and-state-level-farm-income-and-wealth-statistics/

[50] U.S. Department of Agriculture Economic Research Service. "Charts and Maps of U.S. Farm Sector Balance Sheet." Accessed 11.29.17 https://www.ers.usda.gov/data-products/farm-income-and-wealth-statistics/charts-and-maps-of-us-farm-balance-sheet-data/

[51] FDIC. 2017. "Quarterly Banking Profile: Third Quarter 2017." www.fdic.gov/bank/analytical/quarterly/2017-vol11-4/fdic-v11n4-3q2017.pdf

[52] U.S. Department of Agriculture Economic Research Service. 2017. "Documentation for the Farm Sector Balance Sheet." USDA ERS, 1 Sept. 2017, www.ers.usda.gov/data-products/farm-income-and-wealth-statistics/documentation-for-the-farm-sector-balance-sheet/

[53] American Bar Association. Lender Liability Considerations. http://apps.americanbar.org/abastore/products/books/abstracts/5070531_SamCh.pdf

[54] Eapen, Sandy. February 12, 2018. "Four sustainability opportunities in the banking sector." GreenBiz, available at: https://www.greenbiz.com/article/4-sustainability-opportunities-banking-sector

The International Finance Corporation and Sustainable Banking Network notes that sustainable banking spans 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 friendly and socially responsible.[55]

In the agricultural lending sector, there are some existing efforts to integrate sustainability considerations into risk management and loan origination. Interviews with agricultural lenders indicate that lenders look for good farm management when deciding whether to extend credit, which may include using conservation practices, because that speaks to a farmer's capacity to manage and avoid risk.

In addition to financing farm operations directly, many agricultural lenders also finance major food and agriculture companies. This creates an additional leverage point to advance sustainable agricultural practices. For example, Rabobank's Sustainability Policy Framework describes how Rabobank employees are required to incorporate sustainability policies into client analyses and engage those clients in a process of continuous improvement against key sustainability criteria.[56]

Rabobank has also led efforts in sustainable loan origination. Along with the U.N. Environment Program, Rabobank announced $1 billion in financing for farmers in developing countries to transition to more sustainable practices.[57]

"Our global lead role in financing food production urges us to accelerate developments on the sustainable food supply. With our knowledge, networks and financing capabilities, we aim to further motivate and facilitate clients in adopting a more sustainable food production practice globally."

– Wiebe Draijer

Chairman of the Executive Board, Rabobank[58]

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[55] International Finance Corporation and Sustainable Banking Network. 2017. "Greening the banking system – experiences from the sustainable banking network." https://www.ifc.org/wps/wcm/connect/da980744-987e-496d-82e8-e5f146895165/SBN_PAPER_G20_updated+08312016.pdf?MOD=AJPERES

[56] Rabobank Group. Sustainable Policy Framework. www.rabobank.com/en/images/sustainability-policy-framework.pdf

[57] Reuters Staff. 23 Oct. 2017. "Rabobank, U.N. launch $1 billion fund to boost sustainable farming." https://www.reuters.com/article/us-rabobank-sustainability/rabobank-u-n-launch-1-billion-fund-to-boost-sustainable-farming-idUSKBN1CL2Y2

[58] Rabobank. 16 Oct. 2017. "Rabobank and UN Environment Kick-Start $1 Billion Program to Catalyze Sustainable Food Production." www.rabobank.com/en/press/search/2017/20171016-kickstart-food.html

Additional options for agricultural lenders to encourage conservation include:

- **Assess the impacts of conservation on farm budgets:** Many lenders conduct analyses of market trends and other important business issues for the farmers they serve. The type of analysis conducted in this report should be done more broadly to capture farm and location-specific benefits and costs of conservation. Lenders could analyze the business benefits and risks of conservation and share that information with their clients.

