TITLE II CONSERVATION PROGRAMS: EXPLORING CLIMATE-SMART PRACTICES

HEARING

BEFORE THE

SUBCOMMITTEE ON CONSERVATION AND FORESTRY

OF THE

COMMITTEE ON AGRICULTURE
HOUSE OF REPRESENTATIVES

ONE HUNDRED SEVENTEENTH CONGRESS

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TITLE II CONSERVATION PROGRAMS: EXPLORING CLIMATE SMART PRACTICES

WEDNESDAY, MAY 12, 2021

HOUSE OF REPRESENTATIVES,
SUBCOMMITTEE ON CONSERVATION AND FORESTRY,
COMMITTEE ON AGRICULTURE,
Washington, D.C.

The Subcommittee met, pursuant to call, at 10:01 a.m., in Room 1300, Longworth House Office Building, Hon. Abigail Davis Spanberger [Chair of the Subcommittee] presiding.

Members present: Representatives Spanberger, Pingree, Kuster, O'Halleran, Panetta, Schrier, Costa, LaMalfa, DesJarlais, Allen, Kelly, Johnson, Miller, and Moore.

Staff present: Lyron Blum-Evitts, Prescott Martin III, Félix Muñiz, Jr., Ashley Smith, John Konya, John Busovsky, Josh Maxwell, Patricia Straughn, Erin Wilson, and Dana Sandman.

OPENING STATEMENT OF HON. ABIGAIL DAVIS SPANBERGER, A REPRESENTATIVE IN CONGRESS FROM VIRGINIA

The CHAIR. The Conservation and Forestry Subcommittee's hearing entitled, *Title II Conservation Programs: Exploring Climate-Smart Practices,* will come to order.

Welcome and thank you for joining today's hearing.

After brief opening remarks, Members will receive testimony from our witnesses today. And then the hearing will be open for questions. Members will be recognized in order of seniority, alternating between Majority and Minority Members, and in the order of arrival for those Members who have joined us after the hearing was called to order.

When you are recognized, you will be asked to unmute your microphone. And you will have 5 minutes to ask your questions or make a comment. If you are not speaking, I ask that you remain muted in order to minimize background noise.

In order to get in as many questions as possible, the timer will stay consistently visible on your screen.

In consultation with the Ranking Member and pursuant to Rule XI(e), I want to make Members of the Subcommittee aware that other Members of the full Committee may join us today.

I am excited to be here today for our first hearing of the Subcommittee on Conservation and Forestry in the 117th Congress and for the opportunity to work alongside my colleague, Ranking Member Doug LaMalfa, and the rest of the esteemed Members of this Subcommittee. In addition to increasing farm productivity and profitability, conservation agriculture holds enormous potential in

our efforts to combat the climate crisis, both through increased soil carbon sequestration and reduced greenhouse gas emissions.

As we look to scale the adoption of conservation practices, there is perhaps no greater tool available than the farm bill's conservation programs.

Title II programs provide much needed technical and financial assistance to encourage the adoption of cover crops, reduced- to no-till management systems, and prescribed grazing systems, among many other climate-smart practices. As we have seen firsthand, these programs are working well in central Virginia. Studies show that these programs are effective. Not only do they facilitate greater adoption of conservation practices, but they also make it more likely that farmers will keep implementing these practices in the long-term to the benefit of our climate, clean water, and the health of our rural communities.

What's more, these investments are paying dividends to farmers' bottom line. When farmers participate in these voluntary conservation programs, they do not only reduce carbon dioxide emissions in the environment by sequestering carbon through healthier soils, but they also improve crop quantity, yield, and profit margins. Put simply, any investment Congress makes in title II programs are an investment in the long-term economic success of rural America and America's farmers.

In recent years, USDA has developed new tools that make it easier than ever to consider climate mitigation benefits during the conservation planning process. And thanks to USDA's publication of the blue book, we have technical guidelines and science-based methods to quantify emission sinks in agriculture, and, likewise, the development of the COMET-Farm online tool has made it possible to assess a farm's carbon footprint and see how alternative voluntary management projects and practices could achieve greenhouse gas emissions—or reductions, excuse me.

These tools are exciting ways to maximize climate benefits while also making things easier for farmers. And as these tools are refined, I am hopeful that they will strengthen conservation programs and maximize the benefits delivered to farmers.

In this spirit, I worked across the aisle to introduce the H.R. 2820, Growing Climate Solutions Act on Earth Day this year. This legislation would create a certification program at the U.S. Department of Agriculture to help solve technical entry barriers that prevent farm and forest landowner participation in carbon credit markets. This bill is almost universally endorsed by national farmer organizations, like the American Farm Bureau Federation, the National Farmers Union, while also gaining support from large environmental groups, like the Environmental Defense Fund and the National Wildlife Federation, and corporations, like McDonald's, Bayer, and Microsoft.

This legislation has built a broad coalition because it empowers farmers to continue climate-friendly conservation practices, it helps farmers unlock new revenue streams through private carbon markets, and it empowers the USDA to further develop tools that empower climate-friendly conservation practices.

I am excited to hear from our witnesses today on their experiences utilizing these practices and the role that the farm bill's pro-

grams play in facilitating their adoption. And while we have made great progress in developing the science and the tools that let us better quantify the climate benefits of conservation, I also hope to hear today if there are areas where further research or support may be needed.

[The prepared statement of Ms. Spanberger follows:]

PREPARED STATEMENT OF HON. ABIGAIL DAVIS SPANBERGER, A REPRESENTATIVE IN CONGRESS FROM VIRGINIA

Good morning. I'm excited to be here today for our first hearing of the Subcommittee on Conservation and Forestry in the 117th Congress and for the opportunity to work alongside my colleague, Ranking Member Doug LaMalfa, and the rest of the esteemed Members of this Subcommittee.

In addition to increasing farm productivity and profitability, conservation agriculture holds enormous potential to help combat the climate crisis—both through increased soil carbon sequestration and reduced greenhouse gas emissions.

As we look to scale the adoption of conservation practices, there is perhaps no greater tool available than the farm bill's conservation programs. Title II programs provide much needed technical and financial assistance to encourage the adoption of cover crops, reduced- and no-till management systems, and prescribed grazing systems—among many other climate-smart practices. And we have seen firsthand these programs working in central Virginia.

Studies show that these programs are effective. Not only do they facilitate greater adoption of conservation practices, but they also make it more likely that farmers will keep implementing these practices in the long-term to the benefit of our climate, clean water, and the health of our rural economies. What's more, these investments are paying dividends to farmer's bottom lines. When farmers participate in these voluntary conservation programs, they not only reduce carbon dioxide emissions in the environment by sequestering carbon through healthier soils, they can also improve crop quantity, yield, and profit margins. Put simply, any investment Congress makes in title II programs are not just an investment in the future of our planet, but also in the long-term economic success of rural America and America's farmers.

In recent years, USDA has developed new tools that make it easier than ever to consider climate mitigation benefits during the conservation planning process. Thanks to USDA's publication of the "blue book," we have technical guidelines and science-based methods to quantify emissions sinks in agriculture. Likewise, the development of the COMET-Farm online tool has made it possible to assess a farm's carbon footprint and see how alternative, voluntary management practices could achieve greenhouse gas reductions.

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I'm excited to hear from our witnesses today on their experience utilizing climate-smart practices and the role that farm bill programs play in facilitating their adoption. And while we have made great progress in developing the science and the tools that let us better quantify the climate benefits of conservation, I also hope to hear today if there are areas where further research or support may be needed.

The CHAIR. With that, I would like to recognize the Ranking Member, Congressman Doug LaMalfa, for any opening remarks.

OPENING STATEMENT OF HON. DOUG LAMALFA, A REPRESENTATIVE IN CONGRESS FROM CALIFORNIA

Mr. LAMALFA. Well, good morning, everyone.

And thank you, Chair Spanberger, for convening the hearing today and for our panelists that will be speaking with us.

The 2018 Farm Bill offered important environmental and resource benefits through USDA's suite of voluntary incentive-based conservation programs. The conservation title provides an estimated $6 billion per year to farmers, ranchers, and forest landowners for the implementation of practices that truly do work. Through these voluntary programs, producers can improve soil health and water quality, better manage their lands, and incorporate innovations like increased energy-efficient farming practices.

Our conservation delivery system is a proven model that leverages significant funding as a win-win for both producers and the environmental needs. Because of its effectiveness, NRCS's conservation programs have been in the spotlight in recent years and become a staple in ongoing climate discussions. While these programs generate countless on-farm benefits, they also directly result in carbon sequestration.

As we continue to dwell on climate-related policy, voluntary conservation does have an important role to play. I think it is very important to recognize the great conservation work farmers, ranchers, and foresters are already doing each and every day, and they don't always get credit for what has been done in the past before this became such a hot topic.

Despite the calls from some climate alarmists, the U.S. is already making great progress towards meeting carbon reduction goals. The U.S. generates less than 15 percent of the world's anthropogenic carbon emissions. That number is continuing to decline in the coming decades. Currently U.S. farm productivity and management practices have increased dramatically over the past 70 years. U.S. farm productivity has increased by 287 percent since 1948, the inputs have remained relatively the same. That means the efficiency is going up, more bang for the buck, more bang for the same amount of carbon. In short, we are producing more food and fiber while using the same amount of resources we did generations ago.

Additionally, we need to recognize the considerable resources already provided by the farm bill to support voluntary conservation and not rush to unproven approaches that may not actually address the concern being made of climate or consider if it will benefit farmers and ranchers directly.

In addition to improving soil health, there are a variety of other existing agricultural practices and technologies that are just as beneficial and must be fully utilized. This includes increasing the deployment of precision agriculture to reduce over-fertilization and runoff, and adoption of technologies such as anaerobic digesters that convert livestock-generated methane to renewable natural gas.

Incorporating new technologies and innovative practices will reduce emissions, improve water and air quality, and provide new revenue for farmers and ranchers in the process. No singular solution will be appropriate to each crop, each cropping system, or region. Opportunities in ag extend beyond soil health and cover crops. What works for corn in Iowa will not necessarily work for

wheat out in the West, or rice in the Mississippi Delta or rice in northern California.

We need to resist turning the farm bill conservation title into the climate title. We cannot allow one natural resource concern to completely overshadow all others. These programs must continue to be voluntary, which means we must offer practices that provide farmers choices.

Although forests are not the focus of today's hearing necessarily, they must be part of the conversation. Our forests are natural carbon sinks and hold great potential for reducing emitted carbon and sequestering it. For example, any finished wood product stores carbon indefinitely. By improving forest health and actively managing our forests, we can encourage healthier lands, prevent potential fires and the millions of acres of destruction we see so much of these days, as well as the release of more carbon dioxide than all of California's power.

So, during a recent House Appropriations Committee hearing, U.S. Forest Service Chief Vicki Christiansen mentioned our forests are sequestering 14 percent of all U.S. carbon emissions. That number could be nearly doubled to 20 to 28 percent through more reforestation and restoration, greater forest resiliency, and the use of more forest products which store carbon. But we must not be hamstrung from actually getting out there and doing the work.

With that in mind, as we talk about climate and reducing carbon dioxide, I believe we must take a hard look at how we manage our forests and how we address the wildfire crisis and the huge costs via budget or to our landscape. 2020 was the most devastating fire season we have had on record. That includes especially significant fires in my home State of California. We must do more to prevent small fires from unnecessarily becoming huge mega-fires that reduce enormous amounts of otherwise stored carbon dioxide. Addressing wildfires is a crisis and an emergency we can no longer ignore or continue to kick the can down the road.

Thanks again to all of our witnesses for taking the time to come be a part of this today, to provide your testimony, and that we can have this good conversation. As we consider the many stewardship proposals and ideas before Congress, as this Committee starts thinking about the next farm bill, your input will be invaluable from here on out. And it is much appreciated.

I yield back. Thank you.

The CHAIR. Thank you very much, Ranking Member LaMalfa. Your comments made me think of something that a constituent producer said, which is: "Farmers are the original conservationists."

The chair would request that other Members submit their opening statements for the record so witnesses may begin their testimony and to ensure that there is ample time for our questions.

I am pleased to welcome such a distinguished panel of witnesses to our hearing today. Our witnesses bring to our hearing a wide range of experience and expertise, and I thank you all for joining us.

Our first witness today is Mr. Charles Isbell, Jr. Mr. Isbell raises livestock on his family's 340 acre farm, Keenbell Farm, in Rockville, Virginia, not too far from the district I represent. The farm

specializes in grass-fed beef, pork, poultry, turkey, eggs, and specialty grains using intense rotational management, precision agriculture, and conservation practices like cover cropping. He was named the 2020 Virginia Farmer of the Year. He is a founding member of the Common Grain Alliance and a member of the Virginia Association of Biological Farming, as well as the Virginia Farm Bureau Young Farmers Program.

Our next witness today is Ms. Kimberly Ratcliff. Ms. Ratcliff manages Caney Creek Ranch, a diversified ranch in east central Texas that was started by her parents. She has worked on the ranch since 2007 and also owns Farm to Freezer Beef, a family-run business that offers fresh beef direct from east Texas ranches. In 2008, Kimberly helped found 100 Ranchers, which is an organization comprised of minority farmers and ranchers in Texas, to promote agriculture at the local level. And last year Ms. Ratcliff was appointed to serve on the USDA Advisory Committee on Minority Farmers.

Our third witness today is Dr. Keith Paustian. Dr. Paustian serves as the University Distinguished Professor in the Department of Soil and Crop Sciences and Senior Research Scientist at the National Resource Ecology Laboratory at Colorado State University. A major focus of his work involves modeling, field measurement, and development of assessment tools for soil carbon sequestration and greenhouse gas emissions from soils. Dr. Paustian assisted with the development of the COMET-Farm tool used by USDA and the development of models and methodology used to estimate the U.S. greenhouse gas emissions reported annually by the EPA.

Our fourth and final witness today is Mr. James Johansson. Mr. Johansson has been serving as President of the California Farm Bureau since 2017. He serves on the American Farm Bureau Federation Board of Directors, and previously he served as the Chairman of the California Young Farmers and Ranchers State Committee. Mr. Johansson is a farmer himself, growing olives and citrus fruit in Oroville, California.

Welcome to all of our witnesses today, and we will now proceed with hearing your testimony. You will each have 5 minutes, and there should be a timer visible on your screen that will count down to zero, at which point your time has expired.

Mr. Isbell, please begin with your opening statement whenever you are ready. Thank you.

STATEMENT OF CHARLES "CJ" EDWIN ISBELL, JR., FARMER AND CO-OWNER, KEENBELL FARM, ROCKVILLE, VA

Mr. ISBELL. Madam Chair, Members of the Committee, thank you for allowing me the opportunity to testify here today. I am a third-generation farmer, co-owner of Keenbell Farm located in Hanover County and resident of Virginia's First District.

On our farm, we utilize regenerative agriculture practices while we work to produce and market directly to the consumer quality grass-fed beef, pasture-raised pork, chicken, turkeys, eggs, and specialty non-GMO grains. Our mission is to improve the quality of life of our customers, community, environment, and ourselves by producing the highest quality foods and products using humane,

sustainable, biological sound practices. Our focus since inception has been to promote a living, healthy soil utilizing forages, livestock, and crops as the management tools to accomplish this goal.

While growing and developing our farming operation, we have been able to develop relationships with our local Natural Resources Conservation Service offices, soil and water conservation districts, Virginia Cooperative Extension agents, and USDA service centers.

While working towards our overall mission statement, sharing our vision of healing the land utilizing innovative approaches to livestock and crop production, our approach relies heavily on the use of cover crops, particularly multi-species cover crops, no-tillage, and additionally incorporating livestock into this cover/cash crop rotation.

Our local agency's recognition of our approach to environmental stewardship made us aware of title II conservation programs that would fit our production model and we are dedicated to utilizing the conservation programs, regardless of whether we receive an award, if the practices are economically feasible, and, if awarded, the offset in capital is put towards other conservation programs, which are not covered by these outlined conservation programs.

We have been fortunate to participate in numerous Environmental Quality Incentives Program, EQIP, in which we have implemented stream exclusion fencing, prescribed grazing systems, cover crop, nutrient management planning, livestock water systems, just to name a few.

Environmental stewardship is the foundational value of our farm and one key factor when we evaluate management decisions in our operation. Being that our farm is in the Chesapeake Bay watershed, we made the decision to install exclusion fencing to keep livestock out of lakes and streams on the farm. The fencing was installed with twice the minimum buffer to provide additional filter support and stimulate wildlife refuge areas. As part of our conservation efforts, we practice intense rotational management of all of our livestock species we raise. Most are moved daily but at a minimum every 3 days. This rotation allows for natural distribution of manure, preventing the buildup and potential runoff of nutrients, and this rotational management system, combined with the exclusion from our lake and streams, require the installation of over 12,000′ of underground waterlines and 40,000′ of fence lines.

We utilize precision agriculture with grid sample and variable rate fertility application. And, in addition, we utilize multi-species cover crops, both to sustain a living cover in the traditional sense but also as a key component in our crop production cycle that has virtually eliminated the need for chemical applications.

Our structured management of livestock and cover crops have allowed for almost doubling of the soil organic matter, which reduces erosion, increases nutrient holding capacities, and reducing runoff. Conversion of cropland, formerly under a conventional management system, was a hurdle to work through as we grew. Time and management have allowed for this stimulation of soil biology and building of soil organic matter and health. This continues to be our focus in current managed land as we take on new land in expanding our operation.

While implementing this approach to livestock and crop production with the assistance of title II conservation programs, we have seen substantial benefits from the implementation of these practices. We have eliminated erosion, doubled our soil's organic matter, improved our forage and crop quality. We have confirmed these improvements with both anecdotal observation and empirical scientific data.

Although the benefits from title II conservation programs are great in number, the implementation of these programs could be improved. As with most programs reliant on budgetary allocations, there are many more dollars applied for than funding provides. Focus needs to be directed to allow for greater access to these programs and assistance provided to ensure continuation of these conservation practices when funding is not available. As producers, we see the financial and physical benefits of conservation. But they will be more prone to continuing previously awarded practices with this focus.

Barriers to greater adoption of these programs and practices include limited staffing at NRCS service centers, limited access to the offices themselves, excessive paperwork for application, capital costs requirement up-front for the producers, and program requirements sometimes can be too restrictive for today's environmental conditions, which sometimes eliminate their eligibility due to inability to comply with outlined timeframes. And it doesn't allow for some of the newer dynamic regenerative agriculture practices to be implemented with the same.

But, with these problems, I also provide recommendations that would assist in improving the implementation and adoption of these conservation programs and practices. Support continued increased funding allocation for title II programs with a directed focus of continued outreach post-producer funding to encourage the continuation of conservation practices. For example, after a program is awarded, providing the technical assistance to assist the producer in understanding both the environmental and financial benefits from the awarded program. This additional support will give confidence to producers to continue conservation efforts beyond the program award once the operational benefits can be identified.

Conversion of the NRCS brick-and-mortar paper application process to a more computer-based system with remote accessibility. Understandable that some efforts have been placed with the pandemic to do so, but still, as a producer, I have to go in person to file for crop reporting, most recently the CFAP applications, and the like. If a farmer had a web portal with all the farms associated to them, they could apply, file for cover crop reporting, publish yield data without the need for the infrastructure to house the current paper system.

We should provide NRCS agents with the tools, technology, and flexibility to spend more time out in the field with producers. This will allow them to make more contact and hopefully convey the benefits of these conservation programs for continued use.

Some of the program restrictions, they require producers to provide all up-front payment to implement these programs with the hope of reimbursement at a later date as long as complying with the defined requirements of the program. If we allow for up-front

funding at the time of award, we may see more adoption of these conservation programs.

Last, I would recommend for allowing more flexibility within the program guidelines to better reflect the changes in climate, environmental events, and modern regenerative agriculture practices to be more compliant and allow for greater adoption of these practices.

By working together through the implementation of conservation and regenerative agriculture practices, we can heal the soil that feeds the plants which, in turn, feeds all of us.

I want to thank you for allowing me the opportunity to testify and I am happy to answer any questions you may have.

[The prepared statement of Mr. Isbell follows:]

PREPARED STATEMENT OF CHARLES "CJ" EDWIN ISBELL, JR., FARMER AND CO-OWNER, KEENBELL FARM, ROCKVILLE, VA

Dear Madam Chair,

I am a third-generation farmer, co-owner of Keenbell Farm located in Hanover county, and resident of Virginia's First Congressional District. On our farm we utilize regenerative agriculture practices while we work to produce and market directly to the consumer quality grass-fed beef, pasture raised pork, chicken, turkey, eggs, and specialty non-GMO grains. Our mission is to improve the quality of life of our customers, community, environment, and ourselves by producing the highest quality foods and products using humane, sustainable, biologically sound practices. Our focus since inception is to promote a living, healthy soil; utilizing forages, livestock, and crops as the management tools to accomplish this goal.

My grandfather started the farm in 1951 and progressed from a laying hen operation into a farrow-finish hog operation, and then all beef cattle with finishing feedlot. This was all while growing conventional grains for area elevators. My father left the farm full time during the 1980s due to the inability for the farm to support multiple families, but still worked nights and weekends to help out. My grandfather retired from farming in the late 1990s and sold some adjacent tracks of land, all the livestock, most of the equipment, removed fencing infrastructure, and rented out the land to a local grain farmer. Growing up in the farm, I had always wanted to farm but was told "there is no money in farming and to go get an in-town job for stability". In 2006, I started to work and clean up the neglected remains of farm buildings and 2 acres not utilized by the grain farming tenant. I was also providing labor to a local farmer, who had a cow pass away leaving a week-old calf. He gave the calf to me and told me that "we can settle up if she makes it". Well she made it, and I started to do research for opportunities that would allow for profitable farming at a level in which my family's home place could provide. This research yielded a lack of local meat proteins available to local consumers, so I formulated a business plan to take my single heifer and expand over the next 10 year period. With my business plan in hand, and the primitive base farm operation started; my father and I sat down and formally started our partnership with the creation of our LLC in 2008. Since that time, we have grown and diversified to incorporate a multitude of livestock species and food grade grains for direct to consumer sales.

While growing and developing our farming operation, we have been fortunate to have developed relationships with our local Natural Resources Conservation Service office, Virginia Soil and Water Conservation District, Virginia Cooperative Extension agents, and USDA service centers. While working towards our overall mission statement and sharing our vision of healing the land utilizing innovative approaches to livestock and crop production. Our approach relies heavily on the use of cover crops, particularly multi-species cover crops, no-tillage, and additionally incorporating livestock into this cover/cash crop rotation. Our local agency's recognition of our approach to environmental stewardship, made us aware of title II conservation programs that would fit our production model. We are dedicated to utilizing conservation programs regardless of whether we receive an award, if the practices are economically feasible. And if awarded, the offset in capital would be put toward other conservation practices that are not covered by these outlined conservation programs. We have been fortunate to participate in numerous Environmental Quality Incentives Program (EQIP) in which we have implemented stream exclusion fencing,

prescribed grazing systems, cover crop, nutrient management planning, livestock watering systems to name a few.

Environmental stewardship is a foundational value of our farm and one of our key factors when we evaluate management decisions in our operation. Being that our farm is in the Chesapeake Bay watershed, we made the decision to install exclusion fencing to keep livestock out of the lake and streams that are on the farm. The fencing was installed with twice the minimum buffer from water to provide additional filter support and stimulate wildlife refuge areas. As a part of our conservation efforts we practice intense rotational management of all livestock species we raise. Most are moved daily, but at a minimum every 3 days. This rotation allows for natural distribution of manure, preventing the buildup and potential runoff of nutrients. This rotational management in combination with exclusion from our lake and streams required the installation of over 12,000′ of underground water lines and over 40,000′ of fence line. We also utilize precision agriculture, with grid sampling and variable rate fertility application. In addition, we intensely utilize multi-species cover crops both to sustain a living cover in the traditional sense but also is a key component in our crop production cycle that has virtually eliminated the need for routine chemical applications. Our structured management of both livestock and cover crops has allowed for the almost doubling of soil organic matter, which reduces erosion and increases water/nutrient holding capacities, thus reducing runoff potential. Conversion of cropland formerly under a conventionally managed system was a hurdle to work through as we grew. Time and management have allowed for the stimulation of the soil biology and building of soil organic matter & health. This continues to be our focus both in currently managed land and as we take on new land during the expansion of our operation. While implementing this approach to livestock and crop production with the assistance of title II conservation programs, we have seen substantial benefits from the implementation of these practices. We have eliminated erosion, doubled our soils organic matter, reduced water runoff, increased our soil biology, increased our carbon sequestration and improved our forage/crop quality. We have confirmed these improvements with both anecdotal observation and imperial scientific data.

Although the benefits of title II conservation programs are great in number, the implementation of these programs could be improved. As with most programs reliant on budgetary allocations, there are many more dollars applied for than funding provisions. Focus needs to be directed to allow for greater access to these programs and assistance provided to ensure continuation of these conservation practices when funding is not available. As producers see the physical and financial benefits of conservation, they will be more prone to continuing previously awarded practices. Barriers to greater adoption of these programs and practices include: limited staffing at local NRCS service centers, limited access to NRCS offices, excessive paperwork required for application, capital cost requirement up-front, and program requirements are too restrictive. For example, they do not account for environmental conditions which may eliminate eligibility for producers due to inability to comply with outlined timeframes, and the strict verbiage does not account for newer dynamic regenerative agriculture practices.

I have several recommendations that would assist in improving the implementation and adoption of conservation programs/practices. Support continued and increased funding allocation for title II conservation programs, with a directed focus of continued outreach post producer funding award to encourage the continuation of conservation practices. For example, after a program award providing the technical assistance to assist the producer in understanding both the environmental and financial benefits from the awarded program. This along with additional support to give confidence to the producers to continue conservation efforts b[e]yond program award, once operational benefits can be identified. Conversion of the current NRCS brick and mortar paper application process, to a computer-based system. Understandable that some efforts have been placed with the pandemic to do so, but as a producer I continue to have to go in person to file crop reporting, CFAP application, and the like. If each farmer had a web portal with all of the farms associated to them, then could apply, file crop reporting, yield data, *etc.,* without the need for the infrastructure to house the current paper system. Provide NRCS agents the tools, technology, and flexibility to spend more time in the field with producers. Revise program restrictions to allow for up-front program payments to producers when awarded, currently many producers are discouraged to apply due to the financial burden having to spend the up-front capital costs to implement the program, in hopes for reimbursement at a later date. Last, allow for more flexibility within program guidelines to better reflect the changes in climate, environmental events, and modern innovative regenerative agriculture practices.

By working together through the implementation of conservation and regenerative agriculture practices we can heal the soil that feeds the plants, and in turn feeds all of us.

I want to thank you for allowing me the opportunity to testify.

The CHAIR. Thank you very much for your opening statement, Mr. Isbell.

Ms. Ratcliff, please begin whenever you are ready.

