



Report to the Ranking Member,
Committee on Energy and Commerce,
House of Representatives

September 2014

CLIMATE CHANGE

USDA's Ongoing Efforts Can Be Enhanced with Better Metrics and More Relevant Information for Farmers

GAO Highlights

Highlights of [GAO-14-755](#), a report to the Ranking Member, Committee on Energy and Commerce, House of Representatives

Why GAO Did This Study

In 2012, the United States produced about \$395 billion in agricultural commodities, with about half of this revenue from crop sales and half from livestock. According to the Third National Climate Assessment, climate change has the potential to negatively affect agricultural productivity in the United States through warmer temperatures and an increase in weather extremes. In recent years, USDA has taken actions to help U.S. farmers adapt to climate change and reduce greenhouse gas emissions.

GAO was asked to review USDA's climate change efforts. This review examines (1) USDA's climate change priorities and how these align with national priorities, (2) the status of USDA's climate change efforts, and (3) the challenges USDA faces in implementing its climate efforts and the steps it has taken to overcome these challenges. To conduct this work, GAO analyzed USDA documents and data and interviewed USDA officials and other knowledgeable stakeholders, such as farmers and environmental groups.

What GAO Recommends

GAO recommends that USDA develop performance measures that better reflect the breadth of USDA climate change efforts and use its performance plans and reports to provide information on how the agency plans to achieve its goals and the status of its efforts. GAO also recommends that USDA develop and provide information to farmers on the economic costs and returns of taking certain actions in response to climate change. USDA concurred with these recommendations.

View [GAO-14-755](#). For more information, contact John Neumann at (202) 512-3841 or neumannj@gao.gov.

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What GAO Found

The U.S. Department of Agriculture's (USDA) climate change priorities for agriculture include, among other things, providing better information to farmers on future climate conditions. These priorities generally align with national priorities set by the Administration, which include promoting actions that reduce greenhouse gas emissions, advancing climate science, developing tools for decision makers, and developing better projections of future climate conditions. USDA is engaged in research efforts aimed at better understanding climate change's impacts on agriculture and providing technical assistance to farmers. Through the use of existing conservation and energy programs, USDA aims to reduce greenhouse gas emissions and sequester (store) carbon so it is not released, or is actively withdrawn, from the atmosphere.

Helping to make farmers more resilient to climate change is one of USDA's four strategic goals, but the agency is not using its performance planning and reporting process to provide information on how it intends to accomplish this goal or to assess the status of its efforts in this area. According to the Government Performance and Results Act of 1993, as amended, an agency's performance plan is supposed to explain how the agency will accomplish its performance goals, and its performance reports are supposed to review the extent to which those goals have been met. However, USDA performance plans for recent years have not provided a link between the agency's climate efforts and performance goals, and its recent performance reports have not provided information on whether the agency was meeting its performance measures related to climate change. In addition, USDA performance measures do not capture the breadth of the agency's climate efforts. Agency officials told GAO that developing measures for the strategic goal on climate change was difficult. However, USDA has developed measures for other areas, such as conservation, where similar challenges existed. Without developing performance plans and reports that better reflect USDA's climate change efforts, USDA will have difficulty fully assessing its progress in meeting its climate change strategic goal and providing information on its progress to Congress and the public.

USDA faces challenges in encouraging farmers to take measures to adapt to climate change and reduce emissions. For example, USDA faces the challenge of turning the large amount of often technical climate research into readily understandable information. To address this challenge USDA is, among other things, developing tools that summarize climate information and communicate research findings to farmers in a more accessible format. USDA also faces a challenge related to the incentive structure that farmers consider when making decisions for their farms. Farmers weigh the financial costs and returns of taking certain actions, but USDA has not provided much information to farmers on the economic costs and returns of taking certain adaptation or emissions reduction actions, such as changing the extent to which they plow their fields. Under federal internal control standards, agencies are to ensure there are adequate means of communicating with external stakeholders when it may have a significant impact on the agency achieving its goals. Without information that is readily accessible to farmers on the farm-level economic costs and returns of taking certain actions in response to climate change, farmers may be reluctant to take these measures.

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Abbreviations

AFRI	Agriculture and Food Research Initiative
AgMip	Agricultural Model Intercomparison and Improvement Project
ARS	Agricultural Research Service
CAP	coordinated agricultural project
CRS	Congressional Research Service
ERS	Economic Research Service
FSA	Farm Service Agency
GPRA	Government Performance and Results Act of 1993
NIDIS	National Integrated Drought Information System
NIFA	National Institute of Food and Agriculture
NOAA	National Oceanic and Atmospheric Administration
NRCS	Natural Resources Conservation Service
OMB	Office of Management and Budget
PINEMAP	Pine Integrated Network: Education, Mitigation, and Adaptation Project
REACCH	Regional Approaches to Climate Change
REAP	Rural Energy for America Program
RUS	Rural Utilities Service
Sustainable Corn	Climate Change, Mitigation, and Adaptation in Corn-Based Cropping Systems
TCAP	Triticeae CAP
USDA	U.S. Department of Agriculture
USGCRP	U.S. Global Change Research Program

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September 16, 2014

The Honorable Henry A. Waxman
Ranking Member
Committee on Energy and Commerce
House of Representatives

Dear Mr. Waxman:

The United States produced about \$395 billion in agriculture commodities in 2012, with about half of this revenue from crop sales and half from livestock sales. Climate change could present numerous challenges to U.S. agricultural production. According to the Third National Climate Assessment, climate change and associated warmer temperatures will place stress on crops and livestock and benefit weeds, diseases, and insects that will threaten crops and livestock in the future.¹ The Third National Climate Assessment also projects there will be an increase in weather extremes—droughts, heat waves, and heavy rain events—that will also negatively affect U.S. agricultural productivity. For example, heavy rain events are likely to reduce crop yields in some areas because they can erode soil and deprive crops of the nutrients they need to grow. The National Climate Assessment stated that climate disruptions to U.S. agricultural production have increased in the past 40 years and are projected to increase over the next 25 years. According to the assessment, by midcentury and beyond, the impacts of climate change will be increasingly negative on most crops and livestock.

In recent years, the U.S. Department of Agriculture (USDA) has taken actions to begin to help American farmers adapt to climate change and

¹Melillo, Jerry M., Terese (T.C.) Richmond, and Gary W. Yohe, Eds., *Climate Change Impacts in the United States: The Third National Climate Assessment*, U.S. Global Change Research Program (USGCRP), (Washington, D.C.: May 2014). The USGCRP is a federal program that coordinates and integrates global change research across 13 federal agencies. It is required by the Global Change Research Act of 1990 to conduct a National Climate Assessment, which is an important resource for understanding and communicating climate change science and impacts in the United States.

reduce greenhouse gas emissions.² In its strategic plan for 2010-2015, USDA included resilience to climate change as one of its strategic goals for the first time, according to USDA officials. In June 2011, the Secretary of Agriculture issued a departmental regulation that directed all USDA agencies to integrate climate change adaptation planning into their programs, policies, and operations. USDA also issued a Climate Change Science Plan that called for improved understanding of the impacts of climate change and development of knowledge and tools to enable climate change adaptation and mitigation. Adaptation refers to adjustments to natural or human systems in response to actual or expected climate change, such as changing the types of crops planted in a particular area or increasing the use of irrigation during droughts; mitigation refers to actions that reduce greenhouse gas emissions, such as carbon dioxide, methane, and nitrous oxide, or sequester (store) carbon so it is not released, or is actively withdrawn, from the atmosphere. For example, when farmers do not plow their fields, a practice known as no-till farming, more carbon is sequestered in the soil.

In 2013, we included the federal government's fiscal exposure to climate change on our High Risk List and noted that the federal government was a provider of technical assistance to decision makers grappling with the impacts of climate change.³ In our past work, we also have noted the challenge of translating climate information so that it is useful to decision makers.⁴ Farmers routinely adapt to weather events and variability, but the Third National Climate Assessment has stated that increased innovation will be needed to ensure that agricultural production can keep pace with future climate change.

²For the purposes of this report, we are focusing on USDA agencies that are working with farmers and ranchers, which we collectively refer to as farmers. We are not examining the efforts of the U.S. Forest Service, a part of USDA that manages the 193 million acres comprising the nation's 155 national forests and grasslands. GAO recently completed a report that examines U.S. Forest Service adaptation efforts. See GAO, *Climate Change: Various Adaptation Efforts Are Under Way at Key Natural Resource Management Agencies*, [GAO-13-253](#) (Washington, D.C.: May 31, 2013).

³GAO, *High-Risk Series: An Update*, [GAO-13-283](#) (Washington, D.C.: February 2013).

⁴GAO, *Climate Change: Future Federal Adaptation Efforts Could Better Support Local Infrastructure Decision Makers*, [GAO-13-242](#) (Washington, D.C.: Apr. 12, 2013) and *Climate Change Adaptation: Strategic Federal Planning Could Help Government Officials Make More Informed Decisions*, [GAO-10-113](#) (Washington, D.C.: Oct. 7, 2009).

You asked us to review USDA's climate change efforts related to agricultural production. This report examines (1) USDA's priorities related to climate change and agricultural production and how these align with national priorities; (2) the status of USDA's climate change efforts; and (3) the challenges, if any, USDA faces in implementing its climate efforts and the steps it has taken to overcome these challenges.

To describe USDA's priorities related to climate change and U.S. agricultural production and how these align with national priorities, we analyzed USDA documents that describe the agency's priorities in this area. These documents include USDA's 2010-2015 and 2014-2018 Strategic Plans, the agency's Climate Change Adaptation Plan, its Climate Change Science Plan, and Departmental Regulation 1070-001. To identify national priorities regarding climate change and agricultural production, we reviewed U.S. Global Change Research Program (USGCRP) documents, executive orders, Interagency Climate Change Adaptation Task Force progress reports, and the President's Climate Action Plan. We also analyzed budget data that USDA reports to the Office of Management and Budget (OMB) for its annual report to Congress on climate change expenditures. To determine the status of USDA's climate change efforts, we analyzed documents that included annual budget data, progress reports prepared by USDA, and annual performance reports. We also examined the requirements under the Government Performance and Results Act (GPRA) of 1993 and the GPRA Modernization Act of 2010 for strategic plans, performance plans, and performance reports. We focused on USDA's key climate change efforts, which we identified through discussions with USDA officials and by examining budget information, which enabled us to determine where USDA was devoting large amounts of funding. To determine the challenges that USDA faces in implementing its climate efforts, we reviewed documents on USDA's efforts and reviewed our past work on climate change. For all three objectives, we conducted interviews with a range of officials, including USDA officials implementing climate programs and stakeholders who were knowledgeable about USDA's efforts. These stakeholders included officials from farm groups and environmental groups, farmers, and state and local officials. A more detailed description of our objectives, scope, and methodology is presented in appendix I.

We conducted this performance audit from September 2013 to September 2014 in accordance with generally accepted government auditing standards. Those standards require that we plan and perform the audit to obtain sufficient, appropriate evidence to provide a reasonable basis for our findings and conclusions based on our audit objectives. We

believe that the evidence obtained provides a reasonable basis for our findings and conclusions based on our audit objectives.

Background

The agricultural sector is a major part of the U.S. economy and has been and will continue to be affected by climate change, according to the Third National Climate Assessment. The assessment states that climate change will likely cause an increase in temperature, rainfall intensity, and extreme events in some areas, and extreme climate conditions, such as sustained droughts and heat waves. USDA plays an important role in addressing these potential impacts by using its resources to develop and implement both mitigation and adaptation measures.

