

US Department of Agriculture Climate Change Adaptation Plan June 2012

I. Introduction

Role and Mission of USDA

The US Department of Agriculture (USDA) provides leadership on food, agriculture, natural resources, rural development, nutrition, and related issues through its evolving service role at the nexus of traditional rural American food and fiber production and the emerging economic opportunities in renewable energy, broadband, and recreation. The vision statement of the USDA Strategic Plan calls for the Department “to expand economic opportunity through innovation, helping rural America thrive; to promote agriculture production sustainability that better nourishes Americans while also helping to feed others throughout the world; and to preserve and conserve our Nation’s natural resources through restored forests, improved watersheds, and healthy private working lands.” Climate change has the potential to confound USDA efforts to meet these core obligations and responsibilities to the Nation.

Rural America is rapidly transitioning to a diverse and competitive business environment driven by an increasing sophisticated consumer market. The economic vitality and quality of life in rural America depends on a financially healthy agricultural system and access to agricultural and emerging markets. US farmers, ranchers and foresters ensure that all of America and many other parts of the world have nutritious and safe food, adequate energy sources, and fiber products sufficient for the needs of a rapidly increasing population. Climate change adaptation is essential to sustain these capabilities.

Background

A growing body of evidence shows that US climate has changed substantially since 1900, that this change is accelerating, and that even greater change is likely to occur in the next 100 years¹. Climate change has the potential to disrupt USDA’s efforts to meet the core obligations and responsibilities articulated by its mission, and goals. The vulnerability of USDA operations and programs to climate change will be highly dependent on the magnitude and pattern of climate changes, as well as on changes in climate extremes. Changing precipitation and temperature patterns as well as increasing atmospheric greenhouse gas concentrations affects forest and agro-ecosystems at national, regional, and local scales. These changes may have significant implications for USDA program participation and costs. Such projections are accompanied by a great deal of uncertainty so policies will need to be flexible enough to adapt to this uncertainty.

USDA is well-positioned to meet the requirements of the federal agency climate change adaptation guidance. The Department’s Strategic Plan for 2010-2015 provides a strong foundation for climate change adaptation planning. Two Agency Priority Goals for targeted

¹ DRAFT -- Climate Change and Agriculture in the U.S.: An Assessment of Effects and Potential for Adaptation. Technical Submission to the National Climate Assessment 2012.

or accelerated attention in 2012 and 2013 align with the strategic goals set forth in the USDA's Strategic Plan 2010-2015 and also address climate change adaptation.

All four goals of USDA's Strategic Plan have objectives that articulate opportunities and challenges associated with climate change adaptation. Strategic Goal 2 specifically addresses the challenges of climate change and opportunities associated with addressing greenhouse gas emissions "to ensure that our National Forests and private working lands are conserved, restored, and made more resilient to climate change." The Plan calls for the Department to capitalize on opportunities presented by the Nation's efforts to develop markets for ecosystem services. The USDA Strategic Plan further calls on the Department to lead efforts to mitigate and adapt to climate change through Goals 1, 3, and 4.

The following are the USDA Strategic Planning Goals and Objectives that relate to climate change:

Strategic Goal 1: Assist Rural Communities to Create Prosperity so they are Self-Sustaining, Repopulating, and Economically Thriving

Objective 1.1 – Enhance Rural Prosperity;

Objective 1.2 – Create Thriving Communities;

Objective 1.3 – Support a Sustainable and Competitive Agricultural System.

Strategic Goal 2: Ensure our National Forests and Private Working Lands are Conserved, Restored, and Made More Resilient to Climate Change while Enhancing our Water Resources

Objective 2.1 – Restore and Conserve the Nation's Forests, Farms, Ranches, and Grasslands;

Objective 2.2 – Lead Efforts to Mitigate and Adapt to Climate Change;

Objective 2.3 – Protect and Enhance America's Water Resources;

Objective 2.4 – Reduce the Risk from Catastrophic Wildfire and Restore Fire to its Appropriate Place on the Landscape.

Strategic Goal 3: Help America Promote Agricultural Production and Biotechnology Exports as America Works to Increase Food Security

Objective 3.1 – Ensure US Agricultural Resources Contribute to Enhanced Global Food Security;

Objective 3.2 – Enhance America's Ability to Develop and Trade Agricultural Products Derived from New Technologies;

Objective 3.3 – Support Sustainable Agriculture Production in Food-Insecure Nations.

Strategic Goal 4: Ensure that All of America's Children Have Access to Safe, Nutritious, and Balanced Meals

Objective 4.3 – Protect Public Health by Ensuring Food is Safe;

Objective 4.4 – Protect Agricultural Health by Minimizing Major Diseases and Pests to Ensure Access to Safe, Plentiful, and Nutritious Food.

USDA issued an addendum to the 2010-2015 Strategic Plan that contained three additional “priority strategic goals”. Two of these goals have a relationship to climate change.

Priority Strategic Goal 2: Further accelerate the protection of clean, abundant water resources by implementing high impact targeted (HIT) practices through Farm Service Agency (FSA), Forest Service, and Natural Resources Conservation Service (NRCS) programs on 4 million acres within critical and/or impaired watersheds and quantify improvements in water quality by developing and implementing an interagency outcome metric within 2-4 pilot watersheds.

This priority goal supports USDA and Administration priorities, including:

- The Department's Strategic Goal 1 to *Assist Rural Communities to Create Prosperity so They Are Self-Sustaining, Repopulating, and Economically Thriving*, and Goal 2 *Ensure Our National Forests and Private Working Lands Are Conserved, Restored, and Made More Resilient to Climate Change, While Enhancing Our Water Resources*.
- Delivering results on action items in the President's America's Great Outdoors Initiative to build a 21st century conservation agenda; and
- Advancing innovative approaches to accelerating conservation through environmental markets.

Priority Strategic Goal 3: Assist rural communities to build and maintain prosperity through increased agricultural exports through key indicator targets and a baseline of growth over the last 5 fiscal years (FY2006-2010).

This priority goal directly relates to two of the four strategic goals outlined in the *USDA Strategic Plan*.

- Through trade facilitation, increased exports create jobs and increase prosperity domestically, which relates to Goal 1 (*Assist Rural Communities to Create Prosperity so They Are Self-Sustaining, Repopulating, and Economically Thriving*).
- By promoting and increasing exports, including biotechnology exports, this goal also helps to enhance food security around the world, which relates to Goal 3 (*Help America Promote Agricultural Production and Biotechnology Exports as America Works to Increase Food Security*)

Executive Directives and USDA's Role

Climate change challenges the mission, operations, and programs of nearly every Federal agency. Ensuring that the Federal government has the capacity to execute its missions and maintain important services in the face of climate change is essential.

Council on Environmental Quality (CEQ) and Adaptation

By Executive Order in October 2009, the Interagency Climate Change Adaptation Task Force (co-chaired by the Council on Environmental Quality (CEQ), the National Oceanic and Atmospheric Administration (NOAA), and the Office of Science and Technology Policy (OSTP)) was established to examine this challenge and was asked to recommend how the policies and practices of Federal agencies can be made compatible with, and reinforce a national climate change adaptation strategy. The Task Force, composed of more than 20 Federal agencies and Executive branch offices including USDA, was charged to consider the capabilities of the Federal Government to respond to climate change effects on select sectors, institutions, and agency responsibilities, and ultimately to develop recommendation reports. EO 13514 challenged Federal agencies to set sustainability goals for agency operations and directed agencies to improve their environmental, energy and economic performance. Under this EO, each Federal agency is evaluating agency climate change risks and vulnerabilities to manage both the short- and long-term effects of climate change on the agency's mission, programs, and operations.

To facilitate the effort, multiple workgroups, that included USDA scientists and technical experts, were developed. One significant outcome was the recommendation to encourage and mainstream adaptation planning across the Federal Government. This planning includes:

- Implement adaptation planning within Federal agencies
- Employ a flexible framework for agency adaptation planning
- Use a phased and coordinated approach to implement agency adaptation

CEQ issued a set of Implementing Instructions for Federal Agency Adaptation Planning on March 4, 2011. The Instructions provided agencies with templates for preparing strategies to integrate climate change adaptation into their planning, operations, policies, and programs, as recommended by the Interagency Climate Change Adaptation Task Force in its Interim October 2010 Progress Report to the President. On October 28, 2011 the Task Force released the 2011 Interagency Climate Change Adaptation Task Force Progress Report outlining the Federal Government's progress in better understanding, preparing for, and responding to extreme events and other climate change effects. The report provided an update on actions in key areas of Federal adaptation and provided climate information and tools to help decision-makers manage climate risks. The climate adaptation plans will be made publicly available through CEQ's website once finalized and approved.