STATEMENT OF KIMBERLY RATCLIFF, MANAGER/OWNER, CANEY CREEK RANCH, OAKWOOD, TX

Ms. RATCLIFF. Chair Spanberger, Ranking Member LaMalfa, Members of the Committee, thank you for this opportunity to speak on behalf of Caney Creek Ranch.

After leaving a New York City financial information firm in 2007, I returned to Caney Creek Ranch, my family operation, in Oakwood, a small town in central east Texas. Our family-owned ranch was established in 2002 by my parents, Wesley and Marie Ratcliff. I manage daily operations where we produce Charbray cattle, from which bulls, replacement heifers, semen, embryos are sold across the world.

Working with my father and brother, I am leading our family business into the future, developing new line of businesses, using best practices on the ranch to increase resilience and efficiency, and strongly contributing to the success of our entire community.

I am one of the founders of the 100 Ranchers, a community-based organization supporting minority producers across the country. It has introduced me to a number of producers who have shared their personal stories about their journey into agriculture and many important conservation lessons I have learned.

A friend of mine, a third-generation rancher from North Carolina, shared with me the importance of keeping forests as forests and passing on this responsibility to future generations. A friend of mine, a third-generation family, started in 1916, where his grandfather purchased 38 acres for $864. As he described, this was a great feat for a man but particularly for an African American. Initially the focus was to clear the land, but as the old saying goes, money does not grow on trees. But today the story is different.

Organizations like Sustainable Forestry and African American Land Retention Project, where I serve on the Prairie View A&M local chapter board are working with small landowners to introduce them to sustainable forestry as a tool to increase family income and land value. This includes silvopasture, a management system that integrates trees with forage and livestock production. Silvopasture system optimized three components: forage, livestock, and ecosystem. Trees are planted into rows or cluster, or forests are thinned to provide significant light for forage.

On our family operation, we incorporate existing forest area to provide shade, timber, food for our livestock. The carbon captured in the soil and the trees more than makes up for the greenhouse gases ruminants emit through belches and gas. The silvopasture system increases our production of meat and milk in part because the shade of the trees reduces stress on the livestock.

The trees also provide a haven for wildlife habitat. The additional trees have brought about an increase in the number of quail,

deer, turkey that inhabit our farm. The trees also act as a buffer, preventing harmful nutrients from entering the nearby water source.

We also practice rotational grazing, allowing our pastures to rest and recover and soil health to improve.

We were introduced to many conservation plans, including rotational grazing, when we started working with USDA Natural Resources Conservation Service. We learned how to improve the efficiency of our pasture, about cross-fencing, and about programs after working with NRCS to develop a conservation plan.

Conservation plan is free. It is often the introduction to NRCS cost-sharing programs like EQIP, Environmental Quality Incentives Program, like Conservation Stewardship Program, Conservation Reserve Program. These programs support voluntary conservation efforts with landowners in the United States, helping direct owners to practice benefits of environment.

Unfortunately, participation rate of conservation plans and cost-sharing programs are low among small landowners. Minority landowners have even lower rates of participation, have fewer acres enrolled, are less likely to afford cost-share requirements, and less satisfied with the program.

To close this gap, there needs to be a new approach to encourage program participation by small landowners in general but especially minority landowners. Peer-to-peer education about proper management is essential to achieve conservation goals. This is why it is important to support organizations like the Texas Agriculture Life, the Texas Agricultural Land Trust, the National Grazing Lands Coalition, and the Sustainable Forestry and African American Land Retention Project to provide resources and technical support to producers on the ground.

While there are a number of wonderful programs in NRCS, it is important for us to remember our work is not complete. For the past 60 years, agriculture industry admittedly focused on treating climate symptoms with practices and inputs rather than addressing the problem with science-based holistic principles. Innovative producers today understand that we do not solve ecological problems by implementing old practices. Rather we implement best practices that we know work based on science and explore new ways of working. It begins with maintaining a solid foundation with the healthy soil that helps money grow on trees.

We need investment in capital to engage in best practices. We need education. We need access to market. We need partnerships to ensure that we all benefit from opportunities for my industry, specifically minority producers to address climate change, to ensure food security and diversity of our networks of producers.

I appreciate you allowing me to submit this here today.

[The prepared statement of Ms. Ratcliff follows:]

PREPARED STATEMENT OF KIMBERLY RATCLIFF, MANAGER/OWNER, CANEY CREEK RANCH, OAKWOOD, TX

Chair Spanberger, Ranking Member LaMalfa, Members of the Committee, thank you for this opportunity to submit a written statement on behalf of the Caney Creek Ranch.

After leaving a New York City financial information firm in 2007, I joined Caney Creek Ranch to create a generational family business operation. Caney Creek Ranch

is located in Oakwood, a small town in central east Texas. Our family-owned ranch was established in 2002 by my parents Wesley and Marie Ratcliff. I manage daily operations of our family business producing Charbray cattle, from which bulls, replacement heifers, semen and embryos are sold nationally and internationally. Working with my father and brothers, I am leading our family business into the future—developing new lines of business, instituting best practices on the ranch for resilience and efficiency, and strongly contributing to the success of our entire community.

Having witnessed my own family's journey establishing a new ranch, I understand the challenges facing new farmers and ranchers. I am passionate about supporting these groups, particularly minority producers like me. That's why I am engaged in 100 Ranchers. Established in 2008, The 100 Ranchers is a community-based organization for Minority Producers with members from across the country whose primary mission is to unite production agriculture producers to increase their livelihood by strengthening their capacity to produce safe, clean and marketable products.

My experience with 100 Ranchers has introduced me to a number of individuals who have shared their personal stories about their journey into agriculture and many important conservation lessons that I have implemented into my own practices. A friend of mine, a third generation rancher from North Carolina shares with me the importance of keeping forests as forests and passing on this responsibility to future generations. His story, like so many others, connects the dots between forests, sustainable management, and the economic and environmental benefits that come with being a responsible steward of the land.

His family's story starts in 1916 when his grandfather purchased 38 acres of land for $864. As he describes, "This was a great feat for any man at the time, but particularly so for an African American." Initially, the focus was on clearing the land for agriculture—as the old saying goes, "Money doesn't grow on trees".

But today, the story is different. Organizations like the Sustainable Forestry & African American Land Retention Project (SFLR) where I serve on the Prairie View A&M University local chapter board are working with small landowners to introduce them to sustainable forestry as a tool to increase family income and land value, with a broader goal of providing future generations with a better quality of life through pasture and forestland ownership and retention.

Silvopasture is integrates trees with forage and livestock production. The goal of a Silvopasture system is to optimize production of three components: forage, livestock and ecosystems. A Silvopasture operation can enhance soil protection and increase long-term income with the simultaneous production of trees and grazing animals. For Silvopasture, trees are planted or thinned to provide sufficient light for good forage production. Grouping trees into rows or clusters concentrates their shade and root effects while providing open spaces for pasture production.

The Roque Family, a member of the 100 Ranchers and descendants of African slave received more than 660 acres of land through a land grant and established multiple farming operations. They currently operate 600 native pecan trees and feed over 500 calves on the pasture between the pecan trees. For decades, the Roque Family's pecan orchard has provided double source of income from the same parcel of land (pecans + beef), improved soil health, improves water quality, reduces erosion, and has had a greater carbon storage than traditional pasture systems.

On our family operation, we incorporated existing forest area to provide shade, timber and food for our livestock. The carbon captured in soil and trees more than makes up for the greenhouse gases that ruminants emit through belches and gas. The Silvopasture systems increased our production of meat and milk, in part because the shade from the trees reduces stress on livestock. The trees also provide a haven for wildlife habitat. The addition of trees has brought about an increase in the number of quail, deer and turkey that inhabit at the farm. The trees also act as buffers, preventing harmful nutrients from entering a nearby water sources. By implementing a Silvopasture system we are less likely to raise environmental concerns related to water quality, odors, dust, noise, disease problems and animal treatment.

Our family operation stands by a long-term stewardship plan of maintaining and enhancing the quality of our resources by using them in a way that allow them to regenerate for the future. We concentrate on creating a system that rely more on the cycling of nutrients to support our production agriculture with fewer potentially toxic interventions. The prioritization is caring for the soil, because we recognize that a healthy soil promotes healthy crops and livestock. The buildup our soil organic matter help ease the increase of atmospheric CO_2 and therefore climate change.

Our soil management system evaluates the nutritional and forage needs of our cattle, and shifts livestock to a different paddock on a regular sequence to allow recovery and growth of the pasture plants after grazing. This management system is called rotational grazing.

At the very beginning of our operation, we were introduced to rotational grazing when we started working with the local USDA Natural Resource Conservation Service office on developing a conservation plan. We learned how to improve efficiency of our pastures and about cross-fencing to support rotational grazing practices. Since implementing rotational grazing, we have improved the grass structure, the production of the grass, and the production and the performance of the cattle.

The NRCS also supported our family as we developed a conservation plan. A conservation plan is a document that lays out the steps for how an agricultural landowner will implement specific conservation practices on their land. This document is important tool for understanding the soil, water, air, plant and animal resources on your property and the resources available to you to improve these conditions through the NRCS. Unfortunately, participation rates are low among small landowners. Minority landowners have even lower rates of participation, have fewer acres enrolled, are less likely to be able to afford cost-share requirements, and are less satisfied with programs. To close this gap, there needs be a new approach to encouraging program participation by small landowners in general and by minority landowners in particular.

Peer-to-peer education about proper management is critical in working with ranchers to achieve conservation goals. This is why it is important to support organizations like the Texas Agriculture Land Trust, the National Grazing Lands Coalition, and the Sustainable Forestry & African American Land Retention Project that provide resources and technical support to producers on the ground.

Part of the Solution to Climate Change

Grazing lands are one of America's greatest natural resources. They provide the nation and the world with a secure food supply, renewable energy, improved water quality and availability, productive plants that sequester carbon, robust wildlife habitat, and healthy soils, serve as the foundation for our country's farming and ranching families and contribute to food security for our nation and the world. Grazing lands contribute billions annually to the U.S. economy by supporting an estimated 60 million head of cattle. To sustain agricultural production, grazing lands must be conserved and properly managed to produce robust, resilient stands of grasses and forage. All of this starts below our feet with "soil health," the foundation of our operations.

The natural biological processes of grazing by roaming herds and periodic fire that created the natural grazing lands are no longer at work. A decade-long drought, and poor management practices contributed to the great Dust Bowl of the 1930s. This disaster brought about the birth of land conservation and the Conservation Act of 1935, which created the Soil Conservation Service, now the NRCS. Notwithstanding, in the 1950s the Green Revolution took hold, and great advancements were made in agricultural technology, including the development of commodity and forage crops that responded well to fertilizer, advanced farm machinery and other technological advancements that expedited crop production with less need for labor.

In the years that followed, the agricultural industry operated on cheap feed, cheap fertilizer and cheap fuel. Our industry and our research during that time focused on the chemical and physical characteristics of soils with little to no consideration of biological interactions within the soil.

In recent years, however, prices for feed, fertilizer and fuel have increased to a point that has become unsustainable for many operations. Many producers have had to make a choice: continue doing what they have always done or working with nature to find a new way to farm and ranch. Born out of equal parts necessity and frustration, producers began to experiment with farming and ranching techniques that limited the use of inorganic fertilizer, fuel and feed.

They began to see that limiting or eliminating tillage reduced their fuel bill, using the ageless practice of "cover crops" to keep their fields covered provided numerous benefits to the soil (*i.e.,* preventing erosion, increasing water holding capacity and increasing biodiversity), converting marginal soils to perennial pasture land to eliminate tillage and minimize erosion, and through managed rotational grazing the pastoral lands improved in composition and production due to the recovery allowed between grazing events.

In essence, they built a foundation of principles that many producers follow today to manage healthy soils and restore deteriorated soils. These soil health management principles were set forth to achieve specific goals that are inherent to all soils. They are based on mimicking highly diverse, heterogeneous, native grazing land

plant communities by harnessing the power of biologic interactions between plants, soil microbes, fungi and other of life in our soils. These principles build soil aggregation, which further builds soil structure.

These principles have proven the path forward for many innovative producers and substantiated that the conventional farming and ranching practices of the last 6 decades are not the only way to succeed.

Climate-Smart Agriculture

Since producers are often the most vulnerable to the effects of climate change, working with them to build "climate resilience" is critically important for global food security. Working with producers to advance agricultural methods that boost their productivity and decreasing greenhouse gas emissions. These "climate-smart" techniques also increase resilience against droughts, torrential rains, and changing growing seasons. Climate-smart agriculture is not a new form of agriculture. It's a holistic system that identifies the risks posed by climate change and the best practices to address those challenges.

These strategies begin at our feet. Soil is among our greatest resource to combat climate change, serving as a bank to draw carbon deep within. Proper grazing management through livestock production can accelerate this.

Developing a proper grazing plan that provides an effective mechanism for implementing the soil health principles and the natural laws of grazing management is essential for sustainable grazing operations. A well-designed and well-managed grazing plan results in healthy soils and grasses, proper nutrition for grazing animals, and greater livestock production at a lower cost. This is achieved by managing stocking rate, livestock rotation, utilization rate and plant rest and recovery in unison.

Livestock producers must actively manage their stocking rate, or the number of animals on a given area of land over a certain period, by measuring available forage. It is important that the stocking rate match the available production and be used optimally. Improper stocking of grazing lands leads to over-grazing or under-grazing, neither of which provides favorable outcomes. Over-grazing for extended periods of time leads to the degradation of the grazing land and an overall reduction in pasture productivity, soil health and livestock production. Determining a proper stocking rate is essential for proper grazing management and requires balancing the animal numbers with available grass and forage production.

Livestock are selective grazers, and left unmanaged they tend to disproportionally graze more-productive plants over less-productive plants. Livestock also prefer the fresh regrowth over mature leaves. That is why is important for producers to consider where to graze, when to graze, how long to graze, and how long to allow a grazed area to rest and recover. The purpose of a grazing rotation is to manage the impact of grazing on the grazing land while maintaining or improving livestock production. A good grazing management practice is "take half and leave half." Conceptually, this means graze the top half of the leaves and leave the rest to allow for rapid recovery and regrowth.

After being grazed, plants need an adequate recovery period. The more severe the grazing intensity, the longer it takes for the plants to fully recover. Soil moisture and seasonal temperatures also affect the rest and recovery period. In favorable moisture conditions, the recovery period is shorter than in low moisture conditions. As moisture becomes more limiting, longer rest and recovery periods are required. It is important to determine the recovery period based on the key species in the grazing land being managed. In a native grass pasture, the key species are those more productive, more palatable species that have a longer recovery period than the less desirable species. Introduced pastures usually have a shorter recovery period than the native prairies and have to be managed differently for optimum results. Well-managed rest and recovery periods increase pasture production and offer greater potential for livestock production.

To achieve these outcomes, producers should consider the following:

1. Have a Plan

You need to know where you are to know where you're going. A sound management plans allow producers to be better poised to increase their food output, combat food insecurity, run more efficiently, save money, and reduce their climate impact. Reaching out to your local Natural Resource[s] Conservation Office for assistance in creating a baseline assessment which will provide farm managers a clear picture of how the farm operates, and how it can run more efficiently while producing more food. Running more efficiently means reducing greenhouse gas emissions. Producing more food with land already in use means reduced need for fresh farmland, cleared

from forests. Meanwhile, farms also keep close track of weather and farm data, which can help them predict patterns and plan more effectively.

2. Water Conservation

Access to water resources is vital to any operation. Since agriculture consumes roughly 70 percent of the world's freshwater, water conservation is urgent and necessary in areas where water is becoming increasingly scarce. Climate-smart agriculture promotes a number of water conservation practices, such as planting a buffer of trees and bushes along streams and rivers to prevent erosion and contamination from crop runoff.

3. Save the Soil!

Not only does fertile soil impart better flavor and higher nutritional value to food, soil is one of the biggest carbon sinks on the planet. Tending to the soil increases the amount of greenhouse gasses sequestered, and leads to healthier plants with higher yields. Healthy soil holds more moisture, keeping plant roots hydrated in dry periods. Soil conservation methods such as contour planting or no-till farming reduce erosion, keeping the soil in place during heavy rains or floods—a major concern in certain parts of the Unites States. All of this equates to higher climate resilience for farms, and better soil for years down the road.

4. More Trees

Farmers using climate-smart practices understand that trees do a lot on farms: they can act as windbreaks, reduce soil erosion; enrich soil; filter water that results in higher water quality; shade and forage for livestock; habitat for wildlife and wildlife corridors; and suck up and store greenhouse gasses—the list of benefits goes on and on. Approximately 80 percent of deforestation is caused by agricultural expansion, and that conversion from forest to cropland produces a significant amount greenhouse gas emissions. But farmers who utilize climate-smart agriculture practices have lesser need to expand their farms—higher yields negate the need to clear forest, and keeps those greenhouse gases sequestered in the forest.

Conclusion

Money can in fact grow on trees. A collective action of governments, non-governmental organizations, businesses, families, and individuals worldwide need to collaborate to accelerate nature-based solutions and conserve, restore and grow trees. Working together and integrating systems like Silvopasture, we can support environmentally friendly and economically viable ranching operations. However, we must ensure that producers have access to the resources they need to be successful.

Because silvopasture takes advantage of underutilized ecosystems, it has the ability to create the most inclusive forest movement ever. Our efforts can support agricultural producers who have often been over looked, helping under-resourced family forest and landowners use sustainable forestry to increase family wealth and to build a legacy. But this movement does more. It supports conservation, and our quest to combat some of the greatest challenges facing our planet. These Silvopastures deliver benefits shared by all, such as purifying our air and water, conserving wildlife habitat, producing sustainable wood products, and sequestering carbon to mitigate climate change. Forests are an essential part of the solution to tackle climate change and biodiversity collapse, as well as important for jobs and sustainable livelihoods.

It's also important for us to remember our work is not complete. For much of the past sixty years, the agriculture industry admittedly focused on treating climate symptoms with practices and inputs rather than addressing the problem with science-based, holistic principles. Innovative producers today understand that we do not solve ecological problems by implementing old practices, rather, we implement best practices that we know work based on science, and explore new ways of working. We can and are addressing ecological degradation by following principles that rebuild ecological processes and habitat from the ground up rather than focusing on specific singular species or management practices.

It all begins with maintaining a solid foundation with healthy soil as the cornerstone to any agricultural enterprise.

We need investment in capital to engage in best practices, education, access to markets, and partnerships to ensure that we all benefit from the opportunities for our industry and specifically minority producers to address climate change, ensure food security, and diversify the network of producers.

The CHAIR. Thank you so much very, Ms. Ratcliff, for your testimony today.

And, Dr. Paustian, please begin whenever you are ready.

STATEMENT OF KEITH H. PAUSTIAN, PH.D., DISTINGUISHED PROFESSOR, DEPARTMENT OF SOIL AND CROP SCIENCE, COLORADO STATE UNIVERSITY; SENIOR RESEARCH SCIENTIST, NATURAL RESOURCE ECOLOGY LABORATORY, CSU

Dr. PAUSTIAN. Chair Spanberger, Ranking Member LaMalfa, and Committee Members, my name is Dr. Keith Paustian. I am a Professor at Colorado State University. I do research and teaching on soils, agriculture, and climate. Thank you for allowing me the opportunity to speak at your hearing today.

Agriculture, both in the U.S. and globally, is facing several challenges, while being called upon to deliver more and more products and services to an increasing global population. Agriculture is a significant source of greenhouse gases, accounting for about ten percent of total U.S. emissions and 14 percent of global emissions. However, agricultural soils can also be a carbon sink, removing carbon dioxide from the atmosphere and converting it to soil or organic matter that improves soil fertility and soil health.

The key determinants for sequestering carbon and improving soil health are the agronomic practices employed by the farmer. Past management practices have over time significantly depleted soil carbon stocks on our agriculture lands. However, we can reverse much of these historic losses by adopting a variety of conservation practices, including reduced- and no-tillage cover crops, more diverse crop rotation, and other practices.

In addition to sequestering carbon, many of these practices help to tighten up nutrient cycles, reducing nutrient losses that contaminate ground and surface waters. Also soils rich in organic matter are more resilient to flooding and drought conditions.

So, while these agricultural practices, these conservation practices have seen increased use, there is massive room for additional adoption. For example, cover crops are currently planted on about less than five percent of our annual cropland. USDA programs, such as EQIP, Conservation Stewardship Program, and others have been key to encouraging producers to adopt conservation practices across the country. Although many of these practices can pay for themselves in the long run by improving soil function and crop yields, there are numerous barriers to adoption. Farming is inherently risky, and farmers tend to be risk averse. Thus, the support payments and technical assistance from USDA help to mitigate risks while farmers transition to these new practices.

My research team at Colorado State University has been involved with USDA over the past 12 years in developing the COMET-Farm system. COMET-Farm is an online tool that is used to evaluate different conservation practices that can increase carbon sequestration and reduce greenhouse gas emissions on an individual farm or ranch. The tool is available. It is free. It is on the internet. The tool implements USDA's Entity-Scale Greenhouse Gas Inventory Methods, which were developed by top experts from government, academia, and industry. COMET-Farm currently has thousands of users, including Federal agencies, state governments, NGOs, companies, as well as individual farmers and ranchers.

To bring about transformative changes on our nation's agriculture lands will also require increased participation from the pri-

vate-sector. Over the past couple of years, there has been growing interest from major companies towards investing in carbon drawdown approaches to help meet corporate sustainability goals. To increase the willingness of the private-sector to invest in soil carbon solutions and also to design optimal public policy, we need to improve our abilities to cost-effectively measure and monitor carbon sequestration.

While we have many excellent field experiments, as well as highly capable tools such as COMET-Farm, there are a number of R&D initiatives that could significantly improve our capabilities. A number of these priorities have been documented in a 2019 study by the National Academy of Sciences.

One is the need for a national system of on-farm measurements of soil carbon stock changes. The National Resources Inventory System currently managed by USDA would be an ideal platform to supplement with some on-the-ground soil measurements. Our Forest Inventory System provides this type of information on biomass carbon stocks. We need something similar for our soils. We also need additional capabilities for performance testing of new technologies, such as new crop varieties, new soil amendments, new regenerative conservation practices.

Finally, there is a growing scientific consensus that improved quantification systems can be achieved by more fully integrating ground-based measurements and monitoring networks, remote sensing, and dynamic models.

In summary, USDA title II programs have been instrumental in promoting the adoption of conservation practices that yield significant climate benefits, as well as healthier soils and ecosystems. Good tools exist to expand and advance policies to promote climate-smart agriculture. Further improvements in quantification technologies can help increase engagement by the private-sector to take these improved practices to scale.

Thank you, and I will be happy to take any questions.

[The prepared statement of Dr. Paustian follows:]

PREPARED STATEMENT OF KEITH H. PAUSTIAN, PH.D., DISTINGUISHED PROFESSOR, DEPARTMENT OF SOIL AND CROP SCIENCE, COLORADO STATE UNIVERSITY; SENIOR RESEARCH SCIENTIST, NATURAL RESOURCE ECOLOGY LABORATORY, CSU

Chair Spanberger and Ranking Member LaMalfa, my name is Dr. Keith Paustian; I'm a Professor at Colorado State University, Department of Soil and Crop Sciences. I do research and teaching on soil ecology and biogeochemistry related to agriculture and climate. Thank you for allowing me the opportunity to speak at your hearing today.

Agriculture, both in the U.S. and globally, is facing several challenges, while being called upon to deliver more and more products and services to an increasing global population. Agriculture is a significant source of GHGs, accounting for about 10% of total U.S. emissions [1] and 14% of global emissions.[2] However, agricultural soils can also be a carbon sink, removing carbon dioxide from the atmosphere and converting it into soil organic matter that improves soil fertility and soil health.

The key determinants for reducing soil GHG emissions, sequestering carbon and improving soil health are the agronomic practices employed by the farmer. Many so-called conventional practices—including use of continuous annual crops, heavy tillage, extended bare-fallow periods and cultivation of marginal lands—have, over time, significantly depleted soil carbon stocks. However, we can reverse much of those historic carbon losses by adopting a variety of conservation practices including

[1] *https://www.epa.gov/ghgemissions/sources-greenhouse-gas-emissions.*
[2] *https://www.ipcc.ch/report/ar5/syr/.*

reduced- and no-tillage, cover crops, more diverse crop rotations, field buffers, agroforestry, and other practices.[3] These management practices lead to more carbon dioxide being taken up by plants and converted to organic matter stored in the soil and with less soil disturbance, which also helps to maintain more of that added organic matter.

In addition to sequestering carbon, many of these practices help to "tighten" nutrient cycles, reducing leaching losses that contaminate ground and surface waters and reducing emissions of nitrous oxide—another GHG—from soils. In addition, soils rich in organic matter are also more resilient to both flooding and drought conditions, which reduces yield loss due to extreme climate events.

While these conservation management practices are seeing increasing use in the U.S., there's massive room for additional adoption—for example, cover crops are still only planted on less than 5% of our annual cropland. USDA conservation programs such as EQIP, the Conservation Stewardship Program (CSP), the Conservation Reserve Program (CRP) and others have been key to introducing appropriate conservation practices to producers across the country and to encourage adoption through cost-sharing, direct payments and technical assistance. Although many conservation practices can pay for themselves in the long run by improving soil function and yield stability, there are numerous barriers to adoption. Farming is inherently risky and farmers tend to be risk averse. Thus, the support payments and technical training and outreach from these USDA programs help to mitigate risk while farmers transition to these new practices.

One of the activities that my research team at Colorado State University has been involved in with USDA over the past 12 years has been the development of the COMET-Farm system. COMET-Farm[4] is an on-line tool that farmers, ranchers, crop consultants, NRCS field staff and others can use to do a full carbon and GHG inventory of their operation and explore implementing different conservation management practices to estimate how much they could increase carbon sequestration and reduce other greenhouse gas emissions. The tool is free and available for any one that has an internet connection. The tool implements USDA's Entity Scale Greenhouse Gas Inventory Methods which were developed by top experts from government, academia and industry, overseen by USDA's Office of Energy and Environmental Policy and first published in 2014.[5] We've also developed a related tool called COMET-Planner[6] that gives a quick overview at the regional scale of the impacts of implementing NRCS-prescribed conservation practices on carbon sequestration and GHG reductions. The COMET tools are currently being used by 10s of thousands of users, including Federal agencies, state governments, NGOs, companies, consultants, extension personnel, students, as well as individual farmers and ranchers (see attached *Appendix A* of current COMET users.)

To bring about truly transformative changes on the nation's agricultural lands will require continued support from Federal and state governments but also increased participation and investment from the private-sector. Over the past couple of years there's been growing interest from major companies towards investing in carbon drawdown approaches, including soil carbon sequestration, to help meet corporate carbon neutrality and sustainability goals. In addition, many agriculturally-related industries are striving to develop low carbon food and fiber products.