The U.S Agricultural Sector

The U.S. agricultural sector accounted for \$395 billion in sales in 2012, up 33 percent from 2007. According to USDA's 2012 Census of Agriculture, of this \$395 billion, about half is from sales of crops, and half is from livestock sales.⁵ Between 2007 and 2012, crop sales increased nearly 48 percent, while livestock sales increased about 19 percent. Thirteen states—California, Iowa, Texas, Nebraska, Minnesota, Kansas, Illinois, North Carolina, Wisconsin, Indiana, North Dakota, South Dakota, and Ohio—each had more than \$10 billion in agricultural sales and together accounted for about 62 percent of all agriculture sales in 2012. California led the United States in agricultural sales in 2012, with about \$43 billion, or 11 percent, of the total U.S. agricultural sales.⁶ In recent years, there has been a trend toward larger-scale farming operations. For example, according to a 2013 USDA Economic Research Service (ERS) report, between 1982 and 2007, for farms, the midpoint acreage for U.S. cropland nearly doubled, from about 590 acres to about 1,100 acres.⁷

Three important crops in terms of acreage planted and sales in the United States are corn, soybeans, and wheat. In 2012, corn was harvested on more than 94 million acres, and total sales for corn were about \$67 billion. Soybeans were harvested on more than 76 million acres, with sales of

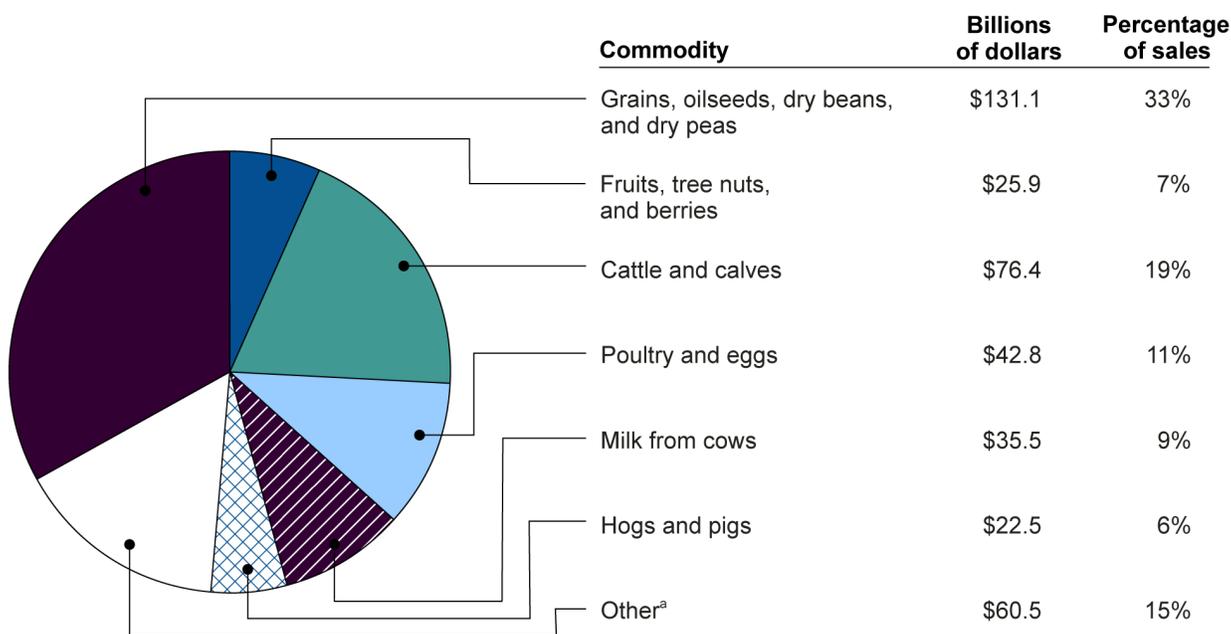
⁵USDA, *2012 Census of Agriculture* (Washington, D.C.: May 2014).

⁶USDA, *Farm Economics – Record High Agriculture Sales; Income and Expenses Both Up* (Washington, D.C.: May 2014).

⁷USDA, *Farm Size and the Organization of U.S. Crop Farming* (Washington, D.C.: August 2013). The “midpoint acreage” defined in the report is a measure in which half of all cropland acres in the United States are on farms with more cropland than the midpoint number and half are on farms with less.

about \$39 billion, while there were about 49 million acres of all wheat varieties, with sales of about \$16 billion. Livestock sales represented nearly half of agricultural sales in 2012, with poultry, cattle, milk, and pigs the most sold commodities in this category.⁸ A breakdown of the agricultural sector's 2012 sales is shown in figure 1.

Figure 1: 2012 U.S. Agriculture Sales by Commodity



Source: GAO analysis of USDA data. | GAO-14-755

^aOther includes sales from various commodities, such as vegetables, nursery, cotton, tobacco, hay, aquaculture, and other livestock, such as sheep, goats, and their products. GAO | 14-755

The United States is also a global supplier of food. In 2012, the United States exported nearly \$136 billion in agricultural products, or around 10 percent of total U.S. exports. The United States exports about 20 percent of the corn grown domestically, is the leading exporter of soybeans, and also is a leading exporter of wheat. In addition, the United States is the largest producer of beef and poultry in the world.

⁸For the purposes of agricultural sales in this report, "livestock" refers to traditional livestock, poultry, and their products.

Climate Change Impacts on the Agricultural Sector

According to the Third National Climate Assessment, climate change is expected to increase disruptions to agriculture production in the future. Increases in temperature, rainfall intensity, and extreme events in some areas, and extreme climate conditions, such as sustained droughts and heat waves, will likely have negative impacts on crop and livestock yields. By the end of the century, the Third National Climate Assessment states that average U.S. temperatures will increase between 3°F and 10°F, and precipitation events will be more extreme, meaning that more rain will fall during these events. In addition, changing climate conditions also will likely affect the geographic distribution and severity of invasive pests, diseases, and weeds. Table 1 shows the projected impacts of climate change and how they could affect agricultural production in the United States.

Table 1: Projected Impacts of Climate Change on Agriculture in the United States

Category	Projected impacts	Examples of impacts on agriculture
Temperature	<ul style="list-style-type: none"> • Increase in average air temperature. • Increase in nighttime temperatures. • Increase in average U.S. temperatures of between 3°F and 10°F by the end of the century. 	<ul style="list-style-type: none"> • Crop yield losses due to exceeding temperature boundaries for growth. • Crop yield losses due to night time air temperature increases. • Longer growing season. • Increased irrigation needs in some areas. • Increase in animal stress.
Carbon dioxide	<ul style="list-style-type: none"> • Increased levels of atmospheric carbon dioxide. 	<ul style="list-style-type: none"> • Increase in plant growth for some species.^a
Water	<ul style="list-style-type: none"> • Change in the timing, intensity, and amount of rain/snow mix. • Increase in heavy rain events. • Increase in drought conditions. 	<ul style="list-style-type: none"> • Increase challenge of getting water to crops at the right time through irrigation systems and practices. • Increase in flooding events, greater erosion, and decreased soil quality. • Increase in water use due to higher temperatures. • Less growth and lower yields.
Extreme conditions	<ul style="list-style-type: none"> • Projected increase in droughts and more extreme precipitation events. 	<ul style="list-style-type: none"> • Increase in soil erosion. • Altered water availability. • Increased loss of organic matter in soil.
Weeds, insects, and disease	<ul style="list-style-type: none"> • Increased growth of weeds, insect population levels, and disease. • Change in the geographic distribution of pests. 	<ul style="list-style-type: none"> • Alter yields and quality of crops. • May increase farming costs through a change in management practices, such as increased herbicide use.

Sources: GAO analysis of the U.S. Global Change Research Program's Third National Climate Assessment and USDA information. | GAO-14-755

^aMost crops are either C3 or C4 plants, which refers to the amount of carbon compound formed during initial stages of photosynthesis. The difference depends on their intake of carbon dioxide and response to light. While most crops are C3 plants, the most recognizable C4 crops are corn and sugarcane. C3 crops are expected to respond more strongly to increases in carbon dioxide.

Both climate mitigation and adaptation options exist in the agricultural sector. According to the Third National Climate Assessment, both of these efforts are required to minimize the damage inflicted by climate change in the United States and to adapt to the changes that already have occurred or that will occur.

The agricultural sector emits about 6 percent of total U.S. greenhouse gas emissions, but U.S. lands (mostly forestlands) sequester enough carbon to offset 12 percent of total greenhouse gas emissions.⁹ Sources of these emissions include fuel consumption, fertilizer that can emit nitrous oxide,¹⁰ and methane emissions from livestock.¹¹ Farmers can take certain mitigation actions to reduce greenhouse gas emissions and sequester carbon. For example, farmers can use energy-efficient buildings, vehicles, or farm equipment that runs on renewable energy, rather than fossil fuels. In addition, farmers can implement mitigation measures, such as no-till farming and precision agriculture.¹² According to a 2011 ERS report, adoption of precision agriculture can improve the efficiency of input use and reduce environmental harm from the overapplication of inputs such as fertilizers and pesticides, which can reduce nitrous oxide emissions.¹³ Through the digestive process, livestock emit a considerable amount of methane, a greenhouse gas; reducing these emissions is another mitigation strategy. According to USDA officials, work is being done to alter the diet of cattle and to

⁹USDA, *FY2010-2015 Strategic Plan*.

¹⁰When fertilizers that contain nitrogen are not absorbed by plants, this nitrogen can transform, via complex processes, into nitrous oxide, a powerful greenhouse gas. One pound of nitrous oxide has about 300 times the warming potential of a pound of carbon dioxide.

¹¹Methane emissions from livestock are primarily from enteric fermentation, which is the livestock digestive process. Together, grazed lands and managed waste also represent a large portion of livestock emissions. About 71 percent of all livestock emissions come from methane, a powerful greenhouse gas. One pound of methane has about 20 times the warming potential as a pound of carbon dioxide.

¹²Precision agriculture uses computer- or satellite-assisted information gathered during field operations to calibrate input (such as fertilizer) application and equipment fuel use. Examples of precision agriculture technologies include yield monitors, variable-rate application technologies, guidance systems, and GPS maps.

¹³USDA, *On the Doorstep of the Information Age: Recent Adoption of Precision Agriculture*, (Washington, D.C.: August 2011).

improve manure management practices in an effort to reduce methane emissions.

Farmers also can improve the resiliency of their operations, as shown in table 2. For example, farmers can change the type of crop they plant to fit the changing climate or change the timing of their planting in response to a longer or shorter growing season. They can also shift to drought-, pest-, or weed-resistant crop varieties to reduce climate change impacts. There are also actions that address both mitigation and adaptation. For example, farmers can choose no-till farming, which allows carbon to remain in the soil and reduces fuel consumption (mitigation) while also improving the capacity of soil to retain moisture to reduce stress on crops during drought (adaptation).

Table 2: Examples of Climate Change Adaptation Strategies for Agriculture

Key climate impacts	Adaptation strategies
Increased variability in growing conditions (changes in seasonal temperature and precipitation patterns)	<ul style="list-style-type: none"> • Change crop variety. • Change timing of farming operations. • Build soil health. • Install irrigation systems. • Precision agriculture.
Increased soil degradation due to erosion	<ul style="list-style-type: none"> • Soil conservation practices (no-till, cover crops, mulch).
Increase in biotic stressors (weeds, insects, and disease)	<ul style="list-style-type: none"> • Use resistant crop varieties. • Use chemical applications such as herbicides and insecticides.
Increased number, length and/or intensity of drought events	<ul style="list-style-type: none"> • Use drought-resistant crop varieties. • Conservation practices. • Install irrigation systems.
Increased number and intensity of flood events	<ul style="list-style-type: none"> • Avoid high risk planting periods and locations. • Increase drainage capacity. • Use flood tolerant crop varieties.

Sources: GAO summary of USDA and U.S. Global Change Research Program documents. | GAO-14-755

USDA Agencies and Offices Involved in Climate Change

Several USDA agencies and offices are involved in climate change work. USDA's Climate Change Program Office, which coordinates all of the department's responses to climate change, leads a Global Change Task Force. The task force includes representatives from 20 USDA agencies and offices and works to coordinate climate activities by holding monthly meetings to discuss climate-related opportunities and efforts across the

department. Table 3 provides information about the eight USDA agencies and offices that are most heavily involved in the agency's climate change work.