USDA and its agencies are participating in developing risk and vulnerability assessments and adaptation implementation plans with guidance from CEQ in response to the Task Force recommendations. In response to the March 2011 CEQ Instructions, USDA prepared an

adaptation planning document as part of its 2011 Strategic Sustainability Performance Plan <http://greening.usda.gov/USDASSPP2011.pdf> , a Preliminary High-Level Analysis of Agency Vulnerability to Climate Change in September 2011 and a Final High-Level Analysis http://www.usda.gov/oce/climate_change/files/HighLevelVulnerabilityAnalysis_Sept2011.DOCX in March 2012. USDA has also prepared a Department-wide climate change adaptation policy statement issued in the form of a Departmental Regulation (DR-1070-001) in June 2011 that instructs each of its agencies with climate change responsibilities to prepare individual Adaptation Climate Change Plans. USDA is including this USDA Climate Change Adaptation Plan as part of its 2012 Strategic Sustainability Performance Plan. The final report will be posted to the Department’s climate change website http://www.usda.gov/oce/climate_change/ .

II. Vulnerability Assessment

Climate change has the potential to confound USDA efforts to meet the core obligations and responsibilities to the Nation. USDA agencies are responding to the risks and vulnerabilities associated with climate change with the following possible strategies:

Strategic Goal	Objective/ Pillar	Risks and vulnerabilities	Agencies Involved ²	Possible response strategies
1. Assist Rural Communities to Create Prosperity to be Self-Sustaining, repopulating and Economically Thriving	1.1 Enhance rural prosperity	Energy crops subject to new and challenging growing conditions.	RD, ARS, NIFA, FS, FSA, NRCS, ERS	Renewable energy can offset GHG emissions. Develop new energy crop varieties that can withstand changing climate conditions Promote resource-efficient cropping
	<ul style="list-style-type: none"> Facilitate sustainable renewable energy development 			
	<ul style="list-style-type: none"> Develop and support regional food systems 	Climate change effects across regions will vary. Some regions will face greater challenges in adapting to changes in extreme events such as droughts and storms.	RD, FSA, AMS, RMA, ARS, NIFA	Better prepare farmers with adaptive responses to climate, encourage regional networks. Develop new crop varieties to withstand changing climate conditions.
	<ul style="list-style-type: none"> Capitalize on 	Ecosystem services	AMS, FAS, FSA,	Work with

² Agency Abbreviations: AMS: Agricultural Marketing Service, ARS: Agricultural Research Service, APHIS: Animal, Plant Health Inspection Service, ERS: Economic Research Service, FS: Forest Service, FAS: Foreign Agriculture Service, FSA: Farm Service Agency, NASS: National Agricultural Statistics Service, NIFA: National Institute of Food and Agriculture, NRCS: Natural Resource Conservation Service, RD: Rural Development, RMA: Risk Management Agency

	opportunities presented by the nation's efforts to develop markets for ecosystem services and mitigate climate change	may be stressed by climate changes and natural disasters.	FS, NRCS, RD, ERS	producers to diversify agricultural practices and protect ecosystem services, promote crops with the mitigation potential and most adaptable to environmental changes
	<ul style="list-style-type: none"> Generate and retain green jobs and economic benefits through natural resource and recreation programs 	Tourism activities and green jobs will be positively (warm-weather activities) and negatively (snow-related activities) affected by climate change. Coastal tourism could be affected by sea-level rise.	FS, RD	Work with rural communities to manage lands for tourism and outdoor recreation and find ways to use lands to enhance green employment opportunities.
	1.2 Create thriving communities	Clean air, clean water, and access to outdoor recreation will be threatened as climate changes.	RD, FS	Establish community forestry programs and develop 'green' and resilient infrastructure.
	1.3 Support a sustainable and competitive agricultural system	Climatic changes will stress some crops and potentially affect sustainability and competitiveness of farming and ranching.	ARS, FAS, FS, FSA, NIFA, NRCS, RMA, ERS	Conduct research to improve seed and feed, improve agricultural practices, and develop ecosystem markets. Provide outreach and education to ensure all producers have necessary risk management tools and knowledge.
2. Ensure Our National Forests and Private Working Lands are Conserved, Restored and	2.1 Restore and conserve the nation's forests farms, ranches, and grasslands	Degradation of resources may lead to increased GHG emissions, and threaten wildlife, fish, plants, lands, water, recreation,	FS, NRCS, FSA	Work with private landowners and public managers to restore and protect forests, crop, and grazing lands, provide incentives

Made Resilient to Climate Change		community, and prosperity.		to maintain working lands, preserve open space, and restore public forests.
	2.2 Lead efforts to mitigate and adapt to climate change	Healthy soils and plants are challenged by a changing climate.	FS, NRCS, ARS, ERS, NIFA, FSA, RMA	Integrate research results into policies and conservation practices, disseminate information, and support land managers who use these practices
	2.3 Protect and enhance America's water resources	Drought, infiltration limitations and runoff pose problems for increasingly limited quantities and quality of water resources.	FS, NRCS, RMA	Encourage producers and forest managers to preserve wetlands, use sustainable practices that put minimal stress on water resources
	2.4 Reduce risk from catastrophic wildfire and restore fire to its appropriate place on the landscape	Parts of the country, especially in the west, are increasingly threatened by drought and longer fire seasons.	FS, NRCS	Work with communities to ensure they are fire-adapted, return prescribed fires to ecosystems where needed
3. Help America Promote Agricultural Production and Biotech to Increase Food Security	3.1 Ensure US agricultural resources contribute to enhanced global food security	Ensuring global food security will become more challenging as countries address a growing global population, land degradation, scarce water supplies, and climate change.	NIFA, ARS, FAS, FSA, NASS, ERS, APHIS	Research should continue to improve and protect US staple crops to adapt to changing climate conditions, markets can be opened to spread these resources abroad

	3.2 Enhance America's ability to develop and trade agricultural products	Risks to food security and human health increase as shifts in distribution and nature of diseases, invasive species and agricultural pests increase.	FAS, APHIS	Enhance protection of agriculture, natural resources through adaptive risk analysis models, engaging larger number of stakeholders
	3.3 Support sustainable agriculture production in food-insecure nations	Many nations may experience failing crops and food insecurity due to droughts and natural disasters.	NIFA, ARS, FAS	Research into climate-resilient crops and farming practices can be disseminated to world farmers to help them become self-sufficient
4. Ensure All America's Children have access to Safe, Nutritious and Balanced Meals	4.3 Protect public health by ensuring food is safe	Flooding effects on ready to eat crops, and increases in temperature potential effects food storage.	APHIS, AMS	Ensure and certify foods are safe to purchase and eat
	4.4 Protect agricultural health by minimizing major disease and pests to ensure access to safe, plentiful, and nutritious food	Diseases, including plant and animal pests and pathogens, are expected to change in distribution as the climate warms and precipitation increases.	APHIS, ARS, FAS, NIFA, ERS	Identify pests and diseases before they enter the US, and continue research into prevention and suppression of disease
Priority Strategic Goal 2: Accelerate Protection of Clean, Abundant Water Resources		Ecosystem services will be stressed by changes in climate variability and extremes, making long-term application of targeted practices more critical.	FSA, FS, NRCS, ERS	Implement high-impact targeted practices in critical and/or impaired watershed and quantify improvements in water quality
Priority Strategic Goal 3: Assist Rural Communities to Build and		Agricultural production is affected by increasing temperatures,	FAS with cooperator groups from a cross-section of US food and	Increase agricultural exports through key indicators and a baseline of growth over the last 5 years

Maintain Prosperity		changing extremes and precipitation changes.	agricultural industries	
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Climate Change Effects on USDA Functions

Climate change presents new challenges for regulatory and response agencies. Public safety is increasingly at risk due to fast-moving wildfires, unpredictable extreme weather events such as flash flooding and associated sudden appearance of disease vectors. Risks to food safety, ecosystem health, and human health associated with many animal and plant diseases, invasive species, and pests may change. Endemic and exotic pests, weeds, and diseases are increasing concerns for agriculture and forestry, with widely seen consequences for productivity and ecosystem health. Although the influence of these factors is increasingly recognized by scientists and policy makers, the role of climate change on their proliferation is often not well understood. USDA is conducting basic and applied research on the interacting effects of climate change on endemic and exotic pests, weeds and diseases, and their resistance to management actions designed to control these types of species.