To increase the confidence and willingness of the private-sector to invest in soil carbon solutions, and to design optimal public policy, we need to improve our abilities to cost-effectively measure and monitor carbon sequestration and greenhouse gas reduction in the agricultural sector and reduce uncertainties in our estimates. While we have many excellent long-term field experiments documenting the performance of conservation practices, as well as highly capable models and tools such as COMET-Farm, there are a number of research and development initiatives that could significantly improve our capabilities. A number of these R&D priorities have been documented in a 2019 study by the National Academy of Sciences[7] on so-called negative emission technologies, including soil carbon sequestration. I will just mention a couple of them here.

One is the need for a national system for on-farm measurements of soil carbon stock changes over time. The National Resources Inventory (NRI) system is managed by USDA and provides a statistical sampling of farms that tell us what man-

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[3] Paustian, K., J. Lehmann, S. Ogle, D. Reay, G.P. Robertson & P. Smith. 2016. *Climate smart soils.* NATURE 532: 49–57.

[4] *https://comet-farm.com/*.

[5] *https://www.usda.gov/sites/default/files/documents/USDATB1939_07072014.pdf*.

[6] *http://comet-planner.com/*.

[7] *https://www.nationalacademies.org/our-work/developing-a-research-agenda-for-carbon-dioxide-removal-and-reliable-sequestration*.

agement practices (such as crop rotations, irrigation, fertilizer use, *etc.*) are being used but there are no on-the-ground measurements of, for example, soil carbon stocks. If USDA chose a few thousand NRI points on which to measure soil C stocks every 7–8 years, we would be able to build up a record of soil C stocks changes over time. Our forest inventory system provides this type of information on biomass C changes; we need something similar for our soils.

We also need capabilities for field performance testing of new technologies, such as new crop varieties, new soil amendments and new practices that aren't currently included in long-term field experiments. Typically assessing the impact of new practices or crop types on soil carbon sequestration can take a decade or more; we need systems to assess capabilities of new technologies much more rapidly.

Finally, there's a growing scientific consensus that improved quantification systems can be achieved by more fully integrating multiple data sources, including ground-based measurements and monitoring networks, remote sensing, crowd-sourced data on management activities and dynamic models.[8] Further R&D investments in developing an integrated soils information system can yield major improvements in the next few years.

In summary, USDA title II programs have been instrumental in promoting the adoption of conservation practices that can yield significant climate benefits along with promoting healthier soils and ecosystems. Good tools exist now to advance and expand policies to promote climate-smart agriculture. Further improvements in quantification technologies can help increase engagement by the private-sector to take these improved agricultural conservation practices to scale.

Thank you. I'll be happy to take any questions.

APPENDIX A. REPORT TO USDA/NRCS, MARCH 2021, SUMMARY OF COMET-FARM AND COMET-PLANNER USERS

COMET-Tools Outreach Report

03/12/2021

COMET-Farm

Year	Total Users	Annual Sessions
2015		3,769
2016	140	4,201
2017	407	2,497
2018	777	3,273
2019	901	2,500
2020	4,181	12,342
2021*	1,345	3,111

*As of 3/12/2021.

COMET-Planner

Year	Total Sessions
2016	4,582
2017	7,985
2018	10,029
2019	8,564
2020	5,626
2021*	**679
Lifetime	37,460

*As of 3/12/2021.

[8] Paustian, K., *et al.* 2019. *Quantifying carbon for agricultural soil management: from the current status toward a global soil information system.* CARBON MANAGEMENT 10: 567–587.

** Excluding an anomaly of 1,121 users on 2/1/2021.

User Support via Help Desk

Year	Sessions	People	Hours	Solution Article Views
2016	37	54	35.2	—
2017	26	40	21.7	—
2018	38	26	11.5	—
2019	74	104	67.8	—
2020	377	398	321.5	413
2021 *	92	59	16	284

* As of 3/12/2021.

YouTube Training Video Views

Video	Views
Assessing Animal Ag (Dairy)	170
Using Shape Files in COMET-Farm	107
Assessing Agroforestry	123
Assessing Croplands	449
Assessing Croplands (Rice)	89
Assessing Forestry	96
Introduction to COMET-Energy	131
COMET-Planner video (2015)	2,250
COMET-Planner video (2017)	1,157
New Drag and Drop Feature	46
COMET-Farm & COMET-Planner Introduction *New Channel*	136
Creating a COMET-Farm Account *New Channel*	27
Navigating COMET-Farm *New Channel*	29
Carbon Farm Planning Using COMET-Farm	231
New Animal Ag Accounting (flexible baseline, defining herds, herd copy)	19

Outreach to Date

Federal, State, Regional and Local Government

USDA Agricultural Research Service	State of Hawaii
USDA Farm Services Agency	San Miguel County, Colorado
California Department of Food and Agriculture	Boulder County, Colorado City of Boulder, Colorado LaPlata County, Colorado
California Air Resources Board Resource Conservation Districts throughout California	Summit County, Utah Johnson County, KS Sierra Resource Conservation District
WHATCOM Conservation District, Washington State	NRCS—Annapolis, MD; Walhalla, SC; McMinnville, OR; Washington, D.C.; Connecticut; Madison, WI; Columbia, MO;
Wilkin Soil and Water Conservation District, Minnesota	Colorado Energy Office
Department of Agriculture, Forestry & Fisheries (S. Africa)	Boulder County (Colorado) Parks and Open Space
California Air Resources Board	Alameda County Resource Conservation District
New Mexico Department of Agriculture	Tualatin Soil and Water Conservation District
Indiana Department of Agriculture	Napa Resource Conservation District
Wisconsin Land + Water	

Higher Education

Colorado State University	University of Northern Colorado
Bard College	University of Wyoming
North Dakota State	University University of Hawaii
University of Maryland	University of Vermont
Western Colorado University	Oklahoma State University
University of Guelph	Yale University
Rutgers University	Northern Arizona University

Outreach to Date—Continued

Higher Education	
Georgia Institute of Technology	University of California Composting Education Program
Nueta Hidatsa Sahnish College—North Dakota	
NGO's	
The Marin Carbon Project	Sunflower City
Environmental Defense Fund	Carbon Cycle Institute
The Nature Conservancy	Chesapeake Bay Foundation
Climate Action Reserve	American Farmland Trust
Verra (formerly Verified Carbon Standard—VCS)	American Carbon Registry
	Innovation Center for U.S. Dairy
Solano Land Trust	Colorado Carbon Fund
The Pinhead Institute	Ducks Unlimited
Sustainable Tompkins	Soil Health Institute
National Corn Growers	Soil Health Partnership
Straus Family Farm	Project Together
Clear Frontier Ag Management	Shelburne Farms
Fish Friendly Farming	Energy District
Carbon 180	California Land Stewardship Institute
Agricultural Industry Organizations	
California Farm Bureau	California Almond Growers Rocky
Mountain Farmers Union	Hawaii Agriculture Research Center
Australian Department of Environment and Water	
Businesses	
Ben & Jerry's	Pure Strategies
Fibershed & The North Face	NORI Indigo
Ag Coca Cola	Agrisoma
Unilever	Monsanto
Strauss Dairy	Stemple Creek Ranch
Native Energy	Mad Agriculture
Cargrill	NORI
Sustainable environmental Consultants	Upstream
Watershed Climate	Nutrient
Indigo Agriculture	Microsoft Azure
Logiag	Boston Consulting Group
GD Associates	PIF California
Anthesis Group	SBC Global
Handsome Brook Farms	Post Holdings
Land O' Lakes	Wheat Sheaf Group
Blue Skye	Simplot
First Earth	Jackson Family Wines
Mondelez International	Keystone Pacific/Wild Rose LLC
Lozensky Farms	Active Renewals
Wheat Sheaf Group	Gould Family Farms
Anuvia	Agrocares
FoodTBS	Solution TF
KWS Berlin GmbH	Frontier Farmland
TeamAg Inc.	Stonyfield Organic
Arcor Group	Quivira Coalition
Polytechnique Montreal	Heffernan Consulting, Inc. Home & Farm Consulting
Caterpillar	
CiBO Technologies	McKinsey & Company
SMARTFARM	Casella Waste Systems
Hudson Carbon	Pipestone Nutrition
Kloberdanz Consulting	Growell Consulting
Locus Agriculture Solutions	Sofies Environmental Consulting
McKinsey & Company	Florida Crystal Corporation

Outreach to Date—Continued

Businesses	
Alltech—Quality Animal Nutrition, Health and Feed Supplements	Philosopher's Farm
Levi's Indigenous Fruit Enterprises	Blockware Technologies (Canada)
Treasury Wine Estates	Soletrac Electric Tractors
Team Ag Inc	Biome Makers
Mountain View Acres Farm & Orchard	Royal Dairy
Kytech Consultant	Ag Grow Tech
Smart Farmer (Thailand)	Hem Mills
Frogs Leap Winery	Net Zero Carbon Buildings
Triple Crown Consulting	Pifer's Land Management
Carbon Credits Group	African Data Technologies
Pekrul Engineering	Fresh Del Monte
Sesenta (South Africa)	LandFund Partners
Deveron	Farmer's Business Network
EMBRAPA (Brazil)	Cedar Valley Farms
North Iowa Agronomy Partners	Farmer's Edge
	Dari Gold

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The CHAIR. Thank you, Dr. Paustian.

Mr. Johansson, please begin with your 5 minutes when you are ready.

STATEMENT OF JAMIE JOHANSSON, PRESIDENT, CALIFORNIA FARM BUREAU, SACRAMENTO, CA

Mr. JOHANSSON. Thank you, Chair Spanberger, Ranking Member LaMalfa, and Members of the Subcommittee for the opportunity to appear before you today.

I am Jamie Johansson, President of California Farm Bureau and a first-generation olive and citrus farmer.

California's producers are all too familiar with changing weather conditions. The current U.S. Drought Monitor reports that over 97 percent of California is experiencing moderate to exceptional drought, impacting over 34 million Californians.

We are also forecast to have above-normal fire potential this year. California's wildfires are very personal to me. Not only as President of an organization who has witnessed countless stories of farmers' loss and frustration but also because my family has been evacuated three times in the last 4 years due to wildfire. Sadly, there is no wildfire season in California. The risk is now year-round, and it is immense.

Last year, the U.S. Forest Service stated in testimony they would need $2 billion to $3 billion per year for treatments required to get ahead of hazardous fuel levels. We urge the Committee to include both forestry and grazing practices as strategies to restore forest health and rangeland health and increase fire resilience. We also ask that the Subcommittee helps to ensure that sufficient disaster

assistance programs, such as the Wildfire Hurricane Indemnity Program Plus, are made available to producers.

Our producers are at the forefront of investment in agricultural research and adopting practices that improve productivity while enhancing sustainability. Conservation is widespread in California agriculture. Our farmers and ranchers have a proven track record of doing more with less. Practices include water recharge, irrigation efficiency, energy conservation, and investment in farm equipment with cleaner emissions.

With so much already happening at the field level, it is important to consider how new Federal policies and programs will overlay with existing state climate programs and, most importantly, grower-led initiatives.

Title II programs provide producers with additional ability to adopt conservation practices while improving agricultural production. We are appreciative of the improvements made to the conservation title by this Committee in the last farm bill, including enhanced flexibility of programs to meet producer needs. EQIP is the most utilized program in California, assisting producers with options and achieving greater conservation goals. It is important that any changes to title II do not walk back those flexibilities.

To help ensure climate benefits are adopted, NRCS can consider prioritizing EQIP contracts that result in emission reductions, increased carbon sequestration, and improved climate resilience. Prioritization would still need to retain flexibility for all crop types with sufficient levels of financial and technical assistance.

California produces over 400 commodities with various cropping systems and farm sizes. Practices will need to be broad and outcome-based, emphasizing a list of options as opposed to a prescriptive checklist. The nexus between a lack of broadband in many agricultural areas and implementation should also be considered.

We also urge the Committee to considered adding feed, genetics, and nutrition management as eligible practices within the Conservation Innovation Grant Program to provide additional opportunities for farmers to test the newest technologies and evaluate their impact within their operation. While trials around feed additives and genetics are not explicitly excluded, it is also not clear that they are included.

We are also very supportive of the Regional Conservation Partnership Program, which offers producers the opportunity to work collaboratively with NRCS and other conservation partners. We supported the change in the 2018 Farm Bill that reconfigured RCPP as a standalone program. And we are currently an RCPP partner, working collaboratively on Tricolored Blackbird nesting colonies with many of our dairy farms in the Central Valley.

Regardless of programs or practice, financial and technical assistance must be consistent, sustainable, and long-term, if our expectations as producers are also long-term. We must also consider the indirect pressure this may place on important CCC-funded programs for California. These programs would include programs like the Market Access Program and the Foreign Market Development Program, the Coronavirus Food Assistance Program, as well as livestock and other disaster programs.

California Farm Bureau supports producer participation in voluntary climate-smart practices, that is, sequester carbon, reduce greenhouse gas emissions, and build climate resilience. While many have been incorporating climate-smart practices on their operations for years, to further adoption of the on-farm climate-smart climate practices, we must not only compensate early adopters but also consider the economics of the farm and assist those being expected to do more. Only in working together can we achieve solutions that make agriculture more climate resilient while remaining viable.

Thank you again for the opportunity to testify today, and I look forward to your questions.

[The prepared statement of Mr. Johansson follows:]

PREPARED STATEMENT OF JAMIE JOHANSSON, PRESIDENT, CALIFORNIA FARM BUREAU, SACRAMENTO, CA

Introduction

Chair Spanberger, Ranking Member LaMalfa, and Members of the Subcommittee, thank you for the opportunity to appear before you today about the important topic of farm bill title II conservation programs and exploring climate-smart agricultural practices.

My name is Jamie Johansson, President of the California Farm Bureau. California Farm Bureau is California's largest farm organization, representing over 31,000 members across 53 counties, that contribute the largest agricultural economy of any state in the nation. Our agricultural producers provide food, fiber and feed to our local communities, the nation and foreign economies across the globe. Farm Bureau strives to protect and improve the ability of farmers and ranchers engaged in production agriculture to provide a reliable supply of food and fiber through responsible stewardship of California's resources. California Farm Bureau has long served as a leading agriculture organization representing over 400 commodities with diverse production practices and continues to work collaboratively with stakeholders within our state and across the nation, including being a general member of the Food and Agriculture Climate Alliance (FACA).

In addition to serving as the California Farm Bureau President since 2017, I am also a first-generation farmer. My family grows olives and citrus fruit in Oroville, California and operates an olive oil company, Lodestar Farms. I am also a co-founder of the Sierra Oro Farm Trail Association and a former board member of the California Olive Oil Council. Additionally, I also serve on the Board of Directors for American Farm Bureau Federation.

General Comments

California's farmers, ranchers and foresters are all too familiar with changing weather conditions including, but not limited to, changing hydrological conditions that result in cyclic drought and catastrophic wildfire seasons that are lengthening and burning more intensely. In addition to the numerous market impacts brought on by the COVID–19 pandemic, California producers have also grappled with burned and smoke tainted crops, dead and injured livestock, and farming at times in dangerous air quality conditions due to catastrophic wildfires and extremely limited access to personal protective equipment.

As our producers look ahead to 2021, they are once again being met by immense weather-related challenges. The most recent data provided by the U.S. Drought Monitor reports that over 97% of California is experiencing moderate (D1) to exceptional (D4) drought resulting in over 34 million Californians experiencing drought. Precipitation totals remain well below normal, and California's below-normal snowpack is melting rapidly. Dry soils are expected to reduce runoff and vegetation is already showing signs of stress. A warmer than normal summer is also forecasted meaning that there will be significant, above normal fire potential for many areas in our state starting in July and continuing through the summer and into the fall.

Wildfire & Forest Management

California's wildfires are very personal to me; not only as the President of an organization who has heard countless stories of loss and frustration from my members but also because my employees and my family have been evacuees three times due to wildfire. Sadly, there is no fire season in California anymore; the risk is now year-round. Destructive mega-fires do not discriminate what or where they burn and

the impacts on our water, energy, environment, and economy are being consistently felt, both in rural and urban areas. This makes it critically important that Federal, state and private forest and rangeland stakeholders across ownership types, including grazing permittees, be included in emerging climate policy discussions.

Additionally, there are many forest management policies designed with preservation, rather than active management and multiple-use approaches in mind. This has resulted in restrictive and inflexible parameters that hinder improving current conditions on our forestlands despite drought, pest infestation, and backlog from underfunded management programs that lack adequate resources to realistically address the catastrophic wildfire risk we now face. During testimony last year, the U.S. Forest Service indicated that they would need $2–$3 billion per year to treat the number of acres required to increase the pace and scale of forest management and get ahead of fuel levels exacerbating wildfire across the National Forest System.

Healthy forests provide an abundant source of clean water, clean air, wildlife habitat and unsurpassed recreational opportunities. It is estimated that California's forests store and filter more than 60% of the state's water supply and store massive amounts of carbon, assisting in our efforts to combat climate change. For these reasons, it is imperative that forest management strategies and adequate funding that significantly increase efforts to improve forest health and resilience are part of the climate conversation. This includes, but is not limited to, focusing attention on both forestry and grazing practices that can help restore forest and rangeland health, increasing our resilience to fire, and reducing fuel load on our National Forests. We must also direct resources toward reforesting the vast areas that have been harmed by recent fires.

We would also ask that the Subcommittee consider the immense impact of wildfire on agricultural producers due to the onset of a changing climate, by ensuring that sufficient disaster assistance, such as the Wildfire and Hurricane Indemnity Program Plus (WHIP+), is made available to agricultural producers who experience production losses caused by wildfire. Additionally, we urge USDA to consider making grants available to rural communities and producers to replace equipment, infrastructure and fencing damaged due to wildfire.

Climate-Smart Agriculture & Forestry Practices

Because agriculture provides society with numerous benefits including, but not limited to, food security, environmental benefits and community stability, California Farm Bureau believes it is critically important that we consider the economics of the farm when considering new climate policies. Only in working together can we achieve climate solutions that not only make agriculture more resilient, but our country stronger because competitiveness and productivity are not hampered.

California's farmers, ranchers and foresters are at the forefront of promoting soil health, utilizing water resources efficiently, enhancing wildlife on working lands, efficiently applying nutrients and caring for their animals. Through investment in agricultural research and adopting practices that improve productivity while enhancing sustainability, California's producers have a proven history of innovation. Conservation is widespread in California agriculture. Our farmers and ranchers have been managing soil health and conserving natural resources for generations and have a proven track record of doing more with less.

Examples of this include applying precision agricultural practices focused on methods that keep our soil, water and air quality as sustainable and healthy as possible. Strategies include water recharge, irrigation efficiency, energy conservation, energy production and investing in farm equipment with cleaner emissions. Depending on the operation, some farmers have also found that diversifying their operation helps make certain that their soil never fatigues. They work with a variety of different crops on the same ranch that are designed to work together. This can help stop soil erosion while keeping the ground fertile. Crop diversification can also help the producer remain economically secure because no single crop makes up most of their income.

Title II Conservation Programs in California

Title II, the conservation title of the farm bill, incorporates several voluntary conservation initiatives that provides California farmers, ranchers and foresters with additional ability to adopt numerous conservation practices while improving agricultural production. California's producers utilize the tools included in title II to help maintain the quality of their operations while also stewarding the environment around them. The conservation title of the 2018 Farm Bill makes up 7% of the bill's total projected mandatory spending over 10 years ($60 billion of the total $867 billion). Within title II, we urge the Subcommittee to focus on the working lands portion of theconservation title.

Environmental Quality Incentives Program

We are very appreciative of the many improvements that were made by this Committee in the conservation title of the last farm bill. Of the conservation title programs, the Environmental Quality Incentives Program (EQIP) is by far the most utilized program in California assisting producers in achieving greater conservation goals. We particularly thank you for including funding for air quality incentives, which has been incredibly important to farmers in California who face strict air standards. EQIP has assisted farmers in making great strides in the areas of air quality and water conservation and we believe additional opportunities exist.

The 2018 Farm Bill also focused on enhancing the flexibility of conservation programs to meet producer needs and it is important that any changes to title II do not walk back those flexibilities. California producers largely turn to the Environmental Quality Incentives Program (EQIP) because of its flexibility and wide array of uses. For this reason, California Farm Bureau was extremely supportive of the 2018 Farm Bill's expansion and reauthorization of EQIP with increased funding levels.

In 2020, California had 1,473 active and completed EQIP contracts over nearly 408,000 treated acres of land. EQIP assists producers with making beneficial, cost-effective changes to production systems, including, but not limited to, addressing resource concerns related to organic production grazing management, fuels management, forest management, crop and livestock nutrient management, pest management, irrigation management, adaption and mitigation to increasing weather volatility, and drought resiliency measures.

To help ensure climate benefits are adopted, the Natural Resources Conservation Service (NRCS) could consider prioritizing EQIP contracts that result in a reduction of emissions, boost carbon sequestration, and provide climate resilience in addition to the practice areas listed above. This would help ensure that positive climate benefits are identified and adopted as part of current and new EQIP contracts, encouraging producers to continue to adopt new climate stewardship measures voluntarily. Given the diversity of the agricultural sector, especially in states like California, we must also emphasize the importance of contacts remaining flexible for all crop types and practices. This change in prioritization would also need to be accompanied by proportionate levels of financial and technical assistance.

Conservation Innovation Grants

Feed, genetics and nutrition management should be eligible under the Conservation Innovation Grant (CIG) On-Farm Trial Program. CIG on-farm trials are a critical tool for farmers to test and prove new practices with reduced risk. While trials around feed additives and genetics are not explicitly excluded, it is also not clear that they are included. Inclusion would provide additional opportunities for farmers to test the newest technologies and evaluate their impact within their operation.

Regional Conservation Partnership Program

The Regional Conservation Partnership Program (RCPP) offers producers the opportunity to work collaboratively with NRCS and other conservation partners to work together and expand voluntary, private lands conservation. For this reason, California Farm Bureau was supportive of the change in the 2018 Farm Bill that reconfigured RCPP as a stand-alone program with its own funding and producer contracts.

Currently, California Farm Bureau is still collaborating in a RCPP partnership with other organizations in the California Bay-Delta region to address the decline of the Tricolored Blackbird. The geographic focus of this RCPP project is in the San Joaquin Valley where nesting of Tricolored Blackbird colonies on agricultural fields conflicts with producer's harvest schedule. This conflict has represented a unique challenge of finding a balance between natural habitat, protecting colonies on agricultural lands and supporting the livelihood of our dairy farmers. While the program has been successful in numerous ways, consistency in funding assistance and funding levels has been a challenge. As we seek to add additional climate-smart practices, this RCPP project is an example of the importance of funding sources being consistent, sustainable and long-term if our expectations of producers are also long-term.

Conservation Reserve Program

There has been much attention on the Conservation Reserve Program (CRP). Compared to other states, California is a relatively low user of this program with less than 100,000 acres enrolled in CRP. As mentioned above, within title II, we urge the Subcommittee to focus on the working lands portion of the conservation title in help keep working lands working.

Title II Conservation Program Recommendations

California Farm Bureau supports enhancing and expanding the ability for growers of all agricultural commodities to be able to voluntarily participate in climate-smart agriculture and forestry practices that help to sequester carbon, reduce greenhouse gas (GHG) emissions and build climate resilience. Additionally, we are aware of legislation and proposals seeking to address the current borrowing authority of the Commodity Credit Corporation (CCC). Absent additional, sustainable and long-term funding for climate-smart agriculture and forestry practices added to title II conservation programs, we also urge the Subcommittee to consider the additional pressure this could place on the CCC and the important programs the CCC funds.

CCC funding is a critical tool for agriculture. As more demands are put on the CCC, it is important to ensure sufficient funding remains for existing core programs. For that reason, California Farm Bureau is supportive of updating the CCC borrowing amount. In California, farmers and ranchers heavily rely on programs funded by the CCC such as:

Market Access Program & Foreign Market Development Program

California farmers and ranchers need continued investment in the Market Access Program (MAP) and the Foreign Market Development (FMD) Program. The twin challenges presented by the ongoing COVID–19 pandemic as well as spikes in competitors' export promotion programs and activities highlight the need for continued investment in these public-private partnerships. In 2019, California exported nearly $21.7 billion in agricultural goods. Programs like MAP and FMD will continue helping us export to current markets as well as new and emerging markets. It is critical the CCC funds be used for these programs to help U.S. farmers, ranchers and food exporters keep pace and to help us make up for lost time after 2½ years of trade conflict and retaliatory tariffs.

Market Facilitation Program

As trade negotiations and tariff issues persist, it is important that we continue supporting our farmers and ranchers through policies and programs such as the Market Facilitation Program (MFP). MFP was created to help those who were impacted by the retaliatory tariffs which resulted in the loss of certain exporting markets. The MFP helped address the financial hit farmers took due to the tariffs. Although the program did not provide relief to all producers, it did help the dairy industry, along with walnuts, pecans and table grape growers in California.

Coronavirus Food Assistance Program

Direct payments through the CCC to producers impacted by the pandemic have played a big role in providing much needed relief to keep them afloat. California farms collected nearly $1.8 billion in CFAP payments with most of these payments going to producers in the Central and Imperial valleys of California, regions with large amounts of dairy, fruit, vegetable and nut production that have traditionally received little to no direct USDA assistance.

Livestock and Disaster Programs

California farmers and ranchers heavily rely on disaster programs and aid as drought and wildfires continue to worsen in the western states. While not all disaster programs are funded by the CCC, our members continue to utilize those that are. Whether it be the Dairy Margin Coverage (DMC) program, Livestock Forage Program (LFP), Livestock Indemnity Program (LIP), Emergency Assistance for Livestock, Honeybees, and Farm-raised Fish (ELAP) or others, California producers cannot afford to see a funding shortfall in any of these programs that they, unfortunately, continue to utilize.

General Climate Policy Recommendations

As this Subcommittee reviews title II conservation programs and how to encourage the voluntary adoption of climate-smart agricultural and forestry practices generally, we urge Members of the Subcommittee to consider the following:

- Policy analyses characterizing domestic U.S. crop and livestock systems should reflect American agriculture's leadership globally in sustainable farming practices. Policy changes will have real world impacts on farmers, ranchers, foresters and the rural communities that depend on them. For this reason, it is important that the Subcommittee continue to engage a broad spectrum of opinions, especially producers who will be directly affected, as it is doing today.
- Retroactive efforts or incremental improvements undertaken by agriculture leaders to reduce greenhouse emissions and/or sequester carbon must be fully eligible to participate and receive applicable compensation. Many farmers and

ranchers in California have been incorporating climate-smart practices, such as cover cropping, no-till farming and compost application, on their operations for years. These producers should be acknowledged and appropriately rewarded for their work.

