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Climate Change Adaptation: U.S. Department of Agriculture

July 17, 2020

Congressional Research Service
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R46454

CRS REPORT
Prepared for Members and
Committees of Congress

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SUMMARY

R46454

July 17, 2020

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Climate Change Adaptation: U.S. Department of Agriculture

Congress has debated the significance of global climate change and what federal policies, if any, should be adopted to address it. Federal policies may focus on climate change *adaptation*—actions taken to avoid the consequences or capture the benefits of climate change—or climate change *mitigation*—interventions to reduce the sources or increase the sinks of greenhouse gases (GHGs). Policies focused on adaptation can reduce risks associated with climate change at federal agencies (including risks to infrastructure, operations, and mission delivery), including at the U.S. Department of Agriculture (USDA). Given that agriculture and forestry are already experiencing the impacts of climate change, adaptation policies are particularly important for these sectors.

Agriculture and forestry are sensitive to climate change, due to relationships between environmental conditions and the health and growth of plants and animals. Policy choices about practices, technologies, and programs can help determine how effectively the agriculture and forestry sectors adapt to climate change. While farmers, ranchers, and land managers continuously adapt to changing conditions, responses to climate change may require new management practices and technologies.

Many policies, programs, and activities at USDA address climate adaptation issues specific to agriculture and forestry. USDA provides federal programs and services related to forestry, farming, ranching, rural development, food, and other areas through its agencies and staff offices. Many USDA agencies and offices conduct programs and activities that address climate change adaptation with respect to their unique missions.

At the department level, the Climate Change Program Office (CCPO) coordinates USDA's response to climate change, and the USDA Climate Hubs work to connect climate adaptation research and practice. CCPO, a component of the Office of the Chief Economist, coordinates within USDA and with other federal agencies and international organizations. As such, it oversees USDA climate change adaptation planning, chairs the USDA-wide Global Change Task Force, oversees departmental GHG accounting, represents USDA to the U.S. Global Change Research Program (USGCRP), and directs international climate change initiatives. The USDA Climate Hubs are a departmental initiative involving several USDA agencies. The 10 regional hubs provide technical support to agricultural producers and landowners, assess and monitor production risks, conduct research, and engage with stakeholders regarding the effects of climate change on agriculture and forests.

USDA agencies that engage on climate change adaptation include those focused on natural resources and conservation (the U.S. Forest Service [FS] and the Natural Resources Conservation Agency [NRCS]); research (the Agricultural Research Service [ARS], the National Institute of Food and Agriculture [NIFA], the Economic Research Service [ERS], and the National Agricultural Statistics Service [NASS]); and production, marketing, and regulatory activities (the Farm Service Agency [FSA], the Risk Management Agency [RMA], and the Animal and Plant Health Inspection Service [APHIS]). Other USDA agencies may address climate change adaptation in more limited ways.

FS and NRCS play an outsized role in climate change adaptation activities at USDA. Together, their mandates cover approximately 1.5 billion acres of land, including national forests, national grasslands, and privately owned agricultural land. FS manages the National Forest System, conducts forestry research, and provides technical and financial assistance to state, private, and international forestry agencies. These responsibilities increase its presence in climate change activities beyond those of most other agencies at USDA. NRCS develops and delivers voluntary conservation technical assistance and financial support programs. USDA strategies for climate change adaptation rely heavily on these NRCS activities.

Considerations for Congress may include the funding of USDA agencies and programs, the voluntary nature of programs that address climate change adaptation, opportunities to incentivize adaptive decisions, USDA staffing levels and leadership positions, concerns about the independence of climate science at USDA, and the design of USDA risk management programs. Congress may choose to address these issues through exercising its appropriations and oversight responsibilities or through new authorizations or directives.

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Table of Acronyms

ACEP	Agricultural Conservation Easement Program
AMS	Agricultural Marketing Service of USDA
APH	Actual Production History
APHIS	Animal and Plant Health Inspection Service of USDA
ARC	Agricultural Risk Coverage
ARS	Agricultural Research Service of USDA
CCPO	Climate Change Program Office of USDA
CEAP	Conservation Effects Assessment Project
CIG	Conservation Innovation Grants
CEQ	Council on Environmental Quality of the White House
CREP	Conservation Reserve Enhancement Program
CRP	Conservation Reserve Program
CSP	Conservation Stewardship Program
DR	Departmental Regulation
E.O.	Executive Order
EPA	U.S. Environmental Protection Agency
EQIP	Environmental Quality Incentives Program
ERS	Economic Research Service of USDA
FCIP	Federal Crop Insurance Program
FPAC	Farm Production and Conservation mission area of USDA
FRR	Forest and Rangeland Research mission area of FS
FS	U.S. Forest Service of USDA
FSA	Farm Service Agency of USDA
GHG	Greenhouse Gas
IBCE	Institute of Bioenergy, Climate, and Environment of NIFA
IPCC	Intergovernmental Panel on Climate Change of the United Nations
LTAR	Long-Term Agroecosystem Research Network
NASS	National Agricultural Statistics Service of USDA
NFS	National Forest System
NIFA	National Institute of Food and Agriculture of USDA
NRCS	Natural Resources Conservation Service of USDA
OCE	Office of the Chief Economist of USDA
OCS	Office of the Chief Scientist of USDA
RCPP	Regional Conservation Partnership Program
REE	Research, Education, and Economics mission area of USDA
RMA	Risk Management Agency of USDA
SPF	State and Private Forestry mission area of FS
USDA	U.S. Department of Agriculture
USGCRP	U.S. Global Change Research Program

Introduction and Background

Congress has debated the significance of global climate change and what federal policies, if any, should be adopted to address risks and effects associated with climate change. Federal policies may focus on climate change *mitigation*—to prevent or slow the progress of climate change—or *adaptation*—to avoid the consequences or capture the benefits of climate change (see **text box**). Policies focused on adaptation can reduce risks associated with climate change at federal agencies (including risks to infrastructure, operations, and mission delivery), including at the U.S. Department of Agriculture (USDA). Such policies may affect costs to the department or the sectors it serves. Given that agriculture and forestry are already experiencing the impacts of climate change, adaptation policies are particularly important for these sectors.

Climate Change Adaptation vs. Mitigation in Agriculture and Forestry Policy

Federal policies to address climate change may relate to *adaptation* or *mitigation*. The United Nations Intergovernmental Panel on Climate Change (IPCC) has defined climate change *adaptation* as "the process of adjustment to actual or expected climate and its effects."[1] The IPCC has defined climate change *mitigation* as "intervention to reduce the sources or enhance the sinks of greenhouse gases (GHGs)."[2]

Mitigation can have a different meaning in the federal government in contexts outside of climate change. For example, the Federal Emergency Management Agency (FEMA) defines *hazard mitigation* as "any sustained action taken to reduce or eliminate long-term risks to human life and property from hazards" (44 C.F.R. §201.2).

In agriculture and forestry, climate change *adaptation* policies may involve developing, deploying, or incentivizing the use of tools and practices for agriculture and forestry to succeed in new environmental conditions associated with projected future climate change. Policies focused on climate change *mitigation* may seek to encourage management practices and other approaches that can increase carbon sequestration (storage) in forests and agricultural soils.

For additional discussion of climate change mitigation versus adaptation, see also National Aeronautics and Space Administration, "Responding to Climate Change," at https://climate.nasa.gov/solutions/adaptation-mitigation/.

While Congress has provided some direction to some departments as part of broader legislation—for example, requiring the Department of Defense to report on climate change impacts to its installations as part of the National Defense Authorization Act of 2018 (P.L. 115-91, §335)—it has not enacted legislation to require or coordinate climate change adaptation at federal agencies. The executive branch has also provided some direction, and such policies can change with a change in administration. A 2019 U.S. Government Accountability Office report states that "beginning in 2017, the administration revoked policies that had identified addressing climate change as a priority and demonstrated top leadership support for executive branch action."[3]

USDA provides federal programs and services related to forestry, farming, ranching, rural development, food, and other areas through its agencies and staff offices. Climate change has the potential to affect its mission delivery. As such, many USDA agencies and offices conduct

[1] Katharine J. Mach, Serge Planton, and Christoph von Stechow (eds.), "Annex II: Glossary," in *Climate Change 2014: Synthesis Report. Contribution of Working Groups I, II and III to the Fifth Assessment Report*, Intergovernmental Panel on Climate Change (IPCC), p. 118.

[2] Mach, Planton, and von Stechow, "Annex II: Glossary," p. 118.

[3] See U.S. Government Accountability Office, "Limiting the Federal Government's Fiscal Exposure by Better Managing Climate Change Risks," *High-Risk Series: Substantial Efforts Needed to Achieve Greater Progress on High-Risk Areas*, GAO-19-157SP, 2019. For example, as discussed later in this report section, the Trump Administration revoked Executive Order (E.O.) 13653, "Preparing the United States for the Impacts of Climate Change," 78 *Federal Register* 66819, November 6, 2013.

programs and activities that directly or indirectly address climate change adaptation with respect to their unique missions.

This report provides information on USDA efforts to identify and address potential vulnerabilities of U.S. agriculture, forestry, and food systems to projected climate change.[4] It reviews certain adaptation activities conducted by the department and by individual USDA agencies. This report is not comprehensive of all relevant programs, and does not review USDA efforts related to climate change *mitigation*, or "intervention to reduce the sources or enhance the sinks of greenhouse gases (GHGs)."[5] This report concludes with considerations for Congress, including how action or inaction may impact future federal operations as well as measures that Congress could take to mitigate potential impacts on federal operations.

Federal Climate Change Adaptation Policy

Congress has played a role in federal climate change adaptation policy by creating new programs, setting funding levels for existing programs, and conducting oversight. Different stakeholders have petitioned Congress to take, delay, or avoid taking specific actions aimed at reducing climate change risks through adaptation or mitigation. While some have argued that adapting to climate change is an immediate imperative,[6] others have argued that proposed mitigation policies "have no measurable effect on global climate but hurt the American economy."[7]

Congress has authorized a variety of climate-change-related activities at federal agencies through standalone legislation and as provisions within other bills. For example, the Global Change Research Act of 1990 (P.L. 101-606) established the interagency U.S. Global Change Research Program (USGCRP) to develop and coordinate "a comprehensive and integrated United States research program" to improve understanding of global climate change. In another example, as part of the National Defense Authorization Act of 2018 (P.L. 115-91, §335), Congress required the Department of Defense to report on climate change impacts to its installations.

The executive branch has played a leading role in shaping climate change policy at federal agencies using its broad and discretionary authorities. The direction and level of emphasis on climate change policy has changed among successive administrations for decades. For example, President Clinton signed the Kyoto Protocol in 1998, and President G. W. Bush rejected it in 2001. Had Congress ratified the Kyoto Protocol, it would have committed the United States to legally binding reductions in GHG emissions.[8] In another example, the Obama Administration established specific climate change policies through Executive Order (E.O.) 13693, "Planning for Federal Sustainability in the Next Decade." This E.O. superseded policies established by the G.

[4] For a broader overview of federal climate change funding, see CRS Report R43227, *Federal Climate Change Funding from FY2008 to FY2014*.

[5] Mach, Planton, and von Stechow, "Annex II: Glossary," p. 125. As discussed in the text box, "What Is Climate Change?," increasing concentrations of GHGs in the atmosphere contribute to global climate change.

[6] For example, National Sustainable Agriculture Coalition, "Farmer Letter on Climate Change Solutions in Agriculture," https://sustainableagriculture.net/our-work/campaigns/emerging-issue-climate-change-and-agriculture/; and Regeneration International, "Farmers and Ranchers for a Green New Deal," http://regenerationinternational.org/farmers-ranchers-green-new-deal.

[7] Club for Growth, "Club for Growth PAC Opposes McCarthy and Romney Liberal Climate Regulations," February 12, 2020, https://www.clubforgrowth.org/club-for-growth-pac-opposes-mccarthy-romney-liberal-climate-regulations/.