Table 3: Summary of Key USDA Agencies and Offices Working on Climate Change Issues

Agency or office name	Background and work on climate change
Agricultural Research Service	USDA's principal in-house research agency that does work in various areas, including nutrition, food safety, natural resources, and crop and animal production. This agency has laboratory facilities across the United States that conduct research on a range of issues, including climate change.
Climate Change Program Office	Coordinates USDA climate program and policy issues. The office aims to ensure that USDA is a source of objective information on climate change; the climate office also serves as a liaison to other federal agencies on climate issues.
Economic Research Service	The primary source of economic information and research at USDA. The agency publishes research reports, market analysis and outlook reports, economic briefs, and data products.
Farm Service Agency	Administers loan programs, along with conservation, commodity, and disaster programs, through a national network of offices.
Forest Service	The Forest Service manages the national forests to be resilient to stresses and able to provide a variety of goods and services (including carbon sequestration). Research and development under way at the Forest Service examines the impact of climate change on the nation's forests, rangelands, and urban areas, which the Forest Service uses to develop management options for maintaining healthy ecosystems in light of climate change.
National Institute of Food and Agriculture	Funds external research, including research on climate change, education, and extension programs in the land-grant university system and other partner organizations.
Natural Resources Conservation Service	Focuses on implementing conservation programs to help private landowners conserve land. Provides technical and financial assistance to private landowners. Conserving land can help to sequester soil carbon. Certain conservation measures can improve soil health by improving the soil organic content, increasing soil moisture content, and reducing soil erosion, all of which can help with climate adaptation.
Rural Development	Helps rural areas to develop and grow by offering federal assistance designed to improve the quality of life. The agency has an energy focus area that promotes energy efficiency and renewable energy.

Source: GAO analysis of USDA information. | GAO-14-755

In June 2011, the Secretary of Agriculture issued Departmental Regulation 1070-001 that required USDA agencies to take climate change into account when making long-term planning decisions and to prepare climate adaptation plans by June 2012.¹⁴ The resulting USDA

¹⁴USDA, *Departmental Regulation 1070-001: Policy Statement on Climate Change Adaptation* (Washington, D.C.: June 2011).

adaptation plan contained individual adaptation plans for 12 of USDA's agencies, lays out the risks and vulnerabilities facing agency missions as a result of climate change, and details the strategies for overcoming these vulnerabilities.¹⁵

As required by GPRA as amended by the GPRA Modernization Act of 2010,¹⁶ executive agencies are to complete strategic plans in which they define their missions, establish results-oriented goals, and identify the strategies that will be needed to achieve those goals. According to USDA officials, beginning with its 2010-2015 Strategic Plan, USDA included climate change as a part of one of its four strategic goals. Specifically, the Strategic Plan states that USDA will ensure that farms are "conserved, restored, and made more resilient to climate change."¹⁷ An objective of this strategic goal is to "lead efforts to mitigate and adapt to climate change." In April 2014, USDA released its 2014-2018 Strategic Plan that includes the same four strategic goals established in the 2010-2015 strategic plan plus one additional strategic goal.¹⁸

The Cooperative Extension System

USDA partners with the cooperative extension system to, among other things, help deliver information to farmers on farm management practices. The cooperative extension system is a partnership between land-grant universities and USDA. Established by the Morrill Act of 1862, the land grant university system is comprised of more than 100 colleges and universities around the country. These institutions receive federal support and are required to provide relevant information to the public through the extension system. Faculty members at land-grant universities may have dual appointments, meaning that in addition to teaching, they spend a certain portion of their time on research and on extension work.

¹⁵USDA, *U.S. Department of Agriculture Climate Change Adaptation Plan* (Washington, D.C.: June 2012).

¹⁶5 U.S.C. § 306(a).

¹⁷USDA's three other strategic goals outlined in both the 2010-2015 and 2014-2018 Strategic Plans are to (1) assist rural communities to create prosperity so they are self-sustaining, repopulating, and economically thriving; (2) help America promote agricultural production and biotechnology exports as America works to increase food security; and (3) ensure that all of America's children have access to safe, nutritious, and balanced meals.

¹⁸USDA's 2014-2018 Strategic Plan also included a fifth strategic goal: create a USDA for the twenty-first century that is high-performing, efficient, and adaptable.

Established by the Smith-Lever Act of 1914, the cooperative extension system is a nationwide system used to disseminate information and research developed at land-grant universities. The system is a network of state and local offices that provide information to the public on a variety of topics, including agriculture.¹⁹ USDA's National Institute of Food and Agriculture (NIFA) distributes federal funding for the extension service. The extension service also receives state and county funding. According to a June 2013 joint USDA and National Oceanic and Atmospheric Administration (NOAA) report on the role of extension in climate adaptation, climate-related research and extension efforts have existed for decades.²⁰ One goal of both research and extension efforts is to provide decision makers with information and tools, disseminated through meetings, written publications, and internet websites, to increase climate literacy.

USDA's Climate Change Priorities Include Providing Better Information to Farmers and Generally Align with National Priorities

USDA's climate change priorities include providing better information on future climate conditions to help farmers in their decision making, conducting research, and delivering decision support tools and technical assistance to farmers. USDA's adaptation efforts focus on research and technical assistance, while its mitigation efforts also focus on reducing greenhouse gas emissions and sequestering carbon. USDA's climate adaptation and mitigation priorities generally align with national climate priorities.

USDA's Climate Change Priorities Include Providing Better Information on Future Climate Conditions to Farmers

USDA's climate change priorities include providing better information to farmers on current and potential impacts of climate change, which is information that farmers need to make decisions. According to a USDA official, there is a need to develop better forecasts for upcoming growing seasons. These forecasts are generally 90-day forecasts, but farmers also need accurate forecasts for 6 to 8 months out, because they order their seeds for spring planting in the fall. Another USDA official we spoke with told us that there is a need to provide farmers with longer-term

¹⁹Extension services are also provided on such topics as financial literacy, natural resources, leadership development, and a youth program, known as 4-H.

²⁰USDA, NOAA, *The Role of Extension in Climate Adaptation in the United States: Report from the Land Grant – Sea Grant Climate Extension Summit* (Washington, D.C.: June 2013).

projections for as much as 20 to 60 years into the future that farmers can use to help make large capital investment decisions, such as whether to install an irrigation system or install a cooling system in a barn. A USDA official told us that USDA itself does not engage in climate modeling, but instead relies on some of the federal agencies with strong climate science capabilities, such as NOAA, the National Science Foundation, and the National Aeronautics and Space Administration, to help USDA officials better understand the climate projections that are available and the associated uncertainties for these projections. USDA officials told us that through the USGCRP, USDA has been encouraging these agencies to downscale modeling results so that they provide more localized and, hence, more helpful information to farmers. According to USDA's 2014 Budget Explanatory Notes for Congress, "Access to consistent and detailed projections of climate change is a major area of uncertainty for our programs and agencies."

USDA Climate Change Adaptation Efforts Focus on Research and Developing Technical Assistance

According to USDA's 2010 Climate Change Science Plan, the agency's adaptation efforts aim to improve the understanding of climate change impacts on agriculture, develop adaptation practices, and deliver science-based information and tools to stakeholders.²¹ USDA officials told us that about 80 percent of the agency's climate research dollars are spent on climate change adaptation. A 2013 Congressional Research Service (CRS) report shows USDA's funding for climate change research under USGCRP has almost doubled from \$63 million in fiscal year 2008 to \$121 million in fiscal year 2010, but funding has remained relatively flat since.²² In fiscal year 2013, total funding for USDA's climate change research programs was about \$82 million, as shown in table 4.²³ According to OMB data on federal climate expenditures, research represents approximately

²¹USDA, *Climate Change Science Plan* (Washington, D.C.: December 2010).

²²CRS, *Federal Climate Change Funding from FY2008 to FY2014* (Washington, D.C.: September 2013). This funding includes the Forest Service. According to OMB, the Forest Service received \$25 million in funding for forest and rangeland research in fiscal year 2013. Because this report focuses on production agriculture, and because GAO has previously assessed climate change efforts at the Forest Service, we are not including additional information about the Forest Service in this report.

²³This total does not include funding for the Forest Service.

20 percent of USDA’s total climate change funding.²⁴ According to USDA officials, USDA does not have a line item in its budget that covers climate change because many of the agency’s climate efforts involve programs across several USDA agencies. However, USDA does compile a “climate change crosscut,” which provides information on the money that various USDA agencies spent on climate change activities and provides this information to OMB. For more information on USDA’s climate change funding, see appendix II.

Table 4: USDA Climate Change Research Funding, Fiscal Years 2012 and 2013

Dollars in millions		
USDA agency	FY 2012 ^a	FY 2013 ^a
National Institute of Food and Agriculture	\$50	\$40
Agricultural Research Service	\$36	\$38
Economic Research Service	\$2	\$2
National Agricultural Statistics Service	\$1	\$1
Natural Resources Conservation Service	\$1	\$1
Total	\$90	\$82

Source: GAO summary of USDA data from the Office of Management and Budget’s (OMB) 2013 Federal Climate Change Expenditures Report to Congress. | GAO-14-755

^aThe totals shown in fiscal year 2012 reflect enacted funding as reported by OMB. The totals shown in fiscal year 2013 reflect current funding as reported by OMB.

NIFA and the Agricultural Research Service (ARS) are the two USDA agencies with the largest amount of climate change research funding.

- **NIFA.** NIFA oversees a competitive grant program called the Agriculture and Food Research Initiative (AFRI) that awards grants for research, extension, and/or education activities. Grant money is also awarded for “integrated” projects that incorporate two or more of these activities. Some integrated projects, known as coordinated agricultural projects (CAP), support large-scale projects that promote collaboration, open communication and the exchange of information, and reduce duplication of effort. In addition, NIFA funds “standard” grants on climate change

²⁴OMB, *Federal Climate Change Expenditures Report to Congress* (Washington, D.C.: August 2013). Funding levels for 2013 in this report represent current funding as reported by OMB. Current funding reflects funding available calculated as the amount appropriated during the annual budget process (fiscal year 2013) minus reductions triggered by the Budget Control Act of 2011.

adaptation and mitigation in agriculture that consist of targeted research, education, extension, or integrated projects.

To help communicate information to farmers, NIFA distributes funding to the cooperative extension system. Extension disseminates science-based information and decision support tools through meetings, written publications, and via the internet. For example, the cooperative extension system supports the eXtension website, which can be used to access information and education resources on a wide range of topics from land-grant university staff and experts, such as entrepreneurship and growing certain crops. In fiscal year 2013, NIFA provided approximately \$296 million for agricultural extension at land-grant universities, or slightly less than one quarter of NIFA's total budget, to supplement state and county funds for the extension system.

- **ARS.** USDA's principal in-house research agency, performs both basic and applied research and presents the results through various sources, including academic papers, fact sheets, and conference presentations. Climate change research conducted by ARS takes place under the National Resources and Sustainable Agricultural Systems program, one of its four national research programs. In fiscal year 2013, ARS spent about \$38 million on climate change research, about 65 percent of which went to adaptation research projects, according to an internal USDA document. For example, ARS researchers are experimenting with different crop varieties to show which of these can withstand drought or higher temperatures.
- **ERS.** ERS also devotes a smaller amount of research money to developing information for decision makers on climate policy, such as examining the costs and benefits of adapting to climate change.²⁵ In 2012, ERS released a report that examined how farmers might adapt to changing climate conditions to reduce the impact of changes in local weather, resource conditions, and price signals.²⁶ The study found that, while changing climate conditions are uncertain, farmers have the

²⁵The National Agricultural Statistics Service and the Natural Resources Conservation Service also devote small amounts of money to climate change research under the USGCRP.

²⁶USDA ERS, *Agricultural Adaptation to a Changing Climate: Economic and Environmental Implications Vary by U.S. Region* (July 2012).

opportunity to adapt to weather, resource, and price changes by altering crops and adjusting their production practices.

USDA's Climate Change Mitigation Efforts Focus on Reducing Greenhouse Gas Emissions and Sequestering Carbon

In the area of climate change mitigation, USDA has set a goal for 2015 of a 40 million metric ton reduction in greenhouse gas emissions from the agricultural sector compared with 2005 levels and an 80 million metric ton increase in carbon sequestration compared with 2005.²⁷ According to USDA's 2010-2015 Strategic Plan, USDA will work to achieve these goals through its existing conservation and energy programs. Many of USDA's conservation programs are administered by the Natural Resources Conservation Service (NRCS) and provide both technical and financial assistance to farmers who voluntarily enroll in them. Under the Conservation Technical Assistance program, for example, NRCS staff work with farmers to develop and implement conservation plans. In addition, NRCS administers programs that provide financial assistance to encourage farmers to adopt conservation practices, such as the Conservation Stewardship Program. USDA's Farm Service Agency (FSA) also administers conservation programs, such as the Conservation Reserve Program, which provides financial assistance to farmers who remove land from agricultural production and plant native vegetation on the land.²⁸ USDA's conservation programs account for about 4 percent of USDA's budget—approximately \$6.2 billion in fiscal year 2013—but the agency does not report this funding to OMB as spending directly related to climate change. USDA officials said they do not report the spending to OMB as climate-related because the environmental benefits of these programs are wide-ranging and not solely related to climate change.²⁹ For example, these conservation programs can help reduce erosion from fields and provide habitat for wildlife, in addition to sequestering carbon and improving soil health.