- The Subcommittee should consider how the overlay of any new Federal policies and programs will impact existing state climate policies and programs. Additionally, the Federal Government should consider ways to partner with state departments of agriculture as appropriate. Recently, the California Department of Food and Agriculture (CDFA) has been holding stakeholder meetings to solicit feedback on ways to boost climate resilience, greenhouse gas mitigation and food security. This work will eventually inform scoping plans, as well as ongoing and future work, associated with state climate laws. We support the Federal Government following a similar approach where crop specific, producer feedback is solicited.
- To further the adoption of on-farm climate-smart practices, we must not only compensate early adopters, but also assist those being expected to do more. This will require a sustainable, stable and long-term funding source for both financial and technical assistance. Additionally, funding parameters attached to farm characteristics, such as size or adjusted gross income levels, should not apply. We also request that the Subcommittee consider how much funding will be allocated to non-farm intermediaries who may divert funding to narrow or non-farm-related purposes.
- Consider the diversity and scale of American agriculture. There has been much discussion on the role of cover crops in climate-smart agriculture. While cover crops can be an effective tool, California produces more than 400 different commodities and has a variety of cropping systems and farm sizes. A one-size-fits-all approach, or emphasizing only one or few practices, will not be the best path forward for American agriculture, especially in states like California that produce large amounts of specialty crops among others.

  Additionally, some crops are more cost-intensive to produce and may be grown on higher-value land than other areas. The cost of production per acre as well as the value per acre of each crop will influence which practices and which incentives are most attractive. For these reasons, we encourage the Subcommittee to be broad and inclusive, emphasizing a menu of practice choices as opposed to a prescriptive checklist. Every farm, every ranch, and every field have a different story to tell. Producers should be able to choose which outcome-based practices best fit their operation.
- Access to technical assistance from USDA staff, USDA Technical Service Providers (TSP), Cooperative Extension specialists, and crop advisors is critical to assist farmers, ranchers and foresters with planning and implementing conservation practices. Being inclusive of these groups will help maximize reach and enhance program delivery. We also support a streamlined approach to TSP certification.
- Climate-smart agricultural practices must be grounded in science but also field-trialed to prove that they have practical applicability for farmers to undertake. Technologies and conservation practices that are readily understood, scalable and easy to implement will likely be the most utilized. Implementing an on-farm change with a full understanding of its tradeoffs (pests, costs, regulatory ramifications, *etc.*) is also important. This should be coupled with funding and emphasis on agricultural research and extension. Additional technologies, traits, and production practices are far more beneficial than burdening the economy with additional, prescriptive regulations.
- The overarching goal should be to keep working lands working. We oppose pursuing practices that do not consider and encourage the economic base value of the property. For farms and ranches to meet their conservation goals, they must also be able to meet their economic goals.
- Consider the nexus between the lack of broadband in many agricultural areas and the modern use of precision agriculture equipment. Precision agriculture tools and practices can result in quantifiable benefits for both the farmer and the environment. However, it is very difficult to implement such practices if the farm location lacks adequate connectivity.
- Farmers have only so much control. California's farmers and ranchers continue to farm amidst great uncertainty when it comes to reliable water supplies and cyclic drought. Drought followed by wet years has recently illustrated what both extended drought and extreme rainfall cycles look like with inadequate water infrastructure. If longer and drier droughts coupled with powerful floods are the

future of California's possible larger climate trend, it means we must do a better job of investing in water infrastructure and capturing water resources when they are available.

Conclusion

On behalf of California's farmers, ranchers and foresters, I appreciate the opportunity to come before the Subcommittee today and share our perspective on climate strategies that impact American agriculture. Having faced many climate initiatives at the state level already, California Farm Bureau is well equipped and stands ready to assist. Thank you for the opportunity to testify.

The CHAIR. Thank you very much, Mr. Johansson.

At this time, Members will be recognized for questions in order of seniority, alternating between Majority and Minority Members. You will be recognized for 5 minutes each in order to allow us to get as many questions as possible. Please keep your microphones muted until you are recognized in order to minimize background noise.

I will begin by recognizing myself for 5 minutes.

But before I begin, I would like to offer a USDA report, *Cover Crop Trends, Programs, and Practices in the United States,* for the record.

[The report referred to is located on p. 55.]

The CHAIR. Mr. Isbell, in addition to reduced soil erosion, improved water filtration, and greater weed and pest suppression, cover crops provide important environmental benefits, including carbon storage. And according to the latest report, cover crop adoption increased by approximately 50 percent from 10.3 million acres in 2012 to 15.4 million acres in 2017. While kind of rather modest in terms of national cropland acreage, the report does demonstrate that programs like CSP and EQIP are helping to drive practice adoption.

In your opening statements you did talk to some degree about the ways that implementation could be improved. You talked about some of the programs being too restrictive, the value of technical assistance, particularly post-implementation.

But, I was wondering if you could speak to the importance of these programs, EQIP and CSP, in achieving greater carbon sequestration through practices like the use of cover crops because, as we here in Congress are debating policies that are investing in expanded economic opportunities and combating the climate crisis, I want to have a firm understanding of the practical impact on growers and producers. If we are thinking about potentially making additional investments in these voluntary and incentive-based programs while also increasing funding for technical assistance, I am curious what your thoughts would be in terms of what that would mean for you on the ground.

Mr. ISBELL. Thank you. Absolutely.

So forages and grasslands have the greatest ability to sequester carbon in that the carbon is then stored in the soil. And so the greatest flexibility to increase carbon sequestration is by cycling those forages and grasses via grazing, haying, mowing, and so. And that is what we have been able to do with our cover crops utilization. And by doing so, not only are we sequestering more carbon, but we are also able to cycle and retain nutrients, free up nutrients that are previously insoluble in the soil, and then also, more impor-

tantly, build organic matter which increases our water-holding capacity, thus drought-proofing.

And so, with utilization of these programs and these conservation practices, we have been able to increase our financial bottom line, and in that, we are able to produce more forages, more crops, despite direct potential drought or lack of rainfall, because of the building of that organic matter, in addition to capturing the nutrients, which then reduces the need for additional fertility application.

I think that it is important to continue these fundings and then also to ensure that the technical assistance is there to follow through with the farmers to actually be able to show them the long-lasting financial and environmental benefits from these programs.

The CHAIR. Thank you very much.

Dr. Paustian, in your testimony, you noted that, while payments from our working lands program, like EQIP and CSP, can help cover some of the initial costs of embracing some of these conservation programs, they don't often cover the full cost of the practices experienced by farmers up-front. You also noted that, while on-farm benefits like improved soil function and yield stability can help pay for these benefits, there are still significant barriers in adoption of these practices.

So, given that, I am curious: What value do you see in helping farmers gain access potentially to private carbon markets that provide additional revenue streams for growers who may choose to adopt these practices?

Dr. PAUSTIAN. Thank you, Chair Spanberger.

I certainly think there are opportunities, and they are growing, for farmers to monetize, if you will, some of the ecosystem benefits that they are creating with these practices. I mentioned in my opening remarks that a number of industries are interested in carbon drawdown, and soil carbon offers a way to do that.

As long as farmers can participate and get a fair return and are able to implement the practices that work well on their operations, then it is certainly an opportunity that would be good to see if it could increase.

I will mention another thing, and that is that the farmers also have potential to get a premium on their products if consumers are looking to pay more for low-carbon products that are produced in the agriculture space, and we see increasing interest in that, and so that is another way in which farmers can increase their bottom line to help cover this transition period in particular.

The CHAIR. Thank you very much, Dr. Paustian.

Certainly, as consumers learn the benefit of, let's say, grass-fed beef, understanding actually the environmental impact as well of making food choices along those lines, is important and particularly helpful for the producer.

Continuing on, I now will recognize Ranking Member LaMalfa for 5 minutes.

Mr. LAMALFA. Thank you again, Madam Chair.

To my neighbor, Mr. Johansson there, California Farm Bureau, thank you for your testimony today and for your good work.

Let me jump right into it here. Now the conservation programs and the conservation title we have had in the farm bills, they are currently oversubscribed. There are more farmers applying for them than are really able to utilize it. How do you think, if we are moving into new programs, is this going to take away from the current ones we have in place with EQIP, *et cetera?* Ought not we prioritize the existing ones that are indeed very well-liked and voluntary, is I think a key point? What are your thoughts on that?

Mr. JOHANSSON. Well, the important part of any conservation program, coming out of the USDA is also, how does it work with state programs as well to further those Federal dollars? We can do that at the state level. We have a Healthy Soils Program here in California that has been successful, administered by the California Department of Food and Agriculture but also works well with NRCS conservation practice standards. It also is a practice ironically that uses the COMET-Planner, which we are discussing here today as well to implement.

I think it is that we also have programs here in California in terms of equipment replacement for more efficient tractors, irrigation pumps as well.

I think it is a good thing that we are over-prescribed. But, we have to figure out how we engage the private market as well, since there are consumer benefits to this, who can also participate, because it is always going to be a level, and that is one of the things. We can have these programs for farmers, and one of the problems we have here in California is the inconsistency of funding. You start a program, and then the next year maybe the funding isn't there to do it.

Mr. LAMALFA. Yes.

Mr. JOHANSSON. I think it is vitally important that, as these programs are over-prescribed, unless we can get more funding for it, that we leverage and prioritize with those states and those farmers who bring in additional dollars.

Mr. LAMALFA. Well, that looks like we will either have to boost funding on the current programs and discover new funding for a new direction or we are going to see these current programs perhaps be reduced in order to go in a new direction. That is my concern on that.

Mr. Johansson, also, please we had some very compelling testimony by our neighbor, a great guy, Dave Daley in the Natural Resources Subcommittee on National Parks, Forests, and Public Lands last week on the fire situation over there in east Butte County and one that is kind of a microcosm of much fire all around the country.

What do you see we should be doing to further prioritize on our forest management, as you mentioned your own area being evacuated? And then the litigation that seems to bog down, as I kind of alluded to in my opening statement, that bogs down any management or salvage operations needing to be done for making forests healthy and good carbon grabbers, so to speak.

Mr. JOHANSSON. Yes, Dr. Daley, a tragic story. I would encourage everyone to look him up and his story, the generations he spent up there in the Plumas National Forest. Now will be probably multiple generations before forests return to normal.

But we are seeing that in California as we saw 4 million acres burned in California. Believe it or not, while it is a record in the modern time, in the early 1900s, it wasn't unusual for 8 million to 9 million acres to burn at a time in California. As we say, California is either under water or it is on fire. And how do we appropriately deal with these natural disasters? And it is about management, and we have great resources in California. Whether it is our soils that produce for different commodities or our forests that at one time really fueled rural California, particularly in the Redwood Coast, where I grew up in Humboldt County, working summers at the Pacific Lumber Company, but it has changed.

And with any amount of resources that we have and if we define what a *resource* is, that which is to be used for economic gain or in a time of need, that is what we have in California, a lot of resources. However, we haven't properly managed it. The opposite of what happens with a resource we have proven has become a liability. And the same also goes with the recent drought declaration so soon after the last emergency drought declaration that we had in California.

How do we manage our water as well? As we know, the temperatures are changing. Lake Oroville, head water, state water project, is 4 miles as the crow flies from my farm, is dependent on snow. And Lake Shasta, which is the Central Valley Project, the Federal project, it is dependent on rain for the most part. But we know that the snowpack, which this year we saw 500,000 extra acres disappear because the snow didn't make its way down the mountain. We have to adapt to either expand our advantage in those high runoff periods or also important part that we are discovering is groundwater recharge.

We have to manage our resources better and how to return funding and profitability to our forests because simply if the National Forests aren't being properly managed, as we have seen in the private forest, it gets overwhelmed with fuel and great destruction happening on private property as well.

Mr. LAMALFA. Yes, great point on that at the end there with people around here don't understand why we have the funds like Secure Rural Schools that make up for the forestry that used to cause timber receipts to help keep local schools and local county roads up. That was the impetus for that. So, without the forest industry, instead, we get millions of acres of fire with this lack of management. I appreciate that testimony.

And I will yield back. Thank you, Madam Chair.

The CHAIR. Thank you.

I now recognize the gentlewoman from New Hampshire for 5 minutes.

Ms. KUSTER. Thank you, Madam Chair.

I appreciate the opportunity, and I appreciate this Committee. It is great to be back on the Agriculture Committee and the Conservation and Forestry Subcommittee this Congress.

I do want to begin by noting the dedication and commitment of farmers and foresters in New Hampshire to reducing emissions and mitigating climate change on our land. Many have already undertaken practices like tillage management, crop rotation, and the use

of cover crops. Sometimes it is on their own initiative, but often it is through participation in the title II programs.

In the Granite State, we are lucky to have an incredible team at the USDA Natural Resources Conservation Service, NRCS. The staff understand our unique agricultural needs of our region and are terrific partners and technical advisors for both farmers and foresters. They expertly manage New Hampshire's participation in NRCS programs, including enrolling over 55,000 acres last year alone.

While programs like EQIP and CSP are much relied-upon staples in the Granite State, NRCS fosters many other climate-smart practices that support our region. Just last month the Merrimack River Watershed Council received nearly $7 million in RCPP funding to conserve land, enhance climate resilience, and restore wildlife habitats in our watershed. This type of public-private partnership is truly a win-win. Critical farm and forest lands are safe, while the water supply for cities like Nashua are also protected.

Additionally, NRCS has supported unique projects like the construction of a high tunnel at the New Hampshire Technical Institute in Concord that was completed just last week. The tunnel will allow beginning farmers to field test farming and conservation techniques right on campus. And I am always excited to hear about these types of projects and look ahead to the next farm bill. I am eager to explore how Congress can strengthen NRCS' role in combating climate change in the years to come.

On that note, Dr. Paustian, I was very interested in your research concerning carbon capture in agricultural soils. And I am curious how you see working forests fitting into the broader picture. Based on your research or your colleagues', would you have recommendations about how NRCS programs can best support carbon capture in our working forests?

Dr. PAUSTIAN. Well, thank you, Representative Kuster.

I think there are several opportunities that are both in working forests, as well as in forests in agricultural lands, if you will, things like agroforestry, and Ms. Ratcliff mentioned silvopasture in her operation, and these kinds of systems, as has been pointed out, can both sequester carbon in the soil but also in the biomass—in woody biomass, it persists for a long time—as well as providing shade and other ecosystem benefits and those kind of things. NRCS does have a pretty active involvement in agroforestry systems, as they do also in working forests.

I would say, in general, in most—if you think of private forest land as forest land, so they are just producing wood or wildlife habitat, these sorts of things, probably the key quantity for carbon sequestration is still in the biomass carbon, and most of the work involved in how do we manage the vegetation to optimize forest health, as well as carbon sequestration, really focuses primarily on the biomass.

But certainly, there are, in instances like afforestation or reforestation and to the extent that NRCS provides advice on that, then there are soil carbon benefits that also accrue with reestablishing forests on, for example, degraded lands or other things like that.

Ms. KUSTER. Good. Thank you.

Just quickly, Mr. Isbell, I am glad to hear of your work that you are doing. I appreciate your collaboration with groups like 4–H. Briefly, could you tell us more about encouraging farmers, including young and beginning farmers, to adopt good conservation practices?

And I apologize. My time is almost up.

Mr. ISBELL. Thank you, Representative Kuster.

We do a lot of outreach, and I think that within the farming community, farmers are rather slow to adopt new practices, and so that is why the importance of having field days, outreach to neighboring farmers is the greatest opportunity to actually show financial and physical benefits from these conservation practices and which then we have seen our neighboring farms and farmers who have attended our events to start to implement some of these conservation practices because of being able to see and talk to somebody who has been doing it and realizing those benefits.

Ms. KUSTER. Great. Well, thank you so much.

And, with that, I yield back.

The CHAIR. Thank you.

I now recognize the gentleman from Georgia for 5 minutes, Mr. Allen.

Mr. ALLEN. Thank you, Madam Chair.

And thank you to our witnesses for being here today. To all of our witnesses, I would like to say thank you for offering your time and expertise, particularly those of you that are our farmers and ranchers because I know this is a busy time of year.

Climate change is clearly the topic of this Congress. We have already had innumerable briefings, Member meetings, hearings, and proposed legislation over the past year or so to address it.

However, when I am in the district, this is not an issue that I hear frequently about. As a matter of fact, it wouldn't even make the top ten. What my constituents are more concerned about, particularly in agriculture, is labor.

I have spent the last several weeks in the district, meeting and communicating with constituents. And I will tell you: they have a lot of concerns. In fact, right now, I understand in Atlanta, Georgia, there is no gas, already lines. You know, there are pipelines down. We have a war on fossil fuels, and it is chaos everywhere, the border, major cities, a lot of things that we need to be addressing, but certainly none more important than agriculture because if certain people get control of this country, I believe climate change is going to exceed starvation.

And that is what we are talking about here is the food needs of the country. In fact, there are many leaders, one business leader, in particular, said that we need to go to synthetic beef, and so I don't know where all this is coming from, but, obviously, it affects many of our witnesses here right now.

The other thing is skyrocketing lumber prices. This is the Subcommittee on *Forestry*. And, it is adding $35,000 to the cost of an average home in my district. Obviously, gasoline is up. Food prices are skyrocketing. Folks, we need to get to work on these issues that are affecting the American people. And we got to do it quick.

The best conservationists in the world are our farmers, and what we have done from a technological standpoint is amazing, and cer-

tainly we want this Congress to help with these conservation issues. But, at the same time, it does not need to be top-down, one-size-fits-all by a bunch of intellectuals in Washington, D.C. It needs to be bottom-up, as the testimony from Ms. Ratcliff, on how—the practices she has put into place, which I was very impressed with, to be successful and to sell some of the finest beef, I would propose, in this country.

As far as the academic study called, *World Market Conditions Suggest Set-Asides Not an Effective Farm Policy for Corn and Soybeans,** argues that set-aside programs are not an effective farm policy because it sends a market signal to our competitors to plant more.

Mr. ALLEN. Dr. Paustian, how concerned are you that by idling tens of millions of acres in the U.S. we could very likely be exacerbating greenhouse gas emissions as our competitors respond to take the U.S. market share here?

Dr. PAUSTIAN. Well, thank you, Representative Allen, for that question. I am not an ag economist, but I have studied the question some. My understanding is that the things like the Conservation Reserve Program as currently configured is not leading to markedly increased commodity prices that would be a driver then of, say, agriculture expansion on forest lands in the tropic or something like that. That is certainly my understanding.

Another thing I would point out about some interesting research going on now is also looking at our—even some of our most productive lands in the Midwest, for example, have areas within the field that are actually unprofitable. And so, as farmers add seed and fertilizer, they actually, if you look at it in a detailed view of the field, they are, in fact, losing money year-in and year-out on particular areas within the fields.

As we get these kinds of understandings of maximizing profitability and how farmers utilize the land, things like, for example, putting in perennial grasses and buffer strips within areas of the field that are not productive can actually maintain production but also improve the bottom line for farmers.

We have the opportunity to look at a more nuanced way of going forward with some of the technologies we have now to obviously keep our agriculture production at the highest level in terms of quality products and enhancing farmers' income but also maintaining, yes, protection for sensitive lands or lands that are not necessarily well suited for production.

Mr. ALLEN. Thank you, sir.

And, unfortunately, I am out of time. Madam Chair, I apologize.

And I yield back.

The CHAIR. I now recognize the gentlewoman from Washington for 5 minutes.

Ms. SCHRIER. Thank you, Madam Chair. And thank you for convening this hearing.

Thank you to our witnesses. First, just some comments. I would like to speak about an issue of critical importance in Washington

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*__Editor's note:__ the *farmdoc Daily* article is available at: *https://farmdocdaily.illinois.edu/2020/07/world-market-conditions-suggest-set-asides-not-an-effective-farm-policy-for-corn-and-soybeans.html*.

State, which is the status of the State Acres for Wildlife Enhancement, or the SAFE Initiative.

In Washington State, these state acres are particularly critical for two native birds. Sage grouse are currently state listed as threatened, and sharp-tailed grouse are state listed as endangered, and their population estimates in 2019 were only 677 and 834 individuals, respectively. Most of the habitat remaining to support prairie grouse in Washington State is on private lands. And the Conservation Reserve Program, CRP, and SAFE, in particular, is really one of the only programs available to conserve this habitat and these acres at meaningful scale.

Now, there is a cap on the number of acres of environmentally sensitive land that the CRP program will pay landowners to farm or not to farm per county and the SAFE acres used to be eligible for a waiver to exempt them from those acres, but because of provisions in the 2018 Farm Bill that is no longer the case. Limiting the acreage that CRP will support by including SAFE lands in that overall number will remove financial incentives for farmers to conserve that land and will have a devastating effect, not just on soil and water but also on these wildlife resources, like the threatened sage grouse and the sharp-tailed grouse on private lands.

So should those SAFE acres remain ineligible for exemption, sage and sharp-tailed grouse conservation efforts could falter as nearly 50,000 acres of CRP land expire and this could leave our farmers subject to violations further endangering these birds. I wanted to ask about reinstating these waivers. I will be sending a letter to FSA Administrator Ducheneaux asking about the best way to reestablish this waiver process and I wanted to bring this to your attention.

Now, I also want to touch on other conservation programs, including the EQIP program, which provides financial and technical assistance to agricultural producers looking to conserve natural resources on their farms and ranches. And through EQIP, the Federal Government provides producers the financial resources and the one-on-one help to plan and implement conservation practices that can lead to cleaner water and air, healthier soil, and more resilient crops all while improving agricultural productivity, as we have heard about already.

EQIP worked so well for the farmers and producers in my district that I have recently heard of some concerns, concerns specifically about the reimbursement rates that NRCS uses being out of date and not really reflecting the true cost of the practices being implemented. This is especially true in urban or semi-urban areas where the costs are so much higher.

So, for example, an EQIP supported irrigation efficiency project in Pierce County, NRCS's reimbursement rate came back at only 31 percent of the total cost forcing the local conservation district to pony up $89,000 to cover the shortfall.

I have a question for Mr. Johansson. You talked about the EQIP program and its importance in California. Have you come across similar issues with reimbursement rates in the farm bill's conservation programs? And given this, how can we better incentivize climate-smart ag practices?

Mr. JOHANSSON. Well, certainly, like I mentioned in my opening statement, it is the most popular program in California, EQIP. Currently, I believe we have 1,400 different EQIP projects covering about 400,000 acres. The reimbursement rates are going to be, are always a question in terms of it makes sense and it depends on what the time is. And right now, any type of irrigation adjustment—if you are going out trying to source any sort of irrigation, it just simply isn't there.

I think Representative Allen had mentioned that we are in a scarcity time for whatever reason when it comes to either timber or also steel. Yes, certainly that has to be taken into account, and that is something that, in California where it is extremely expensive to do business, as it turns out most probably like Washington, too, those rates, there can be an inequity in terms of the reimbursement rates.

Ms. SCHRIER. Thank you. I yield back the remainder of my time. I appreciate it.

The CHAIR. I now recognize the gentlewoman from Illinois for 5 minutes.

Mrs. MILLER. Good afternoon. It is great to be on here. I am a farmer and we implement these practices on our farm, all of them, and we have had great success, but I do have a question for Mr. Johansson. We have observed two issues, and I was wondering if you have any ideas/solutions for this. One is that the other—so we are in the minority of using these practices—cover crops, crop rotation, no-till rotation, and all that, but other farmers will tell us that they want to implement these, but they sharecrop or they are cash renting their land, and the owners are not open to these conservation practices.

And where we are, our big issue is soil erosion because of very flat land. It is the best soil in the world, and our topsoil is running down to the Gulf. If we could just do cover crops and reduced-tillage, that would be fantastic.

So does anybody or do you have ideas of how to motivate the landowners to want to get on board with these practices?

Mr. JOHANSSON. And that is a difficult part in terms of the long-term investments, a lot of these programs are, especially with rented land. And, are landowners willing to sign those long-term leases? Putting in fence that can last up to, for a good organic grazing kind of methods, is a 10, 15 year investment. I think that there could be a part of it, in terms of landowners, outreach to them. They are probably, maybe a generation removed. A lot of times in California, the land that is being rented, the owner actually lives maybe in San Francisco or Los Angeles. I haven't really thought about how we engage the landowner, but certainly, I mean, it is an education part of it. But I would think that most landowners I know, as a first-generation farmer, the first time I tried to go rent land, I lost to the guy who had been farming for 40 years because the landowner was more assured that he knew the practices that would keep that land productive and keep it going.

I think there could be part of the outreach that would have to get in to, and we certainly do at Farm Bureau in terms of outreaching to the urban communities of what we are already doing on our farms to adapt smart agricultural climate practices.

Mrs. MILLER. And I have one other question. Another thing we have observed is—so I have seven children, and several of them have gone to universities, and some have gone to the local community colleges, and some have majored in ag production. And our observation is that the community colleges seem to be slower about teaching these conservation practices than the universities. And I was wondering if you had any ideas for solutions on that end?

Mr. JOHANSSON. No. I appreciate you bringing that up because one of the things—I see Professor Paustian is on here as well, and he would confer that one thing I probably didn't put into my opening statement, but is in the written statement, is the necessary—is the need to fund education. And, in agriculture, that has been our extension advisors, our extension offices, our UC extension offices will be critically important and critically important parts of climate-smart agriculture. And it has been a funding—a difficulty of funding—funding has been cut in California, but they are critical.

UC Davis is our major research university coming up with great programs, but I farm up in Oroville, Chico State, in that area, Butte County, hour north of Sacramento, a different place to farm, a different climate than say farming in the Salinas Valley or farming down in Kern County. It is important that we have—while we invest in our universities and the agricultural research, we can't forget that, at some point, it has to get down to the lower level, whether that is community college or state schools like at Chico State (CSU, Chico), which has a demonstration farm which is tasked with, how do we apply these technologies at the local level that serves local farmers. And certainly as is right now I am sure in community college in California, with the type of budget cuts at one point we thought we were facing—of course now the Governor's announcing a huge surplus so hopefully that trickles down to more investment in our research, a lot of the first programs they cut is in the agricultural program because it is equipment- or property-intensive cost to do those programs, but you bring up a great point.

It does come to having enough funding to engage both at our community college/state schools but also a cooperative extension, who is a trusted entity for farmers.

Mrs. MILLER. Well, if I may add, I believe it is information more than the funding that is my opinion. But any way, thank you so much.

And I yield back.

The CHAIR. I now recognize the gentleman from California, Mr. Panetta, for 5 minutes.

Mr. PANETTA. Thank you, Madam Chair. Speaking of the Salinas Valley—no. I am kidding.

Thank you, President Johansson, for mentioning the salad bowl of the world in your answers, which obviously I am going to go into where I come from on the Central Coast of California. Like many of my colleagues, I was in the district for the past 2 weeks and having a good opportunity to speak with and have sit downs with farmers, ranchers, and forest landowners. And as you can imagine, the topics that are coming up labor, as labor always does, as Mr. Allen mentioned from Georgia, but in California, obviously, that is a big issue. But then, of course, water and wildfire, what is going

on in our state and what we have been and will continue to deal with when it comes to our drought and then our wildfire season as well.