[8] For more information on the Kyoto Protocol, see CRS Report R46204, *The United Nations Framework Convention on Climate Change, the Kyoto Protocol, and the Paris Agreement: A Summary*.

W. Bush Administration and revoked E.O. 13423, "Strengthening Federal Environmental, Energy, and Transportation Management."[9]

Specific actions taken in different administrations have created, increased, reduced, or eliminated federal planning for climate change adaptation. Among these actions, President Trump revoked the Obama E.O. that had required federal departments to prepare climate action plans.[10] In addition, President Trump revoked the Obama E.O. that had directed federal agencies to incorporate resilient (adaptive) design elements into their facilities.[11]

The Trump Administration has also issued new policies, including E.O. 13834, *Efficient Federal Operations*, issued May 17, 2018. This E.O. states that "each agency shall prioritize actions that reduce waste, cut costs, enhance the resilience of Federal infrastructure and operations, and enable more effective accomplishment of its mission."[12] Implementing instructions for this E.O. state, "Resilience generally can be defined as the ability to anticipate, prepare for, and adapt to changing conditions and withstand, respond to, and recover rapidly from disruptions," and do not explicitly reference climate change.[13] The White House Council on Environmental Quality (CEQ) offers limited technical guidance to agencies in *Guiding Principles for Sustainable Federal Buildings and Associated Instructions* to "assess and consider climate change risks."[14]

Notwithstanding these shifts in policy, federal agencies continue to implement policies and programs relevant to climate change adaptation.

Primer on Climate Change, Agriculture, and Forestry

Agriculture and forestry are sensitive to weather, and consequently to the impacts of climate change, due to direct and indirect relationships between environmental conditions and the health and growth of plants and animals. Directly, plants and animals may thrive only within a certain range of temperatures and with access to sufficient, and not overabundant, water (as well as other conditions). Unseasonable heat waves, freezes, droughts, and floods can disrupt or destroy crop production, stress livestock, and increase forest vulnerability to fires and pests. Increases in atmospheric carbon dioxide (CO_2) can alter plant photosynthesis and water management when plant cells respond to increased CO_2 availability (known as *carbon fertilization*). Indirectly, changes in climate may allow plant and animal pests to thrive in regions where they did not exist previously, and where they may be considered invasive and detrimental.

Scientists have found it challenging to predict climate change impacts on agriculture with great certainty. This is due to the large number of interacting variables that influence agricultural production, and the uncertainties of projected changes in those variables and subsequent responses by agricultural producers and consumers. For example, warming conditions may cause plants to initiate flowering earlier in the year. This may lengthen the growing season if conditions remain favorable, or it may result in crop decline or failure if later conditions are unfavorable

[9] E.O. 13693, "Planning for Federal Sustainability in the Next Decade," 80 *Federal Register* 15871, March 19, 2015; and E.O. 13423, "Strengthening Federal Environmental, Energy, and Transportation Management," 72 *Federal Register* 3919, January 26, 2007.

[10] E.O. 13783, "Promoting Energy Independence and Promoting Economic Growth," 82 *Federal Register* 16093, March 31, 2017, revoked E.O. 13653.

[11] E.O. 13834, "Efficient Federal Operations," 83 *Federal Register* 23771, May 17, 2018, revoked E.O. 13693 (2015).

[12] E.O. 13834 (2018).

[13] Council on Environmental Quality (CEQ), Office of Federal Sustainability, "Implementing Instructions for Executive Order 13834 Efficient Federal Operations," Executive Office of the President, May 17, 2018.

[14] CEQ, "Guiding Principles for Sustainable Federal Buildings and Associated Instructions," Executive Office of the President, February 2016, https://www.sustainability.gov/resources.html.

(e.g., freezing or flooding conditions follow flowering, or required pollinators are not available when plants need them to set fruit). Adding to these uncertainties, if the crops that farmers traditionally grow in their fields are no longer economically viable under altered climatic conditions, those farmers may choose to plant different crops or make new land management decisions.

What Is Climate Change?

Climate change refers to long-term changes in average weather patterns over time. These include patterns of daily temperature highs and lows, the timing and amounts of precipitation, humidity, and other factors. Scientists have attributed most climate change since the early 20th century to the impacts of human activities, such as burning fossil fuels as well as deforestation and land degradation, which typically release (emit) greenhouse gases (GHGs) into the earth's atmosphere. GHGs contribute to global climate change by trapping radiation from the sun within the atmosphere. Primary GHGs include carbon dioxide (CO_2), sulfur dioxide (SO_2), methane (CH_4), and nitrous oxide (N_2O). For additional details, see CRS In Focus IF11446, *Weather and Climate Change: What's the Difference?*.

Despite the uncertainties, most researchers expect yields of most major crops in the United States to decline through the end of this century.[15] Yields are lower under the climate change scenarios considered more likely by many scientists, when all primary factors are included in the analyses.[16] Adapting to climate change and reducing global GHG emissions can limit risks and vulnerabilities associated with climate change.[17]

Forests have adapted and responded to changing climatic conditions for millennia.[18] The anticipated future climate changes, however, are expected to be more rapid than past changes, and scientific assessments regarding the range of potential forest responses vary. Scientists anticipate that warming temperatures associated with future climate change could cause geographic shifts in the distribution of many tree populations and species as compared to current conditions. For example, some tree species may die back in some locations and grow in new locations. Some species may face extinction.[19] Temperature and precipitation changes associated with climate change have been observed in some cases to increase forest vulnerability to drought, fire, and pests. Increased CO_2 in the atmosphere may enable trees and other plants to increase their growth and productivity (e.g., due to carbon fertilization), but only if sufficient nutrients are available in the soil to support them and other factors permit such growth. This may lead to additional shifts in the geographic and species distributions of forests: regions with high nutrient availability may support increased productivity, while regions with low nutrient availability may not. In addition, "invasive" species may alter the character of surviving vegetation.

Agriculture and forestry practices and technologies can address both climate change adaptation and climate change mitigation. *Adaptation* refers to actions taken to avoid the consequences or capture the benefits of climate change. Farmers, ranchers, and land managers continuously adapt

[15] U.S. Environmental Protection Agency (EPA), "Agriculture," in *Multi-Model Framework for Quantitative Sectoral Impacts Analysis: A Technical Report for the Fourth National Climate Assessment*, EPA 430-R-17-001, 2017, pp. 156-170.

[16] EPA, "Agriculture," 2017. This report bases these findings on projections using two climate scenarios (RCP8.5 and RCP4.5) through 2100. For information on climate change science, see CRS Report R43229, *Climate Change Science: Key Points*.

[17] EPA, "Agriculture," 2017, p. 211.

[18] For example, Forest Service (FS), "Changing Climate, Changing Forests: The Impacts of Climate Change on Forests of the Northeastern United States and Eastern Canada," General Technical Report NRS-9, July 2012.

[19] See EPA, "Climate Impacts on Forests," January 19, 2017, archived at https://19january2017snapshot.epa.gov/climate-impacts/climate-impacts-forests_.html; and FS, "Climate Change, Forests, and Water," https://www.fs.usda.gov/ccrc/topics/climate-change-forests-and-water.

to changing conditions, though responses to climate change may require new management practices and technologies.[20] Although forest ecosystems have inherent characteristics that enhance their capacity to survive disturbance events (*resistance*) or facilitate recovery after disturbance (*resilience*), most current thinking suggests that the rapid pace and magnitude of climate change may overwhelm the resistance and resilience capacity of many forests.[21] Forest management practices may influence forest resistance, resilience, and recovery, though the future effects of changing climate conditions on forests broadly remain uncertain.

Mitigation in a climate change context refers to actions taken to prevent or slow the progress of climate change, by reducing GHG emissions or increasing GHG sequestration. Forest ecosystems and agricultural land can play a role in mitigating against rising atmospheric CO_2 levels: growing vegetation removes carbon from the atmosphere and stores, or *sequesters*, it in wood and soil.[22] Some disturbance events (e.g., forest fires) release carbon back into the atmosphere. Thus, appropriate management of disturbances may be critical for avoiding potential future releases of large amounts of carbon. Other mitigation activities may include using practices and technologies that reduce the quantity of GHGs—such as CO_2, methane (CH_4), and nitrous oxide (N_2O)—that are released during agricultural production and land management.[23]

USDA Climate Policy and Departmental Activities

Federal policies and programs managed by USDA can influence decisions that agricultural producers and land managers make in response to climate change.

Congress established USDA in 1862 to develop and disseminate information and tools related to agriculture, and it later added rural development, aquaculture, and human nutrition to the USDA mandate.[24] In the present day, USDA consists of nearly 30 agencies and offices, with close to 100,000 employees at 4,500 locations across the United States and overseas.[25] USDA's FY2020 budget of $152.6 billion includes $125.5 billion (82%) in mandatory budget authority and $27.2 billion (18%) in discretionary budget authority.[26] USDA is responsible for the management of approximately 193 million acres of national forests and grasslands in the National Forest System, and provides assistance to the owners and managers of the nation's 1.4 billion acres of privately owned farm, ranch, and forestlands.[27]

Many USDA agencies manage programs and activities related to climate change adaptation. Some of these activities began decades ago.[28] It is challenging to identify a comprehensive listing of all relevant activities. Activities related to climate change adaptation can serve multiple objectives: climate change adaptation may be an unstated *co-benefit* (i.e., an additional benefit beyond an identified primary objective) of activities or programs that do not focus primarily on

[20] Prassana Gowda et al., "Agriculture and Rural Communities," in David Reidmiller et al. (eds.), *Impacts, Risks, and Adaptation in the United States: Fourth National Climate Assessment, Volume II*, U.S. Global Change Research Program, 2018, pp. 391-437.

[21] Gowda et al., "Agriculture in Rural Communities," 2018.

[22] For more information, see CRS Report R46312, *Forest Carbon Primer*.

[23] For additional information, see CRS In Focus IF11404, *Greenhouse Gas Emissions and Sinks in U.S. Agriculture*.

[24] 7 U.S.C. §2201 et seq.

[25] USDA, "Our Agency," http://www.usda.gov/our-agency.

[26] USDA, *FY2021 Budget Summary*, 2020, Appendix, Table APP-1.

[27] USDA, "Summary Report," *2015 National Resources Inventory*, September 2018, https://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcseprd1422028.pdf.

[28] See for example, FS, "Resources Planning Act (RPA) Assessment," https://www.fs.fed.us/research/rpa/.

adaptation. Further, information about individual activities conducted through agency field offices may be broadly dispersed and is not always collected or publicly reported centrally.

Overview

In 2019, USDA estimated its FY2019 climate change spending to be $600.3 million (**Table 1**). This total includes funding obligations made by nine agencies and one staff office (in order of spending amount based on FY2019 estimates): the Forest Service (FS), the Agricultural Research Service (ARS), the National Institute of Food and Agriculture (NIFA), the Natural Resources Conservation Service (NRCS), the Office of the Chief Economist (OCE), the Economic Research Service (ERS), the National Agricultural Statistics Service (NASS), the Farm Service Agency (FSA), the Animal and Plant Health Inspection Service (APHIS), and the Risk Management Agency (RMA). These estimates do not include some programs with primary objectives other than climate change.

Table 1. U.S. Department of Agriculture Global Climate Change Spending

(dollars in thousands)

Agency/Program	2016 Obligations	2017 Obligations	2018 Obligations	2019 Estimates
Forest Service	1,233,438[a]	425,978	525,985	524,493
Agricultural Research Service	47,577	55,002	55,525	55,525
National Institute of Food and Agriculture	20,339	27,503	9,805	10,205
Natural Resources Conservation Service	2,882	2,683	2,789	2,953
Office of the Chief Economist	2,784	2,353	3,137	2,893
Economic Research Service	2,200	2,826	2,826	2,826
National Agricultural Statistics Service	800	800	800	800
Farm Service Agency	269	340	354	388
Animal Plant Health Inspection Service	206	255	235	242
Risk Management Agency	137	227	0	0
Total	**1,310,632**	**517,966**	**601,456**	**600,314**

Source: USDA global climate change budget cross cut tables provided by USDA to CRS on August 8, 2019.