USDA’s costs for administering services such as disaster assistance, crop insurance, conservation and energy programs, and technical assistance are likely to increase as a result of climate change. Severe weather and other climate-related events such as associated excess moisture, drought, pest infestations, and heat stress place pressure on the capacity of agencies to meet demands.

Shifts in climate may also affect USDA infrastructure, particularly in areas of rising sea level and in areas of increased recurrence of extreme, damaging storms, tornadoes, and hurricanes. USDA facilities, lands, and operations may be increasingly and less predictably affected by these events. Rising temperatures influence the energy costs associated with aging structures constructed when energy costs were a less significant portion of agency budgets.

Climate Change Effects on Agricultural Production

Mechanisms for adapting to climate change are critical for continued agricultural production and stewardship of natural resources. An understanding of the effects of climate change on natural and managed ecosystems provides the insights needed to formulate strategies for assessing vulnerabilities and risks, and for leveraging potentially beneficial aspects of climate change. Mechanisms for identifying and detecting indicators of effects are a key to formulating effective management responses. Adaptive responses to climate change must be evaluated for changes in ecosystem function, economic implications, potential feedbacks to the climate system and their consequences for sustainability, and reinforcement of climate change mitigation strategies. Only then can adaptive management be successful.

Key vulnerabilities attributed to climate change in the United States are increasing temperature, precipitation changes, and sea level rise. The US is projected to warm by 1-2°C in the next 40 years and as much as 3-6°C by the 2080’s¹. Temperatures across the country

are expected to increase, with the largest increases expected to occur in Polar Regions throughout interior and northern Alaska and across the northern tier of interior continental US states. The coastal regions of the continental United States are expected to warm less rapidly than inland regions, and heat waves are likely to become more frequent across North America. Changes in drought frequency, higher night-time temperatures, higher annual extreme minimum temperature, and more intense storms and their effects are likely.

Shifts in the amount, intensity, duration, timing, and distribution of precipitation, both regionally and locally are expected to accompany temperature changes. Projected increases in the variability of precipitation will influence agricultural production because of the uncertainty in water availability within the growing season.

Global sea level is projected to rise over this century. Hurricane rainfall and storm intensity is expected to increase in response to climate change. Coastal regions should anticipate sea level rise, increased hurricane intensity, and the associated increases in coastal erosion and damage. Coastal storms, especially of tropical origin, could produce more frequent damaging winds, leading to greater extreme wave heights along the coast.

The agricultural sector has a strong record of innovation and adaptability, but the magnitude of climatic changes projected for this century including increased frequency of extreme events, exceed the variations that have been managed in the past and will challenge all elements of agricultural production systems. USDA agencies need to be prepared to address these issues through carefully planned adaptive strategies. The Synthesis and Assessment Product (SAP) 4.3³ outlined important effects that a changing climate have had and can have on agriculture and forestry. These effects present threats to agricultural production systems as well as opportunities to improve and expand production. Increasing carbon dioxide levels in the atmosphere may alter plant responses, including possible increases in vegetative productivity, weed pressures, and geographic expansion of invasive species. Indirect impacts of climate change must also be considered such as altered host-pathogen relationships that can increase incidence and damage to agricultural and natural ecosystems. Anticipated adaptation to climate change in production agriculture includes adjustments in management practices, including tillage, crop species, crop rotations, and harvest strategies. New research will increase the resilience of agronomic systems to climate change and will enable exploitation of opportunities that may arise.

Agricultural production volatility due to climate variability and change can lead to surplus and deficits in regions where food insecurity is common or food is difficult to obtain due to transportation disruptions. Food assistance programs can expect to experience increases in the number of requests for assistance under severe weather conditions such as flooding, hurricanes, and tornadoes.

Climate Change Effects on Forests and Grasslands

³ Synthesis and Assessment Product (SAP) 4.3, The Effects of Climate Change on Agriculture, Land Resources, Water Resources and Biodiversity in the U.S., 2008.

National forests and grasslands and surrounding farms, ranches, private forests, and range lands help protect water quality; provide wildlife habitat, lumber, and other products; and offer places to recreate. Open space, and the ecological and socioeconomic benefits these ecosystem services provide are lost when forests and working lands are converted for urban and industrial uses. Helping private landowners and communities maintain and manage their open space as sustainable forests and grasslands will become more difficult as climate change affects ecosystem services and factors that influence land use.

Forests and derivative ecosystem services occur in rural areas where human population densities are low and forest cover dominates and in urban settings where trees may provide a high per-capita value even though present in low density stands⁴. Land-use shifts in rural areas could involve conversion of forests to other uses. The extent of wildland-urban interface and urban areas are projected to increase, often at the expense of rural forests. For example, climate change could lead to declines in productivity of agricultural land or increased desirability of land for residential housing that results in the conversion of forest and rangelands to accommodate these needs. Higher temperatures coupled with population growth may increase the value of urban trees for mitigating climate change but may also make it more difficult to maintain healthy trees in urban environments.

The resilience of diverse ecosystems within forests and grasslands is fundamental to the multiple socioeconomic and ecosystem benefits they provide. Climate change affects those benefits, for example, by changing forest and rangeland productivity and composition, which in turn influences biomass availability for livestock and wildlife grazing, wood products, and energy. Any change in ecosystems that affects water resources will typically result in a significant loss of ecosystem services. The increased occurrence of severe drought or other extreme events such as catastrophic fires and insect or disease outbreaks can alter the long-term ecosystem composition, structure, and function as plant and animal species respond to climate change. The most rapidly visible and most significant short-term effects on forest ecosystems will be caused by altered disturbance regimes, including increased wildfires, insect infestations, disease, pulses of erosion and increased drought, all of which have an increased potential for cascading interactions.

International agricultural and forest trade enhances global food security, but provides conduits for geographic expansion of invasive species. Disease, pests and non-native species are easily and rapidly transported globally to countries where no natural predators exist or the where a climate contributes to the species overrunning the natural ecosystem.

Despite attempts to restore fire to appropriate landscape locations, increased effects from catastrophic wildfire are additional threats from climate change. Recent trends indicate increased fire occurrence and severity will affect annual acreages burned, particularly in the western United States even with conservative assumptions in rates of climate change. In addition, fires encompassing extremely large geographic areas are less responsive to suppression efforts.

⁴ Vose, J.M. et al., National Climate Assessment – Forest Sector Technical Report. US Forest Service General Technical Report

A series of risk management frameworks for the forest sector were necessary to help quantify the magnitude and likelihood of environmental and other effects. These frameworks have existed for years but applying them to projecting climate change effects is relatively new³. Risk assessments need to be tailored to particular regions and time frames and modified by an estimate of confidence in the projections made. For example, management strategies for Alaska, where climate change affects permafrost and disturbance regimes, are quite different from the strategies needed for the Pacific Northwest, the Pacific territories, or the Southeastern US. In the Pacific Northwest, climate projections indicate a future unfavorable to parts of the current range of Douglas-fir. Strategies for low-lying islands such as those of the Pacific territories must address the stressors created by increased storm activity, sea level rise, and population demands. Different strategies for the Southeast include competition for water due to rapidly increasing populations combined with increased drought frequency resulting in potential water shortages. Federal agencies have made progress in developing scientifically-based principles and tools for adapting to climate change in forest management that are focused on education, assessment of vulnerability of natural resources and development of adaptation strategies. Science-management partnerships working collaboratively with stakeholders are key to successful adaptation efforts. Although uncertainty exists, land managers are already using climate-related practices such as thinning and fuel treatments to reduce fire hazard to increase ecosystem resilience. Regardless of the approaches, forest and grassland ecosystems in the US at the end of the 21st century will differ from those of today as a result of changing climate, but a broad range of options will be available for managing these resources sustainably.