²⁷Annual greenhouse gas emission targets are for the entire agricultural sector, including forest lands. We are not discussing forest lands or the Forest Service in this report.

²⁸NRCS receives compensation from FSA for providing the necessary technical assistance to farmers applying for FSA programs. An approved conservation plan is needed before a Conservation Reserve Program contract may be approved.

²⁹USDA officials told us that the department does not consider funding under OMB's clean energy technology crosscut to be climate change funding because the aim of these programs is to displace fossil fuels; climate change impacts are ancillary effects of the programs. However, OMB does consider these programs as climate change-related.

USDA officials told us that the agency's research efforts also play a role in promoting climate change mitigation, but these officials acknowledge that research alone does not directly result in emissions reductions. Several research efforts aim to quantify the reduction in greenhouse gas emissions that occurs if farmers take certain actions. For example, ARS has helped develop GRACEnet, a research program that estimates greenhouse gas emissions and carbon sequestration based on crops planted and land management practices. According to a USDA official, mitigation research represents about 15 percent of USDA's total climate change research spending.

Another mitigation goal involves increasing renewable energy generation in rural communities. USDA has set a goal of more than doubling the amount of renewable energy generation in rural communities from 1.5 billion kilowatt hours in 2009 to 3.1 billion kilowatt hours in 2015.³⁰ For example, Rural Development's Rural Energy for America Program (REAP) supports small energy generation projects by providing financial assistance to farmers and rural business owners that institute renewable energy systems, conduct energy audits, and make energy efficiency improvements. According to OMB, REAP received about \$3 million for these efforts in fiscal year 2013. In total, Rural Development received about \$13 in fiscal year 2013 to support agency mitigation efforts, according to OMB.³¹

³⁰A kilowatt hour is a measurement of electricity. For example, 60 kilowatt hours is the amount of electricity that one thousand 60-watt bulbs use in an hour.

³¹The Rural Utilities Service (RUS) within the office of Rural Development provides loans and loan guarantees to borrowers seeking to furnish electrical services in rural areas of the United States. Of the 11 power plants RUS has supported since 2009, one is hydroelectric; five are natural gas-fired; three are wind-driven; one is woody biomass-based; and one is a high-tech coal plant, called an Integrated Gasification Combined-Cycle plant, that is planning to capture and store a portion of its carbon dioxide emissions. According to RUS officials, the last traditional coal fired-power plant RUS funded was in 2007.

USDA's Climate Change Priorities for Agriculture Generally Align with National Climate Change Priorities

National climate change priorities, as articulated by the Administration and the USGCRP, are to promote mitigation actions, advance climate science, develop tools and translate information, better predict future climate conditions, and ensure that federal agencies are incorporating climate change into agency programs and operations. The Administration has set a goal of reducing greenhouse gas emissions by 17 percent by 2020 from 2005 levels. National climate change priorities aimed at meeting economy-wide emissions targets and ensuring climate resiliency are addressed in documents including the President's Climate Action Plan, the 2011 Progress Report of the Interagency Climate Change Adaptation Task Force, and Executive Orders 13514 and 13653. National climate change priorities are also identified in the 10-year USGCRP Research Plan. Table 5 shows climate-related priorities discussed in these documents.

Table 5: National Climate Priorities

Priorities	The President's Climate Action Plan	The National Global Change Research Plan 2012-2021: A Strategic Plan for the U.S. Global Change Research Program	Federal Actions for a Climate Resilient Nation: Progress Report of the Interagency Climate Change Adaptation Task Force	Executive Order 13514: Federal Leadership in Environmental, Energy, and Economic Performance	Executive Order 13653: Preparing the United States for the Impacts of Climate Change
Reduce greenhouse gas emissions	✓	✓	✓	✓	
Energy efficiency	✓	✓		✓	
Advance climate science	✓	✓	✓		✓
Develop tools and translate climate information to guide decision making	✓	✓	✓		✓
Develop forecasts to better predict future climate conditions	✓	✓	✓		
Integrate adaptation into federal government planning and activities through development of climate change adaptation plans	✓	✓	✓	✓	✓
Improve the utility of climate information	✓	✓	✓		✓

Sources: GAO analysis of Administration and other documents. | GAO-14-755

USDA's climate change priorities for agriculture generally align with the national priorities outlined in table 5. USDA officials said they rely on NOAA and other USGCRP science agencies to develop better and more localized climate projections to help farmers make management decisions to adapt to weather variability and a changing climate. USDA also has various adaptation and mitigation research efforts under way that are intended to help understand the current and potential impacts of climate change and develop information and tools for farmers. To help deliver information to farmers, USDA will rely on the cooperative extension system to translate climate information and NRCS staff to provide technical assistance through conservation programs, such as the Conservation Technical Assistance program. According to the USGCRP 2012-2021 Research Plan, USDA's research and extension efforts, conservation programs, and efforts to provide farmers with decision-making tools support USGCRP priorities on "multiple fronts."³²

USDA has also developed a climate change adaptation plan. In accordance with Executive Order 13514, USDA issued Departmental Regulation 1070-001 in June 2011, which directed its agencies to develop climate change adaptation plans. The June 2012 climate change adaptation plan detailed how climate change is anticipated to affect USDA operations and how USDA agencies will prepare and adapt to the projected impacts. For example, FSA stated that threats associated with climate change could make farmers become more reliant on financial and disaster assistance programs administered by FSA. To address this vulnerability, FSA's strategy is to review existing policies and programs and determine if they could be modified to encourage farmers to undertake adaptation measures such as changing crop varieties, diversifying crops, and increasing water-use efficiency.

³²USGCRP, *The National Global Change Research Plan 2012-2021: A Strategic Plan for the U.S. Global Change Research Program* (Washington, D.C.: April 2012).

USDA Climate Change Efforts Consist of Both Mature Programs and New Initiatives, but the Agency Is Not Tracking Progress Adequately

USDA's climate efforts consist of both mature programs and newer initiatives. USDA has been conducting climate change research and implementing conservation programs for several years. Many of these conservation programs were established prior to USDA's more recent focus on climate change. In more recent years, USDA has emphasized the need to turn climate research into technical assistance for farmers. In addition, USDA is working with other agencies to improve climate projections. However, USDA is not using its performance planning or reporting process to provide information on how it intends to accomplish its strategic goal on climate change or to track its progress toward meeting this goal.

USDA Has Engaged in Climate Change Efforts for Several Years

USDA's climate efforts have consisted of research, conservation, and energy programs.

Research: USDA has conducted climate change research since the early 1990s. These research efforts grew out of the Global Change Research Act of 1990, which required the development of a research plan that provides recommendations for collaboration to combine and interpret data to, among other things, "produce information readily usable by policymakers attempting to formulate effective strategies for preventing, mitigating, and adapting to the effects of global change."³³ Both ARS and NIFA and its predecessor organization at USDA, the Cooperative State Research, Education, and Extension Service, have been involved in climate change research since the 1990s.³⁴

ARS and NIFA still play major roles in USDA's climate research efforts. In fiscal year 2013, they accounted for \$78 million of the \$82 million (95 percent) of the monies that USDA spent on climate change research, according to OMB data.³⁵ ARS accounted for \$38 million in research spending, with most of this research conducted under its Climate Change, Soils, and Emissions Program. This program conducts research on four components of climate change: (1) improving air quality; (2) reducing

³³Pub. L. No. 101-606, §104(d)(3), 104 Stat. 3096, 3100.

³⁴NIFA was created following the passage of the 2008 Farm Bill.

³⁵OMB, *Federal Climate Change Expenditures Report to Congress*.

greenhouse gas emissions and sequestering carbon; (3) enabling agriculture to adapt to climate change; and (4) enhancing soil health. According to an internal ARS document, there were 32 ongoing research projects in 2013 focused on climate mitigation at a cost of \$13.7 million, and 53 research projects focused on climate adaptation at a cost of \$24.6 million. NIFA's work on climate change is done through its Institute of Bioenergy, Climate, and the Environment and, in fiscal year 2013, NIFA accounted for about \$40 million of USDA's climate research spending. According to NIFA officials, most of NIFA's climate research is funded through AFRI, the largest competitive grants program that NIFA administers. One of the five challenge areas that AFRI is working on is to "mitigate and adapt to climate change."

Conservation: USDA also has several established conservation programs administered by FSA and NRCS, many of which were established prior to USDA's more recent focus on climate change. Now these conservation programs are being presented as not only helping to conserve land, prevent erosion, or provide wildlife habitat, but also as having the climate benefit of sequestering carbon and promoting soil health. For example, FSA, and its predecessor agency, have administered the Conservation Reserve Program since 1986 and, in fiscal year 2013, about 27 million acres of land were conserved through this program. FSA estimates that this effort results in a net reduction of 45 million metric tons of carbon dioxide annually through sequestration of carbon dioxide and reduced fuel and fertilizer use by farmers.³⁶ Similarly, NRCS oversees a number of conservation programs, and an estimated 52.9 million acres were enrolled in these programs in fiscal year 2012. NRCS's focus on conservation goes back to the Dust Bowl of the 1930s.³⁷ The largest of NRCS's conservation programs is the Environmental Quality Incentives Program, which provides financial and technical assistance to farmers who implement conservation practices and undertake conservation planning.

Energy: Another area where USDA has ongoing climate change mitigation efforts involves energy. FSA, NIFA, NRCS, and Rural Development have programs focusing on different aspects of energy,

³⁶FSA, *Environmental Benefits of the Conservation Reserve Program* (2013).

³⁷NRCS was originally known as the Soil Conservation Service and was established in large part to reduce erosion following the severe drought of the 1930s.

including energy efficiency, renewable energy, and the production of biofuels. Among these programs is Rural Development's REAP program. According to a March 2012 report on REAP, this program funded 5,733 renewable energy and energy-efficiency improvement projects since 2009.

Recent USDA Efforts Have Emphasized the Need to Turn Research Findings Into Technical Assistance for Farmers

In 2009, research program leaders at NIFA developed a new strategic direction, which called for NIFA to support the creation of "innovative tools for communication and education to provide information that people and communities can use in their daily lives."³⁸ Subsequently, USDA's Climate Change Science Plan, released in 2010, emphasized the need for the agency to develop tools to help farmers with both climate adaptation and mitigation. Also, in 2010, NIFA issued a funding announcement under AFRI's climate change challenge area for projects focused on climate research, education, or extension.³⁹ The announcement also provided funding for integrated projects, which combine research along with education and/or extension activities. Among the projects funded under this announcement were the four largest grants the agency had ever awarded according to NIFA officials. NIFA provided \$85 million in total funding over a period of 5 years for these four integrated projects, known as CAP grants.⁴⁰ Each of these grants, now in their fourth year, involves researchers across several universities. Table 6 provides more information on these projects.

³⁸NIFA, Agroclimate Science Portfolio Strategic Plan.

³⁹USDA, *Agriculture and Food Research Initiative Competitive Grants Program, Climate Change FY 2010 Request for Applications* (Washington, D.C.: 2010).

⁴⁰The grantees were not given this money in a lump sum up-front. Rather, they need to submit progress reports on an annual basis, a process known as continuation. During this process, NIFA officials review progress reports from the grantees on what they have accomplished and make a decision on whether to continue providing funding.