- **Create conservation finance funding mechanisms:** Lenders could create new funds or favorable financing terms to target the expansion of conservation agriculture, whether by directly financing practice adoption, new technologies or companies that help farmers make the transition, or rural infrastructure projects that include a sustainability component. They could also consider adjusting underwriting terms for land loans to account for lower-cost farmers, which would allow more efficient producers to increase their borrowing capacity and obtain more land to farm.[59]

Crop insurers

Crop insurance is frequently described as agriculture's most important risk management tool. In 2017, federal crop insurance policies covered 311 million acres, protecting nearly 90 percent of the nation's insurable cropland. Insurers backed more than $106 billion worth of crops in 2017, and farmers paid $3.7 billion for insurance protection.[60] Four crops – corn, cotton, soybeans and wheat – typically account for more than 70 percent of total acres enrolled in crop insurance.[61]

The federal government is heavily involved in the industry through USDA's Risk Management Agency (RMA), which subsidizes a portion of the farmer's premium and provides reinsurance and administrative reimbursement to private insurers. The federal government also approves insurance providers, sets premium rates, and establishes insurance terms and conditions.[62]

A major reason for the substantial government involvement in crop insurance is that crop losses tend to be highly correlated; losses are caused by events that affect the majority of policyholders in a given region. This differs from other insured losses, which tend to be independent events. For example, events such as droughts often impact large geographic areas that may cover most of an insurance company's policies, as compared to car or health insurance, in which claims are scattered throughout the insured population.[63] This correlation of losses makes the crop insurance industry highly volatile. Over the 2012-2016 period, the crop insurance industry was the second most volatile insurance category, following federal flood insurance (Figure D).[64]

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[59] There is a comparable example in the housing sector called the Location Efficient Mortgage (LEM). LEMs offered a way for potential buyers of households in urban neighborhoods to increase borrowing capacity based on the premise that they would spend less on transportation, and therefore have more disposable income, than the national average. See: Center for Neighborhood Technology. 25 Jan. 2018. "Rethinking Mortgages." www.cnt.org/projects/rethinking-mortgages

[60] Farm Press Staff. February 7, 2018. "Crop insurance acreage, farmers' expense for it up in 2017." Southeast Farm Press. Available at: http://www.southeastfarmpress.com/insurance/crop-insurance-acreage-farmers-expense-it-2017

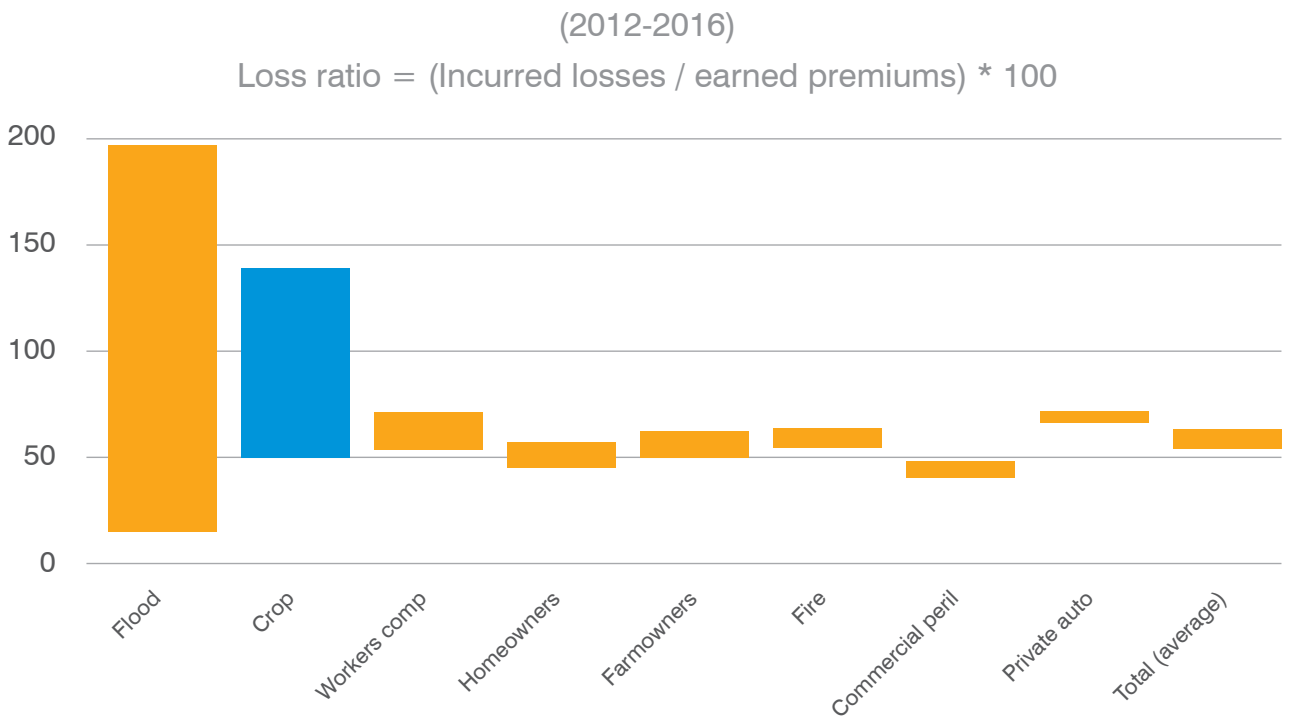
[61] Shields, Dennis A. August 13, 2015. "Federal Crop Insurance: Background." Congressional Research Service CRS Report. (crop insurance fiscal year cost) https://www.fas.org/sgp/crs/misc/R40532.pdf