Economic Effects of Climate Change on US Agriculture

The economic effects of climate change are shaped by an array of institutions from local to global scales ranging from commodity markets to systems of research, development, education, communication, and transportation. These institutions define opportunities and constraints in which stakeholders can modify or adapt their behavior to minimize losses and take advantage of new opportunities for gain associated with changing climatic conditions. The economic implications of climate change in the US are sensitive to yield effects and adaptation opportunities, as well as constraints in the US and abroad. US farmers' capacity to adapt, as well as shifting trade patterns, will mitigate potential effects on domestic producers and consumers. However, future climate scenarios with even mild rates of climate change may result in more severe implications for food security for the very poor and vulnerable populations worldwide.

Adaptive behavior can include changes in consumption, production, education and research. The aggregate effects of a changing climate ultimately depend on the effectiveness of the a network of adaptive responses -- from the local producer adjusting planting patterns in response to crop yield, to seedling producers investing in more drought-tolerant varieties, to nations changing trade restrictions in response to food, fiber, and fuel concerns at a global level. Producers' financial viability will be affected by change in management costs associated with changing biophysical stressors, the effects of variability and extreme weather events, and potential credit or resource constraints. Regional capacity for expanding agriculture, forestry or irrigated production will depend heavily the availability of land and

water. Because agricultural, forest, and natural ecosystems are complex, the manner in which production and consumption systems adapt to biophysical changes and incorporate lessons from research and education will determine the overall effects of a changing climate.

Adaptive behavior can mitigate the potential effects of climate change on food production, agricultural and forest-based income, and food security by moving production out of regions with newly reduced comparative advantages in specific production sectors and into areas with improved relative productivity. Reilly et al, (2007)⁵ find that with adaptation, the production effects of climate change are reduced to one-fifth to one-sixth of initial yield effect.

Attempts to quantify the economic effects of climate change are dependent on number of elements including climate and yield projections, treatment of adaptation constraints and the methods and models used. For example, if global yields are generally lower, global prices rise regardless of domestic yield increases. The resulting price increases could benefit US producers but not necessarily the US consumer. Uncertainty in climate projections is also a critical element in assessing economic effects.

Agency Assessments of Risk and Vulnerability

USDA is composed of many agencies with differing missions. Agencies were requested to assess their risk and vulnerability to climate change. The responses are broad and address risks and vulnerabilities at global, national, regional, and local scales as they relate directly to a particular agency mission.

Physical and Biological Climatic Concerns

USDA agency missions are affected by shifts in climate, extreme events, and climate variability.

- Agricultural Marketing Service (AMS) – AMS administers commodity procurement for programs that address food-security in at-risk populations. Changing climate trends present the need for a baseline to identify and develop indicators to streamline these programs for the future.
- Agricultural Research Service (ARS) – ARS maintains experimental stations and field plots across the US. The following examples of climate change effects illustrate the risks to ARS's capacity to meet its mission. *Extreme conditions and animal research:* Extreme conditions associated with climate change affect livestock, and potential effects on ARS research may be significant. Direct effects are related to the intensity and frequency of animal summer heat stress. *Effect of climate change on crop research:* There are many ways that climate change and weather extremes may affect ARS crop research and allocation of resources to crop research. Included are the many documented effects of increasing CO₂ concentrations, heat, precipitation extremes, and the various combinations on crop growth, reproduction, and yield. Greater uncertainties are associated with the effects on pests and

⁵ Reilly, J, et al., (2007) Energy Policy, 35(11): 5370-5383

pathogens. In general, the geographic distribution of pests is largely dependent upon climate, whereas the incidence and severity of outbreaks are largely dependent upon weather. *Effect on food safety research:* Flooding can have a major food safety impact. A Food and Drug Administration (FDA) rule now considers ready-to-eat crops that have been in contact with flood waters to be adulterated due to potential exposure to sewage, animal waste, heavy metals, pathogenic microorganisms, or other contaminants., To reduce the effect of seasonal extreme weather events, a significant amount of land susceptible to flooding has been taken out of production. This has affected ARS' ability to continue some of its important produce-related research. *Implications for natural resources in research:* Short and long-term water shortages (drought) and excesses (too much, too fast) are expected to increase in frequency with changing climate. Research that has always been based on rain-fed plots may thus require irrigation for the first time. Even among field plots that have been irrigated all along, greater amounts of water may be required, which can alter or compromise research objectives and/or progress. Water shortages may result in the loss of experimental material (plants, soil, animals), delay planting dates, suppress yield quantity and/or quality, and increase the threat of fire on grazing lands research locations. Water shortages will affect research priorities, especially when reduced water availability for research and industry alters what, where and how a crop or livestock can be grown.

- Animal and Plant Health Inspection Service (APHIS) – APHIS protects and promotes US agricultural and forest health, regulates genetically engineered organisms, administers the Animal Welfare Act and carries out wildlife damage management activities. Climate change will affect the distribution of plant pests, diseases and weeds and the population dynamics and number of generations per year for insect pests and therefore the level of risk to food security and associated human health. APHIS in coordination with Customs and Border Protection monitors weather, pest trends and disease outbreaks throughout the world to enhance protection at ports and airports. The approach rate and probability of establishment for invasive alien species will also be affected by climate change and require additional vigilance.
- Farm Service Agency (FSA) – FSA administers financial assistance programs for farmers and ranchers, biomass crop assistance programs, and USDA's largest private lands conservation programs. Vegetative practices and energy crops can be expected to become more difficult to establish and to maintain as a result of more frequent and/or more intense episodes of excess moisture, moisture deficit, and heat stress, increased pest populations, and increased competition from invasive species. Successful practices may require greater amounts of technical and financial assistance. Structural practices, built to withstand precipitation based on historical events, can be expected to fail more often as a result of increased frequency and intensity of severe weather events. Specifications for new structural practices in many regions will need to be redesigned to handle increased and/or more intense run-off. Since yield effects of climate change can be expected to make cropland relatively expensive, annual payments to compensate for foregone returns may also rise. The cost of SURE (SUPplemental REvenue Assistance Payments), a disaster/emergency assistance program and other disaster-related programs could increase as more disasters occur as a result of more frequent and/or more intense episodes of excess moisture and heat stress and increased frequency and intensity of severe weather events. Producers least able to cope with

climate change may be those with limited access to credit, such as beginning and disadvantaged producers, often farming more susceptible marginal lands. Disaster assistance directed toward producers suffering loss from extreme weather may be the short-term support needed for their operations to sustainably bridge and adapt as climatic conditions change.

- **Foreign Agricultural Service (FAS)** – FAS administers scientific exchanges and capacity building programs to engage countries on climate change priorities that enable the U.S. and international counterparts to jointly promote economic development and environmental quality in the agricultural sector and overall promote global food security. FAS also participates in Feed the Future (FtF), a global-scale initiative with working groups that assess conditions, define priorities and align US Government resources that can develop agricultural sectors of food insecure countries. Increasing food security of FtF partner countries will help them become more resilient to climate-related food shortages. Another mission of FAS is to forecast world-wide agricultural production and trade. Variability in global production places demands and risks on FAS to provide market intelligence and commodity analysis for key producing countries and key markets. Without appropriate predictive models, these analyses become more uncertain with increasing climate variability. The World Agricultural Supply and Demand Estimates (WASDE) and USDA Agricultural Long-Term Projections reports are examples of FAS supported analyses that may become more challenging to produce in the face of climate change.
- **Forest Service (FS)** – The FS mission is impacted by shifts in temperature and precipitation patterns and amounts, extreme events, and climate variability. The FS manages public forests and grasslands and works with States, Tribes and private landowners to restore and sustain the health, diversity and productivity of the Nation’s forests and grasslands. Changes in key climate variables affect the seasonality of hydrologic regimes, reproduction cycles of pests and pathogens, length of fire seasons and ultimately ecosystem composition. In the West, fire seasons have increased by 78 days since the mid 1980s.⁶ Disturbance facilitates the introduction and spread of invasive species that disrupt ecosystem processes and functions and increases extinction risks for native species. The changing climate is already altering species ranges and has the potential to alter ecosystem structure in the future as evidenced by the mountain pine beetle (a native insect) epidemic in the West. Management will require forward-looking approaches to novel ecosystems instead of depending on historical ranges of variability. These effects pose challenges to sustaining forests and grasslands and the supply of goods and services upon which society depends, such as clean drinking water, forest products, recreation opportunities, and habitat.
- **National Institute of Food and Agriculture (NIFA)** - NIFA’s mission is to support exemplary research, education, and extension. NIFA will need to balance the increasing demand for scientific research, modeling, educational programs, and extension activities to address climate change issues with those of other research needs. For example, investigations of climate stressors and tipping points will become more essential to climate adaptation science research and will need to be balanced with vulnerable areas of crop and livestock production research and formal and informal state educational programs. NIFA plans a comprehensive

⁶ Westerling, Hidalgo, Cayan, and Swetnam. 2006. Science 313: 940-943.