Table 6: Summary of Selected Coordinated Agricultural Project (CAP) Climate Change Grants Awarded in 2011

Grant name, funding level, and focus	Key research efforts 2011-2014	Key extension and education efforts 2011-2014
<p>Triticeae CAP (TCAP) \$25 million over 5 years Develop new varieties of wheat and barley seeds that have different traits to respond to climate change.</p>	<p>Wheat and barley seed varieties have been tested and developed in field trials, and more than 100 research papers have been written. In 2013, work led to release of 20 new varieties of plants.</p>	<p>The grant is focused on training plant breeders. Total of 117 graduate students have participated in plant training network.</p>
<p>Climate Change, Mitigation, and Adaptation in Corn-Based Cropping Systems (Sustainable Corn) \$20 million over 5 years Climate mitigation and adaptation in corn farming in the Midwest.</p>	<p>Several ongoing research projects on large field plots are examining impacts of different farming practices, such as no-till farming. Year three of the grant resulted in 31 articles, 91 extension publications, and 189 presentations.</p>	<p>Have developed weather guides for nine states in Corn Belt in Midwest. Have at least one dedicated extension agent in each of nine states in the Corn Belt responsible for providing project information to farmers. During year three of the grant, conducted in-depth interviews with 165 farmers on their farming practices.</p>
<p>Regional Approaches to Climate Change (REACCH) for Pacific Northwest Agriculture \$20 million over 5 years Climate adaptation and mitigation in cereal production in the Pacific Northwest.</p>	<p>Fifteen large field experiments are part of the grant examining impacts of different wheat farming techniques, such as planting cover crops and diversifying the crop rotation.</p>	<p>In 2013, hired staff member to prepare extension materials on research. Have hosted webinars and conducted two surveys of farmers. Few web-based tools developed to date, but plan on releasing temperature tool in the future.</p>
<p>Pine Integrated Network: Education, Mitigation, and Adaptation Project (PINEMAP) \$20 million over 5 years Climate adaptation and mitigation in pine forest management in southeastern United States</p>	<p>Conducting hundreds of field research experiments. Research is between one-third and one-half complete, according to PINEMAP officials. Plan to use research results to validate models on yields from tree farms.</p>	<p>Developed fact sheets, hosted webinars, and conducted surveys of forest managers. Plan to develop decision support system based on research results in final years of grant. Developed education module for middle and high school students.</p>

Sources: GAO summary of CAP grant documents and interviews with university officials implementing the grants and USDA officials overseeing the grants. | GAO-14-755

The four CAP grant projects are at various stages of turning research into technical assistance for farmers, based on our review of materials and conversations with leaders of these projects. Most of the grantees had conducted outreach to farmers through conducting surveys or holding webinars, but the grants varied in terms of their use of extension and development of web-based tools to aid farmers in decision making. For example, the Sustainable Corn CAP grant has cooperative extension agents in nine Midwestern states in the Corn Belt who are responsible for

disseminating project information to farmers. This CAP grant recipient also has partnered with another USDA grantee, Useful to Usable,⁴¹ to communicate research to farmers; this joint effort has resulted in the development of two web-based tools for farmers. One of these tools, the Corn-Growing Degree Day tool, compares current weather conditions with 30-year averages and helps farmers decide when to plant their seeds. In contrast, university officials leading the PINEMAP and REACCH CAP grants say their projects have been more focused on research so far, but they are planning to produce tools for farmers in the final years of funding. These university officials said that developing tools for farmers takes time.

In 2013, NIFA awarded two CAP grants focused on livestock, with one focused on dairy cattle, and one focused on beef cattle. These also were 5-year grants, consisting of about \$10 million each. These livestock grants focus on developing information for farmers on adaptation and mitigation options. For example, the CAP grant project on beef cattle is examining ways to reduce methane emissions by altering the animals' diets. NIFA officials told us it was likely that when funding ran out for these CAP grants and the four awarded in 2011, that future CAP grant funding would be less.

A senior ARS official told us that ARS's research on climate mitigation is more mature than its climate adaptation efforts. This official said ARS was more comfortable with making recommendations to farmers about how to reduce greenhouse gas emissions or sequester carbon in soil than with providing information on how to adapt to climate change. He said that ARS's adaptation research had not progressed to the point where a "decision tree" tool could be developed to guide farmers on adaptation options. During our site visits to two ARS laboratories, we observed growth chambers where ARS scientists were examining the impacts that future climate conditions could have on crops to help identify crop types that best withstand these conditions. One area where ARS has made progress is on soil health techniques, such as using no-till farming. According to ARS and NRCS officials, ARS research has been used by NRCS to provide information to farmers on the benefits of healthy soil.

⁴¹This project is funded through a 5-year grant that provides \$1 million annually.

Like ARS, NRCS has also developed some climate change tools for farmers in recent years. For example, NRCS has worked with Colorado State University to develop COMET-FARM, a web-based tool used by farmers to estimate the carbon footprint of their operations and to determine likely impacts from certain actions in reducing their greenhouse gas emissions or increasing sequestration. In 2012, NRCS launched a campaign called Unlock the Secrets in the Soil to share information with farmers on the benefits of healthy and productive soil. As part of this effort, NRCS maintains a website with fact sheets, videos, and other information on soil health.

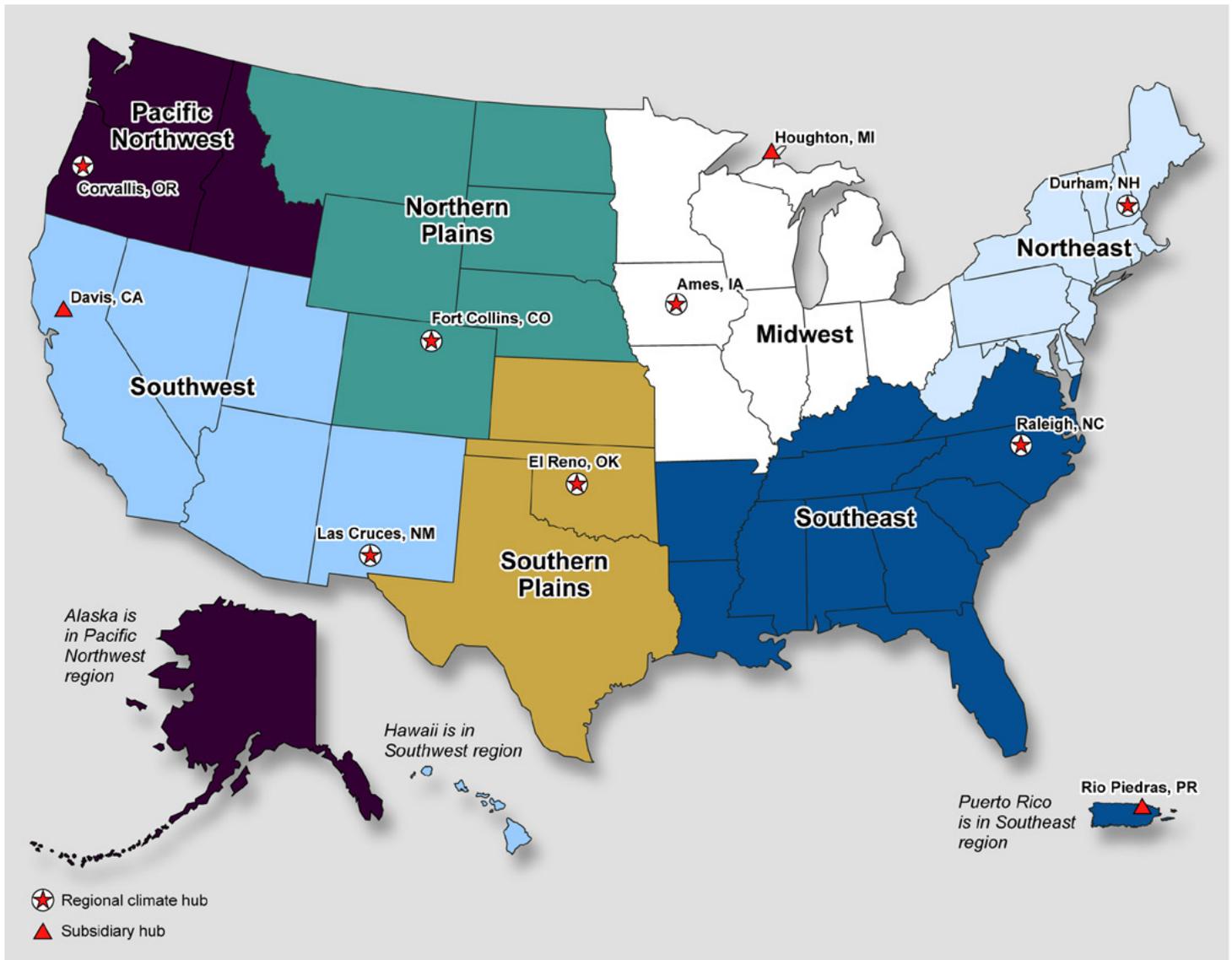
In February 2014, USDA announced the establishment of seven regional climate hubs and three subsidiary hubs to “deliver science-based, practical information to farmers, ranchers” and “to support decision making related to mitigation of, and adaptation to climate change.”⁴² Figure 2 is an interactive map showing the regional climate hub locations. (See app. IV for a printable, noninteractive version of fig. 2.) During the first year of this effort, USDA officials expect the hubs to engage with stakeholders, establish a website, conduct a climate risk assessment for the hub’s region, and develop training for USDA staff. Several USDA agencies will actively contribute to this effort, including ARS, NRCS, Rural Development, and the Forest Service. USDA officials said they expect NRCS staff and the cooperative extension service to help distribute technical assistance from the hubs to farmers and other stakeholders in the region. The climate hubs will also collaborate with other federal agencies that have existing climate offices, such as NOAA, which has regional climate partnerships that include Regional Integrated Sciences and Assessments teams, Regional Climate Centers, and Regional Climate Services Directors. These hubs will be located at existing ARS or Forest Service facilities.

⁴²USDA, *Charter of the Executive Committee of the Regional Hubs for Risk Adaptation and Mitigation to Climate Change* (Jan. 31, 2014).

Interactive Graphic

Figure 2: Location of USDA's Regional Climate Hubs and Information on These Regions

Instructions: Move your cursor over the colored regions below for more information. For a printable, noninteractive version of this figure, see appendix IV.



Sources: GAO analysis of USDA information; Map Resources (map). | GAO-14-755

Some USDA officials said that there was no substitute for the one-on-one attention that farmers receive from extension or NRCS staff. However, representatives from farm groups said that the cooperative extension system is “not what it used to be” because both funding and staffing levels have fallen in recent years. During our site visit to Iowa, a leading agricultural state in crop and livestock production, a university official told us that, until 2009, there had been an agricultural extension agent in each of the 99 county extension offices, but there now are only about 30 such individuals, each of whom covers multiple counties. According to USDA officials leading the climate hubs effort, they have reached out to the extension system by hosting a meeting with all of the land-grant universities and sending a letter to states, urging them to take part in the climate hub effort. USDA is also developing a memorandum of understanding on this topic with the Association of Public and Land-Grant Universities.⁴³ However, there are very few extension specialists that have a focus on climate change; we spoke to two climate change extension specialists during our work, and one of these specialists told us that he knew of only four such specialists in the United States. NRCS officials said that they viewed the staff’s work in the hubs as an extension of NRCS’ traditional work on conservation. These officials did, however, acknowledge that there has been a decline in staffing levels in recent years, which we reported on in a recent report.⁴⁴

With the reduced presence of the extension system, some stakeholders told us that farmers are turning more to the private sector for information on managing their farms. Certified crop advisers,⁴⁵ who provide information to farmers on, among other things, seed selection, irrigation, and fertilizer decisions, are one such source of information. The Useful to Usable grant project is focused on delivering information to crop advisers that can be shared with farmers. Some of these crop advisers are

⁴³The Association of Public and Land-Grant Universities is a research, policy, and advocacy organization representing 234 public research universities, land-grant institutions, state university systems, and affiliated organizations.

⁴⁴We found that staffing levels at NRCS had declined about 1.4 percent annually on average between fiscal years 2003 and 2012. See GAO, *U.S. Department of Agriculture: Workforce Decisions Could Benefit From Better Linkage To Missions And Use Of Leading Practices*, [GAO-14-288](#) (Washington, D.C.: Mar. 31, 2014).

⁴⁵These advisors are certified by the American Society of Agronomy through a process that involves passing exams, having a certain level of experience or education, and earning 40 hours of continuing education every 2 years.

independent, while others are employed by large agribusiness companies.