Notes: This table presents obligations (not budget authorities) for FY2016-FY2018, and estimated obligations for FY2019, as reported by USDA. These obligations include discretionary funding provided through appropriation acts and mandatory funding authorized through legislation (i.e., farm bills). They include funding for programs that may be relevant to both climate change adaptation and mitigation, and may not include some programs for which climate change is a secondary objective or co-benefit. The Forest Service receives some multiyear appropriations, and thus some changes in obligations may reflect prior changes in appropriations. Data provided by USDA indicates that most of the large decrease in Forest Service obligations from FY2016 to FY2017 results from a decrease in "Forest Resilience" spending. CRS was unable to determine what is included in "Forest Resilience." USDA did not respond to CRS requests for additional information.

a. Spending data from prior USDA global climate change crosscut budget tables provided by USDA (for FY2015, actual; FY2016, enacted; and FY2017, budget) indicate that FY2015 global change obligations for the Forest Service were $1,163,216,000.

USDA has considered climate change adaptation in department-level strategic planning for at least the past decade. Overarching USDA strategic plans released in 2010 and 2014 identified climate change as a concern in descriptions of several strategic goals and explicitly addressed climate change resilience through their *Goal 2: Ensure Our National Forests and Private*

Working Lands Are Conserved, Restored, and Made More Resilient to Climate Change … [29] The current USDA strategic plan, released in 2018, does not directly address climate change, although it calls for building "resilience to extreme weather and events."[30]

USDA has also developed department-wide strategic plans specific to *climate change science*. In 2010, USDA released the *USDA Climate Change Science Plan* to "incorporate the management of climate change challenges and opportunities into the scientific missions of the U.S. Department of Agriculture."[31] This document aligned with the 2010 USDA strategic plan. In 2019, a media report indicated that USDA had updated the 2010 Climate Change Science Plan but had not finalized it: *Politico* released a *USDA Climate Science Resilience Plan* marked as "draft" and dated 2017.[32] In a July 18, 2019, Senate hearing, the USDA Deputy Under Secretary for Research, Education, and Economics stated that the 2017 update was prepared for internal use and was not intended to be released publicly.[33] Responding to a *Question for the Record*, USDA stated that "the primary audience for this update was internal to the department to aid in planning and priority setting…. The December 2017 version of the report was provided to the research agencies as a staff report for their use in research agency planning."[34]

As required by the now-revoked E.O. 13653, USDA developed a *USDA Climate Change Adaptation Plan* in 2014, an update of its 2012 plan.[35] This plan remains posted to the USDA website, however it is unclear to what extent it continues to influence USDA activities. In developing the 2014 plan, USDA drew from 11 USDA agencies and offices to assess vulnerabilities and review climate change risks to the USDA mission. The 2014 plan stated that it aims to identify existing and future actions to build climate change resilience.[36] The adaptation plan included individual plans for the 11 agencies.[37] USDA Departmental Regulation (DR) 1070-001, first issued in 2011 and updated in 2015, stated that the USDA adaptation plan would be updated in accordance with guidance from CEQ.[38] The only identifiable guidance from CEQ pertaining to managing climate change risks appears in *Guiding Principles for Sustainable Federal Buildings and Associated Instructions*, related to E.O. 13834, *Efficient Federal*

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[29] USDA, *USDA Strategic Plan FY2010-2015*; and USDA, *USDA Strategic Plan FY2014-2018*.

[30] USDA, *USDA Strategic Plan FY2018-2022*, p. 41.

[31] USDA, *USDA Climate Change Science Plan*, 2010, p. 5.

[32] USDA, *USDA Climate Science Resilience Plan*, Draft, September 17, 2017, posted by *Politico*, July 18, 2019, at https://static.politico.com/b7/ce/e495d2824d08b1957a1ea6b0affd/climate-science.pdf. Also, Helena Bottemiller Evich, "USDA Official: Climate Science Plan Wasn't Supposed to Be Public," *Politico*, July 18, 2019.

[33] U.S. Congress, Senate Committee on Agriculture, Nutrition, and Forestry, *Agricultural Research and 2018 Farm Bill Implementation*, hearing on implementation of P.L. 115-334, 116th Cong., 1st sess., July 18, 2019, S. HRG. 116-192 (Washington, DC: GPO, 2020).

[34] Ibid.

[35] USDA, *USDA Climate Change Adaptation Plan*, June 2014, https://www.usda.gov/oce/climate_change/adaptation/USDA_Climate_Change_Adaptation_Plan_Only.pdf. For additional information on and analysis of this plan, see the USDA section of CRS Report R43915, *Climate Change Adaptation by Federal Agencies: An Analysis of Plans and Issues for Congress*.

[36] The U.S. Climate Resilience Toolkit defines *resilience* as "the capacity of a community, business, or natural environment to prevent, withstand, respond to, and recover from a disruption." See U.S. Climate Resilience Toolkit, "Glossary," https://toolkit.climate.gov/content/glossary.

[37] Eleven agencies and offices contributed individual adaptation plans, including ARS; APHIS; CCPO; the Foreign Agriculture Service; the Grain Inspectors, Packers and Stockyards Administration; NASS; NIFA; NRCS; RMA; and Rural Development.

[38] USDA, "U.S. Department of Agriculture (USDA) Policy Statement on Climate Change Adaptation," DR 1070-001, June 11, 2011, superseded by DR 1070-001, issued June 15, 2015.

Operations, as described earlier.[39] Despite changes in federal policy, the 2015 DR 1070-001 has not been revoked or replaced. USDA agencies continue to operate many of the programs and activities detailed in the 2014 plan.

In February 2020, USDA released an *Agriculture Innovation Agenda*, highlighting a department-wide effort to position USDA to meet future agricultural needs.[40] Through this agenda, USDA committed to increasing landscape resiliency, reducing net GHG emissions, and increasing carbon sequestration, among other goals.

In addition to planning for cross-cutting activities and approaches within the department, USDA also engages in federal government interagency and international activities. As discussed below, the USDA Climate Change Program Office (CCPO) leads USDA climate policy and coordinates USDA participation in and contributions to many federal interagency and international activities. Also discussed below, the USDA Climate Hubs are a USDA interagency collaboration that involves several USDA agencies.

Climate Change Program Office

CCPO, a component of OCE, is responsible for coordinating USDA's response to climate change within USDA and with other federal agencies and international organizations.[41] As such, CCPO

- oversees USDA climate change adaptation planning (and led the development of the 2014 *USDA Climate Change Adaptation Plan*),[42]
- chairs the USDA-interagency Global Change Task Force,
- oversees departmental GHG accounting capabilities and responsibilities,
- represents USDA to the federal interagency USGCRP, and
- directs international climate change initiatives.[43]

The CCPO website provides many resources detailing USDA adaptation, mitigation, and GHG accounting activities.[44]

In terms of federal interagency coordination, CCPO oversees USDA contributions to the *U.S. Inventory of Greenhouse Gas Emissions and Sinks*, an annual report issued by the U.S. Environmental Protection Agency with contributions from multiple federal agencies. CCPO also coordinates USDA contributions to reports prepared by USGCRP, including the quadrennial *National Climate Assessment* mandated by the Global Change Research Act of 1990 (P.L. 101-606) and the decadal North American *State of the Carbon Cycle Report*.[45]

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[39] CEQ, Office of Federal Sustainability, "Implementing Instructions for Executive Order 13834 Efficient Federal Operations," Executive Office of the President, May 17, 2018.

[40] USDA, *USDA Agriculture Innovation Agenda*, February 20, 2020, https://www.usda.gov/sites/default/files/documents/agriculture-innovation-agenda-vision-statement.pdf.

[41] CCPO resides within the Office of Energy and Environmental Policy (OEEP), which is itself a component of OCE.

[42] USDA assigned CCPO this responsibility through DR 1070-001, June 3, 2011, and as superseded by DR 1070-001, June 15, 2015.

[43] CCPO, *The Climate Change Program Office*, http://usda.gov/oce/climate_change/fact_sheets/CCPO_FactSheet.pdf. USGCRP is a federal interagency program mandated by Congress to coordinate federal research and investments focused on understanding the forces shaping the global environment and their societal impacts (15 U.S.C. §2921 et seq.).

[44] USDA, "Climate Change Program Office," https://www.usda.gov/oce/climate_change/.

[45] Recent reports are: David Reidmiller et al. (eds.), *Impacts, Risks, and Adaptation in the United States: Fourth*

Internationally, CCPO coordinates USDA engagement with international organizations that include the United Nations Framework Convention on Climate Change and the Intergovernmental Panel on Climate Change (IPCC).[46]

Climate Hubs

In 2014, USDA established, and continues to operate, a network of "Regional Hubs for Risk Adaption and Mitigation to Climate Change" to facilitate climate-informed decisionmaking.[47] Now known as the USDA Climate Hubs, their mission combines scientific research that is regionally specific with outreach to farmers, ranchers, and land managers. Through the Climate Hubs, USDA

- provides technical support for agricultural producers and landowners responding to climate change,
- assesses and monitors the risk to agricultural production, and
- conducts research and education about the effects of climate change on agriculture and forests.[48]

USDA created the Climate Hubs as a departmental initiative based on existing statutory authorities, including USDA's broad authorities to conduct research and extension and its authorities under the Global Climate Change Prevention Act of 1990 (P.L. 101-624, §2401, et seq.). ARS and FS senior directors lead the Climate Hubs. NRCS, APHIS, FSA, RMA, NIFA, and CCPO contribute to them via research, participation in the executive committee, and other activities. USDA selected the 10 Climate Hub locations through a competitive application process among USDA facilities (see **Figure 1**).

The Climate Hubs continue to operate as a USDA initiative without specific statutory authorization. Available data suggests they operate with approximately $9 million (FY2016) to $13 million (FY2019) per year, contributed by several USDA agencies.[49] OCE explanatory notes for the annual President's budget request routinely include progress updates for Climate Hub activities, and funding requests for the Climate Hubs coordinator.[50]

National Climate Assessment, Volume II, U.S. Global Change Research Program, 2018; and Nancy Cavallaro et al. (eds.), *Second State of the Carbon Cycle Report (SOCCR2): A Sustained Assessment Report*, U.S. Global Change Research Program, 2018.

[46] See "United Nations Climate Change" at https://unfccc.int/. See also CRS Report R46204, *The United Nations Framework Convention on Climate Change, the Kyoto Protocol, and the Paris Agreement: A Summary*.