Climate Change Science Plan to integrate climate change adaptation science and resiliency, mitigation and decision support into relevant NIFA policies, programs and operations.

- Natural Resources Conservation Service (NRCS) – NRCS provides conservation assistance to private landowners under a range of locality-specific conditions. Climate change presents a spectrum of conditions that extend beyond local variability, including conditions that are more extreme than the locality-specific tolerances currently integrated into the NRCS conservation practice standards. Conservation planning needs to be designed to accommodate changes in precipitation (drought, flood frequency, rainfall intensity), temperature (higher night-time temperatures, higher annual or extreme minimum temperatures), and other climatic variables. Conservation planning in coastal regions should anticipate sea level rise, increased hurricane intensity, and the associated increases in coastal erosion and damage. NRCS will evaluate these and other climatic effects on conservation practices, systems engineering designs, nutrient and manure management and work with private landowners to address these issues.
- Risk Management Agency (RMA) – The principal vulnerability to climate change is through insurance coverage offered through crop insurance policies. RMA administers the Federal crop insurance program and provides coverage to farmers and ranchers for flood, drought and other natural disasters. Farming practices may change and growers may approach growing crops differently by adapting to earlier growing seasons, planting new varieties or shifting locations of their farming operations to adapt to climate change. RMA has evaluated the potential risks climate change presents to the Federal crop insurance program and to the tax payer. RMA will continue to monitor climate data and research to the extent that climate changes over time and update program parameters (e.g. sales closing dates, final planting dates, and other program dates) as needed to reflect such changes.

Marketing and Trade Concerns

Disruptions in the traditional commodity supply chain concern USDA agencies whose missions include commodity trading and marketing. These disruptions include transportation and planned emergency hunger relief operations from climate changes, induced diseases outbreaks, invasive species, changing historical recurrence intervals of extreme events, and prolonged droughts or flooding.

- Agricultural Marketing Service (AMS) – Increasing temperatures can affect production that in turn affects the need for employees in grading and auditing of how products are produced, processed and packaged.
- Animal and Plant Health Inspection Service (APHIS) - Climate change and associated shifts in disease and pest prevalence may overwhelm the current ability of off-shore programs to provide real-time information regarding pest and disease potential and may increase risk to US agriculture. Existing surveillance and diagnostic networks for animal and plant health diseases (e.g., avian influenza, foot and mouth disease, agricultural and forest and pests, etc.) could be overwhelmed. Increased requirements for commodity and pathway risk analyses may overwhelm existing capacity.

- Forest Service (FS) - Climate change may influence the demand for energy and its mix of sources. Woody biomass is gaining attention as a renewable energy source. An increasing demand for renewable energy may affect how forests are managed and influence a wide range of ecosystem services, such as water quantity and quality, wildlife habitat, and carbon sequestration. Management options to maintain healthy ecosystems include thinning stands to reduce moisture stress and regenerating stands where they have been decimated by insects or disease. Because of the demise of the forest industry in many rural and local areas, a major marketing effort will be necessary to reestablish mills and processing plants. Climate change may adversely affect river-based outdoor recreation opportunities through changes in the timing and volumes of stream flow; thereby affecting many rural communities dependent on favorable water flow and a river based economy.
- Foreign Agricultural Service (FAS) - The international demand for FAS-administered food aid programs could increase significantly in regions that experience decreased domestic production due to climate change or extreme climate events. Increased frequency of extreme weather events may destabilize import markets, develop long-term strategies for building markets, and increase the volatility of prices. Climate change may lead to production shortfalls and export bans abroad, undermining FAS efforts to promote free trade. Warmer average temperatures may increase the range and severity of disease outbreaks in the US raising technical barriers to trade and sanitary or phyto-sanitary concerns abroad. Climate change may lead to an increased number of countries that request FAS administered food assistance, and, thereby collectively intensify pressure on FAS' limited resources.

Infrastructure Concerns

Many USDA agencies have established research experimental sites and built facilities to withstand climatic variability and extreme events based on historical weather records. These records insufficiently represent future climatic changes.

- Agricultural Research Service (ARS) – The ARS is the largest research agency in USDA and has experimental stations and field plots throughout the United States. Extreme weather events have recently, and will continue to damage research facilities and infrastructure. Experiments have been disrupted due to plant and animals loss. Heavy snowfall and rain events leading to flooding have affected the agency's ability to care for animals, and greenhouse plants. Flooding of research facilities and fields has occurred. Drought has affected experimental fields and animal facilities. Energy use has varied considerably from past experience due to prolonged high and low temperatures. Heating and cooling expenses for workers, laboratories, and greenhouses have varied such that projecting needs and costs is increasingly difficult. Increased vigor of weeds and appearance of invasive species have required additional resources to control in experimental plots and fields. Wide temperature and precipitation swings affect work force health and food safety and increase likelihood of pathogens and skin irritants. Water quantity and quality needed to maintain research may become an issue for locations where prolonged drought occurs or where water-treatment plants are compromised by weather events. These occurrences may require a shift in research priorities. Incorporating additional environmental factors related to climate change

must be considered in research planning for developing new crop varieties, management strategies, and conservation practices.

- Animal and Plant Health Inspection Service (APHIS) - APHIS has established animal and plant health emergency frameworks to facilitate coordinated timely responses to disease and pest emergencies and established frameworks to address all hazards (e.g., hurricanes, floods, wildfires) both for effects on plant and animal health, and on the needs of individuals with household pets and service animals. In the event of wide-ranging climate disruption events, capacity could be overwhelmed and assistance from other USDA and Department of Homeland Security emergency response resources would be required. State, local, tribal, industry and other stakeholders with key roles in threat mitigation may also be overwhelmed.
- Forest Service (FS) – The recreation infrastructure, including ski areas, reservoirs and campgrounds, is strongly influenced by past and current climate. Preserving high-quality recreational experiences will depend not only on the condition of the land, facilities, and transportation infrastructure but also on where such opportunities can be accommodated safely and managed under a changing climate. The projected increase in US population and the continual decline of public access to privately-owned land will increase demand for more recreational opportunities on public land. With increasing intensity of rain events, the extensive road systems of the National Forest System will require increased maintenance and/or modifications to culverts, bridges, and erosion control measures.
- National Agricultural Statistics Service (NASS) - Evidence of effects from extreme weather events on NASS assets, operations, resources, security infrastructure, economic activities, or coordination over the past decade include: 1) In each of the past six years, NASS has had to conduct a reinterview survey for one or more time periods. Reinterviews add additional respondent burden to previously sampled and enumerated farm operators and agribusinesses and result in delayed information to the public for affected crops and states; 2) An increasing demand for quick response, ad hoc requests to the NASS Remote Sensing unit to support the monitoring and assessment of extreme weather on agency operations and agricultural production; 3) Following extreme weather events, requests for information (often demanding a quick response) increase significantly from news media, businesses, and government officials seeking additional information. Any increase in frequency and/or intensity of such events poses an additional burden on NASS staff responding to the information demands; 4) Comparison of changes to average planting dates, as compiled by NASS from prior publications (1997 and 2010), reveal earlier planting dates for corn in 10 major states. This suggests that the NASS *Crop Progress* reports, now beginning on the first week in April, may need to be started earlier in the future to adapt to an earlier seasonal climate regime.
- National Institute of Food and Agriculture (NIFA) – NIFA will need to improve notification of employee and invited panels of expert reviewers and gather status information in the event of national capitol area disasters, extreme weather events and increased severity of air quality warnings. NIFA is examining new ways to increase telework capacity and hold virtual review panels rather than on-site meetings in the capitol area. Climate will also affect the technological infrastructure in the national capitol area where information systems are housed and require a controlled temperature and humidity environment.