Efforts Are Under Way to Improve Climate Change Projections, but They Are Generally at an Early Stage

One of the key pieces of information farmers need to make planting and other decisions is reliable information on future climate projections. USDA officials told us that farmers need projections that cover longer periods of time so they can make longer-range and seasonal decisions, such as what type of seed to buy for the upcoming planting season or whether to purchase a certain piece of equipment. One of the ways that USDA and NOAA are addressing the need for longer-term climate projections is through participation in the Agricultural Model Intercomparison and Improvement Project (AgMIP) consortium, an international effort established in 2010 to examine and improve globally integrated climate, economic, and agricultural production models. A USDA official involved in this effort told us that the AgMIP effort is at an early stage of development. Currently, most climate models provide projections over large geographical regions. For example, the Third National Climate Assessment provided information on possible future climate conditions across nine regions in the United States under different greenhouse gas emissions scenarios.⁴⁶ However, NOAA officials said that these were scenarios and not forecasts because they do not include probabilities of these occurring. Officials at USDA told us that they recognize farmers need both localized information to make decisions and more information on the likelihood that certain climate conditions will occur. The process of refining larger-scale model results and arriving at a more local geographic scale is known as downscaling. According to the National Research Council, downscaling can be challenging, and additional evaluation of the various downscaling methodologies is needed.⁴⁷

Currently, farmers can obtain more localized projections on weather and drought conditions with shorter time frames from various sources. NOAA's Climate Prediction Center produces seasonal weather outlooks

⁴⁶In developing these scenarios, the report focused on the climate impacts of two emissions pathways. One pathway, A2, is known as the "high emissions" case where greenhouse gas emissions increase through the year 2100. In the "low emissions" case, B1, greenhouse gas emissions increase at a slower rate until 2050 and then begin to decline.

⁴⁷National Research Council, *A National Strategy for Advancing Climate Modeling* (Washington, D.C.: 2012).

that cover 90-day periods for both temperature and precipitation and provide probabilities on whether conditions will be average, below average, or above average. NOAA also leads the National Integrated Drought Information System (NIDIS), which provides information on current drought conditions and projections for future drought conditions and communicates these on a regular basis. NIDIS is made up of representatives from USDA, along with the Departments of Energy, the Interior, and Transportation, and various other federal agencies.

USDA Is Not Using Its Strategic Planning and Reporting Process to Provide Information on Its Climate Change Efforts

Helping to make farms more resilient to climate change is part of one of USDA's four strategic goals, but the agency is not using its performance planning and reporting process to provide information on how it intends to accomplish this goal or the status of its efforts. Developing a strategic plan and establishing performance measures is the first step in an agency's performance management process. According to GPRA, as amended by the GPRA Modernization Act of 2010, an agency's performance plan is supposed to explain how the agency will accomplish its performance goals, and its performance reports are supposed to review the extent to which performance goals have been met, and if the performance goals are not met, explain why.⁴⁸ We found shortcomings in both of these documents that USDA had been preparing on an annual basis:

- **Performance plans.** In USDA's performance plans for the years 2011, 2012, and 2013, there was only general information about its climate change efforts, and there was no specific linkage between these efforts and its performance goals and how these efforts would be used to accomplish its goals. For example, in the 2013 USDA performance plan, there is no explicit discussion on how ARS's or NIFA's research efforts relate to climate change. When asked, USDA officials were uncertain as to why this linkage was not included in the department's performance plan. GPRA requires that agencies use their performance plans to describe how an agency's performance goals contribute to the goals laid out in its strategic plan. Without this information in its performance plans, USDA is not providing a plan to the public on how it intends to accomplish its goals.

⁴⁸31 U.S.C. §§ 1115, 1116.

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- **Performance reports.** In its performance reports for the years 2011, 2012, and 2013, USDA did not provide any information on whether it was meeting its performance goals under its strategic objective to lead efforts to mitigate and adapt to climate change. USDA provided information on its other measures for its strategic objectives. USDA officials stated that since climate efforts were largely excluded from the performance plan, these efforts were excluded in the performance report. GPRA requires that agencies use their performance reports to provide information on whether they have achieved their performance goals. Without this information, USDA cannot demonstrate whether its efforts have been successful and whether changes need to be made to its programs to address any unmet goals.
 - **Performance measures.** USDA does not have performance measures in its 2014-2018 strategic plan for some of the adaptation practices, such as no-till farming and the planting of cover crops, which the agency is encouraging farmers to adopt. USDA officials in both ARS and NIFA told us that it is difficult for them to track farm management practices. However, USDA conducts several surveys of farmers, and its Agricultural Resource Management Survey collects information on farm management practices, including the use of no-till farming. Agency officials also said that it has been difficult to develop performance measures for climate change since it was first included as a strategic goal in the 2010-2015 strategic plan. Nonetheless, USDA has developed performance measures to track progress for some of its other strategic objectives that track acreage amounts where certain practices have been implemented on public or private lands.⁴⁹ USDA has a wide-ranging set of climate efforts under way, but the performance measures that are part of its strategic plan do not capture the breadth of its efforts. Without measures to track progress on more of its climate efforts, USDA will not be able to fully assess its progress in meeting its climate change strategic goal and provide information to Congress and the public on its progress. See appendix III for more information on the strategic goal, objectives, and associated performance measures that are part of USDA's strategic plans for fiscal years 2010-2015 and fiscal years 2014-2018.

⁴⁹In its FY 2014-2018 Strategic Plan, USDA has set a performance goal to increase the "percentage of public and private forest and grazing land with conservation or management applied to improve or sustain productivity and ecological health."

USDA Faces Challenges in Implementing Its Climate Change Efforts

USDA faces challenges in encouraging U.S. farmers to take measures to mitigate and adapt to climate change. To address some of these challenges, USDA is, among other things, developing tools that summarize climate information and communicate research findings to farmers. However, USDA does not provide farmers with information on the costs and returns of taking climate change actions.

USDA Faces Challenges in Encouraging Farmers to Adapt to Climate Change and Reduce Greenhouse Gas Emissions and Sequester Carbon

As mentioned earlier, USDA is developing and delivering technical assistance on climate change to farmers, and we found that the agency faces challenges in these efforts. USDA officials we spoke with, as well as researchers and representatives of environmental groups, said that climate change is a very complex topic, and it is difficult to turn the large amount of often technical research into readily understandable information. Our 2009 report on climate change found that turning climate data into information useful for making climate adaptation decisions was a challenge facing federal, state, and local decision makers.⁵⁰

USDA officials acknowledge a need to develop climate projections at geographic scales and time frames relevant to farmers. To accomplish this goal, USDA officials said they must rely on other agencies and researchers, such as NOAA, because USDA does not have the technical capability to do this work. NOAA officials told us that providing climate predictions covering a 5- to 10-year period is one of the largest unmet needs in climate forecasting. Currently, it is difficult for climate modelers to predict when certain key climate features will occur that can have major influences on the climate on these time frames, such as El Niño/Southern Oscillation events.⁵¹ However, to provide additional help to farmers, NOAA is seeking to extend its climate forecasts beyond one year. NOAA officials also told us that climate models will always involve a degree of uncertainty and that local cooperative extension staff need to be trained on how to present information about this uncertainty in the models.

⁵⁰[GAO-10-113](#).

⁵¹The El Niño/ Southern Oscillation is a naturally occurring event in which large areas of warm water periodically move to the surface in the Pacific Ocean near the Equator and affect climate conditions around the world. In the United States, El Niño events usually lead to warmer winters in the northern part of the country and additional precipitation from California to Florida.

Another challenge USDA faces is the incentive structure that farmers consider when making decisions. Officials at USDA, researchers, and farmers we spoke with told us that farmers need incentives to take climate adaptation or mitigation actions. For example, planting cover crops has a financial cost for the farmer in the short-term in the form of seed and planting costs, but the benefits of healthier soil may not be realized for a few years.⁵² Similarly, an acre of land that is maintained in perennial vegetative cover for conservation purposes is not available to a farmer for revenue-generating crops, such as corn or soybeans.⁵³ USDA's existing conservation programs provide payments to farmers who take such conservation actions, but these payments are generally less than the revenue the farmer would receive from growing and selling crops on the land. Total acreage placed in the Conservation Reserve Program has declined between 2007 and 2013 from about 37 million acres to about 27 million acres, and one USDA official told us this was due in part to higher market prices for corn. Also, farmers who have marginal farmland have been able to convert it from grassland—which provides conservation benefits and sequesters carbon—to revenue-generating crops and qualify for crop insurance coverage offered by USDA, thus lowering their financial risk.⁵⁴ As some Iowa farmers told us, farmers generally make decisions based on short-term economic incentives because the farming industry is focused on producing commodities at the lowest price. For example, if climate change measurably decreases yields for farmers in the future, farmers may have an incentive to change their practices.

There was also general agreement among university researchers that climate change can be a polarizing topic in the agriculture community. According to a USDA-funded survey of almost 4,800 farmers in the Corn Belt, 66 percent believed that climate change was occurring and, of these

⁵²There can also be costs to terminate cover crops prior to a farmer planting a cash crop.

⁵³See GAO, *Agricultural Conservation: Farm Program Payments Are an Important Factor in Landowners' Decisions to Convert Grassland to Cropland*, [GAO-07-1054](#) (Washington, D.C.: Sept. 10, 2007).

⁵⁴Several factors—including crop prices, crop production technology and farm program benefits—may affect farmers' decisions about whether to grow crops on marginal land. However, it is difficult to assess the relative importance of these factors in farmers' decisions. The Agricultural Act of 2014 (2014 Farm Bill) generally made farmers who convert highly erodible land or wetlands to agricultural purposes ineligible for crop insurance premium subsidies.

respondents, 41 percent believed that humans were at least partly responsible.⁵⁵ The authors of this research found that if farmers do not believe climate change is happening or poses a threat, they may be less likely to take adaptation or mitigation actions.

USDA Has Taken Steps to Address Challenges but Does Not Provide Farmers with Information on the Costs and Returns of Taking Climate Change Actions

USDA has taken several steps to address the challenges it faces. For example, it is working to improve the information that can be provided to farmers from climate models. USDA is also taking steps to deliver information to farmers that is more accessible and easier to understand and apply to their operations. According to USDA officials, the regional climate hubs are intended to provide an avenue to deliver region-specific information to farmers on climate change. In addition, in three of the large CAP grant projects that USDA funded in 2011, farmers have been surveyed or interviewed to get more information on their needs and to better tailor the information provided to them to their needs. An official with the Useful to Usable CAP grant project told us that the project has used focus groups to gather information on the types of information that the farm community needs on climate change. Another USDA project maintains a website called AgroClimate, with weather forecast links and other tools, including fact sheets on different farm management practices, such as planting cover crops. University researchers we spoke with said that an understanding of the farm community is critical in communicating with farmers about climate change.

USDA reports have highlighted the importance of providing information to farmers on the costs and returns of taking certain actions in response to climate change. For example, USDA Technical Bulletin 1935 states that there is a need for “risk-weighted” costs and benefits of taking adaptation actions, but “few efforts have been made to develop such comprehensive quantification efforts in the context of climate change.”⁵⁶ According to officials at USDA, researchers, and farmers we spoke with, this

⁵⁵There was a 26 percent response rate for this survey. Of those farmers who responded, 31 percent reported that there was not enough information to determine whether climate change was occurring, and 4 percent reported that it was not occurring. These numbers do not sum to 100 percent due to rounding. This research was done as part of the CAP grant examining corn farming in the Midwest, known as Sustainable Corn. J. Gordon Arbuckle. *Climate Change Beliefs, Concerns, and Attitudes Toward Adaptation and Mitigation among farmers in the Midwestern U.S.* (Apr. 9, 2013).

⁵⁶USDA, *Climate Change and Agriculture in the United States: Effects and Adaptation, Technical Bulletin 1935* (Washington, D.C.: February 2013).

information is important because farmers weigh the financial costs and returns when making decisions about their farm operations. When we asked USDA officials about the agency's efforts to develop this information, they highlighted a 2013 report that examined the financial incentives necessary for farmers to adopt certain mitigation practices.⁵⁷ For example, the report provides estimated changes in costs, yield, and revenue for farmers changing from conventional tillage to reduced tillage for certain crops including corn and wheat. However, we found that the report does not provide information on instances where crop yields increased as a result of changes in practices, and we did not find evidence of USDA efforts to make information in this 270-page technical report more accessible to farmers. NRCS officials we spoke with did not seem aware of the report, and the website for NRCS's soil health campaign provides general information on the benefits of healthy soil but not on the farm-level costs to farmers or the demonstrated impact on crop yields from having healthier soil. According to federal standards for internal control, federal agencies are to record and communicate to management and others who need it and in a form and within a time frame that enables them to carry out their responsibilities.⁵⁸ Also under these standards, in addition to internal communications, management should ensure that there are adequate means of communicating with, and obtaining information from, external stakeholders that may have a significant impact on the agency achieving its goals. NRCS officials said they did not have information on the costs and returns of taking certain actions in response to climate change and suggested that farmers might get it from other farmers. They noted that this information is challenging to develop because several variables can affect the costs and returns for a particular farmer. In keeping with Technical Bulletin 1935, USDA has taken some steps to develop estimates of costs and benefits of taking actions in response to climate change, but if this information is not distributed in an accessible format, its usefulness to farmers may be limited. Without information that is readily accessible to farmers on the farm-level economic costs and returns of taking certain actions in response to climate change, farmers may be reluctant to take climate adaptation or mitigation actions.