As many of you know, our Governor expanded the state's drought emergency proclamation to include 41 counties, including San Benito County in my district, and that means that basically 30 percent of California's population is now living in a drought state of emergency. At the same time, many of these places are still recovering from the historic 2020 wildfire season. In my district alone, we endured wildfires in or around my district that affected 650,000 acres that were actually burned, unfortunately. And then we had to go through the post-wildfire effects dealing with the flooding and burn scars as well. And, we can all probably acknowledge that climate change is at the root of these crises, and that is why this hearing is so important today.

I thank you, Madam Chair, for holding it. As we look to reassess and build on our Federal conservation programs, I do believe that we have to ensure that farmers, ranchers, and foresters have a seat at the table in these types of discussions, first of all. Second of all, they have to have the ability to access and fully leverage these programs to save water, reduce wildfire risk, and to ultimately invest in the long-term health of their lands.

Now, Dr. Paustian, in California, you are probably familiar with the USDA's Natural Resources Conservation Service, the NRCS, that has been helping producers employ irrigation water management techniques, including irrigation scheduling.

Can you elaborate in ways that those types of Federal programs can better help producers who are seeking to conserve water, and what are some of the co-benefits of these types of water-saving practices that they employ?

Dr. PAUSTIAN. Thank you, Representative Panetta, and you make a really great point. And that is there is a lot of synergism between things like water management, drought, soil carbon, greenhouse gas emissions, nutrient management. And we are working a lot with NRCS in California but also with the California Department of Food and Ag, and we have actually been working with them recently on developing a new online tool called the SWEEP (State Water Efficiency Enhancement Program) tool, which looks at the co-benefits of water savings from improved irrigation management systems on things like water savings but also greenhouse gas emissions.

There is a lot of room for, yes, for improving programs that support conservation practices that are, if you will, holistic, that look at the multiple benefits of not only carbon storage, greenhouse gas, but water use efficiency and nutrient use efficiency and things of this nature. It is really key that we take that approach, and, fortunately, I would say that the conservation practices that NRCS has defined and which are supported by these different programs, one of the real virtues of them is they have these multiple benefits. They are, in general, they help the health and productivity of the systems, and so there is not so often that you have major tradeoffs: Oh, I want to save water; oh, that is going to hurt my carbon.

It tends to be synergistic.

Mr. PANETTA. Okay. And I appreciate that, and I agree. And, look, I just want to follow up real quickly on Mrs. Miller's line of questioning of how we get the benefits of no-till farming and cover cropping, but, man, in my district, we have specialty crops, and we don't have the water resources necessary to do that.

Can you assure us that the Federal conservation programs can better take into consideration these realities of the different crops throughout our nation?

Dr. PAUSTIAN. Well, I can't really speak for USDA, but certainly from the scientific standpoint, we understand that there is not a single solution that works everywhere, right? We have to have not only programs, but also the scientific knowledge that is granular, that looks at the particular circumstances in a particular area, particular soil type, climate growing system. I think we can do that, and I think that needs to be, perhaps, emphasized more in policy, but I believe it is to a large extent.

Thanks.

Mr. PANETTA. Great. Thank you, Dr. Paustian.

Thank you, Madam Chair.

I yield back.

The CHAIR. The chair now recognizes the gentleman from South Dakota, Mr. Johnson, for 5 minutes.

Mr. JOHNSON. Thank you very much, Madam Chair. I appreciate it. I agree with so much of what my colleagues have said today and, of course, that is what I hear from a lot of farmers and ranchers. And really any time I am talking to South Dakotans who work in production ag, they emphasize time and time, again, to me two things: First, farmers and ranchers really are a part of the climate solution, and they have contributed so much to the progress we have already made as a country, and they have pride behind that. And then, second, the rural economies really do need production agriculture, and, frankly, the world needs American production agriculture if we are going to continue to feed the world.

And so, with those things in mind, I would like each of the panelists, and we will just go in the witness list order, so Isbell, Ratcliff, Paustian, and Johansson, I have concerns, I have serious concerns, and I know many of my producers have concerns, when they hear about 30 by 30. And I know it is more of a concept right now than a plan. I mean, details are pretty light, but when we hear about setting aside and conserving at least 30 percent of the American land mass by 2030, I think that causes them concern about what does that mean for American competitiveness, what does that mean for a push to feed the world, and what does that mean with regard to environmental stewardship?

So could each of you comment about how you would prioritize these efforts with regard to whether or not we should be idling lands or whether or not we should be focusing on working lands conservation?

And, again, we will start with Mr. Isbell. And if you could each keep your answers to between 40 and 60 seconds, I think that would be fair to the other witnesses. I want to make sure they have time to respond as well.

Mr. ISBELL. Thank you for that. I will take an approach to it. So, for me, the concept of feeding the world and conservation are not

exclusive. They can be synergistic. New challenges require new approaches. Setting aside 30 percent of our land mass and not allowing it for food production is not contributing towards our goal of American competitiveness and feeding the world, but we have to look at the way CRP is implemented, and we have ways to be able to set aside land from tillable agriculture but be able to still produce food in a regenerative way, sequester carbon, but also keep the American edge and provide financial stability for farmers.

Mr. JOHNSON. Is it fair to say, Mr. Isbell, you wouldn't want us to overly prioritize idling land over working conservation? There is a role for both and an important role for working lands conservation. Is that right?

Mr. ISBELL. Absolutely. Working lands conservation should be the number one priority.

Mr. JOHNSON. Very good. Thank you, sir.

Ms. Ratcliff.

Ms. RATCLIFF. And I am in agreement with him. I think my main comment would be is, what is the goal of the 30 by 30? And is the goal actually accomplished by the producer? Is the goal actually going to hit the ground? Is the goal actually something that is ultimately going to affect the producers? Because a lot of times, these programs are implemented without even coming down to people who are producers and asking our input in them. We have to have a seat at the table when it comes to programs that are initially coming out, so we can put our input in and allow us to be profitable and allow us to have some kind of success story when it comes out. I don't know if the 30 by 30 will actually provide that.

Mr. JOHNSON. Oh, Ms. Ratcliff, that is very well said, ma'am. Thank you.

Dr. Paustian.

Dr. PAUSTIAN. Thanks for the question. I would echo what Mr. Isbell said that there is not a conflict between, yes, best regenerative practices on our working lands, and if there are some lands that are not as well suited for production agriculture, that there is this role for some set aside there, but I don't believe the conflict. I think they go together. You know, 30 by 30 is looking at focusing on biodiversity, it is looking at all land covers, and certainly we have deserts and forests and other things where there is a lot of biodiversity. Our working lands can, they can supplement that pollinator habitat, for example, in some of the systems that Mr. Isbell and Ms. Ratcliff manage, I am sure is an important attribute of those as well. So that it contributes to the overall goal of biodiversity maintenance.

Mr. JOHNSON. Dr. Paustian, I have to cut you off to be fair to Mr. Johansson.

Mr. Johansson, any final comments.

Mr. JOHANSSON. I agree with my fellow farmers here on the panel. Focus on working lands, of course, in California, we have already embarked on this with the Governor's executive order, I believe, last January for a 30 by 30 by 2030. We have already engaged in roundtables. And, as we remind the Governor, working lands only work when people are allowed to work them. And if you look at California, which is already at 49 percent public land, both state and federally owned, we can meet that number because farm-

ers at heart are conservationists, and we know that if we look at some of the state programs we have implemented, depending how you look at it, we are already at around 23 to being over 30 percent already working lands conservation.

Mr. JOHNSON. Thank you, sir.

Madam Chair, thanks for your indulgence.

And I yield back.

The CHAIR. I now recognize the gentlewoman from Maine, Ms. Pingree, for 5 minutes.

Ms. PINGREE. Thank you so much, Madam Chair. And thank you for hosting this hearing. I apologize to some of our presenters. I had to go off to a different agricultural hearing for a little while, and if I am repeating a question, I also apologize, but I did appreciate the testimony that I heard.

And, Ms. Ratcliff, you really made a very important point about the barriers to participation for smaller operations and minority farmers. Some of the NRCS conservation programs have set-asides or advanced payment options for historically underserved producers, but it seems like the barriers are still too high for many farmers.

So what recommendations would you make to increase awareness of access to NRCS resources for smaller farms and farmers of color?

Ms. RATCLIFF. Thank you for that question. I think the number one issue is I don't know if they are really coming to smaller producers and looking at our goals. The goal that necessarily NRCS wants and the goal that is actually hitting the ground might be a little bit of disconnect. The number one thing needs to be outreached and figure out what the small producer's goals are and then from there try to move it up. Because a lot of times it is coming down instead of moving up. And it is prohibiting us because we do have some barriers. Our barriers might be because we don't have the cost to actually implement these programs. We need some cost assistance to help implement those programs. We might not even have the resources to implement the program, and we might not have the capacity to aptly implement these programs.

So my first thing is that we need to sit at the table. We need to make sure that these small producers are sitting at the table to help make these decisions and help make these decisions that are good for our operation because a lot of times you come to us and say you must implement these, which we might not have the capacity to implement.

So, please, we need a foot at the table.

Ms. PINGREE. Thank you. I think that is a really important point, and I would certainly hope that new USDA understands the importance of having small farmers, farmers of color at the table, but also to change the way the systems work so we are asking the questions, not just deciding how the system should work.

Dr. Paustian, I want to talk a little bit about COMET-Farm. We often hear that climate change solutions can't be one-size-fits-all, and we certainly know that agriculture doesn't look the same in every part of the country. I represent Maine, and our farmers certainly have different climate-related challenges and opportunities

to reduce emissions and sequester carbon than someone would in the Midwest or California.

So could you talk a little bit about the accuracy of COMET-Farm and accounting for carbon sequestration and greenhouse gas emissions across different types of operations? Yes, that would be helpful to know.

Dr. PAUSTIAN. Thank you for that question. Probably one of the advantages of COMET-Farm is it is really a platform that includes quite detailed data on things like weather and soil types that are down to the field and subfield scale, so you are capturing some of the differences, obviously, as you go across the landscape and certainly from region to region.

The other attribute is that it uses a dynamic model that integrates things like soil moisture and temperature and the conditions that determine the agricultural system's performance. In a sense, it is quite good at capturing these local capabilities. Our basis for how good the model is, is really based to a large extent on our fundamental understanding, but also on field experiments that are out across the nation. And, we utilize sort of all the data that we can from field experiments that have looked at measuring carbon changes over several decades even in different practices.

So we try to integrate all that in there. I do think there are some improvements that could be made that I mentioned in my opening remarks, including development of an on-farm monitoring system attached to the national resource inventory system. Thanks.

Ms. PINGREE. Yes. And thank you for that. I did see those recommendations in your testimony, and it is critically important that we make this a reliable tool and a dependable and credible measurement system. It is important to look at your recommendations, and I have the good fortune of sitting on the Agriculture Appropriations Subcommittee. I will certainly make that a priority to support the system.

With that, I yield back, Madam Chair, and thank you, again, for having this hearing.

The CHAIR. I now recognize the gentleman from Alabama, Mr. Moore, for 5 minutes.

Impeccable timing, Mr. Moore.

Mr. MOORE. Thank you, Madam Chair, and I have a couple of other committee meetings going on as well. This is for Dr. Paustian. I thank you all for appearing today. [inaudible] Leading conservation efforts, often through partnerships with land-grant universities, such as Auburn University, where I graduated, Tuskegee University and Alabama A&M. Would you be willing to go into more detail regarding state programs and land-grant universities support producers in improving soil and water health and incorporating technology such as precision agriculture?

Dr. PAUSTIAN. Now thanks for that question. And, as a number of the other panelists had mentioned before, this outreach to producers is critically important. We have more that we can do from the university side, bringing this information out to farmers. We are actually working with NRCS, as well as some NGOs, including the Carbon Cycle Institute and Mad Agriculture [inaudible] And other universities in developing a curriculum for carbon farm planning that we hope to be launching soon and working with NRCS

so that their technical service providers can go out and help to provide more information about how these new practices work and how they can best be implemented for the particular areas that farmers are in because, as we mentioned before, kind of the site-specific context, things in Alabama are very different than they are in Minnesota or Maine or other places. We really need to have that granularity. And, both the ag college folks as well as NRCS have a key role to play there.

Mr. MOORE. [Inaudible.]

The CHAIR. Mr. Moore, it appears you have a challenged connection. We are having trouble hearing you.

Mr. MOORE. [Inaudible.]

The CHAIR. Mr. Moore, the connection that you have is—Mr. Moore, we are having trouble understanding your question with your connection.

Mr. MOORE. [inaudible.]

The CHAIR. Mr. Moore, we have a connection that is not working with you. We are going to continue on——

Mr. MOORE. [inaudible.]

The CHAIR. Mr. Moore, if you can hear me, we are having trouble hearing you. The connection is quite bad. It appears to be the case for everyone else. We are going to continue on with Mr. Costa's question and come back to you, Mr. Moore, if we get the connection rectified. Thank you.

The chair now recognizes Mr. Costa for 5 minutes. And Mr. Moore, we are going to try and get your connection clearer, and we will come back to you. Thank you so much.

Mr. COSTA. Thank you, Madam Chair, for the Subcommittee hearing. This is an important hearing that the Subcommittee is holding looking at title II and exploring smart climate change practices because I believe American agriculture can play and is playing an important role in reducing our carbon footprint, as well as wastewater waste streams.

I want to underline a comment that our colleague Congressman Panetta talked about that really many of you have spoken to and that is one size doesn't fit all in terms of regional challenges that we face as it relates to our carbon footprint and how we can make efforts. And I am glad that, Dr. Paustian, you indicated that cover crops may have good applications in some areas, but certainly where you have drought conditions in the West, especially in California, as we are experiencing extreme drought conditions, cover crop is just not going to work.

Kimberly Ratcliff, you talked about some of the issues that was raised with my previous colleague about programs for small farmers, minority farmers, and my experience over the years has been that NRCS and Farm Service Administration, frankly, don't have the capability to reach out to small farmers.

In my area, especially, we have cultural and language barriers that exist. Would you agree that we need to do a better job—and I have said that to the current Secretary of Agriculture—in making these efforts with the USDA more user-friendly?

Ms. RATCLIFF. I would absolutely agree. One of the major issues is the locations of a lot of the USDA office. They are so distant from a lot of producers that it is pretty much hard to participate in the

program. If you have to drive an hour and a half just to see someone within the USDA office, it is going to be hard for someone to get off a ranch or a farm that are out there every day to go visit a USDA office. So many USDA offices were shut down. So that is one thing. We need to open up all these USDA offices back up in regions that will assist more producers.

The other thing that is key that can actually help USDA is partnerships. I am going to go back to 100 Ranchers. We have private university partnership and USDA partnership. All of us help get out the USDA requirements. All of us help fill out documentations for producers. If there are more ways for us to partner with private institutions, I think that will be a tremendous help.

Mr. COSTA. And I would agree with you. My time is expiring, but the public-private partnerships are essential, as well as with our colleges and universities, land-grant universities, and I am attempting in California to do just that.

Jamie Johnson—Johansson, I am sorry, my friend. You are doing a terrific job as the President of California Farm Bureau, your leadership nationwide. I have limited time, but you talked about the importance of title II programs, EQIP. I think we are going to get broadband expanded nationwide. It is one of the good things to come out of this horrific pandemic, but I would like you to talk about the efforts that we have had in California in terms of Federal conservation programs to complement California's efforts. Do they work together? Do we need to make changes as we work on additional strategies to help farmers implement climate-smart practices?

Mr. JOHANSSON. Yes. It is fairly—I had mentioned that EQIP does work or our Healthy Soils Program does work well with the EQIP. It is a potential there. The other big program we have, and I know important in the Valley as well, is the FARMER Program, which is the Funding Agricultural Replacement Measures for Emission Reductions program. That is to replace tractors, and so cleaner, more efficient tractors, cleaner engines, cleaning burning engines. It has been a struggle to maintain that funding. Certainly, there could be greater interaction on the Federal level along with that program.

Another important program, and Dr. Paustian had mentioned, it was our SWEEP Program, the State Water Efficiency and Enhancement Program, that we have going on in California that has been successful in conserving around 130,000 acres now annually as we bring in water efficiencies.

If we can use these state programs and the Federal program just to build on each other and expand, there is a lot of opportunities out there.

Mr. COSTA. My time is expiring, Jamie, but you are doing a terrific job, but on the soliciting solutions, I have worked with Karen Ross, our Ag Secretary in California, about the reviews that they have done to assess California's success. I want to talk to you further about how we implement that in terms of a nationwide effort and your thoughts and ideas. I don't know if you care to comment or if we have any—I have no time left, but it is an important effort.

Mr. JOHANSSON. Always happy to visit, Congressman. And all too often, it feels like California kind of we have been down this road

before. I am happy to share our experiences, whether that is a success or even just the burden of new programs sometimes.

As farmers, we get a lot of programs that start out as carrots and can end up as a stick down the road. And we have to remember that, like the climate, it can change and so can conditions on the farm in terms of what works and what doesn't work based on that condition.

Mr. COSTA. Long-term funding commitments are critical.

Mr. JOHANSSON. Absolutely.

Mr. COSTA. Thank you. Thank you, Madam Chair, for allowing me to sit in on your Subcommittee. Let's keep up the good work and work together. You are doing a great job.

The CHAIR. Thank you very much.

And to the witnesses, we have heard from Mr. Moore's office that he will not be coming back to ask a question, but the Committee invites him to submit any additional questions in written form, moving forward.

This concludes the first round of questions. The Ranking Member and I would like to do an additional round for anyone who might have any additional questions.

And so I will begin. Very briefly, Mr. Isbell, I would like to ask you a pretty straightforward, simple question. We have gone into depth in your written testimony and in your spoken testimony as well about the benefits of the different practices and programs that you make use of on your farm, but if you could just tell us a little bit for anybody who might be watching this hearing and not with an agricultural background, not someone who is really focused on these topics, what compelled you to utilize these practices on your farm, and what does that look like from a day-to-day perspective, and why do you keep doing it?

Could you explain kind of more in layman's terms some of the real benefits of the practices that you utilize on your farm?

Thank you.

Mr. ISBELL. Thank you, Madam Chair.

So, for me, when we were growing and developing our farming operation and me being the third generation and my kids hopefully becoming the fourth, for us, it is looking about sustainability. And a lot of people throw around the term *sustainability*, but it is not just about conservation, environmental sustainability, but also financial stability and sustainability. And so, by utilizing these practices, we were turned on to them through a lot of research, talking to folks who have implemented the practices and the benefits that they have seen from that implementation, and that is what led us down that direction.

So, instead of continuing a traditional sense of cropping and livestock raising, we wanted to see—we could see things changing within the environment, within the marketplace and wanting to adapt and knowing that the practices of the last 50 years are not going to get us to the next 50 years.

And so, looking at those and how they would incorporate. And so really we have seen a reduction in our manpower that is needed to accomplish the same goal. We have increased our soil organic matter, which holds more water, which helps prevent us from seeing the effects of the droughts that we are seeing. We are seeing

greater soil biology. That biology then gives us fertility, which allows the plants to grow at a better rate without us having to purchase/implement a nutrition program. We are able to recycle nutrients by incorporating our livestock into our cover crops and our crop rotations. So it is really a synergistic effect. It is not a one-size-fits-all, but it is definitely an approach that, with adaptation, can be implemented across the states.

Of course, with each environment, there are different needs and conditions that dictate different implementation, but it is certainly utilizing a land stacking enterprising operation, allows for both conservation, food production, and economic stability for us.

The CHAIR. Thank you very much for that answer.

And if I could get you, again, for anyone who may not be focused on these issues, the use of cover crops and the use of rotational grazing in pretty basic straightforward terms, what does that actually mean, the use of cover crops?

Mr. ISBELL. Yes, for us, typically, a grain operation would plant a harvestable crop, say, corn, and then they may leave it fallow or empty and not plant anything else until the following year when they would plant, say, soybeans or sometimes, in Virginia, we have a typical three crop rotation where it is corn, soybeans, and wheat in succession. If you leave the land fallow in between with nothing growing on it, the cover crop then takes that place. It allows for you to grow a crop that you are not going to harvest, which captures nutrients to keep them from running off in the off-season. It reduces erosion.

And in turn, when we roll down the cover crop or terminate it mechanically, so what we are doing at that point is we are—and the whole time that cover crop is growing, we are sequestering carbon. The plant that is growing, is pulling carbon, pulling it into its roots. Then, when the plant dies off, we are now adding carbon to the soil, which feeds the biology of the soil. We are capturing nutrients, feeding the soil, growing organic matter, and all this in a time in which the average producer would not have anything growing in the field.

It costs us money up-front, and most farmers, well, why would I spend the money to put in the crop that I am not going to gain anything out of? You see it leave your bank account, but don't see anything come in return. But it requires—to convey to farmers that really what I see when I am investing in a cover crop is I am putting money in the bank for the future. By building that organic matter and soil health, I am putting money in the bank that I will be able to utilize later by having my successive cash crop after the cover crop usage.

And, in turn, with our livestock operation, we are also able to utilize the livestock on those cover crops, periodically grazing them, stimulating vegetative growth, and furthering our sequestering of carbon and building of soil biology.

The CHAIR. Thank you, Mr. Isbell.

I appreciate you indulging me in that question. Living in the county just next door to where you are and representing a district that is suburban and rural in agriculture, it is so important that those who may not have an agricultural background really under-

stand the benefits and the choices that you all are making on your land.

And so I am grateful that you took the time to make that explanation. Hopefully, it will make clear why these programs are so important, and so I thank you for that.

And I now yield to the Ranking Member for a second round of questions.

Mr. LAMALFA. Thank you, again, Madam Chair. I will probably go mostly with Dr. Paustian on this. I want to get into maybe a little technical on no-till and on sequestration. This isn't some political rhetorical question here. I am a farmer in my real life myself, and so we farm rice. We farm it in a certain way that has been successful for many, many years. And so we don't generally engage in the cover crop kind of thing because we don't really have the luxury of time and certainly, this year in California, we don't have the luxury of water to do anything other than trying to grow—whether it is my or any of my neighbor's crops or anybody else up and down the state, we got to grow to try and stay in business this year with what water they have.

And as we have seen, some areas have been cut dramatically. Some were told they are going to get five percent of their normal allocation, now they are going back and taking that five percent. That is from right out of—from Bureau of Reclamation in certain parts of the state. I mean, zero percent allocation. They don't have any options on doing any of this that we are talking about here because it is survival.

Klamath Basin same thing. I mean, it is just incredible how difficult it is going to be this year.

And so—but when we are talking about whether it is no-till and what is sequestered in, say, that top 4″ to 8″, maybe 12″ layer of soil, what are the effects when you do finally go back and till the land to change a crop or put it back into play after it has been idle for 1 year, 5 years, what have you?

The next time you till that ground, are we releasing the carbon that you have just done all the work to try to sequester in the soil? I understand carbon stays sequestered in wood products and things like that that are more or less permanent, but talk about that, Dr. Paustian, and others on the panel that would like to weigh in on that, feel so. Thank you.

Dr. PAUSTIAN. Yes. Thank you, Representative. Yes, when we are looking at soil carbon, we are really trying to essentially manage a balance, right, and what Mr. Isbell said was really important that conservation practices, you are generally trying to accomplish two things to add more carbon to the soil. And one is, you want to, the carbon is in the atmosphere. The longer you can have a growing plant on the soil and capturing more of that CO_2 and introducing it into the soil through the roots and the crop residues, the better off you are.

Also, in general, if you can reduce the amount of soil disturbance, you tend to maintain the organic matter from being decomposed as quickly as it might otherwise do. You are trying to manage that carbon balance and increase the stocks there. But, it is different with different types of systems. And you mentioned rice cultivation, and typically I would say, in a rice system probably from a climate

standpoint, the thing that you want to focus on is probably the ways to reduce methane emissions from rice either through varieties, if they are suitable, or through water management to have the system not flooded quite as often.

So there are management techniques that work in rice systems to reduce methane emissions.

Mr. LAMALFA. We have been trying them all for 90 years. It is a situation where we used to burn the rice straw at the end of the season, which wasn't popular finally more recent years. And so my own farm, we have been working really hard to bail it and remove it and find other products for it, but it is a very extremely limited market. We are stuck with having to instead of the burn, chop, disc, and flood, which does have its own new problems when you do that making the straw decompose.

We don't have the option of cover crop or no-till in that situation, and there are other crops that would probably chime in with other unique situations. I guess what is the bottom line, though, on if you do till the soil, are you going to lose the carbon that you have sequestered?

Dr. PAUSTIAN. Let's say you are doing, maybe not rice farming, but maybe you are in upland soils and you have been doing no-till and cover crops and things like this, if you then sort of abandon those practices, then over time your carbon levels will tend to go back down towards where they were before.

So it is important that we have systems that—as in Mr. Isbell said, are not only environmentally sustainable but economically sustainable. So, if you have a system that is sequestering carbon, building that carbon, and you are making more money doing that, then the good news is that the likelihood of maintaining those practices over time is much greater if they are more profitable.

Mr. LAMALFA. Yes. Many in the Midwest are multi-cropping on a rotation and such so. I am not here to bad mouth it or anything. It sounds to me like, once you get into a particular flow on this, a particular method, that you don't get out of a no-till method without the carbon penalty, I guess you would say. And that will lead to other concerns for me as somewhere on the line are you required to stay in that type; otherwise, you are emitting carbon, and now you are one of the bad guys. Even though, crop rotations, changing crops, or just the necessity to air the soil and maybe you have—when they change orchards and such, they have to go in a deep rip and kill nematodes, things like that. Anyway, it is just an ongoing discussion, and I want to be sure that we all have flexibility in ongoing programs that if there is a need to change or to move in a different direction with that crop, that doesn't become a penalty or a red letter on how our farmers need to practice.

So thank you for the extra time. I appreciate it.

The CHAIR. The chair now recognizes Mr. Costa, of California, for 5 minutes.

Mr. COSTA. Okay. I want to, once again, thank the Chair for this important Subcommittee hearing today and make a few points.

Certainly, my colleague from California, Congressman LaMalfa, makes some important points. It gets back to one size doesn't fit all, but beyond that, farming has changed. We know a lot more today than we did a generation ago. I farm too. It is my primary

source of income, but I don't farm the way my father farmed because of a lot of reasons, not only technology, but obviously change in crop patterns and the impacts of climate change.

I want to make a point I would like the three of you to respond. I have been simultaneously, Madam Chair, participating in the Foreign Relations Committee hearing today with Senator Kerry talking about our role in the international arena towards climate change. It seems to me that American agriculture has played a role and continues to play a role in reducing our carbon footprint and reducing waste streams, but you need two things, and the Chair and I have discussed this. I have discussed it with Senator Kerry and Secretary Vilsack.