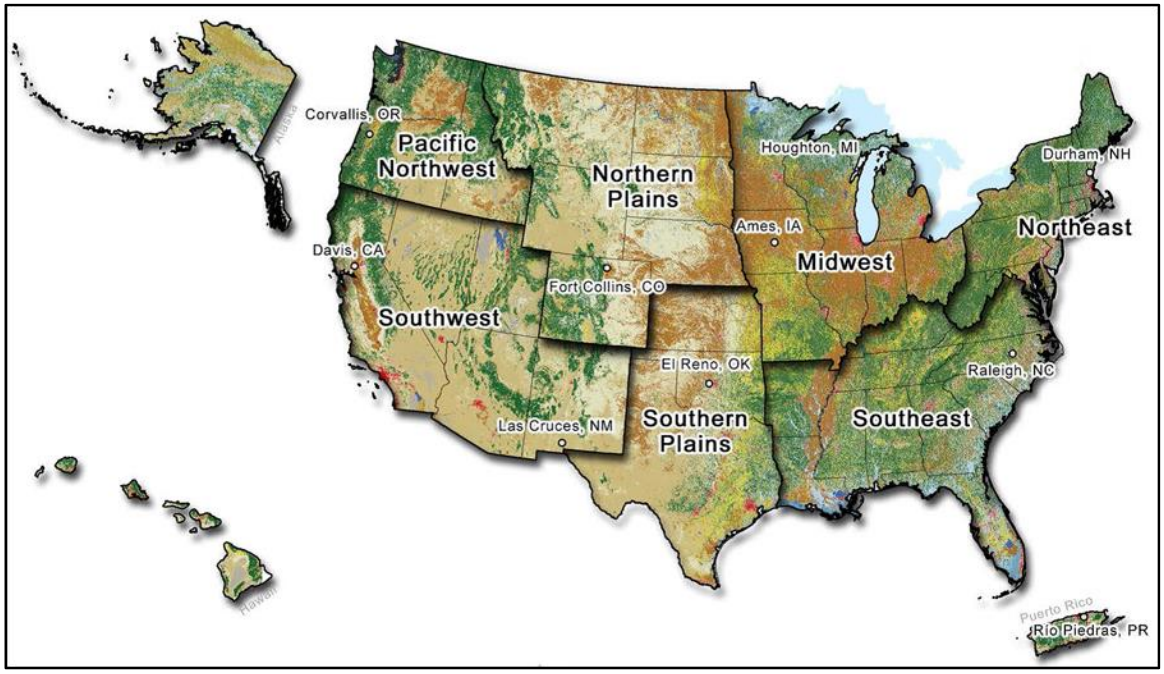
[47] USDA, "Secretary Vilsack Announces Regional Hubs to Help Agriculture, Forestry Mitigate the Impacts of a Changing Climate," press release, February 5, 2014. See also USDA, Climate Hubs, "About Us," https://www.climatehubs.usda.gov/about-us.

[48] USDA, *Charter of the Executive Committee of the Regional Hubs for Risk Adaptation and Mitigation to Climate Change*, January 31, 2014, http://www.usda.gov/oce/climate_change/hubs/RegionalHubCharter.pdf.

[49] Climate change budget information provided to CRS by OCE on August 8, 2019, shows agency Climate Hub contributions totaling approximately $9.0 million for FY2019, from ARS ($5.6 million), NRCS ($2.7 million), FS ($400,000), APHIS ($250,000), and OCE ($100,000).

[50] See, for example, explanatory notes for the President's FY2021 budget request at https://www.obpa.usda.gov/06oce2021notes.pdf (especially pp. 6-4 and 6-15). This document notes that FY2020 enacted appropriations provided $120,000 for the Climate Hubs coordinator.

Figure 1. Map of the USDA Climate Hubs



Source: USDA, "USDA Regional Hubs for Risk Adaptation and Mitigation to Climate Change," http://www.usda.gov/oce/climate_change/hubs/Hub_PPT_11182014.pdf.

Activities of Selected USDA Agencies

Individual USDA agencies address climate change adaptation in accordance with their statutory mandates. This section discusses major programs and activities of many of USDA's 16 agencies, grouped thematically for purposes of this report by natural resources and conservation agencies; research agencies; and production, marketing, and regulatory agencies.[51] Some USDA agencies have fewer adaptation-relevant activities and programs and so are not discussed in this report. These include the Agricultural Marketing Service; the Food and Nutrition Service; the Food Safety and Inspection Service; the Foreign Agriculture Service; the Grain Inspection, Packers and Stockyards Administration; and Rural Development, which includes the Rural Business-Cooperative Service, the Rural Housing Service, and the Rural Utility Service.[52]

Natural Resources and Conservation Agencies

USDA agencies focused on natural resources and conservation include FS and NRCS. These agencies have local and regional offices located throughout the country. FS programs and activities include the management of federal lands as well as conducting research and providing

[51] Agency summaries draw from multiple sources, including individual agency plans within the 2014 *USDA Climate Change Adaptation Plan*, agency climate change fact sheets that were released in 2011 and 2012 and are available on the CCPO website, and other publicly available materials. Links to adaptation plans for agencies not included in this report, where available, may be access through the CCPO website at https://www.usda.gov/oce/climate_change/adaptation/adaptation_plan.htm.

[52] Links to adaptation plans for agencies not included in this report, where available, may be access through the CCPO website at https://www.usda.gov/oce/climate_change/adaptation/adaptation_plan.htm.

assistance to nonfederal forest owners. NRCS programs and activities are directed toward privately owned land, including cropland, grassland, rangeland, and forest land. Together, the mandates of these two agencies cover approximately 1.6 billion acres of U.S. land.

U.S. Forest Service[53]

The FS mission is to "sustain the health, diversity, and productivity of the nation's forests and grasslands to meet the needs of present and future generations."[54] To accomplish this mission, FS is responsible for

- managing the National Forest System (NFS);
- conducting forestry research; and
- providing assistance to state, private, and international forestry agencies.

These are accomplished through three mission areas: NFS, Forest and Rangeland Research (FRR), and State and Private Forestry (SPF). FS is headquartered in Washington, DC, with over 27,100 permanent employees located throughout the country in nine regional offices, over 600 ranger district offices, and seven research stations.[55]

While CCPO has primary responsibility for organizing and leading USDA climate change activities, FS's mission increases its presence in climate change activities above those of most other agencies at USDA. For example, FS has identified several intertwined roles regarding climate change adaptation within its mission areas. As described below, these include research, engagement and outreach with other forestry managers, and federal land management. Many of these activities are coordinated through the FS Office of Sustainability and Climate.[56]

Climate change research is identified as one of five priority areas on the FRR website,[57] though the agency's FY2021 budget justification does not include climate change as a priority research area.[58] In 2009, FS established a *Global Change Research Strategy 2009-2019*, with research on adaptation, mitigation, and decision-support strategies related to climate as the primary objectives.[59] The strategy does not appear to have been updated. FS has continued to publish research studies and other resources related to climate adaptation.

Through SPF, FS provides technical and financial assistance to states and private forest landowners.[60] Several of the USDA Climate Hubs (see **Figure 1**) are operated in partnership with both FRR and SPF activities. In addition, the Climate Change Resource Center is a compilation of FS's related research, outreach, and management activities.[61] This resource provides land

[53] This section was written by Katie Hoover, Specialist in Natural Resources Policy. For more information, see Katie Hoover and Anne Riddle, Analyst in Natural Resources Policy.

[54] For more information, see FS, "About the Agency," https://www.fs.usda.gov/about-agency.

[55] The FS workforce also includes over 10,000 seasonal employees. FS, *FY2021 Budget Justification*, pp. 4, 97, https://www.fs.usda.gov/sites/default/files/2020-02/usfs-fy-2021-budget-justification.pdf.

[56] For more information, see FS, "Sustainability and Climate," https://fs.usda.gov/managing-land/sc.

[57] FS, "Research and Development Priority Areas," https://www.fs.fed.us/research/priority-areas/.

[58] FS, *FY2021 Budget Justification*, p. 27, https://www.fs.usda.gov/sites/default/files/2020-02/usfs-fy-2021-budget-justification.pdf.

[59] FS, *Forest Service Global Change Research Strategy, 2009-2019*, FS-917a, June 2009, https://www.fs.fed.us/climatechange/documents/global-change-strategy.pdf.

[60] For more information on SPF, see CRS Report R45219, *Forest Service Assistance Programs*.

[61] For more information, see FS, "Climate Change Resource Center," http://www.fs.usda.gov/ccrc.

managers and other decisionmakers—private and public—with information, research, decision-support models, maps, and simulations. These tools may be used to incorporate climate change management activities into forest planning and project management. In addition, FS addresses climate change in international forestry issues through policy engagement and technical cooperation to develop capacity and strengthen existing institutions related to forest governance and management worldwide.

As a land manager, FS addresses climate change first through strategic planning and policy initiatives regarding the management of the NFS.[62] The foundation of the FS land management strategy is to focus on forest restoration and improving the resilience of NFS lands to withstand stressors and to facilitate adaptation to climatic changes over the long term, so that the national forests and grasslands may continue to provide multiple services and uses.[63] To implement that strategy, FS adopted an adaptive framework for incorporating resilience and restoration goals into land management planning and decisionmaking in the FS 2012 Planning Rule.[64] The adaptive framework includes an expanded inventory and monitoring system as part of the planning process to assess progress toward the restoration goals and refocus efforts as necessary. In addition to strategic planning and policy initiatives, FS developed several tools and resources to better inform and evaluate the potential climate impacts of different forest management decisions across the NFS.[65] For example, FS developed baseline carbon assessment reports and various climate change vulnerability assessments for each NFS region.[66]

FS previously developed several climate policy initiatives.[67] In 2008, for example, the agency published the *Forest Service Strategic Framework for Responding to Climate Change*, which set forth seven goals as the overarching structure for agency strategies, priorities, policy decisions, and resource allocations for responding to climate change.[68] To implement the strategic framework, FS published the *National Roadmap for Responding to Climate Change* in 2011, which established short- and long-term actions to respond to climate change on the NFS.[69] In 2014, FS released its *USDA Forest Service Climate Change Adaptation Plan 2014*, which included activities to address adaptation across the agency's three mission areas.[70]

The extent that FS has implemented, retained, updated, or replaced these plans and policy initiatives is unclear. However, FS has continued to conduct climate research, provide resources,

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[62] For more information, see CRS Report R43872, *National Forest System Management: Overview, Appropriations, and Issues for Congress*.

[63] FS, "Ecosystem Restoration Policy," 81 *Federal Register* 24785, April 27, 2016, https://www.govinfo.gov/content/pkg/FR-2016-04-27/pdf/2016-09750.pdf. See also FS, *Forest Service Manual (FSM) Chapter 2020—Ecosystem Restoration*, May 2016, p. 5.

[64] FS, "National Forest System Land Management Planning," 77 *Federal Register* 21161, April 9, 2012. The regulations are promulgated at Title 36, Part 219, of the *Code of Federal Regulations*.

[65] FS, "Carbon," https://www.fs.usda.gov/managing-land/sc/carbon.

[66] The baseline assessment are available from FS, "Carbon," at https://www.fs.usda.gov/managing-land/sc/carbon. The vulnerability assessments are available from FS, "Vulnerability Assessments," https://www.fs.usda.gov/managing-land/sc/vulnerability-assessments.

[67] See USDA, *Climate Change Adaptation Plan 2014: Forest Service*, http://www.usda.gov/oce/climate_change/adaptation/adaptation_plan.htm.

[68] FS, *Forest Service Strategic Framework for Responding to Climate Change*, October 2008, http://www.fs.fed.us/climatechange/documents/strategic-framework-climate-change-1-0.pdf.

[69] FS, *National Roadmap for Responding to Climate Change*, http://www.fs.fed.us/climatechange/pdf/Roadmapfinal.pdf.

[70] FS, *USDA Forest Service Climate Change Adaptation Plan 2014*, https://www.usda.gov/oce/climate_change/adaptation/Forest_Service.pdf.

and assess climate risks across the NFS to some degree. Nevertheless, a 2017 report from the USDA Office of the Inspector General found that FS's policies and practices for measuring and documenting progress toward achieving the USDA's strategic goals for climate change were insufficient.[71] More specifically, the report found that FS's performance measures did not adequately demonstrate accomplishments, and that FS did not provide enough guidance or training for incorporating climate change considerations into project planning.

Natural Resources Conservation Service[72]

NRCS has primary responsibility at USDA for leading "the conservation, development and productive use of the Nation's soil, water, and related resources."[73] Over 9,400 NRCS employees are locally based in USDA service centers, state-level offices, and county-level offices across the country.[74] The agency provides farmers and ranchers with science-based technical assistance and financial resources to address natural resource concerns. All assistance is voluntary and focused on private lands.