⁵⁷ICF International, *Greenhouse Gas Mitigation Options and Costs for Agricultural Land and Animal Production within the United States* (Washington, D.C.: February 2013).

⁵⁸GAO, *Internal Control: Standards for Internal Control in the Federal Government*, [GAO/AIMD-00-21.3.1](#). (Washington D.C.: November 1999).

Conclusions

USDA is taking several promising steps to begin to help farmers mitigate and adapt to climate change. In recent years, USDA has increased funding for its climate efforts, particularly in the area of research, and has been working to help develop tools and useful information for farmers such as the recent establishment of regional climate hubs.

The importance of climate change at USDA is reflected in the fact that one of the agency's four strategic goals focuses on climate change. However, the agency does not have associated performance measures that reflect the breadth of USDA efforts in the climate area. In addition, its performance plans and performance reports do not provide adequate information on how the agency planned to accomplish its goals or the status of its efforts. By not using its performance plans to explain how it will accomplish its goals in the area of climate change, USDA has not provided Congress and the public with important information on its efforts. Without a more robust performance measurement system, USDA will have difficulty assessing its progress in meeting its strategic goal on climate change and providing information to Congress and the public on the status of its efforts.

Farmers weigh the financial costs and returns of taking certain actions carefully. However, USDA has made few efforts to quantify the costs and returns of taking certain actions that could help farmers make both short- and long-term decisions in the face of a changing climate. USDA has taken some steps in this area, but without communicating more accessible information on the economic costs and returns to farmers of taking certain adaptation or mitigation actions on their farms consistent with federal internal control standards, farmers may be reluctant to take certain actions.

Recommendations for Executive Action

To better promote agency accountability, we recommend that the Secretary of Agriculture direct the Climate Change Program Office and the Office of Budget and Program Analysis to take the following three actions:

- Work with relevant USDA agencies to develop performance measures that better reflect the breadth of USDA's climate change efforts.
- Ensure that the department's annual performance plans explain how agency actions will lead to the accomplishment of performance goals in the area of climate change.

-
- Use annual performance reports to provide information on the status of agency efforts toward meeting its performance measures in the area of climate change.

In addition, to provide relevant information to farmers, we recommend that the Secretary of Agriculture direct the Climate Change Program Office to work with relevant USDA agencies to develop and provide readily accessible information to farmers on the farm-level economic costs and returns of taking certain actions in response to climate change.

Agency Comments and Our Evaluation

We provided a draft of this report to the Departments of Agriculture and Commerce for review and comment. We also provided a copy to the U.S. Global Change Research Program for a technical review. In its written comments, reproduced in appendix V, the Department of Agriculture agreed with our recommendations and said that the report reflects the wide range of actions that the department is taking to address climate change in the agriculture sector. USDA also noted it has begun to address some of these recommendations. Specifically, the department is conducting additional work to provide tools to farmers that assess the costs and impacts of adopting technologies that help to mitigate climate change. The Departments of Agriculture and Commerce and the U.S. Global Change Research Program also provided technical comments, which we have incorporated as appropriate.

As agreed with your office, unless you publicly announce the contents of this report earlier, we plan no further distribution until 14 days from the report date. At that time, we will send copies of this report to the appropriate congressional committees, the Secretary of Agriculture, the Secretary of Commerce, and other interested parties. In addition, the report is available at no charge on the GAO website at <http://www.gao.gov>.

If you or your staff have any questions about this report, please contact me at (202) 512-3841 or neumannj@gao.gov. Contact points for our Offices of Congressional Relations and Public Affairs may be found on the last page of this report. GAO staff who made major contributions to this report are listed in appendix VI.

Sincerely yours,

A handwritten signature in black ink, appearing to read "John Neumann", with a long horizontal flourish extending to the right.

John Neumann
Acting Director, Natural Resources and Environment

Appendix I: Objectives, Scope, and Methodology

Our objectives were to examine (1) U.S. Department of Agriculture's (USDA) priorities related to climate change and agricultural production and how these align with national priorities; (2) the status of USDA's climate change efforts; and (3) the challenges, if any, USDA faces in implementing its climate efforts and the steps it has taken to overcome these challenges.

To describe USDA's priorities related to climate change and agricultural production and how these align with national priorities, we analyzed USDA documents that describe the agency's priorities in this area. These documents include USDA's fiscal year 2010–2015 and fiscal year 2014–2018 Strategic Plans, the agency's Climate Change Adaptation Plan, its Climate Change Science Plan, and Departmental Regulation 1070-001. To identify national priorities regarding climate change and agricultural production, we analyzed the U.S. Global Change Research Program 10-year strategic research plan, the Interagency Climate Change Task Force 2010 and 2011 progress reports, Executive Orders 13514 and 13653, and the President's Climate Action Plan. We also analyzed budget data that USDA reports to the Office of Management and Budget (OMB) for its annual report to Congress on climate change expenditures. We also interviewed officials responsible for climate change policy from USDA's Climate Change Program Office and other USDA agencies.

To determine the status of USDA's climate change efforts, we analyzed documents that included annual budget data, progress reports, and annual performance reports. These included the budget data that USDA reports to OMB. We focused on USDA's key climate change efforts, which we identified through discussions with USDA officials and by examining budget information, which enabled us to determine where USDA was devoting large amounts of funding. We also reviewed USDA's strategic plans for fiscal years 2010–2015 and fiscal years 2014–2018 and the performance plans and performance reports for the years 2010, 2011, 2012, and 2013. We also examined the requirements under the Government Performance and Results Act (GPRA) of 1993 and the GPRA Modernization Act of 2010 for strategic plans, performance plans, and performance reports. In addition, we reviewed progress reports that had been prepared by various USDA agencies. For the six large Coordinated Agriculture Project grants that had been funded by USDA's National Institute of Food and Agriculture (NIFA), we interviewed officials that were leading these grants and USDA officials that were responsible for overseeing five of these grants. We also interviewed officials that were leading two standard grants that had been funded by NIFA.

To determine the challenges that USDA faces in implementing its climate efforts and steps it has taken to overcome some of these challenges, we reviewed key documents on USDA's efforts and reviewed our past work on climate change. These USDA documents included USDA's Technical Bulletin 1935 on climate change and various reports prepared by USDA agencies. Our past work on climate change has identified several potential challenges in implementing climate change efforts at the federal and local level.

For all three objectives, we conducted interviews with a range of officials, including USDA officials implementing climate programs, and stakeholders who were knowledgeable about USDA's efforts and the challenges the agency faces. Specifically, we spoke with officials from 10 USDA agencies and had multiple conversations with officials from the following USDA agencies because of their extensive involvement in climate change work: Agricultural Research Service (ARS), Economic Research Service, Farm Service Agency (FSA), NIFA, Natural Resources Conservation Service (NRCS), and Rural Development. We also spoke multiple times with officials from USDA's Climate Change Program Office, which is responsible for coordinating USDA's climate efforts, and USDA's Office of Budget and Policy Analysis, which is responsible for USDA's preparation of budget estimates, legislative reports, and regulations, as well as USDA's strategic planning and reporting efforts. The stakeholders we spoke with included officials from farm groups, environmental groups, and an agribusiness company. We also spoke with farmers from Iowa and Kentucky.

Finally, we conducted two site visits on this engagement. We visited ARS's Beltsville Agricultural Research Center in Maryland, where we met with ARS researchers that were examining the impacts that different climate conditions could have on crops. We also toured the facilities where this research is taking place. We conducted a site visit in Iowa, where we spoke with a variety of officials, including USDA officials from ARS, NRCS, FSA, and Rural Development. We also spoke with a variety of officials at Iowa State University, including professors and extension staff. In addition, we met with extension staff in a county office, visited a corn and pig farm, and spoke with farmers that operated this farm. We selected Iowa because it is a large agriculture producer; according to the 2012 National Census of Agriculture, Iowa was the largest producer of corn and soybeans in the United States.

We conducted this performance audit from September 2013 to September 2014 in accordance with generally accepted government

auditing standards. Those standards require that we plan and perform the audit to obtain sufficient, appropriate evidence to provide a reasonable basis for our findings and conclusions based on our audit objectives. We believe that the evidence obtained provides a reasonable basis for our findings and conclusions based on our audit objectives.

Appendix II: Summary of USDA Climate Change Budget and Associated Programs

This appendix presents information on the U.S. Department of Agriculture's (USDA) budget and programs that are related to climate change. According to USDA officials, USDA does not have a line item in its budget that covers climate change because many of the agency's climate efforts involve programs across several USDA agencies. However, USDA does compile a "climate change crosscut," which provides information on the money that various USDA agencies spent on climate change activities. For the purposes of this report, we used budget data that USDA reports to the Office of Management and Budget (OMB) for its annual report to Congress on climate expenditures. Table 7 below is a summary of the amount these agencies spent on climate change efforts, according to OMB, along with a summary of USDA programs associated with this spending.

Table 7: USDA Climate Change Budget and Associated Programs

Dollars in millions		
USDA agency	FY 2013 climate change expenditures ^a	Examples of USDA programs
Climate Research		
Agricultural Research Service (ARS)	\$38	Natural Resources and Sustainable Agriculture Systems research program – One of four ARS national research programs. Under this program, there is National Program 212, titled Climate Change, Soils, and Emissions. In 2013, ARS scientists conducted 74 research projects under this program.
National Institute of Food and Agriculture (NIFA)	\$40	Agriculture Food Research Initiative (AFRI) – According to USDA officials, this is USDA's largest competitive grants program. AFRI funds projects in five challenge areas, one of which is climate change.
Economic Research Service (ERS)	\$2	Resource and Rural Economics – One of four ERS national research programs. According to USDA officials, climate change research outputs are categorized under three areas: publications, capacity-building, and datasets. USDA officials told us while no specific branch is dedicated to covering the topic of climate change, most of ERS' climate work falls under this program.
Conservation Programs		
Natural Resources Conservation Service (NRCS)	\$0 ^b	<p>Conservation Technical Assistance Program – NRCS staff work with farmers to implement conservation plans.</p> <p>Conservation Stewardship Program – Provides funding for farmers who take certain conservation actions.</p> <p>Environmental Quality Incentives Program – Provides technical and financial incentives to farmers who undertake conservation measures.</p> <p>Agricultural Conservation Easement Program – Provides financial and technical assistance to help conserve agricultural lands and wetlands.</p> <p>Conservation Innovation Grant Program – Provides grant money to stimulate the development and adoption of innovative conservation approaches and technologies.</p>
Energy Programs		

Appendix II: Summary of USDA Climate Change Budget and Associated Programs

Dollars in millions

USDA agency	FY 2013 climate change expenditures^a	Examples of USDA programs
NIFA	\$56	Biomass Research Development Initiative – Joint effort between NIFA and the U.S. Department of Energy, which seeks to promote research and development of biofuels and biobased products.
ARS	\$32	Biorefining National Research Program – ARS scientists conduct research on developing new commercially viable technologies to (1) convert agricultural materials and byproducts into fuels and other marketable products, and (2) reduce risks and increase profitability in existing industrial biorefineries.
ERS	\$2	Resource and Rural Economics – One of four ERS national research programs. According to USDA officials, climate change research is categorized under three areas: publications, capacity-building, and datasets. While no specific branch is dedicated to covering the topic of climate change, most of ERS’ climate work falls under this program.
Rural Development	\$13	Rural Energy for America Program (REAP) – Provides assistance to agricultural producers and rural small businesses to complete a variety of projects. Offering both loan guarantees and grants, the REAP program helps eligible applicants install renewable energy systems, such as solar panels or anaerobic digesters; make energy efficiency improvements, such as installing irrigation pumps or replacing ventilation systems; and conduct energy audits and feasibility studies. Biorefinery Assistance Program – Provides loan guarantees for the development, construction, and retrofitting of commercial-scale biorefineries. The Advanced Biofuel Payment Program – Provides payments to biofuel producers to support and expand production of advanced biofuels refined from sources other than corn.
Farm Service Agency (FSA)	\$0 ^c	Biomass Crop Assistance Program – Provides financial assistance to farmers that wish to produce biomass feedstocks and provide them to biomass refineries.
Administration		
Office of the Chief Economist – Climate Change Program Office	\$3	The Climate Change Program Office – Coordinates USDA’s climate activities. For example, according to USDA officials, the office is leading the effort to set up the seven USDA regional climate hubs. The office facilitates USDA’s Global Change Task Force, which is comprised of 20 USDA agencies, and aims to coordinate and share information on USDA’s climate efforts. The climate office is also responsible for coordinating climate activities with other federal agencies. The Climate Change Program Office also conducts multi-institutional assessments of climate change’s influence on agriculture, forests, and food security in support of the U.S. Global Change Research Program’s National Climate Assessment efforts.