[62] D'Costa, V. (2017). Fertile ground: Revenue will rise as regulatory changes aid industry performance. (Agricultural Insurance Industry Report OD4875). Retrieved February 01, 2018, from IBISWorld database.

[63] D'Costa, V. 2017.

[64] National Association of Insurance Commissioners. 2017. "2016 Market Share Reports for Property/Casualty Groups and Companies by State and Countrywide." http://www.naic.org/prod_serv/MSR-PB-17.pdf

Figure D: Range of loss ratios across insurance categories

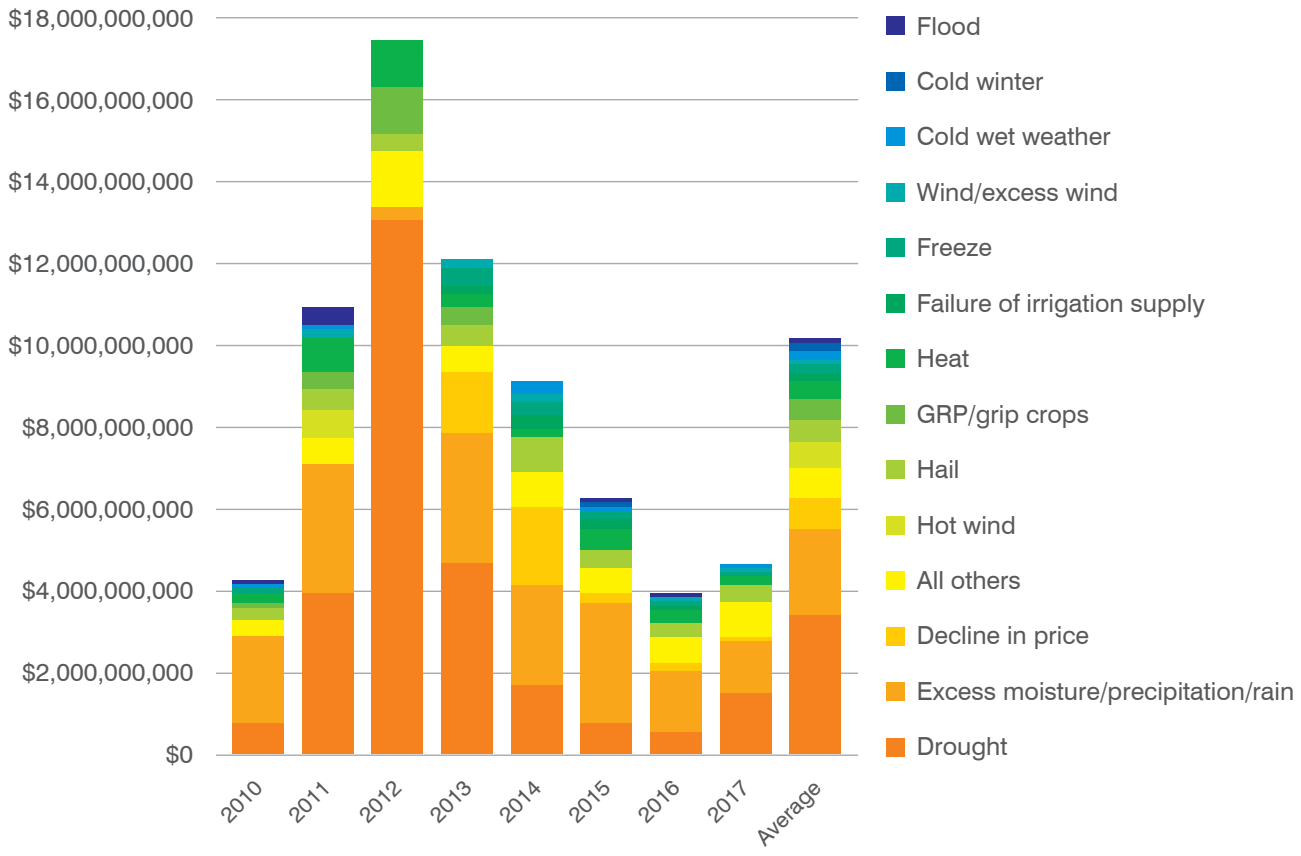


Crop insurance volatility is largely driven by fluctuation in water availability for the crop – drought and excess precipitation. Figure E shows crop insurance indemnity claims over the 2010-2017 period, which includes the 2012 drought. Between 2012 and 2016, crop insurers experienced a $13.5 billion swing in loss payments, driven by a $12.4 billion swing in drought claims alone.[65] The entire industry suffered heavy losses in 2012 and 2013. In 2012, the industry suffered a 10 percent loss in profit, compared to 2017, when industry profits were 23.7 percent.[66]

[65] U.S. Department of Agriculture Risk Management Agency. "Cause of Loss Historical Data Files." https://www.rma.usda.gov/data/cause.html

[66] D'Costa, V. (2017). Fertile ground: Revenue will rise as regulatory changes aid industry performance. (Agricultural Insurance Industry Report OD4875). Retrieved February 01, 2018, from IBISWorld database.

Figure E: Crop insurance indemnity claims by type



Crop insurance profits and losses are driven by yield impacts from volatile weather, which will continue to increase as the climate changes. Therefore, crop insurers have a significant interest in agricultural practices that can increase crops' resilience to volatile weather. Farms that participate in federal crop insurance are subject to strict conservation compliance provisions, but the highly regulated nature of crop insurance policies have prevented significant innovation to date with regard to rewarding conservation practices that reduce insurer losses.

Despite these barriers, there are opportunities to advance conservation through crop insurance. In fall of 2017, Iowa Deputy Secretary of Agriculture Mike Naig announced a new program aimed at increasing acres of cover crops in the state. The Iowa Department of Agriculture and Land Stewardship worked with USDA's RMA to establish a three-year demonstration project aimed at expanding the usage of cover crops in Iowa. Iowa farmers who plant cover crops can apply for a $5 per acre premium reduction on their crop insurance in 2018. The program is funded by the state.[67]