NRCS prescribes conservation practices through the conservation planning process and funds them through financial assistance programs. NRCS bases these practices on scientifically researched, publicly reviewed conservation practice standards. These standards describe why and where a practice is applied, and the minimum quality criteria required to achieve its intended purpose. The agency develops standards nationally and tailors them to local resource conditions.[75] Additionally, practice standards are dynamic. They are reviewed at a minimum of every five years and amended as new information and data becomes available.[76] This established review process could be advantageous when evaluating future changes in climate.[77]

Existing conservation practices such as conservation tillage, residue management, cover crops, forest stand improvement, and management of livestock grazing intensities have the potential to reduce negative impacts of climate change that would arise due to increased soil erosion or changes in water availability.[78] Adaptability, however, is not the only environmental benefit these practices provide. They can also reduce nutrient and sediment runoff, improve water quality,

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[71] USDA, Office of the Inspector General, *Forest Service's Plan for Addressing Climate Change*, 08601-0005-41, August 2017.

[72] This section was written by Megan Stubbs, Specialist in Agricultural Conservation and Natural Resources Policy.

[73] 7 C.F.R. §2.43. For more information on the role and mission of NRCS, see NRCS, "Mission and Vision," https://www.nrcs.usda.gov/wps/portal/nrcs/detailfull/national/about/?cid=nrcseprd1547221.

[74] CRS In Focus IF11452, *Staffing Trends in the USDA Farm Production and Conservation (FPAC) Mission Area*.

[75] National conservation practice standards are not used to plan, design, or install practices, as they do not account for state and local conditions and laws which may be more restrictive than national criteria. State-level conservation practices standards are available through the Field Office Technical Guide (FOTG), at https://efotg.sc.egov.usda.gov. All national conservation practices and related material are available on the NRCS website at https://www.nrcs.usda.gov/wps/portal/nrcs/detailfull/national/technical/cp/ncps.

[76] NRCS, "Review of USDA Natural Resources Conservation Service National Conservation Practice Standards," 84 *Federal Register* 8663, March 11, 2019; and NRCS, "Notice of Proposed Revisions to the National Handbook of Conservation Practices for the Natural Resources Conservation Service," 85 *Federal Register* 16607, March 24, 2020.

[77] As part of the *USDA Climate Change Adaptation Plan* in 2014, NRCS found that integrating adaptation to changes in climate could be developed within the current NRCS conservation structure. The agency's plan remains posted to the USDA website, however it is unclear to what extent it continues to influence NRCS activities. NRCS, *Climate Change Vulnerability Assessment and Adaptation Plan 2014*, https://www.usda.gov/oce/climate_change/adaptation/Natural_Resources_Conservation_Service.pdf.

[78] OCE, *Agricultural Conservation on Working Lands: Trends from 2004 to Present*, Technical Bulletin 1950, November 2018, https://www.usda.gov/oce/oeep/USDA_Conservation_Trends.pdf.

enhance soil quality through increasing soil organic matter content and improving soil structure, and improve yields, among other benefits.[79] In this sense, adaptation may be a co-benefit of other objectives.

USDA strategies for climate change adaptation rely heavily on the delivery of NRCS's voluntary conservation technical assistance and financial support programs.[80] Most of these conservation programs are designed to address multiple concerns through locally adaptable practices. As such, no NRCS conservation program is specific to climate change adaptation, but most programs can integrate adaptation to changes in climate within their current structure.[81]

Most NRCS financial assistance programs are authorized to receive mandatory funding in omnibus farm bills. NRCS funding for technical assistance is generally provided through annual appropriations under the Conservation Operation's Conservation Technical Assistance account.[82] Farm bill-authorized conservation programs such as the Environmental Quality Incentives Program (EQIP), Conservation Stewardship Program (CSP), Agricultural Conservation Easement Program (ACEP), and Regional Conservation Partnership Program (RCPP) represent the largest (in terms of acres and funding levels) NRCS conservation programs currently available to provide adaptation-related practices on private agricultural land.[83] The 2018 farm bill (Agriculture Improvement Act of 2018, P.L. 115-334) amended EQIP and CSP to include specific reference within each program's purpose and activities to assisting producers with "adapting to, or mitigating against, weather volatility."[84]

In additional to providing technical and financial assistance, NRCS also conducts inventories and assessments related to the effectiveness of conservation practices and systems in managing the agricultural landscape for environmental quality, including its adaptability to climate change. Some NRCS programs such as the Conservation Innovation Grants (CIG, a subprogram of EQIP) and On-Farm Demonstration Trials (a subprogram of CIG) provide grants to nonfederal partners and individuals to implement innovative conservation practices and techniques.[85] Other initiatives, such as the Conservation Effects Assessment Project (CEAP), seek to quantify the environmental effects of NRCS conservation practices and programs.[86] Some NRCS initiatives related to soil health—such as the Rapid Carbon Assessment project, Science of Soil Health Initiative, and Soil Health Demonstration Trials—provide measurable assessments of dynamic soil properties that may inform and improve adaption policies.[87]

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[79] For additional information on the physical effects of NRCS conservation practices, see NRCS, "Conservation Practice Physical Effects on Soil, Water, Air, Plants, Animals, Energy, and People: National Summary Tool 2017," https://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/technical/econ/tools/?cid=nrcs143_009740.

[80] For example, see USDA, *USDA Agriculture Innovation Agenda*, February 20, 2020, https://www.usda.gov/sites/default/files/documents/agriculture-innovation-agenda-vision-statement.pdf.

[81] NRCS, *Climate Change Vulnerability Assessment and Adaptation Plan 2014*.

[82] For more information on NRCS annual appropriations, see CRS Report R46011, *FY2020 Appropriations for Agricultural Conservation*.

[83] For a list of additional agricultural conservation programs and authorized funding levels, see CRS Report R40763, *Agricultural Conservation: A Guide to Programs*.

[84] EQIP, 16 U.S.C. §3839aa(4), and CSP, 16 U.S.C. §3839aa-21(2)(B)(v).

[85] For additional information on both programs, see NRCS, "Conservation Innovation Grants," https://www.nrcs.usda.gov/wps/portal/nrcs/main/national/programs/financial/cig.

[86] For additional information on CEAP and other assessment initiatives, see NRCS, "Natural Resources Assessment," at https://www.nrcs.usda.gov/wps/portal/nrcs/main/national/technical/nra/.

[87] For additional information on the Rapid Carbon Assessment, see NRCS, "Rapid Carbon Assessment (RaCA)," https://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/research/?cid=nrcs142p2_054164. For information on the Soil

Research Agencies[88]

Four agencies and one staff office comprise USDA research. The Research, Education, and Economics (REE) mission area consists of four agencies: ARS, NIFA, ERS, and NASS. These agencies conduct and/or support scientific research on agriculture and related topics. The Under Secretary for REE, who oversees these agencies, holds the title of USDA Chief Scientist and is responsible for coordinating research, education, and extension activities across the entire department. The Office of the Chief Scientist (OCS)—a staff office within the Office of the Secretary of Agriculture—supports the USDA Chief Scientist in this coordination role.[89]

REE has considered climate change adaptation in its strategic planning. The *USDA Science Blueprint*, released in February 2020, provides strategic guidance to REE agencies, as well as other USDA agencies, by identifying overarching themes for USDA science initiatives.[90] "Ag Climate Adaptation" is one of the blueprint's five program themes. Within this theme, USDA states that "based on the best available science, new strategies and management practices must be developed to allow unmanaged and managed systems to be fully leveraged to mitigate and address climate change."[91]

Each REE agency conducts activities related to climate change adaptation. In addition to their individual agency activities discussed below, the REE agencies also collaborate with each other and with domestic and international partners. For example, both ARS and NIFA represent the United States to the Global Research Alliance on Agricultural Greenhouse Gases, a voluntary organization that brings together more than 60 countries to focus on "research, development and extension of technologies and practices that help deliver ways to grow more food (and more climate-resilient food systems) without growing greenhouse gas emissions."[92]

Agricultural Research Service

ARS is USDA's chief intramural (employing federal scientists) scientific research agency. ARS employs approximately 2,000 scientists and manages a network of more than 90 federal research laboratories located across the country and abroad.[93] Many of these laboratories are co-located with land-grant universities. ARS research is organized into 15 National Programs to coordinate the nearly 700 research projects carried out by ARS scientists.

Climate change adaptation issues at ARS include risks to federal infrastructure as well as research on agricultural adaptation. ARS's geographically distributed research locations provide workplaces for employees and house sensitive research collections. In its 2014 climate change adaptation plan, ARS cited several concerns regarding its ability to conduct its mission in the face

Health Demonstration Trial, see NRCS, "CIG On-Farm Conservation Innovation Trials," https://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/programs/financial/cig/?cid=nrcseprd1459039.

[88] This section was written by Genevieve K. Croft, Analyst in Agricultural Policy.

[89] 7 U.S.C. §6971.

[90] USDA, *USDA Science Blueprint: A Roadmap for USDA Science from 2020 to 2025*, December 2019, https://www.usda.gov/sites/default/files/documents/usda-science-blueprint.pdf. This blueprint succeeds the *REE Action Plan* created in 2012 and updated in 2014. USDA publicly released the blueprint document, which is marked December 2019, in February 2020.

[91] USDA, *USDA Science Blueprint*, 2020, p. 5.

[92] For more information, see the Global Research Alliance website at http://www.globalresearchalliance.org.

[93] ARS, "About ARS," https://www.ars.usda.gov/about-ars.

of climate change.[94] These included limitations on conducting research at current locations if environmental changes exceed agricultural resilience, reallocation of funds away from current high-priority research due to unexpected climate change impacts, threats to field personnel from extreme weather events, increased overhead costs to mitigate extreme environmental conditions for staff and research collections, and increased buildings and facilities costs to provide resilience to climate change.

Most climate change research at ARS is conducted under the National Soil and Air Program (NP #212, formerly the National Climate Change, Soils, and Emissions Program). In FY2018, 89 full-time scientists worked on 23 ARS-appropriated research projects and 111 cooperative research projects within NP #212.[95] This research addresses both climate change adaptation and mitigation.

In addition to individual research projects, ARS also manages and funds a national network of research sites: the Long-Term Agroecosystem Research (LTAR) network. LTAR has the vision of "developing national strategies for the sustainable intensification of agriculture production."[96] ARS designed LTAR to compare the results of different standardized agricultural practices across different U.S. regions over many years. It compares current practices ("business as usual") to practices that incorporate new research findings ("aspirational").[97] This type of consistent, long-term research can provide insights into how climate change impacts agricultural productivity, if at all, as well as practices that mitigate impacts of climate change. ARS established LTAR in 2011 based on existing authorities, and it continues to manage it as an ARS priority. ARS allocates funds to LTAR from the congressionally appropriated ARS Salaries and Expenses account. The 18 LTAR sites include ARS and non-ARS research locations in various types of agroecosystems (**Figure 2**).

In addition to ARS research programs, ARS also engages in international collaborations related to agricultural adaptation to climate change. ARS co-leads the Agricultural Model Intercomparison and Improvement Project (AgMIP). AgMIP's goal is to better assess the risks of climate change on global food production and food security, and to enhance adaptation capacity in developing and developed countries. It involves research in the United States as well as other countries, and is intended to help improve the comparability of analyses across studies to enhance learning. Approximately 40 countries participate in the project, with researchers working together to improve crop yield simulation models under projected future conditions.[98]

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[94] USDA, "Agricultural Research Service Agency Climate Change Adaptation Plan," in *US Department of Agriculture Climate Change Adaption Plan*, June 2014, pp. 23-37.