Sources: GAO analysis of Office of Management and Budget (OMB) and USDA information. | GAO-14-755

^aFunding shown in appendix II reflects current budget authority as reported by OMB.

^bAccording to USDA officials, USDA does not count any of the conservation funding under its climate change funding. This is because these programs have a variety of environmental impacts, such as reducing erosion, supporting wildlife, and sequestering carbon. In fiscal year 2013, NRCS and FSA spent approximately \$4.3 billion and \$1.9 billion, respectively, on their conservation programs.

^cAccording to a USDA official, this program did not receive any funding in fiscal year 2013, but it was authorized. In fiscal years 2010, 2011, and 2012, the program received \$248 million, \$24 million, and \$16 million in funding.

Appendix III: Information on USDA's Strategic Objectives and Performance Goals

In this appendix, table 8 provides information on the objectives and performance measures related to climate change that are part of the U.S. Department of Agriculture's (USDA) fiscal years (FY) 2010-2015 and 2014-2018 strategic plans. These underlie USDA's second strategic goal to "ensure our national forests and private working lands are conserved, restored, and made more resilient to climate change, while enhancing our water resources." Working lands include both farms and livestock operations.

Table 8: Selected Information on Climate Change Related Objectives, Measures, and Performance Goals for USDA's Strategic Goal Two from FY 2010-2015 and FY 2014-2018 Strategic Plans

Objective	Performance measure	Baseline and targets for performance measures in FY 2010-2015 strategic plan	Baseline and targets for performance measures in FY 2014-2018 strategic plan	Explanation for differences in performance measures between strategic plans
2.1 Improve the Health of the Nation's Forests, Grasslands and Working Lands by Managing Our Natural Resources ^a	Improve soil health and sustainability on cropland (in tons of soil carbon loss avoided annually) ^b	Measure not in FY 2010-2015 Strategic Plan	2011 – 75,000 tons 2018 – 125,000 tons	USDA officials told us this was a new goal for the 2014-2018 strategic plan.
2.2 Lead Efforts to Mitigate and Adapt to Climate Change, Drought, and Extreme Weather in Agriculture and Forestry ^c	Annual greenhouse gas emissions by the U.S. agricultural sector measured in carbon dioxide equivalents	2005 – 482.6 million metric tons, carbon dioxide equivalent ^d 2015 – 441.6 million metric tons, carbon dioxide equivalent ^d	Measure not in FY 2014-2018 Strategic Plan	USDA officials told us that reducing greenhouse gas emissions remains an outcome the department wants to achieve but there is not a performance measure associated with this because the department cannot control all factors that influence emissions levels.
	Number of established regional hubs for risk adaptation and mitigation to climate change	Measure not in FY 2010-2015 Strategic Plan	2012 – 0 2018 – 7	The climate hubs are a new initiative and their location was announced by USDA in February 2014.

Source: GAO summary of USDA 2010-2015 and 2014-2018 Strategic Plans. | GAO-14-755

^aThis is the wording of the strategic objective 2.1 in the FY 2014-2018 Strategic Plan. In the FY 2010-2015 Strategic Plan, objective 2.1 read "Restore and Conserve the Nation's Farms, Ranches and Grasslands."

^bThis is also one of the agency's three priority goals. According to Office of Management and Budget Circular A-11, agency priority goals reflect the top priorities of agency leadership and are intended to be accomplished within 24 months. Agencies are required to review progress in achieving agency priority goals on a quarterly basis, and publicly report on their performance compared with their goals.

^cThis is the wording of the strategic objective 2.2 in the FY 2014-2018 Strategic Plan. In the FY 2010-2015 Strategic Plan, objective 2.2 read "Lead Efforts to Mitigate and Adapt to Climate Change."

Appendix III: Information on USDA's Strategic Objectives and Performance Goals

^dEach of the six greenhouse gases—carbon dioxide, methane, and nitrous oxide, as well as three synthetic gases: hydrofluorocarbons, perfluorocarbons, and sulfur hexafluoride—is assigned a unique weight based on its heat-absorbing ability relative to carbon dioxide over a fixed period. This weighting provides a way to convert emissions of various greenhouse gases into a common measure, called the carbon dioxide equivalent.

Appendix IV: Information on USDA's Regional Climate Hubs (Corresponds to Fig. 2)

In this appendix, table 9 provides additional details on the U.S. Department of Agriculture's (USDA) regional climate hubs that are part of the rollover information contained in interactive figure 2.

Table 9: Information on Climate Hubs Contained in Figure 2

Hub region and location	Agriculture characteristics of region	Examples of observed climate impacts on farmers	Other information
Northeast Durham, NH	Varied production including fruits, vegetables, and field crops.	Intense precipitation. Warmer temperatures. Weed, pest, and disease outbreaks.	
Southeast Raleigh, NC	Nicknamed the "wood basket" of the United States, but also produces large amounts of food and fiber crops.	Reduced forage. Crop losses. Tree mortality.	Contains subsidiary hub in Rio Piedras, Puerto Rico, that will focus on tropical forestry and agriculture.
Midwest Ames, IA	Contains the "Corn Belt" and is a major producer of soybeans. One of the most intensively farmed areas in the world.	Floods. Drought. Temperature shifts.	Contains a subsidiary hub in Houghton, Michigan, that will focus on northern forestry.
Northern Plains Ft. Collins, CO	Diverse production with both livestock and crops grown such as corn, soybeans, and wheat.	Extreme weather. Drought. Longer, hotter growing seasons.	
Southern Plains El Reno, OK	Large amount of wheat and beef production.	Drought. Temperature changes. Pests and diseases.	
Pacific Northwest Corvallis, OR	Accounts for half of nation's potato crop, 17 percent of wheat, and 11 percent of milk. Timber is also a big part of the economy.	Reduced snowmelt. More frequent fires. Higher temperatures and drought.	
Southwest Las Cruces, NM	Diverse production with cotton, lettuce, fruits, and livestock. Relies on irrigation more than any other region.	Extreme drought. Large wildfires. Forest mortality due to insects. Declining reservoir levels. More frequent heat waves, reduced cold snaps.	Contains a subsidiary hub in Davis, California, that will focus on specialty crops, which include fruits, nuts, and vegetables, and forestry.

Source: GAO analysis of USDA information. | GAO-14-755

Appendix V: Comments from Department of Agriculture



United States Department of Agriculture

Office of the Chief Economist
1400 Independence Avenue, SW
Washington, D.C. 20250-3810

SEP 5 2014

Mr. John Neumann
Acting Director
Natural Resources and Environment
U.S. Government Accountability Office
441 G Street NW
Washington, D.C. 20548

Dear Mr. Neumann:

The U.S. Department of Agriculture (USDA) appreciates the opportunity to respond to the U.S. Government Accountability Office (GAO) draft report *CLIMATE CHANGE: USDA Needs to Better Track Progress and Develop More Relevant Information for Farmers*, (GAO-14-755). The USDA agrees with the findings in the GAO draft report and would like to provide the following comments.

The report reflects the wide range of actions that USDA is taking to address climate change in the agricultural sector. As the report acknowledges, USDA's climate change priorities align with those set by the Administration. The report recognizes the efforts being taken across the Department to integrate concerns about climate change into research, planning, and programs. It discusses the Department's ongoing research to help stakeholders understand the effects of climate change. The report notes a new focus on providing information on future climate conditions, management options, and tools to support decision-making to farmers, ranchers, forest landowners, and rural residents. It notes the complexity of the climate change issue and the challenges facing the Department in pursuing these priorities. Finally, the report provides a series of recommendations that can improve our efforts to assess progress and track the performance of our climate change efforts.

USDA concurs with each of the four recommendations contained in the GAO report and is committed to correcting these issues and, in some cases, is already undertaking actions to address them. The first three recommendations cover performance reporting; the fourth recommendation is related to the development and accessibility of economic information related to climate change.

Recommendation:

1. Work with relevant USDA agencies to develop performance measures that better reflect the breadth of USDA's climate change efforts.
2. Ensure that the Department's annual performance plans explain how agency actions will lead to the accomplishment of performance goals in the area of climate change.
3. Use annual performance reports to provide information on the status of agency efforts toward meeting its performance measures in the area of climate change.

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USDA Response:

In 2010, for the first time, USDA included efforts to address climate change in our Strategic Plan. Strategic Plan Goal 2 calls on the Department to “ensure our national forests and private working lands are conserved, restored, and made more resilient to climate change, while enhancing our water resources.” USDA’s strategic plan outlines several performance measures related to climate change. Under Objective 2.2., the Department will “lead efforts to mitigate and adapt to climate change, drought, and extreme weather in agriculture and forestry.”

As GAO notes, the Department does not report on specific performance measures under Objective 2.2 in our Annual Performance Reports. USDA’s Office of Budget and Program Analysis and the Climate Change Program Office will work with relevant USDA Agencies to identify a set of annual performance metrics and include them in future Annual Performance Plans and Annual Performance Reports.

We note that USDA currently reports annual greenhouse gas emissions and carbon sequestration from agricultural and forest sources as part of the U.S. Government’s Greenhouse Gas Inventory report to the United Nations (UN). USDA also reports on the effectiveness of conservation and energy programs in addressing greenhouses gases in biennial reports to the UN. The latest of these reports, the U.S. Climate Action Report for 2014, was submitted to the UN last spring. USDA has prepared a formal Climate Adaptation Plan and intends to release it this fall. The USDA Adaptation plan will include specific measures and actions that could serve as metrics for annual performance reporting. We intend to draw on these sources to establish measures in support of Strategic Plan Objective 2.2.

In addition, USDA’s Annual Performance Report includes several measures that can assess performance in addressing climate change, although these measures are reported under other goals and objectives. For example, USDA reports the amount of lands enrolled in various conservation programs. Using this information, the Department can describe how it is helping to mitigate climate change through agriculture in the U.S. Similarly, USDA tracks the annual acres of public and private forest lands restored or enhanced and the acres of wildland-urban interface treated to reduce the risk of catastrophic fire.

Recommendation:

4. Develop and provide readily accessible information to farmers on the farm-level economic costs and returns of taking certain actions in response to climate change.

USDA Response:

Providing information to the agriculture and forestry communities continues to be a priority for USDA. Historically, that information has been provided through extension services and technical assistance, and we are currently working to provide climate change information to farmers and forest owners through similar programs. There are two specific efforts to note.

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Recently, USDA recently established its Climate Hubs, which will serve as a conduit to provide information on climate change to national, regional, and local stakeholders. In addition, the GAO report acknowledges USDA's report describing the options and costs for mitigating greenhouse gas emissions in the agriculture sector. The findings from that report are being combined with an additional report on potential greenhouse gas mitigation technologies to provide tools for farmers and ranchers to assess the costs and impacts of adopting specific mitigation technologies.

Thank you for the opportunity to review and comment on this report. We look forward to working with you on future USDA engagements.

Sincerely,


Joseph W. Glauber
Chief Economist

Appendix VI: GAO Contact and Staff Acknowledgments

GAO Contact

John Neumann, (202)512-3841 or neumannj@gao.gov

Staff Acknowledgments

In addition to the individual named above, Anne K. Johnson (Assistant Director), Cheryl Arvidson, Thomas Beall, Carol Bray, Kevin Bray, Christine Broderick, Andrew Burton, Frederick K. Childers, Elizabeth Curda, Scott Heacock, Richard P. Johnson, Leah Marshall, Susan Offutt, Dan Royer, and Sarah Veale made key contributions to this report.

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