You need two things to be successful in that for outcomes: one, determine what consistent funding sources we can have on a regional basis throughout the country to reduce that carbon footprint and the waste stream, water waste streams; and, two, continuous funding to determine which management practices work best on a farm and the dairies and the ranches, realizing the regional differences. But, goals over the next 10 years are critical, that are achievable, and a commitment on funding sources on this public-private partnership. Where, to your knowledge, are there realistic goals based upon existing practices and hopefully new practices that we can achieve in the next 10 years in American agriculture, and what are the consistent revenue streams you believe necessary as we develop a legislative package and strategy?

In less than 2½ minutes, who would like to respond?

Mr. JOHANSSON. Well, I will start, Congressman. And thanks, again. I mean, really quickly, we haven't really discussed it here, but one of the difficulties as well to in implementing these programs is what is the baseline, right? Where do we set the baseline at and how do we not punish the early adopters?

Mr. COSTA. Absolutely.

Mr. JOHANSSON. And you saw that in our own carbon program here in California and what that meant to our food processors, and that is the other part of this equation, too, is our food processors and ultimately those brands that sell our products. How do we engage them that we know the economic benefit they get for marketing a product that is, say, carbon neutral or has a lower carbon footprint, how does that end up back to the farmer which encourages them further in those practices?

I mean, we certainly saw it in the organic industry as that grew in the 1980s and 1990s to where it is today, but how do we engage that private-sector to reward those farmers and those ranchers who are taking those steps, but, again, as we implement these programs, as we come up with this baseline, it is going to be critical that the early adopters aren't penalized.

Mr. COSTA. I agree. And, voluntary is an important concept in that public-private partnership.

Ms. Ratcliff, you care to comment?

Ms. RATCLIFF. Absolutely. And I am in agreement with that baseline, and I guess my baseline would be the size—you mentioned it previously in your open comment is not all size fits everyone. There are always different climates. There are different grasses. There are different soil types. Just within Texas, our big

state, is different from north to south. I think you really have to do it regionally and look at each region separately.

I don't think you can do a global around the United States and, say, "Hey, this is what needs to go in every single state." I really think we need to concentrate it on regionally because it is different for each region.

Mr. COSTA. It has to be a regional strategy to set national goals.

Ms. RATCLIFF. Exactly.

Mr. COSTA. Finally, Doctor, would you care to comment?

Dr. PAUSTIAN. I would agree with Ms. Ratcliff. We have the technologies to integrate local solutions with national policies, and I think we want to work in that area.

Mr. COSTA. And as a 30 year member of the California Farm Bureau, to Jamie Johansson's comments, we don't want to punish under the category of no good deed goes unpunished, the fact that good practices have already been installed, and we want to incentivize those good practices if we want to develop a successful, overall nationwide strategy.

Thank you, Madam Chair. I really appreciate you allowing me to participate, once again.

The CHAIR. Thank you very much.

If there are any other Members remaining on with us today who would like to ask additional questions, please unmute yourself and seek recognition.

All right. Seeing none, we are going to move towards closing today. Ranking Member LaMalfa needed to head to the floor and will not be giving closing statements. I will continue and close out this hearing.

I want to thank Ranking Member LaMalfa.

And, to all of our witnesses here today, I truly appreciate this discussion. It has been informative. I thank you for spending extra time with us for our second round of questions. And I want to emphasize my commitment to ensuring that we are exploring every avenue for addressing the climate crisis through every avenue for improving upon our conservation programs. I appreciate the time that you all spent today, answering our questions, making clear why these programs are so incredibly important, the value that they have on the farms in your states.

Dr. Paustian, thank you for all of your research.

And as the committees consider opportunities to leverage title II programs and research, our continuing possibilities for mitigating climate change, I do want to keep in mind many of the excellent points that were raised here today. I also hope that we will walk out of this hearing with a greater clarity of the benefits of these conservation programs and also how we may continue to ensure that we are seeing these benefits at a larger scale.

So I appreciate you bringing your personal experiences, answering our questions, and really helping to inform Committee Members here today. So, to all of our witnesses, again, I thank you very much.

Under the Rules of the Committee, the record of today's hearing will remain open for 10 calendar days to receive additional material and supplementary written responses to the witnesses to any question posed by a Member.

This hearing on the Subcommittee on Conservation and Forestry is adjourned.

[Whereupon, at 12:04 p.m., the Subcommittee was adjourned.]

[Material submitted for inclusion in the record follows:]

SUBMITTED REPORTS BY HON. ABIGAIL DAVIS SPANBERGER, A REPRESENTATIVE IN CONGRESS FROM VIRGINIA

U.S. DEPARTMENT OF AGRICULTURE

Cover Crop Trends, Programs, and Practices in the United States

STEVEN WALLANDER, DAVID SMITH, MARIA BOWMAN, and ROGER CLAASSEN
Economic Research Service
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Cover Crop Trends, Programs, and Practices in the United States

STEVEN WALLANDER, DAVID SMITH, MARIA BOWMAN, and ROGER CLAASSEN

Abstract

On U.S. cropland, the use of cover crops increased by 50 percent between 2012 and 2017. During this same period, Federal and state conservation programs increased efforts to promote cover crops through financial and technical assistance. When farmers introduce cover crops into a crop rotation, there can be important on-farm benefits for the farmers as well as benefits to society. These benefits depend upon how the farmers manage the cover crop, such as the type of cover crop, the method used to terminate its growth, and other soil health and residue-management practices employed. Based on a series of farm- and field-level surveys, this report details how cover crops are managed on corn, cotton, soybean, and wheat fields. These surveys reveal that there are many different approaches to using cover crops. This includes considerable variation in the other soil-health-related practices farmers use with cover cropping, such as no-till farming, conservation cropping, and soil testing.

Keywords: Cover crop, conservation practice, soil health, conservation program, financial assistance, erosion, tillage.

Acknowledgments

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About the authors: Steven Wallander is an economist with the USDA, Economic Research Service (ERS). David Smith, Maria Bowman, and Roger Claassen were economists at ERS when this research was conducted.

Contents

A report summary from the Economic Research Service

ERS is a primary source of economic research and analysis from the U.S. Department of Agriculture, providing timely information on economic and policy issues related to agriculture, food, the environment, and rural America.

What Is the Issue?

Farmers grow cover crops for a variety of production and soil health benefits that do not include the sale or direct use of the crop. This distinguishes cover crops from both cash crops, which are harvested and sold, and forage crops, which are grazed by livestock or harvested for hay or silage. Well-managed cover crops provide a living, seasonal coverage of soil between commodity or forage crops. Depending upon the field, soil, climate, and weather, cover crops can result in a variety of on-farm benefits: reduced soil erosion and compaction, improved water infiltration and storage within the soil profile, greater weed and pest suppression, and better nutrient cycling and soil stability to support machine operations. Cover crops can also provide public environmental benefits: less runoff of sediments and nutrients into waterways, reduced flooding in watersheds, and greater soil carbon sequestration. As the understanding of links between soil health and these environmental benefits has grown, USDA and many states have increased financial assistance for cover crops through working lands conservation programs. This report summarizes unique, nationally representative data available on cover crop adoption rates, crop type, and management choices, and the links between cover crop use and other conservation practices.

What Did the Study Find?

U.S. farmers are rapidly expanding the adoption of cover crops.

- In 2017, farmers reported planting 15.4 million acres of cover crops, a 50 percent increase compared to the 10.3 million acres reported in 2012.
- Field-level surveys of corn, cotton, soybean, and wheat fields reveal the use of cover crops; and rates of expanded adoption are highest on fields that include corn silage in the rotation and lowest on fields that include wheat.

Financial incentives provided by Federal, state, and private organizations to encourage cover crops are one driver of increased cover crop adoption.

- In 2018, about ⅓ of the acreage planted with a cover crop received a financial assistance payment from either Federal, state, or other programs that support cover crop adoption.
- In Fiscal Year 2018, USDA's Environmental Quality Incentives Program (EQIP) obligated $155 million in planned payments toward cover crops on about 2 million acres. This is about 20 times the level of financial support for cover crops through EQIP in 2005, driven primarily by an increase in acres enrolled in a cover crop practice.
- Between 2011 and 2015, the total acreage enrolled in USDA's Conservation Stewardship Program (CSP) through contracts, including cover crop practices and enhancement, increased from about 350,000 acres to more than 2 million acres.
- A variety of incentive programs administered by at least 22 states supported more than 1 million acres of cover crops in 2018.
- In 2018, financial assistance for cover crops across a variety of Federal and state programs, excluding CSP, ranged from $12 per acre to $92 per acre.

Farmers use a variety of cover crops and diverse strategies to manage them.

- Fields in cotton and corn silage are much more likely to use cover crops compared to fields in corn-for-grain or soybeans.
- The most common cover crops are rye (cereal rye or annual ryegrass) and winter wheat. (Note Summary figure).
- To prepare for the planting of cash crops, most cover crops are terminated with herbicide or tillage.

Cover crops are often part of a suite of conservation practices that comprise a farmer's soil health management system. Other conservation practices, such as no-till farming and a written nutrient management plan, are more common on fields with cover crops than on fields without cover crops.

- No-till planting is two to three times more likely on fields with cover crops.
- Testing for nutrients and soil organic matter and the use of written nutrient management plans are all more likely on fields with a cover crop.

How Was the Study Conducted?

We estimate cover crop adoption rates using data from the 2012 and 2017 Census of Agriculture and the Agricultural Resource Management Survey (ARMS), a national survey of farming operations and production practices conducted by USDA's

National Agricultural Statistics Service (NASS) and Economic Research Service (ERS). The field-level data are based on the Production Practice and Cost Report (Phase 2) ARMS that is conducted periodically for corn (2010 and 2016), cotton (2015), wheat (2017), and soybeans (2018). Field-level data on cover crop adoption and management are obtained from a series of questions that ask farmers about what crops they grew during the 4 years prior to the survey, whether the crop was a cover crop, and what tillage and termination practices were used. To capture potential relationships between cover cropping and other management practices, we also use field-level survey data to estimate the extent to which different tillage practices, conservation cropping, soil testing, and other practices are associated with the use of cover crops on surveyed fields.

We use data obtained from the USDA, Natural Resources Conservation Service (NRCS) ProTracts database and other online NRCS resources to estimate the magnitude of Federal financial incentives for cover crops and trends in these incentives provided through EQIP and CSP. Information on state-level programs and financial incentives for cover crops was compiled from various sources, including publicly available documents and conservation program reporting, and personal communication with state departments of agriculture and conservation districts.

Cover Crop Trends, Programs, and Practices in the United States

Background

Maintaining, supporting, and enhancing soil health is a cornerstone of an agroecosystem that sustains productive agricultural land. Soil health management follows four basic principles: (1) minimize soil disturbance; (2) maximize soil cover; (3) maximize biodiversity; and (4) maximize the presence of living roots in the soil (USDA–NRCS, 2018f). Cover crops, a soil-health-related conservation practice, have received increased attention from Federal and state conservation programs, farmers, and nongovernmental organizations. This single conservation practice meets three of the four basic principles for improving soil health (principles 2–4).

The soil health improvements that can come with the use of cover crops are associated with a variety of potential on-field benefits for the farmer. Cover crops can enhance soil properties such as aggregate stability, beneficial microbial activity, and the amount of organic matter in the soil (Snapps, *et al.,* 2005). Depending upon the local soil and climate, these changes can help suppress and control weeds, reduce nutrient and pesticide losses, increase infiltration, and increase the volume of water retained in the soil profile, which may lead to greater drought resilience (Myers, *et al.,* 2019). The types of soil health improvements and on-farm benefits are variable, complex, and context-specific (Tonitto, *et al.,* 2006). Many of these benefits are also associated with public benefits, such as improved downstream water quality (Dabney, *et al.,* 2001).

Cover crops can also have costs—both monetary and non-monetary—that limit the willingness of many farmers to plant them (Plastina, *et al.,* 2018). Establishing a cover crop involves seed, machinery, and time. Managing a cover crop to achieve the desired benefits can require significant learning and adjustments in other aspects of the farming system. Terminating a cover crop to prepare for the following cash crop also involves machinery, time, and sometimes additional herbicide. In some situations, there can be unintended or undesired negative consequences from cover crops, such as allelopathy or an increase in certain crop pests (Lu, *et al.,* 2000; Bakker, *et al.,* 2016).

This report relies on survey data in which farmers self-report whether they are growing cover crops on their operation or on a given field. For any management practice, such data collection relies upon survey respondents defining the practice in the same way as the analysts interpreting the survey data. What is a cover crop? In general, a cover crop can be a single species or a mix of grasses, legumes, or forbs grown primarily to provide seasonal cover and related benefits. For example, cereal rye is often planted as a cover crop in the fall to provide winter cover between the planting of cash crops such as corn and soybeans.

USDA defines a cover crop based on the primary intended use for the crop (see box "How does USDA define a cover crop?"). This definition separates cover cropping from double cropping, a practice in which farmers plant and harvest a second cash crop within a year (Borchers and Wallander, 2014). Sometimes this distinction is simplified to define cover crops as crops that are not harvested; though as the data below show, many farmers use harvesting as a method to terminate the cover crop. In some cases, farmers even harvest a cover crop for grain. While such cover crop management is not allowed in USDA financial assistance programs (NRCS, 2014b), some state programs have allowed for such management of cover crops in return for reduced payments. For example, between 2007 and 2017, roughly 20 to 40 percent of the cover crop acres planted in Maryland as part of the state's Agricultural

Water Quality Cost Share Program were "commodity cover crops" that could be harvested for sale (Bowman and Lynch, 2019). Since there are conflicting rules around cover crops in these conservation programs, statistics on cover crop adoption inherently capture a certain amount of acreage that would not qualify as having cover crops under some program definitions. This challenge of consistently defining cover crops reflects the inherent complexity of managing cover crops.

How does USDA define a cover crop?

In 2014, USDA agencies revised their definition of a cover crop for consistency across agencies, as follows:

> "Crops, including grasses, legumes, and forbs, for seasonal cover and other conservation purposes. Cover crops are primarily used for erosion control, soil health improvement, and water quality improvement. A cover crop managed and terminated according to these guidelines is not considered a 'crop' for crop insurance purposes. The cover crop may be terminated by natural causes such as frost, or intentionally terminated through chemical application, crimping, rolling, tillage, or cutting" (USDA–NRCS, 2014c; USDA–NRCS 2014e).

Further, USDA's definition allows for grazing and harvesting under specific conditions, as follows:

> "Cover crops may be grazed or harvested as hay or silage, unless prohibited by RMA (Risk Management Agency) crop insurance policy provisions. Cover crops cannot be harvested for grain or seed" (USDA–NRCS, 2014c; USDA–NRCS, 2014e).

Adoption of Cover Crops

In 2017, U.S. farmers reported planting 15.4 million acres of cover crops. The adoption of cover crops increased 50 percent from 2012 when farmers reported planting 10.3 million acres of cover crops (USDA–NASS, 2019, table 47). Various conservation groups and experts have suggested long-run targets for cover crop adoption that range from 20 million acres by 2020 to 100 million acres by 2025 (Hamilton, *et al.,* 2017). Currently, though, there is no official USDA goal or target for the extent of cover crop adoption.

Looking at adoption rates, rather than total acreage, allows for comparison across regions. Previous research has suggested that total cropland is not the correct denominator for calculating adoption rates (Hamilton, *et al.,* 2017). For this study, we calculate adoption rates using a denominator of harvested cropland minus harvested alfalfa acreage.[1] Harvested cropland excludes fallow land, failed crops, and the long-term, perennial cover on land enrolled in the Conservation Reserve Program (CRP). As a share of harvested cropland, excluding alfalfa, cover crop adoption increased from 3.4 percent in 2012 to 5.1 percent in 2017.

Cover crop adoption rates in 2017 and the change from 2012 to 2017 vary a great deal across the United States (*figure 1*). Maryland, which has been heavily promoting cover crops for well over a decade, has both a high adoption rate (about 33 percent in 2017) and a high growth rate (more than six percentage points from 2012 to 2017). States with both high adoption and high growth rates are often in the eastern United States (*e.g.,* Pennsylvania, Virginia, and Georgia). Several states in the Midwest and Great Lakes regions had moderate adoption and growth rates (*e.g.,* Missouri, Indiana, Michigan, and Ohio). There was a slight decline in cover crop adoption in Colorado, Washington, and Wyoming, and a much larger decline in New Mexico.

Adoption levels can also vary considerably within states, reflecting the combined effects of different soils, primary crops, livestock density, outreach and training availability, and conservation technical assistance and financial incentive programs (*figure 2*). For example, within Texas, some of the highest adoption rates are in the panhandle, where a larger share of acreage is planted to cotton. As shown later in

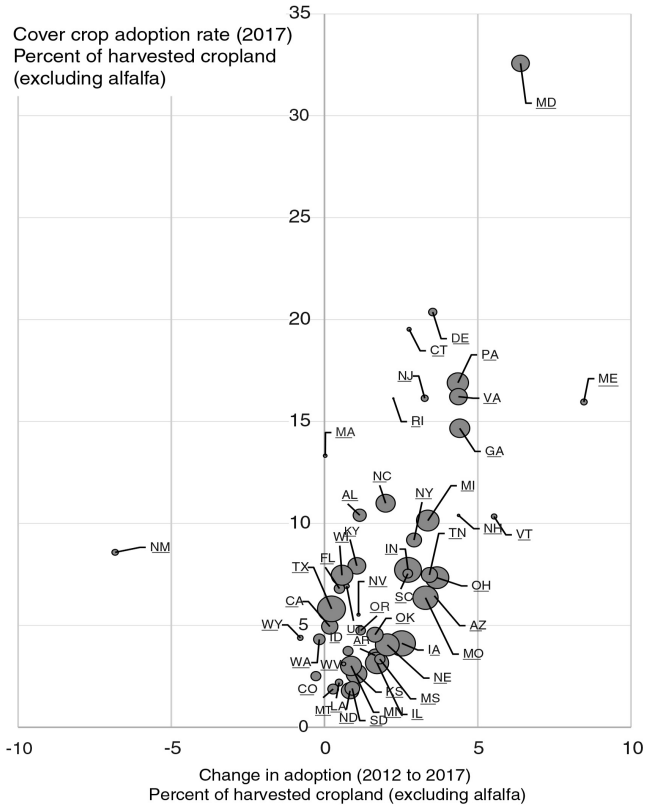
[1] We do not exclude orchards, as suggested by Hamilton, *et al*., (2017), because it is possible to plant cover crops within an orchard. We do not exclude non-alfalfa hay and haylage because an examination of county-level data makes clear that in some areas, particularly the northeastern United States, a large share of cover crops is reported as hay or haylage. We do not exclude double-cropped acres, which are similar to perennial rotations in lacking the ability to include crops, because the Census of Agriculture data do not capture double-cropped acreage.

this report, cotton fields have higher adoption rates than corn for grain or soybeans. In Pennsylvania, cover crop adoption is more common in counties within the Chesapeake Bay watershed, which could reflect greater conservation program- or regulation-related incentives in those counties. In Iowa, cover crop adoption is more common in the southeastern portion of the state, where soils have lower organic matter and higher erodibility compared to the rest of the state. These potential drivers of variation in adoption suggest a complex mix of both the benefits and costs of using cover crops, which include variation in cover crop incentive programs.

As noted above, cover crop adoption was high in 2017 compared to where it was in 2012 but is still relatively rare at a 5.1 percent adoption rate. Given the extensive interest in cover crops and calls for expanded adoption, comparing cover crop acreage to the acreage of other crops, conservation practices, and land uses can provide useful perspective even though these other practices and land uses generally provide different economic, agronomic, and environmental benefits (*figure 3*).

Figure 1

State comparisons of 2017 cover crop adoption rates and 2012–17 trends



Notes: Alaska and Hawaii are not included in the chart. Share of acreage is calculated as harvested cropland acreage (which excludes Conservation Reserve Program, fallow, and failed cropland acres) minus harvested hay and forage acreage. The size of circles is proportional to the total cover crop acreage in 2017; states with more total acreage in cover crops have larger circles.

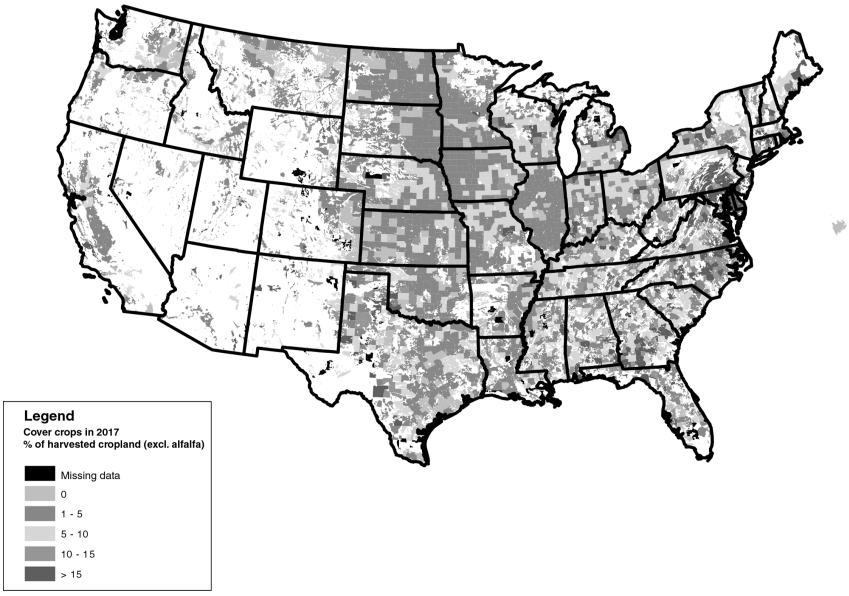
Source: USDA, Economic Research Service using data from USDA, National Agricultural Statistics Service.

As a conservation practice focused on both increasing organic matter and reducing erosion, cover crops are often considered alongside tillage practices. Both no-till (104 million acres) and conservation tillage (97 million acres, excluding no-till) are much

more widely adopted than cover crops, which suggests there is still potential for cover crop adoption to increase.[2] However, no-till and conservation tillage generally involve reduced on-farm costs because of fewer field operations and lower input use relative to conventional tillage. In contrast, cover crops can involve increased costs, at least in the short run, due to seed purchases and additional field operations and, often but not always, greater use of inputs such as herbicide.

Figure 2

Cover crop adoption as a share of harvested acreage by county, 2017



Note: County boundaries are clipped to show only cropland. Non-cropland appears white. Missing data occur when county-level estimates cannot be publicly released due to an insufficient number of observations in a county.

Source: USDA, Economic Research Service estimates using 2017 Agricultural Census, USDA, National Agricultural Statistics Service.

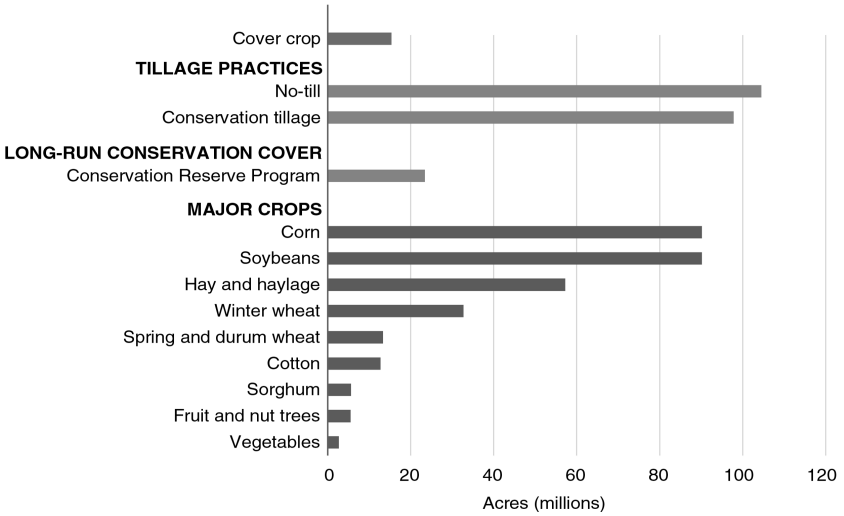
As a crop that is generally not harvested and that can have very high benefits if used on highly erodible land, cover crops may also be compared to the CRP. In 2017, CRP contracts enrolled 24 million acres. However, there are very different costs and benefits involved in the two different land uses since the environmentally sensitive land in CRP is effectively retired from active crop production for at least 10 years.

Given that cover crops are integrated into cash crop rotations, it is also helpful to compare cover crop acreage to cash crop acreage. In 2017, only corn, soybeans, winter wheat, and hay had more total acreage than cover crops. Winter wheat and hay are probably the most relevant comparisons because of the potential use of cover crops for forage in some circumstances. There were more cover crops planted in 2017 than spring wheat (including durum), cotton, sorghum, and many other crops.

[2] According to the NASS Census of Agriculture definition, conservation tillage includes all reduced tillage operations, excluding no-till, that leave at least 30 percent of the soil covered in crop residue at the time of planting.

Figure 3

Comparing cover crop acreage to other crop and conservation acreage in 2017



Note: Conservation tillage acreage does not include no-till acreage.

Source: Crop acreages are from USDA, National Agricultural Statistics Service annual surveys. Cover crop and tillage acreages are from 2017 Census of Agriculture. Conservation Reserve Program acreage is from September 2017, USDA, Farm Service Agency monthly report.

Conservation Programs for Cover Crops

Federal and state conservation programs reduce the cost of cover crop adoption through financial assistance payments, which encourage greater adoption of cover crops than would occur without the program payments. As detailed in this section, during 2017, these programs provided more than $180 million in total incentives for the adoption of cover crops on more than 5 million acres of cropland. The per-acre payment rates, the eligibility requirements, and even the types of cover crops and management practices vary significantly across programs as well as between states and regions within Federal programs.

USDA has two major programs that provide such financial assistance: the Environmental Quality Incentives Program (EQIP) and the Conservation Stewardship Program (CSP). In addition to the Federal programs, farmers may be eligible for state programs that provide financial assistance to farmers who plant cover crops. In most cases, farmers cannot simultaneously receive payments from multiple programs for the cover crops on the same field in the same year, although some exceptions do exist.

The Environmental Quality Incentives Program

Under EQIP, farmers may be eligible to receive annual payments for introducing cover crops if the conservation planning process finds their fields have environmental resource concerns that cover crops could address. Farmers are ineligible for payment through EQIP on fields where they are already planting cover crops. In this way, EQIP is meant to encourage trial adoption of cover crops for up to 5 years.

Farmers who receive an EQIP payment cannot harvest their cover crop for grain or seed. In many cases, participants can terminate their cover crop by grazing livestock on the forage or harvesting the cover crop for hay or silage (USDA–NRCS, 2014c), but these requirements can vary by state. Each EQIP contract specifies the type of cover crop to be established, seeding rates and dates, when and how farmers will apply nutrients, and how they will terminate their cover crop (USDA–NRCS, 2014b).