- Rural Development (RD) – RD is committed to helping improve the economy and quality of life in rural America. Climate change challenges rural communities to strengthen utility infrastructure and rural housing programs, prepare community facilities, businesses and agricultural producers to respond to weather related events, mitigate the environmental effects of climate change and adapt to changing conditions.
- Risk Management Agency (RMA) – When losses occur, the Standard Reinsurance Agreement requires that approved insurance providers send loss adjusters into the field to determine the extent of damage and the appropriate losses under the insured’s policy. The health of RMA employees and loss adjusters sent to assess damages could be affected by extreme weather events and more frequently than in the past.

Capacity Building

USDA agencies are developing plans to educate its employees and their stakeholders, and accommodate expected changes associated with climate change vulnerabilities and risks.

- Agricultural Research Service (ARS) – ARS is communicating internally, externally to stakeholders, and to customers the need to elevate the importance of changing climate as a factor affecting agency operations and research results. ARS sets its research priorities, develops National and management unit-level research plans, and implements its plans through a highly developed process that includes established procedures for obtaining formal input from a wide variety of customers, stakeholders, and research partners. Research project plans are developed by agency scientists in response to input from customers, stakeholders, and partners and peer-reviewed by non-ARS scientists for adequacy of research approaches and likely successes. ARS anticipate that the agency’s customers, stakeholders, and partners will identify changes to research programs and changes in allocations of research resources to address pressures from climate variability and change.
- Animal and Plant Health Inspection Service (APHIS) – APHIS is working with ARS to develop a list of research needs that ARS scientists will investigate to learn how pests and diseases adapt to climate change. APHIS has international partners in climate modeling and closely follows research in universities. In addition, APHIS is increasing coordination and collaboration with domestic and international partners to develop predictive modeling capabilities, develop regulatory strategies and leverage resources. For example, Animal Care Emergency Programs (ACEP) work to protect the public in supporting the well-being of pets and animals at facilities regulated by the Animal Welfare Act (AWA). Although ACEP does not have expertise to directly analyze the effect of climate change scenarios on disasters, it uses information provided by NOAA, FEMA, and other subject matter experts on the implications of climate change on disaster risk. Current ACEP efforts toward capacity building focus on enabling regulated facilities and pet owners to plan for disasters to decrease the time from the event to full recovery. APHIS works with federal, state,

university, and industry partners to enhance detection, identification and response to animal and plant health emergencies.

- Economic Research Service (ERS) – ERS is the primary source of economic information and research for USDA. This mission is not vulnerable to climate change in the same way that USDA agencies responsible for land management, applications and technology transfer, and assistance are. Changing climate conditions do not compromise ERS’ ability to conduct research in support of its strategic goals. ERS efforts to address mission challenges related to climate change center around building research capacity in the area of climate change effects and adaptation, including building linked economic models, resource and economic data systems, as well as developing improved in-house modeling and analysis capacity to implement the most up-to-date science and methodologies available. Specific research priorities are established based on formal and informal strategic planning efforts that incorporate input from customers, stakeholders, and USDA and external partners.
- Foreign Agricultural Service (FAS) – FAS relies on its Climate Change Working Group to raise awareness and disseminate information across FAS about emerging climate change issues that may affect the mission, activity pillars, and objectives of FAS. FAS is currently engaged in assessing the risks and opportunities associated with climate change. There are various means by which FAS understands and evaluates these risks and opportunities. They include engaging in climate change related intra- and inter-departmental working groups (e.g. USDA’s Climate Change Task Force, and Feed the Future working groups). FAS also relies on the extensive intelligence gathering of Foreign Service Officers, who are the “on-the-ground” source of information for over 100 countries. FAS also monitors and advises the work of many international organization (e.g. FAO, OECD, World Bank) and participates in many United Nations negotiations (e.g. Framework Convention on Climate Change, Committee on Trade and Development, Sustainable Development Council). The FAS Climate Change Working Group will further consider *additional actions* to better understand the risks and opportunities that may affect its key pillars.
- Forest Service (FS) – The FS provides a wide variety of climate change communication materials and training opportunities for its employees, other agencies, and the public. These range from basic awareness education to highly technical seminars, workshops, and courses for conducting vulnerability assessments and developing adaptation and mitigation strategies. Partnerships between scientists and land managers are being strengthened to improve the focus of research and technology to address current and emerging science and information needs. Resource inventory, monitoring, and assessment activities and decision support tools are being better aligned and coordinated across FS programs and with partner agencies at multiple scales. Examples of ongoing and newly initiated capacity-building efforts are: Conservation Education Programs, Climate Change Resource Center, Environmental Threat Assessment Centers and Inventory, Monitoring and Assessment Strategy.
- National Agricultural Statistics Service (NASS) – NASS’ numerous reports provide the information necessary to facilitate research to address issues related to climate change. Changes in climate conditions influence crop variability and will influence information NASS collects and publishes, such as crop yields and production data. Farmland use and

conservation practices also affect crop production and contribute to carbon storage in the soil.

- National Institute of Food and Agriculture (NIFA) - NIFA collaborates or has formal working partnerships with many institutions and individuals. NIFA's key partners are the institutions of higher learning making up the Land-Grant University System, however, NIFA also partners with other federal agencies, within and beyond USDA; non-profit associations; professional societies; commodity groups and grower associations; multistate research committees; private industry; citizen groups; foundations; regional centers; the military; task forces; and other groups. NIFA and its partners focus on critical issues such as climate change that affects people's daily lives and the nation's future. NIFA will advance research and educational technologies that empower people and communities to solve problems and improve climate adaptation and mitigation efforts at the local level. NIFA also supports the base programs of state Agricultural Experiment Stations and the Cooperative Extension System nationwide at land-grant universities. NIFA helps ensure that a high-quality higher education infrastructure will be available at the nation's land-grant universities to address national needs, and it uses the infrastructure of scientific expertise from these and other colleges and universities, and also of public and private laboratories, to partner in addressing national priorities, such as climate change. NIFA is expanding the Climate Change Community of Practice within eXtension (www.extension.org) to reach a broader audience.
- Natural Resources Conservation Service (NRCS) – NRCS will examine human capital, expertise areas and levels and other agency infrastructure components relative to climate change effects. NRCS has developed an online curriculum for climate change that is accessible to employees and stakeholders. To date nearly 9,000 (80% of total employees) NRCS employees nationwide have completed the “Air Quality, Climate Change and Energy” online course. The NRCS also has formed a Climate Change Coordination Team that has completed a climate change vulnerability assessment recommending adaptation approaches for NRCS to guide future agency planning. This is expected to be the start of a sustained effort to better integrate changing climate and climate variability into natural resource conservation planning.
- Natural Resources Conservation Service (NRCS) and Forest Service (FS) - Management practices, technologies, and quantitative tools that do not account for climate change will hinder the ability of private land owners and federal land managers to plan and manage resources. Existing decision support tools and their supporting databases need to be reviewed and new approaches to decision support must be developed to enhance their ability to address complex issues facing private landowners and land managers, such as linkages among ecosystems, water resources, and regional species migration patterns.
- Risk Management Agency (RMA) - RMA will increase its outreach to policyholders to inform them of choices when dealing with drought and flood related events that may have prevented them from planting insured crops. RMA is increasing the number of press releases, interviews, factsheets and questions and answer pages on RMA's website to inform stakeholders and others of our policies when dealing with the severe climate and weather

events. Through a partnership with Oregon State University's PRISM Climate Group (Parameter-Elevation Regressions on Independent Slopes Model) PRISM is also building a Climate and Weather web portal that will be used by RMA and by the 16 approved insurance providers that sell and service crop insurance for services, such as adjusting producer's crop losses quickly and accurately. In addition, the portal can be used by producers to make planting and production decisions every day.