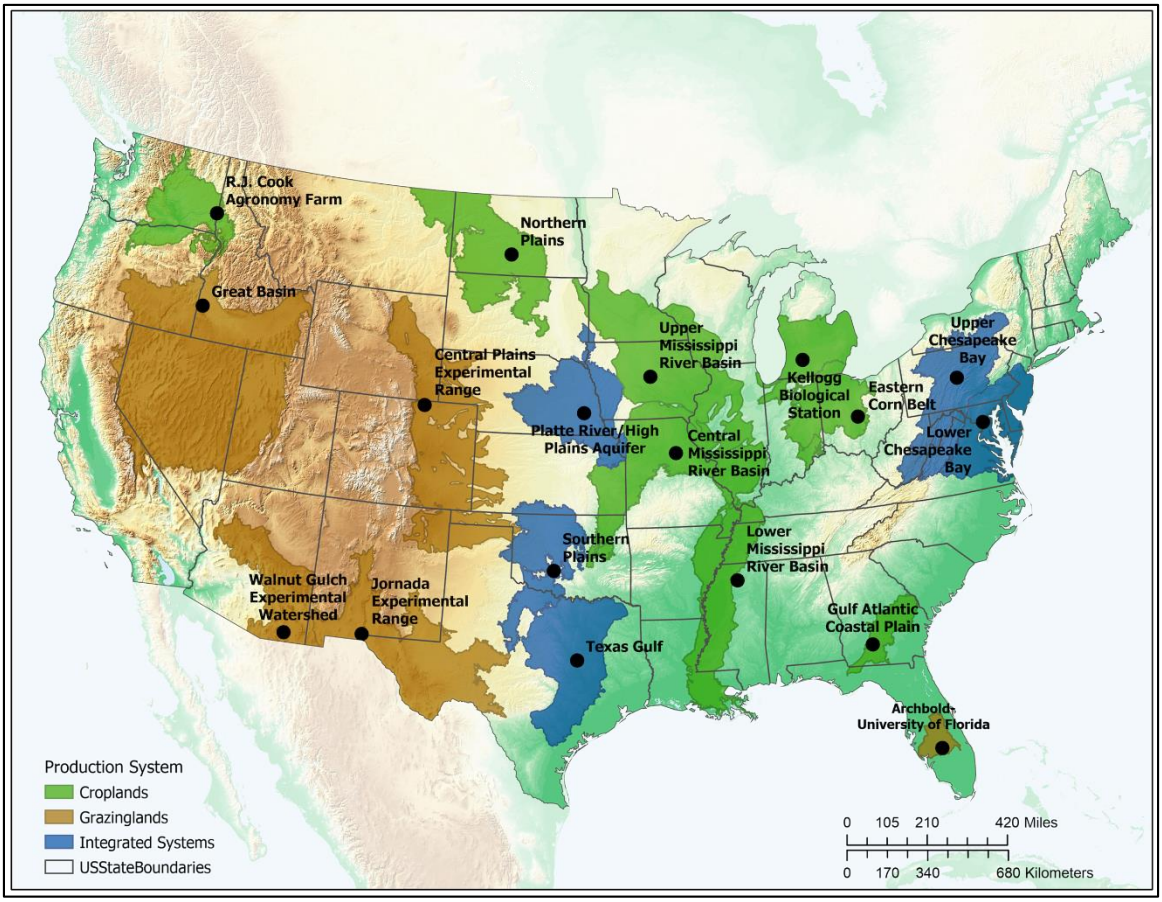
[95] Examples of related activities may be found in ARS, *FY2018 Annual Report*, "National Program 212—Soil and Air," https://www.ars.usda.gov/ARSUserFiles/np212/NP212%20Annual%20Report%20FY18.pdf.

[96] ARS, "The Long-Term Agroecosystem Research (LTAR) Network," https://www.ars.usda.gov/natural-resources-and-sustainable-agricultural-systems/water-availability-and-watershed-management/docs/long-term-agroecosystem-research-ltar-network. USDA frequently uses the term *sustainable intensification*, which some scientists define as "a process or system where agricultural yields are increased without adverse environmental impact and without the conversion of additional non-agricultural land." See Jules Pretty and Zareen Pervez Bharucha, "Sustainable Intensification in Agricultural Systems," *Annals of Botany*, Vol. 114, No. 8 (October 2014). Sustainable intensification can include best management practices and technologies for climate adaptation.

[97] Charles L. Walthall, "Forum: Transforming Agriculture with LTAR," *AgResearch Magazine*, October 2017.

[98] ARS, "AgMIP: The Agricultural Model Intercomparison and Improvement Project," https://www.ars.usda.gov/ARSUserFiles/OIRP/Brief%20-%20AgMIP%20Overview%20-%20ARS%2018-Sept-2012cw.pdf.

Figure 2. Map of the USDA Long-Term Agroecosystem Research Network



Source: ARS, "About the Long-Term Agroecosystem Research Network," https://ltar.ars.usda.gov/about/.

Notes: USDA's LTAR network is comprised of 18 long-term research sites across the United States that use coordinated observations and experiments to develop and share research findings that can advance sustainable intensification of U.S. agriculture. No LTAR facilities are located in Alaska and Hawaii.

National Institute of Food and Agriculture

NIFA supports research, education, and extension programs in the land-grant university system and other organizations.[99] NIFA's headquarters is located in Washington, DC, while most of its staff positions were relocated to Kansas City, MO, in October 2019. The agency does not perform research, education, or extension activities, but rather provides funds and national leadership in these areas.[100] NIFA programs are organized under four institutes, including the Institute of Bioenergy, Climate, and Environment (IBCE), which manages programs to help agricultural,

[99] For more information on the land-grant university system and NIFA's role in its funding, see CRS Report R45897, *The U.S. Land-Grant University System: An Overview*.

[100] For additional information, see CRS Report R40819, *Agricultural Research: Background and Issues*.

forest, and range production systems adapt to climate variables.[101] "Agroclimate science" is a NIFA priority science area, with projects administered through IBCE.[102]

Most NIFA-funded grants that focus on climate change are multimillion-dollar, integrated, transdisciplinary projects that address the adaptation of food, feed, and fiber production systems to changing climates. Most of these projects have the goal of reducing GHG emissions and increasing carbon sequestration in agriculture and forestry. In NIFA's 2014 climate change adaptation plan, NIFA anticipated the need to balance an increasing demand for scientific research, modeling, educational programs, and extension activities to address climate change issues with other research, education, and extension needs for agriculture.[103] For example, if investigations of climate stressors and tipping points become more important to climate adaptation science research, NIFA may need to balance funding this work with funding it provides for other crop and livestock production research and formal and informal educational programs.[104] NIFA has not issued an agency-wide strategic plan to follow its 2014-2018 strategic plan.[105]

Economic Research Service

ERS supports economic and social science analysis with a focus on agriculture, rural development, food, commodity markets, and the environment. It also collects and disseminates data concerning USDA programs and policies. ERS is one of the 13 principal statistical agencies of the Federal Statistical System of the United States.[106] Its headquarters is located in Washington, DC, while much of its staff was relocated to Kansas City, MO, in October 2019.

As part of its work, ERS conducts research on issues related to climate change, including climate change impacts on crop production, livestock production, and agricultural markets; the cost of federal policies and programs; international land use; agricultural adaptation prospects; agricultural GHG mitigation; the role of USDA programs; and risk management.[107] This research can inform consideration of potential policy responses to the impacts of climate change on agriculture and the effects of agriculture on climate change. Two examples of relevant ERS products are *Climate Change and Agricultural Risk Management Into the 21st Century* and *Development, Adoption, and Management of Drought-Tolerant Corn in the United States*, both published in 2019.[108]

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[101] NIFA, *Institute of Bioenergy, Climate, and Environment*, Institute Fact Sheet IBCE R7, December 11, 2012, http://www.csrees.usda.gov/about/pdfs/fact_sheets/inst_fs_ibce.pdf.

[102] NIFA, "NIFA Fact Sheet," September 23, 2019, https://nifa.usda.gov/sites/default/files/resource/NIFA-Fact-Sheet-2019.pdf.

[103] USDA, "National Institute of Food and Agriculture Agency Climate Change Adaptation Plan," in *US Department of Agriculture Climate Change Adaption Plan*, June 2014, pp. 100-110.

[104] USDA, "National Institute of Food and Agriculture Agency Climate Change Adaptation Plan," 2014.

[105] NIFA, "Strategic Plan," at https://nifa.usda.gov/strategic-plan, and NIFA, *NIFA Strategic Plan 2014-2018*.

[106] National Academies of Sciences, Engineering, and Medicine, *Principles and Practices for a Federal Statistical Agency, Sixth Edition*, National Academies Press, 2017, https://doi.org/10.17226/24810, p. 20.

[107] ERS, "Climate Change," https://www.ers.usda.gov/topics/natural-resources-environment/climate-change.

[108] Andrew Crane-Droesch et al., *Climate Change and Agricultural Risk Management Into the 21st Century*, ERR-266, ERS, July 2019; and Jonathan McFadden et al., *Development, Adoption, and Management of Drought-Tolerant Corn in the United States*, ERS, EIB 204, January 2019.

National Agricultural Statistics Service

NASS provides official statistics on agricultural production and indicators of the status of the farm sector. NASS is one of 13 principal statistical agencies of the Federal Statistical System of the United States.[109] NASS has its headquarters in Washington, DC, a National Operations Center in St. Louis, MO, and 12 regional field offices.[110]

NASS's mission is to "provide timely, accurate and useful statistics in service to United States agriculture."[111] The Geospatial Information Branch, within the Research and Development Division, employs satellite imagery to assess crop conditions, and this information is used to develop production forecasts. This detailed documentation of current conditions can inform agricultural adaptation planning, by documenting current conditions over time for departmental and public use.

Production and Regulatory Agencies

Among USDA agencies that focus on production, marketing, and regulatory activities are FSA, RMA, and APHIS. These agencies have local and regional offices across the United States. FSA and RMA focus on providing farm production support to U.S. farmers and ranchers. FSA administers many of the agricultural support programs (e.g., farm loans, commodity support, and disaster assistance) directly to producers through local field offices. RMA administers the Federal Crop Insurance Program (FCIP) through approved insurance providers and responds to producer interests and concerns. APHIS serves a diverse constituency when pursuing its mission of protecting the health of U.S. agriculture through its many programs. Each agency plays a role in agricultural climate change adaptation, as described below.

Farm Service Agency[112]

FSA administers a number of financial incentives for farmers and ranchers through farm ownership and production loans, farm income and commodity support programs, disaster assistance, and conservation programs. Similar to NRCS, FSA is locally based with over 99% of its 9,300 staff located in state- and county-level offices across the country.[113]

As part of the 2014 *USDA Climate Change Adaptation Plan*, FSA identified three climate change adaptation actions, including amending policy to facilitate adaptation, providing outreach to producers through the existing FSA service center structure and USDA's climate change hubs, and conducting a "continuity of operations" exercise to prepare for an increase in large-scale crop failures resulting from climate change.[114] While recent farm bills have reauthorized a number of the existing programs FSA cited as necessary for its response to climate change—for example, the Conservation Reserve Program (CRP), the Conservation Reserve Enhancement Program

[109] National Academies of Sciences, Engineering, and Medicine, *Principles and Practices for a Federal Statistical Agency*, 2017,, p. 20.

[110] NASS, FY2021 Budget Justification, p. 19-4, https://www.usda.gov/sites/default/files/documents/17nass2021notes.pdf.

[111] NASS, *National Agricultural Statistics Service Strategic Plan FY2020-FY2025*.

[112] This section was written by Megan Stubbs, Specialist in Agricultural Conservation and Natural Resources Policy.

[113] For more information, see CRS In Focus IF11452, *Staffing Trends in the USDA Farm Production and Conservation (FPAC) Mission Area*.

[114] FSA, *USDA Farm Service Agency Climate Change Adaptation Plan 2014*, https://www.usda.gov/oce/climate_change/adaptation/Farm_Service_Agency.pdf.

(CREP), loan programs, and disaster programs—the programs were not amended to specifically address adaptation. In most cases, these programs have continued with few changes related to adaption since the 2014 adaptation plan was issued.