[67] Iowa Department of Agriculture and Land Stewardship. November 16, 2017. "Iowa farmers using cover crops may be eligible for crop insurance premium reduction" https://www.iowaagriculture.gov/press/2017press/press11162017.asp

Another promising effort is the AGree Conservation and Crop Insurance Task Force, of which EDF is a member. This group works collaboratively to understand the correlation between conservation practices and risk, advocates for updated USDA data collection methods and improved data integration across the agency, and is examining potential improvements to the federal crop insurance program that could support adoption of conservation practices.[68]

There is significant promise to expand farmer interest in conservation through crop insurance programs, especially where actuarial data is collected to show impacts on crop yields and indemnity payments. While subsidizing such programs may be necessary in the short term, the goal should be collecting sufficient data to prove the business case for reduced risk to the farmer and the insurer. Such data is needed to show crop insurers how conservation adds value to their business, and ultimately to make the case for federal crop insurance policy changes.

Additional options for innovative crop insurance products to incentivize conservation include:

- **Adjust federal crop insurance rates to consider conservation impacts:** USDA's RMA has an existing process in place to incorporate new data into crop insurance rates and underwriting terms. The impacts of soil quality or conservation practices on crop yields are not currently considered in those rates, and rates could be updated to incorporate that data.[69] This could improve conservation outcomes by providing appropriate incentives, or at least avoiding disincentives, for practice adoption through insurance that is appropriately designed and rated.[70]

- **State programs to deliver conservation incentives through crop insurers:** States are permitted to offer an additional crop insurance premium reduction. States could replicate the Iowa cover crop program or offer a broader suite of incentives. This approach would be particularly powerful if paired with a data collection effort to support the development of revised actuarial tables.