Processes for Assessing Effects and Vulnerabilities

USDA agencies have established various pathways and processes to assess agency vulnerabilities to climate change effects:

- Agricultural Marketing Service (AMS) – AMS gathers information internally for evaluation and does not address climate change directly. Many stakeholders are proactively and voluntarily taking steps to address sustainability through their own business models.
- Agricultural Research Service (ARS) - ARS has been engaged in dialogue across program theme areas (Natural Resources and Sustainable Agriculture, Crop Production and Protection, and Animal Production and Protection) to determine adjustments to research approaches needed to incorporate climate change adaptation. This adaptation plan will be reviewed during the first quarter of each fiscal year by the ARS Deputy Administrator for Natural Resources and Sustainable Agricultural Systems (NRSAS), in consultation with the other three subject-matter Deputy Administrators of the Office of National Programs, the National Program Leader for Climate Change, Soils, and Emissions, the Director of the Human Resources Division, and the Director of the Facilities Division. Prior to that review, the Deputy Administrator for NRSAS will solicit information from the eight Area Directors to ascertain occurrences of significant interference from climate and weather with research goals, personnel, or facilities during the previous fiscal year coordinate responses whenever possible. Knowledge gained from agency-wide, national information will be used to identify priorities and update the plan.
- Animal and Plant Health Inspection Service (APHIS) – To better understand risk, APHIS will adapt risk analysis models both epidemiological and forecasting to incorporate changes in the distribution of environmental and biological attributes predicted under different climate scenarios. Model results will help prioritize likelihood and severity of threats and focus activities on specific high-impact diseases or agricultural pests and pest categories. APHIS will develop or revise surveillance and detection strategies for changes in distribution, transmission and outbreak of pests and diseases known to affect food and human health. APHIS will engage more partners and stakeholders in gathering information, evaluating modeling and supporting decision-making to enhance protection of agriculture, natural resources and trade.
- Economic Research Service (ERS) - ERS is working closely with other USDA and federal agencies to develop a solid, spatially detailed baseline of current and past conditions related to land resources, climate, and land use and farmer decision-making. Such a baseline will be

necessary to support robust analyses of how changes in the climate, and associated changes in the resource base, will affect farmer decision-making. In particular, ERS works closely with NASS to identify and collect the data needed to assess impact of climate change on farming operations. This effort also involves a comprehensive integration into ERS analyses of key data sets from FSA, NRCS and NASS as well as close collaboration with other Federal agencies such as U.S. Department of Energy and U.S. Environmental Protection Agency. Development and enhancement of integrated economic, crop, climate and environmental process models expand ERS' capacity to meet expected increases in demands for information about the costs, benefits and policy implications of climate adaptation strategies in both the crop and livestock sectors. ERS participates in the USDA Global Change Task Force to further enhance integration and coordination with other USDA agencies working in this arena. ERS tracks stakeholder requests for information and impacts of activities, and incorporates that information regular program reviews.

- Farm Service Agency (FSA) – FSA will review programs and policies to ascertain the extent and improvement of response to producers for climate change adaptation information. Review would include asking whether programs encourage adaptation or status quo, how to target enrollment of specific lands for Conservation Reserve Program, simplification of field trials, loan investments emphasizing investments that reduce water and heat stress and how well disaster programs encourage adaptation rather than return to current practices following losses. FSA will also partner with USDA Research, Education and Economics mission area and outside organizations to make appropriate decision support tools more accessible to field offices.
- Foreign Agricultural Service (FAS) – FAS will continue to rely on its Climate Change Working Group to coordinate annual reviews and updates to the Climate Change Adaptation Plan. The review process will include in-depth discussions with each FAS program area and final approval at the administrator level. Additionally, the input of stakeholders and Foreign Service Officers will be considered when developing updates to the plan. Prioritization of climate change adaptation actions will include: (1) Effect on FAS mission and potential to improve services to stakeholders; (2) Financial resources and the availability of trained personnel; and (3) USDA priorities for foreign affairs associated with climate change. FAS will rely on a diverse set of information sources to aid in developing the Climate Change Adaptation Plan over time. FAS will consider the needs and input of stakeholders, the intelligence gathered by Foreign Service Officers, as well as technical information on climate change effects reported in the National Climate Assessments. FAS relies on the USDA Global Change Task Force to provide linkages to cutting-edge scientific developments about climate change and agriculture. Additionally, FAS employees can subscribe to the National Agricultural Library's climate change and agriculture newsfeed to receive weekly updates on current events. The FAS Climate Change Working Group will be the coordinating body for evaluating FAS performance on climate change adaptation. As part of the annual review process, each FAS program area will be asked to provide input on progress towards addressing the vulnerabilities and opportunities related to each FAS activity pillar.
- Forest Service (FS) – The FS has a number of comprehensive policies, strategies and processes being implemented or developed including a National Roadmap for Responding to Climate Change, Climate Change Performance Scorecard, Forest Service Global Change

Research Strategy (2009-2019), a new Planning Rule, a Watershed Condition Framework and Terrestrial Condition Assessment, a Forest and Rangeland Renewable Resources Planning Act (RPA) Assessment, an Inventory, Monitoring and Assessment Strategy, and the Genetic Resource Management and Climate Change Strategy. In response to climate change stresses, these strategies allow FS to create responsive planning, improve FS' capacity to deliver science, resource information and tools to forest managers to assess and monitor forest conditions, and to focus attention on helping localities improve resilience of urban and community forests. In addition, comprehensive risk assessments are being completed when planning recreation infrastructure projects and a risk assessment of all developed recreation sites recently was conducted to identify and mitigate public safety issues related to extreme weather events.

- National Agricultural Statistics Service (NASS) – NASS programs and policies are regularly reviewed both internally and externally. Adapting to the dynamic agricultural industry requires constant vigilance and assessment of the statistical and informational needs of the entire food and fiber sector. NASS works closely with other USDA Agencies, such as ERS to identify and collect the data needed to assess effects of climate change on farming operations. The Cropland Data Layer (CDL) Program annually produces digital categorized geo-referenced products using satellite imagery. The completion of a conterminous National CDL and web portal CropScape fills a data gap critical for research and decision support for conservation, climate change, and water resources. NASS plans to integrate climate change adaptation into policies, programs, and operations as follows 1) NASS, along with other USDA agencies, conducts annual “Data User” meetings with public users of USDA and NASS data. NASS also has an Advisory Committee on Agriculture Statistics. NASS will propose Climate Change Adaptation Planning to be a topic for discussion with stakeholders; 2) Internally, NASS senior executives will be briefed on past and potential effects of the changing climate; 3) As educational opportunities become available, NASS employees will be offered opportunities to “learn from the experts,” how the changing climate may affect agriculture and possible impacts on their work and employment; 4) Continue to develop the science and operational capacity of the NASS Remote Sensing program to support agency natural disaster response, produce time-sensitive monitoring and assessment data and products, and expand support to the NASS Mission.
- National Institute of Food and Agriculture (NIFA) - NIFA conducts a portfolio review of its projects and programs to evaluate the program success in achieving goals for the environment and natural resources. The portfolio review makes use of NIFA's established knowledge areas of which Weather and Climate is one. In addition, a knowledge area for Alternative Uses of Land is focused on climate change. A new portfolio review process has been developed by NIFA that includes a portfolio planning, assessment, and quality improvement plan. Continuous assessment through Post-Award management of successfully-funded grants is needed to identify gaps that NIFA's unique approach can fill. NIFA will establish new opportunities to better understand vulnerability through science-based assessments to assess vulnerability, monitor climatic effects, and project outcomes based on scenarios through collaborative interagency funding, marketing strategies and promoting partnerships. NIFA will establish a Science Priority-making process team with an established management structure and guidance from the NIFA science leadership

council. This team will address portfolio goals as well as planning for competitive and non-competitive funding lines related to climate change.

- Natural Resources Conservation Service (NRCS) – The NRCS Climate Change Coordination Team has developed a climate change vulnerability assessment with recommended adaptation strategies. NRCS will use this report and an adaptation plan to design and implement specific actions over the coming few years to make conservation activities more resilient to both short and long-term changes in climate. The NRCS collects critical high-elevation climate data with its Snow Telemetry (SNOTEL) network. These data are used by NRCS to develop water supply forecasts for the entire western U.S., and are necessary for assessing changes in climate (snow, precipitation, temperature, etc.) in these otherwise unmonitored regions. The agency also collects and soil moisture and temperature data throughout the US including Alaska, Hawaii, and island territories in the Caribbean and the Pacific with its automated Soil Climate Analysis Network (SCAN). These two networks play a critical role in assessing trends in climate variability and change, and are the only such soil climate observational national data networks in the U.S.
- Risk Management Agency (RMA) – RMA monitors the premium rating methodology, loss adjustment standards, underwriting standards, and other insurance program materials as well as research results to ensure that they are appropriate for new production regions or for changes in practices within existing regions. RMA is also increasingly monitoring the widening scope of pest problems associated with crops and crop loss. RMA uses climate and weather services provided through a partnership with Oregon State University’s PRISM Climate Group (Parameter-Elevation Regressions on Independent Slopes Model) climate mapping system to strengthen RMA’s underwriting and oversight of the Federal crop insurance program. PRISM will provide high quality climate and weather data that will assist RMA with its Actual Production History (APH) modernization effort by developing crop suitability maps based on climate and soils to more accurately assess the production potential of land being farmed; to account for variations in climate due to elevation, rain shadows, coastal effects, temperature inversions and other conditions that may affect crop production; and it is assisting RMA in developing nationwide Bio-fuel resource mapping. RMA will continue to evaluate and monitor potential risks that climate change presents to the Federal crop insurance program. With over a million crop insurance policies in force and the world’s most extensive database of actual farm yields, RMA will use PRISM and other risk management tools to monitor the effects of climate change on crop yields, provide a reality check for crop yield guarantees and to update program parameters such as the crop planting dates as needed to reflect the changing risks resulting from climate change.