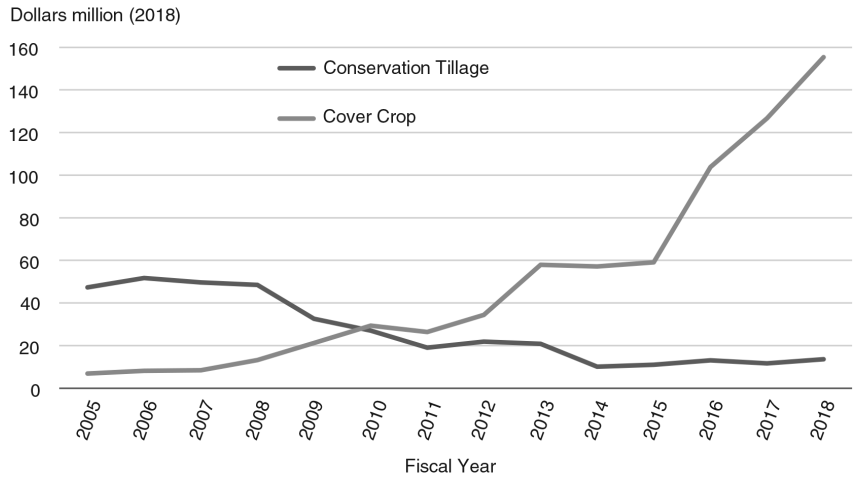
Cover crops are considered an annual practice in EQIP and can be included in an EQIP contract for a maximum of 5 years on the same field (USDA–NRCS, 2017b). Per-acre payment levels for cover crops through EQIP differ by region, in part due to variation in the costs of implementing the practice (USDA–NRCS,

2018a). In FY 2017, the median per-acre payment at the state level for the cover crop practice ranged from $62.33 (Illinois) to $92.27 (Delaware). Payment rates for cover crops in EQIP vary according to whether a single crop or multiple crop mix is planted, may differ in organic production systems, and can be higher if the farmer is a member of a historically underserved producer group.[3]

There is a significant upward trend in total funding going toward cover crops through both EQIP and CSP. During the past 14 years, USDA funding for cover crops through EQIP has increased—both in absolute terms and relative to other practices included in the programs such as no-till. Between 2005 and 2018, funding for cover crops through EQIP increased from about $7 million to more than $155 million (in 2018 dollars) (*figure 4*). During this same period, funding for no-till declined substantially.

Figure 4

Spending trends on conservation tillage and cover crops in EQIP



Note: Dollar figure is the total amount of funding obligated for financial assistance ("cost-share") payments on the cover crop practice within EQIP contracts signed in each fiscal year. Adjustments for inflation are made with the Consumer Price Index.

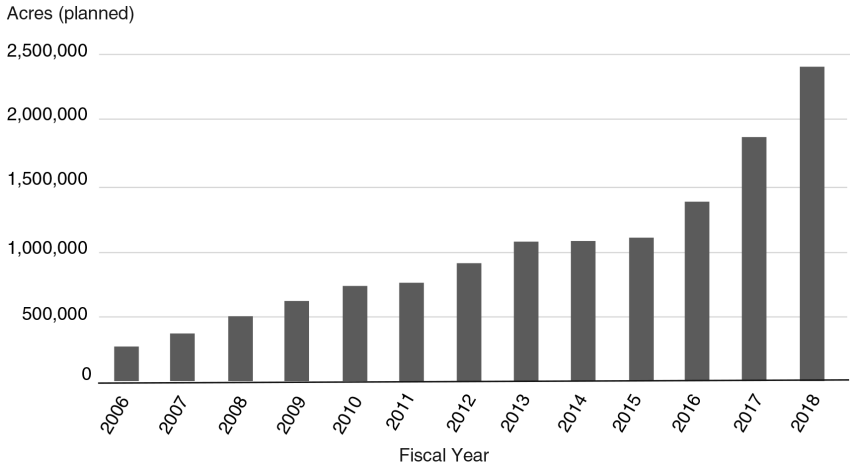
Source: USDA, Economic Research Service analysis of USDA, Natural Resources Conservation Service ProTracts data on Environmental Quality Incentive Program (EQIP) obligations.

The growth in total financial assistance for cover crops reflects both an increase in the per-acre financial assistance payment for cover crops and the large increase in the total number of acres enrolled in the cover crop practice (*figure 5*). The analysis here reports total funding by the fiscal years in which contracts are initiated. However, many practices in a contract are planned to be implemented in subsequent years, at which point payments for the practices will be made. For this reason, the actual increase in cover crop acreage receiving financial assistance through EQIP lags slightly behind the increase in quent years, at which point payments for the practices will be made. For this reason, the actual increase in cover crop acreage receiving financial assistance through EQIP lags slightly behind the increase in EQIP funding levels for cover crops. For example, total planned acreage for cover crops in 2018, about 2.4 million acres, reflects contracts from the 2018 Fiscal Year as well as from earlier fiscal years.

[3] Historically underserved producer groups, as defined by the Agricultural Act of 2014, include Limited Resource Farmers, Socially Disadvantaged Farmers, Beginning Farmers and Ranchers, and Veteran Farmers (NRCS, 2014d).

Figure 5

Cover crop acres enrolled in EQIP

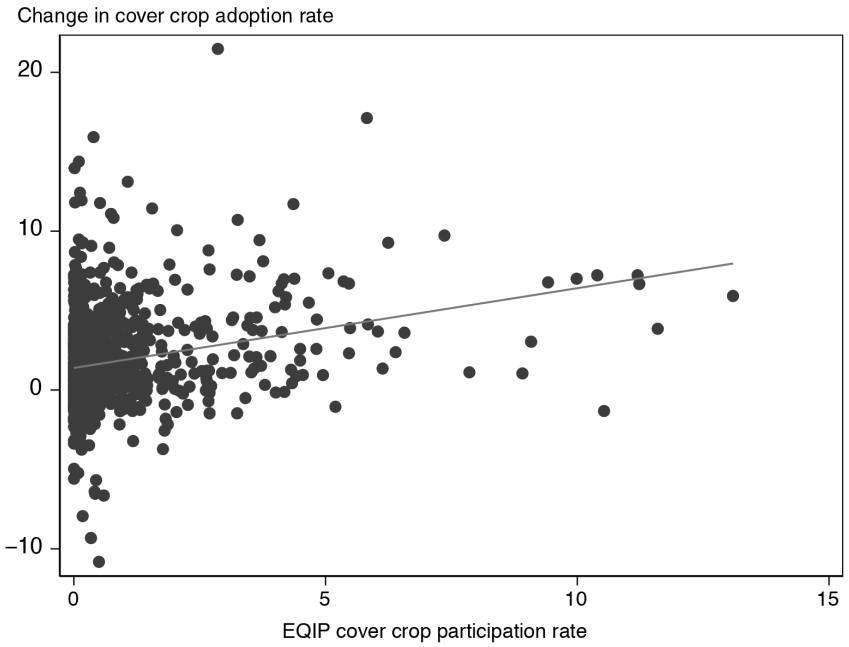


Source: USDA, Economic Research Service analysis of USDA, Natural Resources Conservation Service ProTracts data for the Environmental Quality Incentive Program.

To examine how well the increase in EQIP funding explains the increase in cover crop adoption in the Census of Agriculture data, we estimate the correlation between the county-level change in adoption between 2012 and 2017 and the total planned acres of cover crop in EQIP for 2013 to 2017 by county. If EQIP financial assistance were the only driver of changes in cover crop adoption and all contracts resulted in new adoption, then we would expect to see a perfect (one-to-one) correlation between the share of acreage enrolled in EQIP cover crop practices and the change in the cover crop rate of adoption. On average, there is a positive correlation, and a one-percentage-point enrollment of county-harvested cropland in EQIP is associated with a 0.5-percentage-point increase in cover crop adoption (*figure 6*). That this correlation is less than one-to-one is consistent with both the fact that not all farmers will continue the use of cover crops after an EQIP contract expires, and that some farmers receiving financial assistance would have adopted the cover crops without the payments (Claassen, *et al.,* 2018).

Figure 6

County-level changes in cover crops and EQIP participation



Note: Change in cover crop adoption is the difference between the share of harvested, non-alfalfa cropland with cover crops in 2017 and 2012. EQIP enrollment in cover crop practices is expressed as the share of harvested, non-alfalfa cropland enrolled for financial assistance on the cover crops (practice code 340) in at least 1 year from 2013. Enrollment acreage is the total number of acres based on planned year in the original contract and divided by 3 since most contracts specify 3 years of cover crops on the same fields. Only counties with at least 100,000 acres of harvested, non-alfalfa cropland are included in the chart because of the noisier adoption rates in the smaller counties. The predicted line is a simple linear fit to the displayed data with no weighting.

Source: USDA, Economic Research Service analysis of USDA, Natural Resources Conservation Service ProTracts data for the Environmental Quality Incentive Program (EQIP) and Census of Agriculture (2012 and 2017), USDA, National Agricultural Statistics Service.

In addition, while this correlation is statistically significant, there is a lot of variation in cover crop adoption rates not explained by EQIP funding. This likely reflects the influence of other programs, weather, shifts in cash crop acreage, and perhaps other factors such as cover crop seed availability.

The Conservation Stewardship Program

While EQIP generally focuses on incentivizing new adoption of practices to address resource concerns and deliver environmental benefits, CSP seeks to incentivize enhanced conservation stewardship on farms that have the potential to achieve even higher levels of environmental benefits by implementing enhancements to existing practices (USDA–NRCS, 2016a). This means farmers who are already using cover crops (with or without financial assistance) might be eligible for CSP if they shift to enhanced cover crop systems, such as more diverse cover crop mixes or systems that promote specific ecosystem services or address additional resource concerns. Examples of eligible CSP enhancements involving cover cropping include the use of

multi-species cover crops to improve soil health and increase soil organic matter.[4] Cover crop enhancements can be used to address several resource concerns, including soil erosion, weed and pest pressure, soil health degradation (*e.g.,* aggregate instability, soil organism habitat degradation, compaction, organic matter depletion), and water quality degradation (USDA–NRCS, 2018b).

Farmers enrolled in CSP sign a 5 year contract committing to engage in conservation activities ("practices, enhancements, and bundles of enhancements") included in a whole-farm stewardship plan. In 2017, CSP shifted to a system with enhancement-based payment rates similar to the structure of EQIP. Under this system, the per-acre payment levels for CSP are generally lower than those for EQIP (*table 1*). In part, this reflects the fact that CSP payment rates are based only on the enhancement component of the activity—such as moving from a simple cover crop, which typically would be required to meet eligibility for CSP, to a more complex cover crop—and these costs are lower than the costs of adopting cover crops for the first time.

Going further back into the history of the program, CSP payments are not itemized by activity during the timeframe covered by this report, so it is generally not possible to disaggregate CSP funds by specific activity. Therefore, the trends in cover crop funding under CSP cannot be charted in the same way as for EQIP. For CSP, the cover cropped acres are estimated as the total acres under contracts with at least one cover crop practice or enhancement receiving financial assistance. The total cover crop acreage receiving CSP payments increased from just over 350,000 acres in 2010 to more than 2 million acres in 2015. This growth in CSP acreage with cover crop practices or enhancements mirrors the shift toward cover crops in EQIP.

State Programs

In addition to Federal sources of funding to incentivize the adoption of cover crops, there are many state programs (AGREE, 2019). The seven largest and longest standing state programs enrolled about 1.4 million acres in 2017 (*table 2*). In combination with the 1.8 million acres planned for 2017 in EQIP (*figure 5*) and the approximately 2 million acres in CSP (*table 1*), this means that at least 5 million acres, ⅓ of total cover crop acres, were receiving some form of financial assistance for cover crops in 2017. In addition to the seven states listed in *table 2,* at least 17 other states or conservation districts within states have provided a per-acre incentive payment for cover crops.[5]

In terms of both total funded acreage and per-acre payment levels, Maryland has the largest program in the United States: In FY 2017, the Maryland program provided incentives on 639,710 acres and payments of more than $20 million statewide. After Maryland, the next-largest programs were in Iowa and Virginia. In FY 2017, Iowa spent $5 million to incentivize the planting of cover crops on 250,000 acres; in FY 2016, Virginia spent $5.1 million to incentivize cover cropping on approximately 200,000 acres.

The requirements of these state programs vary widely; some substitute for Federal programs, while others are complementary to Federal financial assistance or are designed to make sure the farmer is receiving a 100 percent cost-share for using a cover crop practice. Some programs limit the total acreage a farm can enroll or the length of time a field can enroll. Others limit their programs to farmers who have never previously used cover crops. In Missouri, the Department of Natural Resources requires farmers participating in the cover crop cost-share program to provide initial soil samples to the University of Missouri Soil Health Assessment Center, and they are encouraged to complete a follow-up soil health test after 4 or 5 years of cover cropping (Missouri Department of Natural Resources, 2016).

In addition to per-acre payments to plant a cover crop, several other types of incentives or cover crop support also exist. Examples of other support include tax credits and programs that rent out or loan equipment related to cover cropping, such as no-till drills, cover crop inter-seeders, or roller crimpers. Pennsylvania has a tax credit program that gives farmers a 50 percent tax credit for eligible cover crop costs (such as equipment and cover crop seed) in their first year of cover crop-

[4] For a full list of 2018 CSP enhancements, including enhancements that incorporate cover cropping, see USDA–NRCS, 2018b.

[5] Other states that offer either statewide or conservation district-level cover crop incentive programs include California, Georgia, Idaho, Illinois, Minnesota, New Jersey, New York, North Carolina, North Dakota, Pennsylvania, South Dakota, Tennessee, Vermont, West Virginia, and Wisconsin. Since a few programs allow participants to receive assistance from multiple sources, simply adding acreage across programs can lead to some double counting. However, such allowances are an exception to most programs and the total acreage receiving payments is consistent with reported acreage receiving assistance in ARMS.

ping.[6] The Scott Soil and Water Conservation District in Minnesota rents out no-till drills and interseeders (Scott Soil and Water Conservation District, 2017), and the Three Rivers Soil and Water Conservation District in Virginia rents out no-till drills and has a pilot project providing free use of a roller crimper to terminate cover crops (Three Rivers Soil and Water Conservation District, 2018). In the fall of 2017, the Iowa Department of Agriculture and Land Stewardship began a 3 year demonstration project offering farmers a $5 per acre reduction on their crop insurance premium if they planted a cover crop in the fall and were not enrolled in other state or Federal cover crop programs (Iowa Department of Agriculture and Land Stewardship, 2017).

Table 1

Comparison of incentive payments for cover crops in USDA working lands conservation programs

Program	Practices or enhancement	Scope of program	Payment range in FY 2017
Environmental Quality Incentives Program (EQIP) 1997–present	Cover crop (basic, or with multiple species)	About 2.4 million acres planned in 2018	Median per-acre-payment from $62.33 (Illinois) to $92.27 (Delaware)
Conservation Stewardship Program (CSP) 2010–present	Various types of cover crops and management	More than 2 million acres in 2015	Median per-acre-payment from $7.96 (Arizona) to $14.65 (Wyoming).

Note: Per-acre median payment range for CSP enhancements represent the additional activity payment for a single cover crop enhancement, not the total amount of the farmer's per-acre CSP payment.

Source: USDA, Economic Research Service using USDA, Natural Resources Conservation Service (NRCS) online resources and NRCS ProTracts data.

Table 2

Summary of select state programs for cover crops

State (years active)	Program/Implementing agency	Scope of program (acres)	Per-acre payment range (dollars)	Annual state spending (dollars)
Maryland (2009–present)	Agricultural Water Quality Cost-Share	639,710	30–75	22.5 million
Iowa (2013–present)	Department of Agriculture and Land Stewardship (IDALS)	250,000	15–25	5 million
Virginia (1998–present)	Virginia Department of Conservation and Recreation with funding from Water Quality Improvement Fund and real estate recordation fees	200,539 (2016)	15–33	5.1 million (2016)
Missouri (2015–present)	Department of Natural Resources	117,175	30–40	3.8 million
Delaware (at least 2011–present)	County conservation districts	85,438	30–50	
Ohio (2012–present)	Various, including Muskingum Watershed Conservancy Project, Ohio Department of Natural Resources, and Ohio Department of Agriculture	–50,000	12–40	–600,000
Indiana (2015–present)	Watersheds and county conservation districts with funding from Indiana State Department of Agriculture (ISDA) Clean Water Indiana Grants	18,278	Up to 20	307,385

Source: USDA, Economic Research Service, drawing from publicly available information on state websites and personal communication with staff at programs and implementing agencies.

Cover Crop Management

Field-level surveys reveal the many variations in how farmers manage cover crops, including the types of cover crops, the frequency of cover crop use, and the method of terminating growth of the cover crop to prepare for planting a cash crop. These cover crop management decisions can affect the success of the cover cropping, the cost of cover cropping, and strategies for managing cash crops on the field.

Crop Rotation

The crops preceding and following a cover crop can influence the decisions about cover crop selection and cover crop management. In most fields, cash crops are rotated to improve nutrient cycling, control pests, and improve soil health. For example, alternating corn and soybeans is a very common rotation. One challenge for

[6] The 50 percent tax credit in Pennsylvania was capped at a maximum $45 per acre in FY 2018 (Pennsylvania State Conservation Commission, 2016).

farmers in managing cover crops is determining how to fit them into an existing rotation.

Since cash crop planting and harvesting occur at different times of the year, the sequence of cash crops planted can influence decisions about whether to use a cover crop and how that cover crop is managed. The earlier a spring cash crop is planted, the tighter the window to terminate the cover crop and prepare the soil for planting. Similarly, the later the cash crop is harvested, the shorter the window in the fall to plant the cover crop. For example, in major corn and soybean regions, soybeans are planted in late May and early June, while corn tends to be planted earlier—in late April and early May. On the other end of the season, corn-for-silage is harvested in September, while corn-for-grain is harvested in October and early November. Such differences in timing may affect the viability of planting cover crops before and after certain crops; later planting and earlier harvest of the cash crop both increase the length of the cover crop season and facilitate cover crop use.

The benefits of cover crops depend upon the planned cash crops in the rotation. Legume cover crops, which increase available nitrogen, will be more beneficial to subsequent nitrogen feeding crops (*e.g.,* corn) than to a legume crop (*e.g.,* soybean). However, legume cover crops often take longer to produce biomass in the spring. In contrast, grasses or small grains work well to scavenge leftover nitrogen from the preceding crop. However, these high-residue cover crops have a high carbon-to-nitrogen ratio, which reduces the availability of nitrogen for the following cash crop (USDA–NRCS, 2011). In addition to their potential nutrient benefits, cover crops also increase residue on the soil surface, which can reduce erosion between cash crop seasons, contribute organic matter to the soil for long-term soil health, suppress weeds, and buffer soil temperature extremes. This residue can be especially beneficial following low-residue crops such as corn silage, cotton, and soybeans.

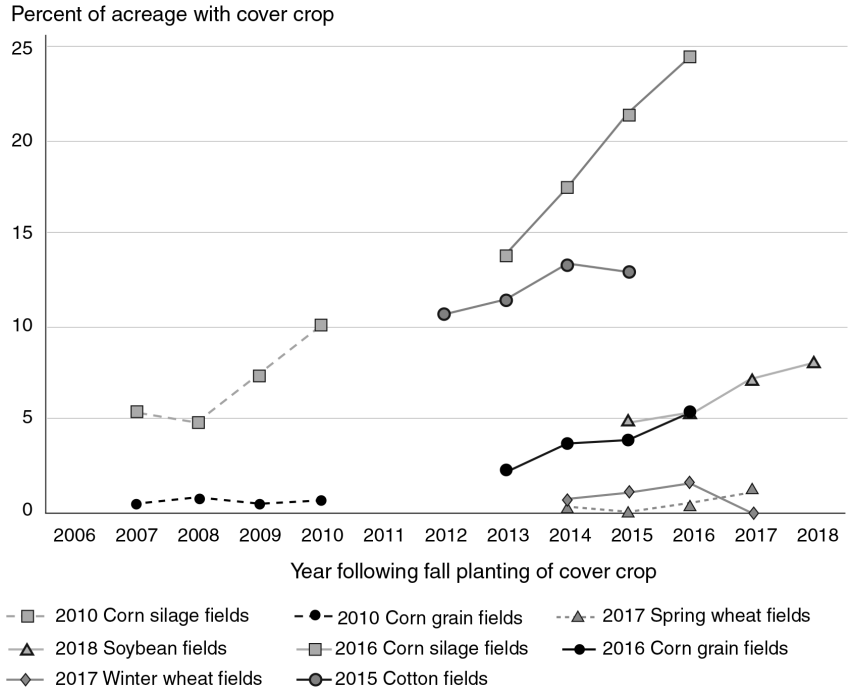
Cash Crops and Cover Crop Adoption Rates

To examine differences in cover crop adoption by rotation, we draw on commodity-specific field-level data from the Phase 2 Agricultural Resources Management Survey (ARMS). For this report, we use a sample of fields that were planted as corn in 2010 or 2016, cotton in 2015, wheat in 2017, or soybeans in 2018. For each survey year and targeted commodity, we also ask about 4 years of cropping history including cover crops.

The level of cover crop adoption varies considerably by the primary commodity (*figure 7*). In the fall preceding the survey year, cover crop adoption ranged from just over five percent of acreage on corn-for-grain (2016), to eight percent on soybeans (2018), just under 13 percent on cotton (2015), and just under 25 percent on corn-for-silage (2016). Wheat has an adoption below two percent of acreage (2017) for the preceding fall on spring wheat and the previous year on winter wheat. Some fields, particularly those with winter wheat, have 4 year crop sequences that mix spring-planted and fall-planted cash crops in different years. In some cases, these include spring-planted rather than fall-planted cover crops. The statistics above look only at fall-planted cover crops since they are much more common, which is true even for the surveyed winter wheat fields.

Figure 7

Trends in fall cover crop adoption by related cash crop



Note: For each crop, the sampled fields are planted with the designated crop in the survey year and a mix of other crops in earlier years. The samples used to calculate these adoption percentages are restricted to fields that had a 4½ year history of crops.

Source: USDA, Economic Research Service and USDA, National Agricultural Statistics Service; 2010, 2016, 2017, 2018 Agricultural Resource Management Surveys.

Cornfields harvested for silage differ from cornfields harvested for grain in three primary ways. First, and probably most importantly for cover crops, corn silage involves removing both the grain and stalks, thus leaving a low amount of residue in the field after harvest. Second, corn silage is used exclusively for feeding livestock, which may imply that farmers growing corn silage are capitalizing on the opportunity to grow cover crops for both the soil health and the grazing or forage benefits. Third, corn silage is harvested much earlier than corn-for-grain, allowing for more time to plant cover crops in the fall.

Like corn for silage, cotton is also a low-residue crop. In addition, cotton is the dominant crop in the rotation with non-cotton crops rotated in every 3 to 4 years. Because of the prevalence of low-residue crops in these fields, cover crops provide an opportunity for cotton farmers to increase residue. This may reflect the common practice of growing cotton following a winter cover crop such as winter wheat so that the stalks protect the cotton seedlings from early spring winds.

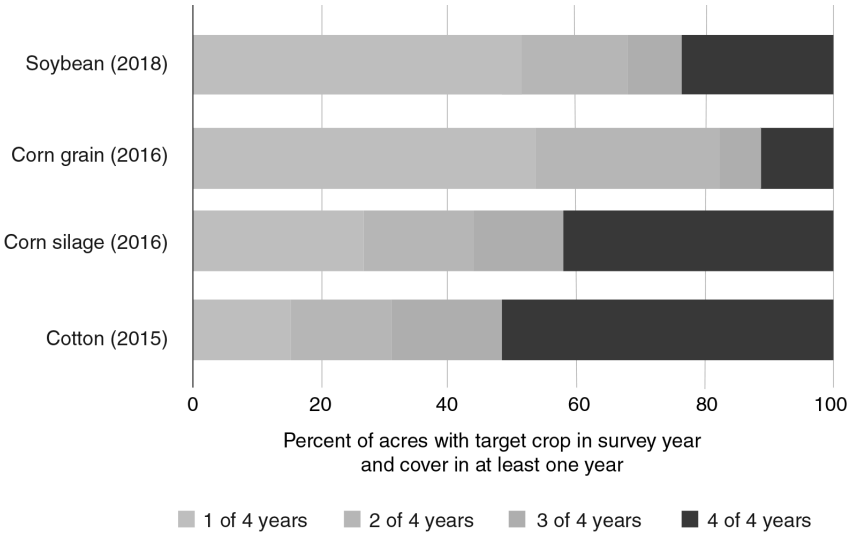
The trends evident in these field-level surveys largely mirror the national trends revealed in the Census of Agriculture data; however, there are important differences between the crops. The differences between the 2010 corn survey and the 2016 corn survey track the year-by-year trends within the different fields captured by each of those surveys. The soybean and corn-for-grain trends largely overlap, reflecting the fact that a random survey of cornfields and a random survey of soybean fields will capture similar fields given the prevalence of a 2 year rotation of corn-for-grain and soybeans. The trend within fields for 2016 corn-for-silage fields is much steeper than any of the other crops.

Frequency of Adoption

Some of the benefits of cover crops, particularly the accumulation of soil organic matter, require frequent or sustained adoption. The ARMS data on crop history provide detail on the frequency with which cover crops are adopted (*figure 8*). With the upward trend in adoption, these numbers are impacted by new adopters, so fields that are adopting cover crops in only 1 or 2 years out of the 4 years will be more common than they would be if cover crop adoption were stable.

Figure 8

Frequency of cover crops within 4 year crop sequences



Note: For each surveyed commodity, fields with a full 4 years of reported cropping history and at least 1 year with a cover crop are included. Percentages are weighted to reflect the share of total planted acreage for the targeted commodity. Of acres with a cover crop planted in at least 1 of the last 4 years, 16 percent of 2015 cotton acres, 27 percent of 2016 corn silage acreage, 53 percent of 2016 corn grain acres, and 52 percent of soybean acres planted a cover crop. The share of adoption in all 4 years also varies across crops with 52 percent of 2015 cotton, 42 percent of 2016 corn silage, 11 percent of 2016 corn grain, and 24 percent of 2018 soybean acres.

Source: USDA, Economic Research Service and USDA, National Agricultural Statistics Service, 2015 (cotton), 2016 (corn), and 2018 (soybeans), Agricultural Resource Management Survey.

Looking at the subpopulation of fields with cover crops in at least 1 of 4 years, sustained cover cropping over the 4 year history, which we define as 3 or 4 years of adoption, occurs on 19 percent of (2016) corn-for-grain acres, 56 percent of (2016) corn-for-silage acres, 69 percent of (2015) cotton acres, and 32 percent of (2018) soybean acres. Given the similar trajectories for corn-for-grain and soybeans, the greater sustained adoption among soybean acreage may have more to do with the later timing of the soybean survey (2018) relative to the corn survey (2016).