- **High-risk land into conservation:** Some land, typically in floodplains, is classified as high risk by USDA's RMA and costs farmers more to insure.[71] Floodplain land is also important for water quality, flood prevention, wildlife and biodiversity. Insurers could partner with a conservation program to incentivize farmers to exclude their high-risk land from insurance and put it into conservation instead of agriculture.

- **Supply chain sustainability:** Many food and agriculture companies are instituting sustainability programs or incentives to encourage grain farmers in their supply chains to adopt conservation practices.[72] Companies that offer a contract or premium for sustainably grown grain can leverage that financial incentive by partnering with an insurance provider to structure a private crop insurance policy that helps farmers in their supply chain make the change. The private policy could be targeted to the portion of risk not covered by federal crop insurance.

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[68] Meridian Institute. "Our Work." AGree Conservation and Crop Insurance Task Force, www.merid.org/CCITF/Our_Work.aspx

[69] Datu Research. 2014. "Adoption of Conservation Agriculture: Economic Incentives in the Iowa Corn Value Chain." http://www.daturesearch.com/wp-content/uploads/Datu_Iowa-Conservation-Agriculture_FINAL.pdf

[70] Woodard, Joshua and Leslie Verteramo-Chiu. (2017) "Efficiency Impacts of Utilizing Soil Data in the Pricing of the Federal Crop Insurance Program."Amer. J. Agr. Econ. 99(3): 757-772; doi: 10.1093/ajae/aaw099

[71] Bechman, Tom. February 9, 2008. "Why some face higher crop insurance premiums." Indiana Prairie Farmer. http://www.indianaprairiefarmer.com/story-why-some-face-higher-crop-insurance-premiums-16-15665

[72] Smithfield Foods, 2015 Sustainability Report. "Making conservation the norm in our grain supply chain." https://www.smithfieldfoods.com/integrated-report/2015/environment/case-study-making-conservation-the-norm-in-our-grain-supply-chain

Conclusion

This report adds to the growing body of evidence that environmental and economic progress are interdependent and fuel each other. Agricultural conservation practices that protect the soil, water and air can also produce financial benefits to farmers in the form of reduced costs of production and increased or more resilient crop yields. However, the transition to adopt these practices includes costs and risks, and it can take years for farmers to gain the full benefits of conservation management. If we want more farmers to adopt conservation practices, we need to support them along the way.

The responsibility to encourage sustainable agriculture extends beyond farm fields to the broader agricultural system of grain buyers, input providers, financial service providers and landowners. The risk of inaction should be considered material to the businesses in that system, and the failure to recognize conservation as material will result in greater costs and risks in the future. The good news is that the responsibility to address conservation comes paired with opportunity. Conservation can generate real financial value and risk reduction to businesses and individuals in the farm financial system.

It is time for the mainstream farm financial system to better recognize and address the value of conservation agriculture. This report shares a variety of ideas for how the farm financial system can correct disincentives to conservation and monetize its value. Modified lease terms, land appraisal practices, crop insurance policies and other financial instruments could provide incentives for farmers to adopt conservation practices. Conducting additional research on conservation practices can strengthen the business case for those practices and provide better guidance for how to best apply them on a farm-by-farm basis. Providing farmers with the financial backing and rewards they need to pursue conservation agriculture will accelerate the adoption of conservation practices and their benefits.

Some of these ideas are already in progress. Others can be acted upon immediately, and some will require policy change. There are also other opportunities to discover. It is important for farmers, conservation and agriculture organizations, and farmers' financial partners to collaborate on solutions. This will allow us to incorporate the value of conservation into decision-making in a way that will result in the greatest conservation and financial value.

The challenges of a volatile farm economy, growing global population and changing climate require a resilient agricultural system. Resilience starts with the soil and extends to the global financial and commodity markets that affect, and are affected by, daily life on the farm. Lasting solutions to these challenges will be provided by farmers, but they can't do it alone. Our hope is that the farmers, landowners, lenders, insurers, policymakers and others who read this report gain insight into the financial value of conservation and collaborate to encourage conservation agriculture more broadly.