According to the agency's most recent strategic plan, FSA's adaptation and mitigation response focuses primarily on CRP—a farm bill authorized program that pays private agricultural land owners to replace commercial crop production on highly erodible and environmentally sensitive land with long-term resource-conserving plantings.[115] The 2018 farm bill expanded CRP enrollment, including CREP, and emphasized water quality improving measures such as reducing sediment and nutrient loading.[116]

Other FSA programs such as disaster assistance payments are discussed less in the context of adaptation.[117] These and other ad hoc disaster assistance payments could provide needed assistance in response to climate-change-induced disasters affecting agriculture in the short term, potentially allowing producers more time to adapt.[118] However, if these programs are used to compensate a producer's vulnerability to weather variability, then these types of programs may actually serve to impede adaptation.[119]

Risk Management Agency[120]

RMA administers, regulates, and sets the premium rates (*prices*) for the Federal Crop Insurance Program (FCIP). RMA has about 350 permanent employees located at 10 regional offices, six regional compliance offices, a national office in Kansas City, MO, and its headquarters in Washington, DC.[121]

The FCIP is one of the principal federal programs available to help farmers manage weather risk. In recent years, the FCIP has emerged as the largest direct subsidy program to domestic commercial agriculture among USDA's farm safety net programs, with annual taxpayer costs averaging $9.4 billion in outlays during the past 10 years.[122] As a result, the FCIP has the potential to misrepresent the underlying costs of risk protection to producers for their agricultural resource and land use if not designed and priced properly.[123]

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[115] FSA, *Farm Service Agency Strategic Plan: Fiscal Year 2016-2018 Update* (the most recent strategic plan available).

[116] For additional information on changes to CRP in the 2018 farm bill, see CRS Report R45698, *Agricultural Conservation in the 2018 Farm Bill*.

[117] For a summary of USDA disaster assistance programs for production loss and land rehabilitation, see CRS Report RS21212, *Agricultural Disaster Assistance*; CRS In Focus IF10565, *Federal Disaster Assistance for Agriculture*; and CRS Report R42854, *Emergency Assistance for Agricultural Land Rehabilitation*.

[118] FSA, *USDA Farm Service Agency Climate Change Adaptation Plan 2014*.

[119] For example, see "Vulnerability Assessment," in Charles L. Walthall et al., *Climate Change and Agriculture in the United States: Effects and Adaption*, USDA Technical Bulletin 1935, February 2013, p. 130.

[120] This section was written by Randy Schnepf, Specialist in Agricultural Policy.

[121] USDA, "Explanatory Notes—Risk Management Agency," *President's Budget Request—FY2021*, 2020, p. 27-2.

[122] This average includes $6.4 in premium subsidies, $1.4 billion in administrative and expense support, and $1.6 billion in shared underwriting risk for the 10-year period 2010-2019, compiled by CRS using RMA's "Summary of Business" data as of February 24, 2020, and the RMA "Crop Year Government Cost of Federal Crop Insurance Program" data file as of March 11, 2019. For a comparison with other farm safety net programs, see CRS In Focus IF11163, *2018 Farm Bill Primer: The Farm Safety Net*.

[123] Joshua D. Woodard and Leslie J. Verteramo-Chiu, "Soil Data Not Considered in Cornerstone U.S. Agricultural Policy," Working Draft, *AG-Analytics.org*, February 2016.

RMA's principal vulnerability to climate change is through the insurance coverage offered under the FCIP. Since 2010, RMA's annual insured liability has averaged over $107 billion.[124] Producers of insurable crops may purchase subsidized insurance coverage to help manage financial risks associated with crop yield or revenue losses, primarily from natural causes—such as drought, flooding, diseases, and pests—as well as adverse movements in market prices. Yield and revenue losses, in particular, may be adversely influenced by climate change.[125] Policies can be purchased for a wide variety of field crops, vegetables, fruits, aquaculture, and forage crops, with endorsements available for some crops to account for special circumstances associated with those crops.[126] The producer pays a premium that increases in price with the coverage level—USDA pays a share of the premium that declines with higher coverage levels.

RMA monitors climate change research and, to the extent that climate changes emerge over time, updates FCIP parameters such as "earliest planting dates," "final planting dates," and "sales closing dates" to better help producers manage their production risks.[127] RMA will also extend policy coverage for selected crops into new regions as changes in agronomic conditions allow crop production to expand outside of traditional growing zones, or for extreme weather events. An example is hurricane insurance protection via an endorsement (available since February 2020) for counties in the vicinity of the Gulf of Mexico and the Atlantic, as well as Hawaii.[128] But the principal mechanism by which RMA addresses climate change and its potential effects on commercial agriculture is through the pricing of crop insurance policies.

By statute, the Federal Crop Insurance Corporation (FCIC) is tasked with establishing crop insurance premiums that are actuarially sound and that reflect the risk of loss.[129] Currently, the FCIP bases crop insurance premium rates exclusively on a crop's yield history at the insured unit level—referred to as the Actual Production History (APH).[130] Further, FCIP premium rates and indemnity payments hinge on how expected yields are estimated. In particular, several options are available for producers to offset the effect of low yields on the APH used to determine their insurance guarantees—including yield substitutions, yield floors, yield cups, yield exclusions, and trend-adjustments to yields.[131] Other concessions are also available that mitigate the costs of producing on marginal soils or land with higher yield variability—for example, for new or beginning producers, or in situations where new land is added to a policy or insured acres are prevented from being planted.

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[124] Data are for the 10-year period 2010-2019, compiled by CRS using "Summary of Business" data as of February 24, 2020, RMA, USDA.

[125] Reidmiller et al., *Fourth National Climate Assessment*, 2018.

[126] An endorsement is a set of contract terms that modifies the standard crop insurance policy for different circumstances. RMA offers many types of endorsements to the Common Crop Insurance Policy Basic Provisions for production practices, specific commodities, or other unique circumstances. For more details, see the RMA website.

[127] For example, on February 25, 2020, RMA announced that the earliest planting date for soybeans for central parts of Illinois was moved from April 20 to April 15 to reflect changing agronomic conditions. Similarly, the final planting date for soybeans was moved to July 5 from June 20 for first crop soybeans. RMA, "Crop Insurance Changes for Soybeans and Grain Sorghum," news release, February 25, 2020.

[128] See RMA, "Hurricane Insurance Protection—Wind Index (HIP-WI) Endorsement," February 2020, https://www.rma.usda.gov/en/Fact-Sheets/National-Fact-Sheets/Hurricane-Insurance-Protection.

[129] 7 U.S.C. §1506(n)(2).

[130] Each parcel of land that is insured independently of other parcels is called a unit. The APH yield is usually a simple average of the production history for each insurance unit. Alejandro Plastina, "Proven Yields and Insurance Units for Crop Insurance," *Ag Decision Maker*, A1-55, Iowa State University Extension and Outreach, revised June 2017.

[131] Barry J. Barnett and Ryan Stockwell, "Potential Conservation Implications of Federal Crop Insurance Actual Production History (APH) Procedures," AGree research paper, March 2017, https://foodandagpolicy.org/research.

Research reported by ERS suggests that the expected effects of climate change on the FCIP—increased yield and price variability, higher premium rates, and higher insured liability—will be to raise future costs to the federal government.[132]

Animal and Plant Health Inspection Service[133]

The APHIS mission is "to safeguard the health, welfare, and value of American agriculture and natural resources."[134] APHIS has approximately 5,500 permanent employees, with 22% located at its headquarters in Washington, DC, and the remainder located at its two regional offices and 431 field offices.[135]

As the climate changes, pests and diseases can pose increased threats to agriculture.[136] APHIS's primary role with respect to climate change adaptation is to anticipate, analyze, and respond to changes in these threats. Many APHIS programs and activities support this role: emergency preparedness for pest and disease emergencies, natural disasters, and biosecurity hazards; early warning systems for vector-borne diseases (i.e., those spread by insects) in livestock and wild animal populations; management of such vector-borne diseases; plant health response programs; and management and regulation of trade with regard to international disease outbreaks.[137] Through these and other activities, APHIS collaborates with diverse stakeholders and federal, state, local, academic, and business community partners.

In recent years, APHIS strategic planning has deemphasized the role of climate change in influencing pest and disease risks to agriculture. Whereas the agency's 2015-2019 strategic plan, includes explicit consideration of climate change under multiple objectives, its current strategic plan (2019-2023) does not refer to climate change, climate variability, or extreme weather.[138]

From the 2015-2019 strategic plan, tactics to achieve *Objective 6.2: Ensure effective preparedness and response systems* included "integrate climate change modeling into emergency preparedness and biosecurity hazard planning to respond to adverse conditions such as hurricanes, floods, droughts, and wildfires caused by climate change, thus mitigating damage to plants, animals, and humans."[139] Tactics to achieve *Objective 6.3: Ensure effective control, eradication, management, and enforcement programs* included "work with USDA and university researchers to study the impact of climate change on the emergence or spread of pests and diseases in the United States, and redesign regulatory approaches to better prevent or mitigate the impact of pests and diseases on U.S. plant and animal resources."[140] These tactics are not in the current strategic plan.

The examples from the 2015-2019 strategic plan represented potential approaches that APHIS could be taking to facilitate climate change adaptation with respect to its mission. It is unclear

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[132] Crane-Droesch et al., *Climate Change and Agricultural Risk Management Into the 21st Century*, 2019.

[133] This section was written by Genevieve K. Croft, Analyst in Agricultural Policy.

[134] USDA, "Explanatory Notes—Animal and Plant Health Inspection Service," *President's Budget Request—FY2021*, 2020, p. 22-2.

[135] USDA, "Explanatory Notes—Animal and Plant Health Inspection Service," p. 22-5.

[136] See, for example, Curtis A. Deutsch et al., "Increase in Crop Losses to Insect Pests in a Warming Climate," *Science*, vol. 361, no. 6405 (August 31, 2018), pp. 916-919.

[137] APHIS, *Animal and Plant Health Inspection Service and Climate Change*, http://www.usda.gov/oce/climate_change/fact_sheets/APHIS_Climate_Change_Fact_Sheet.pdf.

[138] APHIS, *Safeguarding the Health and Value of American Agriculture Since 1972: Strategic Plan 2015-2019*, and APHIS, *Strategic Plan FY2019-2023*.

[139] APHIS, *Strategic Plan 2015-2019*, p. 18.

[140] APHIS, *Strategic Plan 2015-2019*, p. 19.

whether APHIS is incorporating adaptation strategies into its work now. As of June 2020, the APHIS website includes little information about climate change. Direct spending on climate change accounted for a small share of APHIS budget during the 2015-2019 period. The USDA climate change budget in **Table 1** indicates spending by APHIS ($242,000 estimated for FY2019) at about 0.02% of its annual budget ($1.0 billion in FY2019 [P.L. 116-6]). For FY2016, USDA reported $206,000 in climate change spending when the annual APHIS budget was $898 million (P.L. 114-113).

Issues for Congress

Agriculture and forestry face challenges (e.g., weather, disease, pests) from a changing climate. As the federal entity tasked with providing "leadership on food, agriculture, natural resources, rural development, nutrition, and related issues based on public policy, the best available science, and effective management,"[141] USDA could play an integral role in assisting U.S. producers and land managers with adapting to a climate that scientists project is virtually certain to continue changing over coming decades.[142] While Congress continues to debate and discuss USDA's role in assisting the agriculture and forestry sectors to adapt to climate change, it has not passed legislation specifically directing the department's actions on climate change adaptation. USDA has largely undertaken adaptation measures through existing authorities to meet its core mission in support of U.S. agriculture and forestry. As Congress continues to debate and discuss USDA's role in addressing climate change adaptation in agriculture and forestry, the following potential issues may be of interest.