A closer look at the fields with only 1 or 2 years of adoption reveals that many of these appear to be farmed by new adopters. Half of the corn-for-grain acres (2016) using a cover crop in 2016 had not used a cover crop in the previous 3 years. On corn-for-silage fields that used cover crops in 1 or 2 out of every 4 years, many (79 percent) had not used cover crops at all in 2013 or 2014. On just over half of soybean fields (52 percent), cover crops were used only once in the 4 years preceding the survey.

We find mixed evidence on whether the frequency of cover crop adoption is related to the specific crops grown within a 4 year rotation. On corn-for-grain (2016) fields, the frequency of cover crop adoption in the prior years is not statistically different for different spring crops. In contrast, on corn-for-silage fields, patterns of cover crop usage were correlated with crops in the rotation. When corn-for-silage was rotated

with soybeans and cover crops, cover crops were used on average about half the time (47 percent). However, when corn-for-silage was grown every spring and rotated with cover crops, cover crops were used almost all the time (92 percent). These patterns of usage suggest a strong link between growing corn-for-silage and cover crop usage. A similar relationship holds for cotton; rotations that planted cotton more often used cover crops.

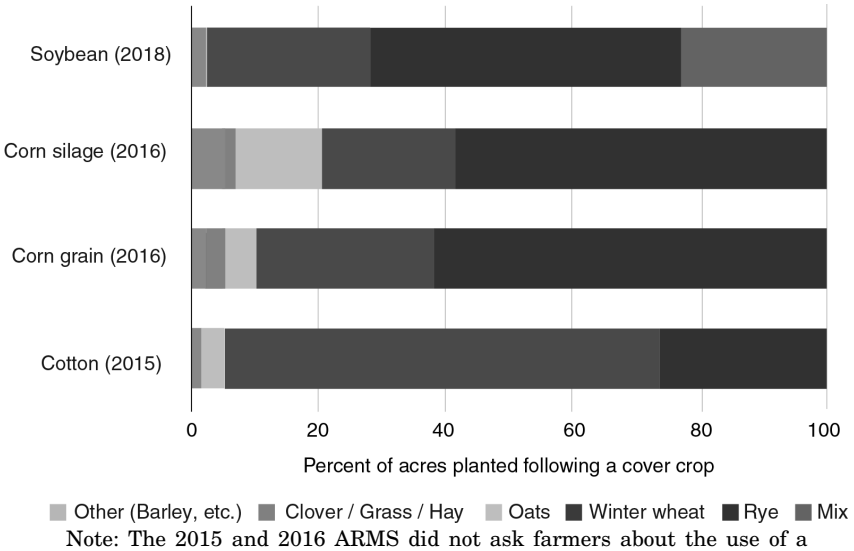
Type of Cover Crop

When planting cover crops, farmers have a myriad of choices for the type of cover crop to plant. The choice of cover crop typically depends on its purpose as well as its limitations because of harvesting and planting dates of the cash crops in the crop rotation. If the cover crop is harvested for forage or grazed, farmers may choose a cover crop that provides abundant and nutritious forage. If the purpose of planting the cover crop is to build soil organic matter, then the farmer may choose a high-residue cover crop. The farmer may also be using the cover crop to reduce erosion or provide nutrients to the succeeding cash crop. The costs of the cover crop are also a consideration. In corn, cotton, and soybeans—the crops for which we have a statistically reliable sample of the type of cover crops—small grains are planted most often preceding these spring crops (*figure 9*). Small grains are used as a cover crop in corn most of the time (94 percent). Rye, which in the earlier years of the ARMS questionnaire included both cereal rye and annual ryegrass, is used before corn more than twice as often as winter wheat, regardless of whether the corn was harvested for grain or silage. Rye is also commonly used in soybeans. In contrast, winter wheat is used most often as a cover crop on cotton acres. In 2018, for the first time, the field-level ARMS asked farmers about the use of a cover crop mix and found that just under a quarter of soybean fields with cover crops were planted with a cover crop mix.

One important consideration when choosing a cover crop is the cost of the seed. In corn, cotton, and soybeans, the average cover crop seed costs (*table 3*) did not differ statistically by the type of seed (*i.e.,* winter wheat, rye, oats, mixed, or other). Seed costs for these cover crops were also similar to seed costs for cash crops as captured in other USDA surveys (USDA–ERS, 2019).

Figure 9

Type of cover crop planted in the fall before the cash crop



Note: The 2015 and 2016 ARMS did not ask farmers about the use of a cover crop mix.

Source: USDA, Economic Research Service and USDA, National Agricultural Statistics Service, 2015 (cotton), 2016 (corn), and 2018 (soybeans) Agricultural Resource Management Survey (ARMS).

Cover Crop Termination

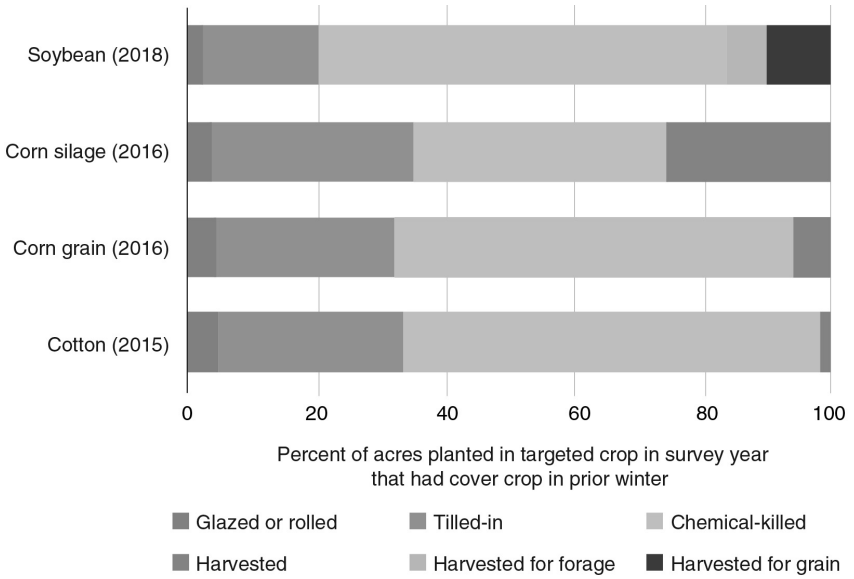
Farmers who use cover crops must plant either a cover crop killed by cold (*e.g.,* "winter kill" cover crops such as oats or radishes) or terminate (kill) their cover crop so that it does not compete with their cash crop. This could include terminating the cover crop after the cash crop is planted (*i.e.,* planting green). Farmers have four main ways to terminate a cover crop: mechanical (*i.e.,* tillage, mowing, or rolling); chemical (*i.e.,* herbicides); livestock (*i.e.,* grazing); or harvest (*i.e.,* forage). The choice of method will depend on the purpose of the cover crop, type of cover crop, need for livestock forage, seedbed preparation needs of the cash crop, and the need to minimize tillage in the field.

In soybean, corn-for-grain, and cotton fields, chemical termination was used on almost ⅔ of the acreage (*figure 10*). Tillage was also a common termination method, used on about 30 percent of the acreage surveyed. Termination methods on corn-for-silage fields are somewhat different. Corn silage growers report termination through harvest on more than 25 percent of acres. They are less likely to use herbicide for termination and more likely to use tillage.

Harvesting is a common termination method for cover crops in soybeans and corn-for-silage. According to the USDA, NRCS practice standard, a farmer can harvest a cover crop for forage but not for grain. If a farmer harvests a winter crop for grain, then the field is double-cropped. In about ten percent of the soybean fields in 2018, farmers self-reported planting cover crops and harvesting that cover crop for grain. This is about 550,000 acres of self-reported cover crops in soybeans that appear to be double cropping. Most of this acreage (84 percent) is winter wheat followed by soybeans and is found only in states that typically double crop (*i.e.,* Kentucky, North Carolina, South Carolina, Tennessee, and Virginia). As noted above, the distinction between cover crops and double cropping is based on the intended use of the cover crop. The expansion of survey questions to include information about harvesting for grain and termination through grazing reveals that, given the multiple uses and purposes of cover crops, national statistics on cover crop adoption necessarily include some fields that might not meet practice standard definitions of cover crops.

Figure 10

Cover crop termination method



Note: The grazed and rolled categories are combined because, for some crops, the number of positive responses is too low to report individually. Soybeans (2018) was the first year the survey asked separately about harvesting for forage and harvesting for grain.

Source: USDA, Economic Research Service and USDA, National Agricultural Statistics Service, 2015 (cotton), 2016 (corn), and soybean (2018) Agricultural Resource Management Survey.

Table 3

Cover crop seed costs on cotton, corn, and soybean fields, and commodity seed costs

	Cotton (Dollars per acre)	Corn (Dollars per acre)	Soybean (Dollars per acre)	Commodity seed cost (Dollars per acre)		
	2015	2016	2018	2015	2016	2018
Oats	20.48 ±7.05	11.09 ±4.30		20.65	19.54	19.08
Rye	16.22 ±6.55	14.26 ±2.03	16.27 ±5.96			
Winter wheat	14.22 ±2.76	12.79 ±5.01	27.38 ±7.68	16.12	15.26	15.08
Mix			21.99 ±11.09			
Other	D	14.51 ±4.97	26.12 ±14.51			

Note: "D" indicates a disclosure limitation. The estimate cannot be reported due to sample size limitations.
Source: USDA, Economic Research Service and USDA, National Agricultural Statistics Service, 2015 (cotton), 2016 (corn), and 2018 (soybeans) Agricultural Resource Management Survey; USDA, Economic Research Service, Commodity Costs and Returns.

Conservation Rotation, Tillage, and Nutrient Management

While cover crops can help conserve soil, keep nutrients in place for the next cash crop, and promote improved soil health, these benefits may be more fully realized when cover crops are used in conjunction with other practices. We consider conservation crop rotation, several forms of conservation tillage, manure and compost applications, as well as testing for soil organic matter, nitrogen, and phosphorous. The exact mix of practices that is optimal on any given farm will depend on the climate, ecosystem, soil, and other factors (USDA, 2018a).

ARMS data for corn (2016), cotton (2015), and soybean (2018) provide evidence that farmers who planted cover crops in the fall before planting these crops are more likely than other farmers to use other conservation practices along with cover crops. The descriptive analysis presented here suggests cover crop users might be adopting a suite of practices to promote soil health or that they believe the benefits of these practices are greater when used together (*i.e.,* that cover crops complement other practices).

Conservation crop rotation is growing a planned sequence of various crops on the same piece of land for a variety of conservation purposes including soil erosion control, soil health, and others (USDA–NRCS, 2014f). In terms of soil health management principles, conservation rotations can help ensure soil cover and promote crop diversity (USDA–NRCS, 2017a). While crop rotation is common in the United States, not all rotations are conservation rotations. We use a definition of a conservation rotation based on four criteria:[7] (1) an average residue rating greater than 1.5; (2) inclusion of more than one crop; (3) including a low-nitrogen-demand crop; (4) and at least one crop with residue rating greater than or equal to 2. The average residue rating is the sum of residue ratings for individual crops in the conservation rotation divided by the number of years in the rotation. For each crop in the crop history, we assign an annual residue rating obtained from NRCS. Residue ratings range from 0.25 to 4.0 for each crop. Very high-residue perennial crops (*e.g.,* alfalfa and grasses) have a residue rating of 4. High-residue annual crops (*e.g.,* corn, wheat, sorghum, and barley) have a residue rating of 2. Low-residue annual crops (*e.g.,* soybeans and cotton) have a residue rating of 1. Extremely low-residue rotations typically involve the harvesting of nearly all biomass, such as in corn silage rotations. To examine conservation rotations, we used all 4 years of cropping information available in the field-level ARMS, while acknowledging that not all crop rotations fit neatly into a 4 year timeframe.

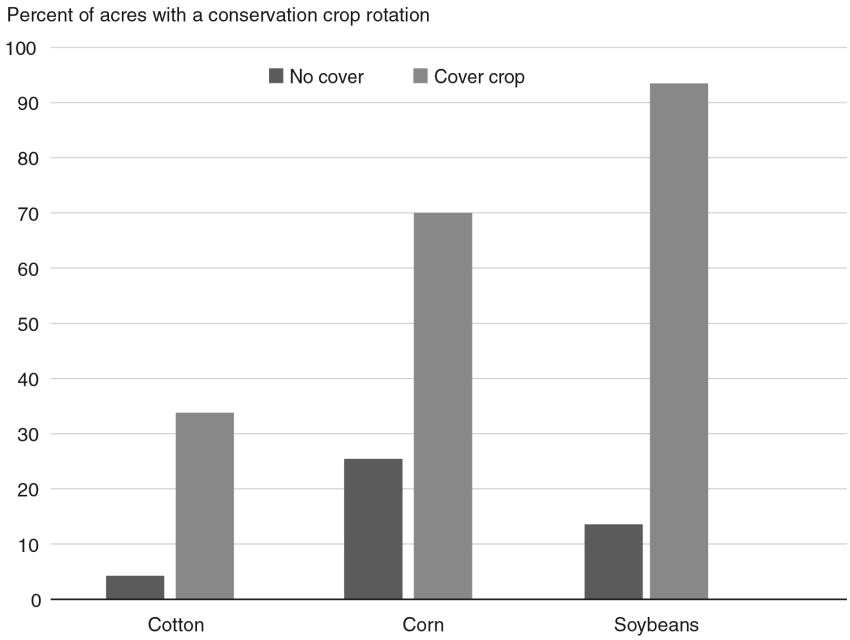
Cropping systems that include cover crops are, in fact, more likely to be in conservation rotations because cover crops help satisfy residue and crop diversity requirements (*figure 11*). For example, a simple corn and soybean rotation would not meet the definition of a conservation rotation, but a corn and soybean rotation with winter cover crops would meet the definition. For corn (2016), 70 percent of acres preceded by a cover crop were in a conservation rotation; for cornfields not preceded by a cover crop, only 26 percent of acres were in a conservation rotation. For cotton (2015), 34 percent of acres preceded by a cover crop were in a conservation rotation; only four percent of cotton not preceded by a cover crop was in a conservation rotation. For soybeans (2018), 94 percent of acres preceded by a cover crop were cropped

[7] These criteria are designed to be consistent with characterizations of conservation crop rotations used in the Conservation Effects Assessment Project (CEAP) carried out by USDA's Natural Resources Conservation Service (NRCS) (Norfleet, 2018).

in a way that met the definition of a conservation rotation, compared to only 13 percent of acres on fields without a preceding cover crop. The association between cover crops and the use of conservation rotations in corn and cotton is more limited than for soybeans because corn and cotton fields do not always include a legume or other crop with low-nitrogen fertilizer demands.

Figure 11

Adoption of conservation rotations with and without cover crops



Note: Acres adopting cover crops are based on whether the selected fields had a cover crop on the field in the survey year.

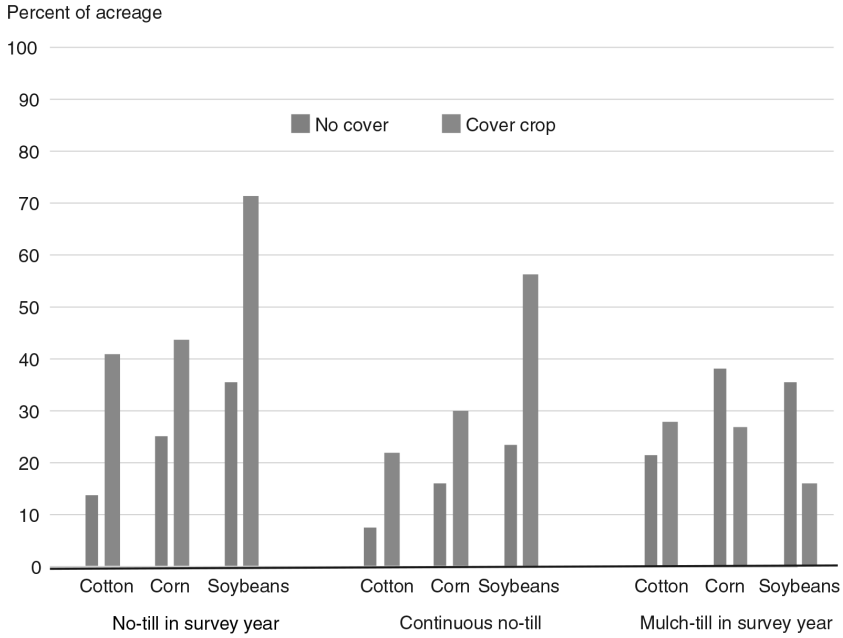
Source: USDA, Economic Research Service and USDA, National Agricultural Statistics Service, 2015 (cotton), 2016 (corn), and 2018 (soybean) Agricultural Resource Management Survey.

No-till can help minimize physical soil disturbance (including soil compaction), particularly when farmers use no-till continuously over time. Farmers who reported using a cover crop in the fall before planting were also more likely to use no-till in corn (43 percent *versus* 26 percent), cotton (41 percent *versus* 14 percent), and soybeans (72 percent *versus* 36 percent) (*figure 12*). Continuous no-till (no-till in the survey year and on all crops in the crop history—a total of 4 years)—is less frequent. In 2016, for example, 27 percent of corn was in no-till, but less than 20 percent of surveyed fields had been in no-till continuously for more than 4 years (Claassen, *et al.,* 2018). No-till is often rotated with other tillage practices and is frequently based on the crop grown in any given year (*e.g.,* no-till is more likely in soybeans than in corn) (Wade, *et al.,* 2015). Land with a cover crop in 2015 was also more likely to have been in no-till continuously over the full 4 year crop history compared to fields without cover crops (30 percent *versus* 17 percent in corn; 21 percent *versus* 8 percent in cotton; and 57 percent *versus* 24 percent for soybeans). Differences in mulch till[8] adoption rates between cover crop and non-cover crop fields were not statistically significant in corn or cotton; soybean farmers who reported cover crops were less likely than all other farmers—non-cover crop soybeans as well as cotton and cornfields regardless of cover crop use—to use mulch till.

[8] Mulch till involves full-width tillage that is limited so that the Soil Tillage Intensity Rating (STIR) is 80 or less. What we define as "mulch tillage" is similar to "reduced tillage" in the most recent Natural Resources Conservation Service (NRCS) practice standards (USDA NRCS).

Figure 12

Adoption of selected tillage practices with and without cover crops



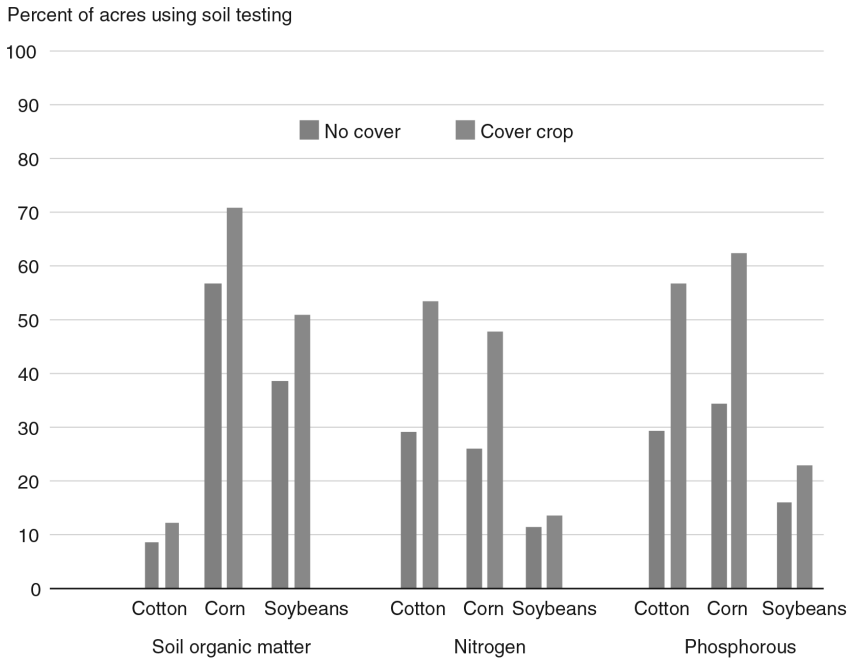
Note: Acres adopting cover crops are based on whether the selected fields had a cover crop on the field in the survey year.

Source: USDA, Economic Research Service and USDA, National Agricultural Statistics Service, 2015 (cotton), 2016 (corn), and 2018 (soybean) Agricultural Resource Management Survey.

Nutrient management is also important when applying soil health principles. This is one reason that USDA working lands programs sometimes provide financial assistance for soil testing. Adjustments to nutrient management strategies may be needed to account for changes in the availability of nitrogen from increased use of legumes (as cover crops or part of conservation rotations), higher levels of crop residue, reduced tillage, and the amount of nitrogen mineralized from soil organic matter (Kabir, 2018; Geisseler, *et al.,* 2018). Nitrogen may also be tied up in the residue of small grain cover crops during the early part of the season, a situation that could require additional fertilizer early in the growing season for some crops. Corn farmers who planted a fall cover crop were more likely than other corn farmers to have performed a soil nitrogen test within 2 years (48 percent *versus* 26 percent), a soil phosphorous test within 2 years (62 percent *versus* 35 percent), or a soil organic matter test within 10 years (71 percent *versus* 58 percent) (*figure 13*). For cotton preceded by a cover crop, soil testing is more likely for both nitrogen (54 percent *versus* 29 percent) and phosphorous (57 percent *versus* 30 percent). On soybean fields, there is no difference in the frequency of soil nitrogen testing, but fields with cover crops were more likely to be tested for soil organic matter (52 percent *versus* 39 percent) and soil phosphorous (24 percent *versus* 17 percent).

Figure 13

Use of soil testing with and without cover crops



Note: Acres adopting cover crops are based on whether the selected fields had a cover crop on the field in the survey year

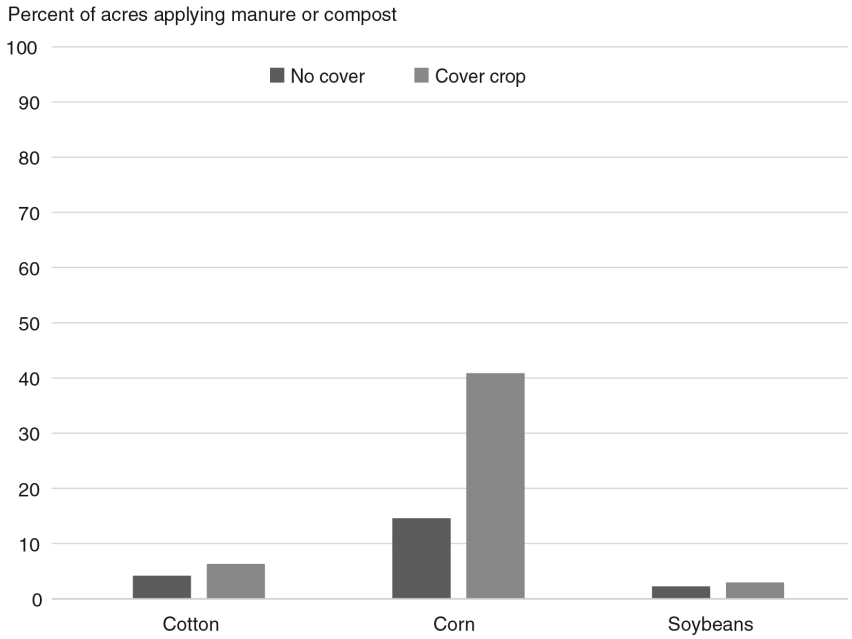
Source: USDA, Economic Research Service and USDA, National Agricultural Statistics Service, 2015 (cotton), 2016 (corn), and 2018 (soybean) Agricultural Resource Management Survey.

Manure and composted manure are soil amendments that have been shown to increase soil organic matter, soil microbial activity, and improve soil physical properties (*e.g.,* water holding capacity) when applied consistently at agronomic rates (Haynes and Naidu, 1998). Corn farmers who planted a cover crop were more likely to apply manure or compost compared to other farmers (41 percent *versus* 15 percent) (*figure 14*). On cotton and soybean fields, the data suggest there is no statistically significant difference in the frequency of manure or compost application or soil organic matter testing on cover crop and non-cover crop fields. Compared to corn, a relatively small portion of land in cotton (four percent of acres without cover crops) and soybeans (two percent of acres without cover crops) receive manure.

Our descriptive analysis suggests that cover crop users also are more likely than other farmers to engage in other soil health-related conservation practices. However, since cover crop adoption is still quite modest, the use of management systems that include cover crops as well as other soil health practices is occurring on only a limited number of acres.

Figure 14

Application of manure or compost with and without cover crops



Note: Acres adopting cover crops are based on whether the selected fields had a cover crop on the field in the survey year.

Source: USDA, Economic Research Service and USDA, National Agricultural Statistics Service, 2015 (cotton), 2016 (corn), and 2018 (soybean) Agricultural Resource Management Survey.

Conclusions

In 2017, farmers in the United States planted an estimated 15.4 million acres of cover crops. This area is larger than the area planted to spring wheat, cotton, sorghum, or rice. The recent growth in cover crop acreage has been rapid, with cover crop acreage increasing 50 percent between 2012 and 2017. Corn-for-grain and soybean fields accounted for most of this growth in acreage. However, corn-for-silage and cotton fields had the highest adoption rates. Compared to practices such as no-till, overall adoption rates remain low with only about five percent of cropland using a cover crop in 2017.

Some of the growth in cover crop acreage is due to Federal and state conservation programs that pay farmers to plant cover crops. In 2015, more than 3 million acres received a cover crop payment from either CSP or EQIP. In EQIP alone, funding for cover crops has increased by nearly $150 million (2018 dollars) between 2005 and 2018. In addition to the Federal programs, at least 22 states also had cover crop programs of their own. The largest of these are the Maryland and Iowa programs with approximately 640,000 acres and 250,000 acres in 2017, respectively.

In the spring, most cover crop farmers commonly terminate their cover crops using chemicals. On corn-for-silage fields, using chemicals for termination is less common than on fields in corn-for-grain, soybeans, and cotton. Harvesting of cover crops is also practiced on more than 25 percent of corn-for-silage acreage.

Managing for soil conservation and soil health requires more than just the use of cover crops. Conservation tillage, conservation crop rotations, and nutrient management are among the practices that can make up a soil-health-focused management system. In corn, soybean, and cotton fields that used cover crops, no-till, including continuous no-till, is more common than it is on fields without cover crops. The use of manure or compost is also more common on cornfields with cover crops than those without. Cover crop fields are also more likely to be testing for soil or-

ganic matter and nutrients (with the exception of soil organic matter on cotton fields).

While this report provides a number of insights, future cycles of the ARMS will be able to provide additional information about cover crop trends and management in U.S. field crops as cover crops become a more common practice. Of particular interest will be the impact of government programs on adoption, the impact of cover crops on production practices (*e.g.,* nutrient management), and the impact of cover crops on soil health and yields.

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