USDA Department-Level Planning and Coordination

USDA previously identified climate change as a risk to the USDA mission. USDA's efforts to address this risk appear to have declined in recent years. Congress may choose to review the extent to which climate change affects the ability of USDA and its individual agencies to successfully carry out their missions, whether existing departmental coordination is sufficient to address substantial risks, and/or whether additional coordination, planning, or policy development should occur at the department level.

At the USDA agency level, the climate change adaptation plans that a number of USDA agencies developed in 2014 remain publicly available. CRS could not determine to what extent the agencies continue to implement these plans. Although the executive order that prompted these plans was revoked by President Trump, USDA has not rescinded its 2015 Departmental Regulation (DR 1070-001) that guided their development. More recently, E.O. 13834 (2018) directs agencies to address resilience for efficient federal operation with no mention of climate change. How USDA may consider climate change as it addresses resilience in the production of food, feed, and fiber may be of interest to Congress.

Federal Funding of USDA Agencies and Activities

Congress may choose to review federal funding of climate change adaptation activities at USDA through annual appropriations, other legislation, or oversight hearings. Congress may assess whether the amount of funding requested by USDA for these programs is sufficient or consistent to meet its aims. Similarly, the amount of and manner by which USDA allocates spending on

[141] USDA, "About the U.S. Department of Agriculture," https://www.usda.gov/our-agency/about-usda.

[142] Reidmiller et al., *Fourth National Climate Assessment*, 2018.

research, conservation, outreach, and other activities related to climate change adaptation may be an issue of interest. For example, Congress may be interested in how agency priorities relate to funding levels for the USDA Climate Hubs and NIFA climate-change-related research activities.

The tracking of and accounting for funding directed at adaptation-related activities may also present a challenge for Congress. USDA identifies most funding on an agency-specific basis (see **Table 1**). Few details regarding programs and activities are typically provided, thus raising questions about which activities are included in funding compilations and to what degree their focus is on adaptation compared to other co-benefits. Should Congress determine to review USDA's recent adaptation activities and provide greater direction, the agency's budget justifications would be of limited assistance in clarifying objectives, priorities, and program effectiveness.

Voluntary Nature of Existing USDA Programs

Congress may consider how effective the voluntary nature of existing USDA programs is in meeting climate adaptation objectives. Many of USDA's programs rely on voluntary participation by producers and landowners (e.g., EQIP, CSP, CRP, and NRCS and FS technical assistance). The voluntary nature of these programs could result in slower adoption of adaptation-related activities relative to required adaptation measures. Producers are not required to adopt practices recommended by USDA, or, if they are paid to do so, they are not required to maintain practices beyond the period for which payment is received. Similarly, FS technical and financial assistance programs also rely on voluntary participation by nonfederal forest landowners.

USDA Leadership and Staffing

Congress may consider exercising additional oversight of USDA leadership and staffing. Leadership and organizational management can influence successful planning and delivery of climate change adaptation policies and programs. As of July 2020, acting and deputy officials were leading several USDA mission areas and agency offices. Several USDA agencies—including those in the Farm Production and Conservation (FPAC) mission area (including FSA, NRCS, and RMA) and in Research, Education, and Economics (REE, including ARS, ERS, and NIFA)—were operating with reduced staffing levels.[143]

Congress may consider exercising its oversight authority in view of leadership and staffing issues within the REE mission area. Such issues may impact mission delivery in terms of providing producers, policymakers, and other stakeholders with the research and analyses needed to adapt efficiently to climate change and abate risks to U.S. food supplies and exports. USDA has not had a Senate-confirmed Under Secretary for REE (a position with the dual role of USDA Chief Scientist) since December 2016.[144] Nominations for this position in 2017, 2018, and 2019 were returned to the President without Senate confirmation. A 2020 nomination was pending Senate consideration as of July.

Congress may be interested in monitoring how NIFA and ERS are meeting their responsibilities now, with reduced workforces, and in the future, as new staff are hired. In October 2019, USDA relocated the majority of staff positions at NIFA and ERS from Washington, DC, to Kansas City,

[143] For more information on staffing at FSA, NRCS, and RMA, see CRS In Focus IF11452, *Staffing Trends in the USDA Farm Production and Conservation (FPAC) Mission Area*.

[144] By statute (7 U.S.C. §6971), the Under Secretary for REE is also the USDA Chief Scientist.

MO.[145] Many affected staff, including staff and leadership of NIFA's IBCE, declined to relocate and left the agencies.[146] Some Members of Congress have questioned whether staffing shortages, loss of expertise, and lack of permanent leadership for key agency positions following the relocation have the potential to impact delivery of all programs at NIFA and ERS, including those focused on climate change adaptation.[147]

Climate Science at USDA

Congress may be interested to assess the status of the research that USDA is carrying out to address the needs of agricultural producers in the context of changing climatic conditions. Some farmers and agricultural groups have called on USDA to increase its engagement in helping farmers to anticipate and adapt to changing climate conditions, which may include increased instances of drought and extreme rainfall, historically unseasonable temperatures, and changes in the dates of first and last frost.[148]

Some Members of Congress have expressed concern that USDA did not publicized its climate change research or publicly release its draft 2017 *Climate Resilience Science Plan*, which identifies the science that USDA needs to pursue to meet national agricultural needs.[149] Some Members of Congress have called on USDA to address its role in publicizing and supporting climate change research or have introduced legislation aimed at safeguarding scientific integrity at USDA.[150]

The 2020 *USDA Science Blueprint* includes "Ag Climate Adaptation" as one of five program themes.[151] Congress could exercise its oversight authority to assess how USDA plans to implement this theme.

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[145] For additional details on the relocation of NIFA and ERS, see CRS In Focus IF11527, *Relocation of the USDA Research Agencies: NIFA and ERS*.

[146] See CRS In Focus IF11527, *Relocation of the USDA Research Agencies: NIFA and ERS*. As of February 1, 2020, ERS and NIFA were operating with approximately 67% of full staffing levels. As of July 1, 2020, NIFA's IBCE has an acting deputy director and two of its three divisions are led by acting division directors, according to an organizational chart available at https://nifa.usda.gov/sites/default/files/resource/NIFA_Org_Chart.pdf. The ERS organizational chart as of June 2020, is available at https://www.ers.usda.gov/media/10631/ers-org-chart_june2020.pdf.

[147] U.S. Congress, Senate Committee on Agriculture, Nutrition, and Forestry, *Agricultural Research and 2018 Farm Bill Implementation*, hearing on implementation of P.L. 115-334, 116th Cong., 1st sess., July 18, 2019, S. HRG. 116-192, (Washington, DC, GPO, 2020). See pp. 5 and 155 for relocation concerns specific to climate change research and throughout for general concerns regarding mission delivery. For additional potential impacts of the ERS and NIFA relocation on mission delivery, see Ben Guarino, "USDA Relocation Has Delayed Key Studies and Millions in Funding, Employees Say," *Washington Post*, October 2, 2019; and Rebecca Beitsch, "USDA Nixes Release of Multiple Reports Over Researcher Exodus," *The Hill*, September 27, 2019. For leadership status following the relocation, see the NIFA and ERS organizational charts identified in footnote 146.

[148] For example, "Letter from U.S. Farmers & Ranchers to Congress: We Need a Green New Deal," May 20, 2019.

[149] U.S. Congress, Senate Committee on Agriculture, Nutrition, and Forestry, *Agricultural Research and 2018 Farm Bill Implementation*, hearing on implementation of P.L. 115-334, 116th Cong., 1st sess., July 18, 2019, S. HRG. 116-192, (Washington, DC, GPO, 2020).

[150] For example, Senator Debbie Stabenow, "Letter to USDA Secretary Sonny Perdue," August 8, 2017; Representative Lauren Underwood, "Letter to USDA Secretary Sonny Perdue," June 25, 2019; Senator Amy Klobuchar, "Letter to USDA Secretary Sonny Perdue," June 24, 2019; and the Scientific Integrity Act (S. 775, 116th Congress).

[151] USDA, *USDA Science Blueprint*, 2020, p. 16.

Integration of Climate Change Adaptation into Existing Programs

Ongoing research through existing programs at USDA continues to evaluate the effect of climate change on agriculture and its capacity to adapt. How traditional production methods and conservation practices may affect agriculture and forestry's resiliency continues to be studied.

CRS could not determine how this research is being used to inform decisions within existing USDA programs or the guidance that USDA provides to farmers and ranchers. For example, USDA provides billions of dollars annually through disaster assistance programs administered by FSA. These programs may provide financial compensation for a production loss due to a natural disaster.[152] These programs have few, if any, requirements on how the assistance is to be utilized, and at present, most programs have no requirement that actions be taken to reduce risk as a condition to receive future assistance. With an observed increase in the frequency and severity of climate-change-induced disasters, Congress could consider whether these programs should include incentives and resources to encourage producers to take steps to adapt to climate change, rather than potentially prolonging producers' vulnerability to intense weather events.[153]

Risk Management Programs at USDA

Congress could also choose to review how, or whether, USDA's risk management programs address current and future climate change and manage the associated risks, including potential incorporation of climate change adaptation measures. Congress may also wish to consider the potential for program costs to escalate under existing program options and in the absence of adaptation measures.

Currently, the FCIP bases crop insurance premium rates exclusively on a crop's APH. If APH yields do not accurately reflect the effects of climate change, or because other factors such as soil quality are not taken into account, then FCIP policies may not be priced efficiently.

Currently, producers may choose among options to offset the effect of low yields on the APH used to determine their insurance guarantees. While these exceptions to the pricing of insurance policies may mitigate the effect of extreme loss events, they can also have unintended consequences, such as encouraging production on marginal lands that otherwise might not be cultivated. If, as repeated research indicates, projected climate changes are likely to adversely affect yields of many crops in the United States, the APH policy may raise federal expenditures over time.

Research suggests that the expected effects of climate change on the FCIP—that is, increased yield and price variability, higher premium rates, and higher insured liability—will be to raise future costs to the federal government.[154] Research also suggests that premium rates that incorporate soil quality variations and climate-driven weather interactions, and better reflect the risk of loss to a producer, could improve the actuarial soundness of crop insurance, remove or minimize the incentive to plant on marginal lands, and possibly encourage greater producer adoption of environmentally beneficial behavior, such as shifts in crop choices or increased use of

[152] CRS Report RS21212, *Agricultural Disaster Assistance*.

[153] Similar challenges have been raise in the context of other federal programs—for example the National Flood Insurance Program and flood resilience. For additional discussion on this program, see CRS Report R45017, *Flood Resilience and Risk Reduction: Federal Assistance and Programs*.

[154] Crane-Droesch et al., *Climate Change and Agricultural Risk Management Into the 21st Century*, 2019.

soil-quality-improving conservation practices.[155] These research results suggest that stronger insurance incentives could encourage producers to better adapt to their risk environment. CRS could not determine whether USDA is considering any changes along these lines.

As new research and evidence improves society's understanding of how climate interacts with agriculture in different regions, Congress may consider evaluating the nature of incentives being provided to producers from subsidized federal crop insurance (i.e., FCIP). Inherent in FCIP is the question: Are producers being encouraged to make crop and land choices that reflect both short-term market conditions and long-term resource productivity related to changing local agro-climatic conditions? Underestimating or overestimating the impacts of climate change, and the policy choices that are made in response, could have widespread effects on agriculture.

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[155] Joshua D. Woodard, "Integrating High Resolution Soil Data into Federal Crop Insurance Rates: Actuarial, Policy, and Sustainability Implications," Working Draft, Cornell University, January 2016; Joshua D. Woodward and Leslie J. Verteramo-Chiu, "Efficiency Impacts of Utilizing Soil Data in the Pricing of the Federal Crop Insurance Program," *American Journal of Agricultural Economics*, vol. 99, no. 3 (April 2017), pp. 757-772; and Woodard and Verteramo-Chiu, "Soil Data Not Considered in Cornerstone U.S. Agricultural Policy," 2016.