USDA Challenges in Identifying Effects and Vulnerabilities

The challenges faced by USDA and its agencies in identifying climate change effects and vulnerabilities have common themes. These are based in part on capacity and resources but equally on the need for better forecasting and reduced uncertainties associated with climate change.

- Difficulties in forecasting climatic stress at relevant scales: One of the most commonly occurring challenges is the inability to forecast changes in climate, climate variability, extreme events and weather on scales that are meaningful to USDA agency missions and their stakeholders. Climatic changes are important to understand and anticipate at regional and national scales and are extremely useful, but for the individual land owners' needs, the effects are exceedingly difficult to predict.
- Lack of effective tools to identify and predict climate change effects on different time and different spatial scales. It is difficult to definitively decouple the effects that can be attributed to climate change from other factors that traditionally influence operations.
- Challenges in precisely forecasting how and where climate change is most likely to influence risk pathways for pests, agricultural diseases, and food-borne pathogens that could potentially affect global food security and natural and agricultural ecosystems.
- Uncertainties in methodologies (empirical and process-based) used to evaluate any changes in climate with specific resource effects.
- Climate dynamics are extremely complex, and projected shifts in climate conditions are associated with a great deal of uncertainty, particularly with respect to changes in precipitation patterns and in the variability of weather patterns and the frequency and intensity of extreme events. Such uncertainty presents a challenge in the ability to generate policy-relevant research results for the spatial implications of prospective climatic changes that can affect resource distribution, targeted policy and program recommendations, and for adaptation strategy design. An additional challenge is supporting analytics for adaptive strategic planning that systematically varies both regionally and by sector.
- Public perceptions of climate change discussions can create resistance to the importance of climate change education. Information needs to be presented in a manner that stakeholders can relate to and accept more easily.

III. Federal Government Activities on Climate Change and USDA's Role

Climate change has the potential to confound USDA efforts to meet the core obligations and responsibilities to the Nation. USDA strongly supports activities across government that helps its agencies adapt to and become positioned to meet the risks, challenges, and opportunities presented by climate change and variability. USDA participates in these climate change activities in the following ways:

USDA Climate Change Science Plan

The USDA Climate Change Science Plan, developed by an interagency USDA team, provides a guide for the Department and its stakeholders to enable clear and consistent consideration of current and potential investments in climate change science activities. This research provides farmers, ranchers, foresters, land owners, resource managers, policy-makers

and Federal agencies with science-based knowledge to manage the risks, challenges, and opportunities of climate change and position themselves for the future. It offers a framework for assessing priorities to ensure consistency with USDA's role in the Federal Government's broader US Global Change Research Program (USGCRP) and related efforts. The document identifies important roles and responsibilities for USDA agencies and areas in which USDA agencies are reliant on other agencies and stakeholders for cooperation. This is the first document of its kind in USDA.

US Global Change Research Program

USDA and its agencies play an important role in Federal climate change research, mitigation and adaptation activities. USDA is one of the 13 Federal departments and agencies comprising the US Global Change Research Program (USGCRP) that Congress mandated in the Global Change Research Act (GCRA) of 1990. The USGCRP was tasked with improving the understanding of uncertainties in climate science research, expanding global observing systems, developing science-based resources to support policymaking and resource management and communicating findings broadly among scientific and stakeholder communities. USDA agency research scientists and program managers participate by serving on a variety of working groups and strategic planning and program report committees. The USGCRP recently restructured and is re-evaluating the types of working groups and their charges. USDA is playing an active role in the new strategy and structure. The USGCRP provides an annual report entitled *Our Changing Planet* as a supplement to the President's Budget. USDA research activities and plans are included in these annual reports.

National Climate Assessment

The GCRA also requires that USGCRP agencies produce periodic (not less than four years) National Climate Assessments (NCA) that integrate, evaluate, and interpret findings of the USGCRP and discuss associated uncertainties. The assessments also provide analysis of the effects of global change on the natural environment, agriculture, energy production and use, land and water resources, transportation, human health and welfare, human social systems, and biological diversity. Finally, the assessments analyze current trends in global change, both human-induced and natural, and project major trends for the subsequent 25 to 100 years. USDA has an important role in the preparation of the 2013 NCA in organizing writing teams to provide technical reports on agriculture, forestry, land use, biogeochemical cycling, rural communities, and regional sector studies, and supports the process through participation in the Interagency National Climate Assessment Task Force and the National Climate Assessment and Development Advisory Committee. USDA scientists are leaders and participants in writing the 2013 document itself. The Office of Science and Technology Policy (OSTP) is leading the government-wide NCA.

Previous NCA reports were built around Federal agency-led studies, technical reports, and extensive scientific literature that addressed historical and potential effects of climate change and climate variability on managed and unmanaged ecosystems and their constituent biophysical processes. These reports included the agency-led Synthesis and Assessment Products (SAPs) from 2006–2009. USDA led SAP 4.3, entitled *The Effects of Climate*

Change on Agriculture, Land Resources, Water Resources, and Biodiversity in the United States' (2008), which discussed the nation's ability to identify, observe, and monitor stresses that influence agriculture, land resources, water resources and biodiversity. It evaluated the relative importance of these stresses and the likelihood that they would change in the future. SAP 4.3 also identified changes in resource conditions and examined whether these changes might be attributed in whole or in part to climate change. The report covered the recent past through the 2030-2050 period. USDA authors also addressed adaptation options for US National Forests in SAP 4.4, 'Preliminary Review of Adaptation Options for Climate-Sensitive Ecosystems and Resources'.

IV. USDA Agency Plans

In the next section, USDA Agencies have provided their Agency Climate Change Adaptation Plans. These agencies are: Agricultural Research Service (ARS), Animal, Plant Health Inspection Service (APHIS), Economic Research Service (ERS), Foreign Agricultural Service (FAS), Farm Service Agency (FSA), Forest Service (FS), National Agricultural Statistics Service (NASS), National Institute of Food and Agriculture (NIFA), Natural Resources Conservation Service (NRCS), Rural Development (RD), Risk Management Agency (RMA), and the Climate Change Program Office (CCPO).

Annex: USDA Agency Climate Change Adaptation Plans

- 1. Agricultural Research Service**
- 2. Animal and Plant Health Inspection Service**
- 3. Climate Change Program Office**
- 4. Farm Service Agency**
- 5. Foreign Agricultural Service**
- 6. Forest Service**
- 7. National Agricultural Statistics Service**
- 8. National Institute of Food and Agriculture**
- 9. Natural Resources Conservation Service**
- 10. Risk Management Agency**
- 11. Rural Development**

USDA Agricultural Research Service
Climate Change Adaptation Planning Document
May 20, 2012

**USDA Agricultural Research Service
Climate Change Adaptation Planning Document
May 20, 2012**

**Agency contact: Steven Shafer, Deputy Administrator for Natural Resources and Sustainable Agricultural Systems, Office of National Programs. Tel. 301-504-7987
email steven.shafer@ars.usda.gov**

This plan has been prepared in accordance with Executive Order (E.O.) 13514, requiring all federal agencies to have a climate change adaptation plan submitted to the Council of Environmental Quality (CEQ) no later than June 29, 2012. USDA Departmental Regulation 1070-001 calls for the Climate Change Program Office (CCPO) to develop the USDA Climate Change Adaptation Plan with the full support and participation of USDA agencies and offices. To accomplish this, the Agricultural Research Service (ARS) has prepared this adaptation strategy that addresses how it is going to integrate climate change into its programs, policies, and operations. ARS's plan is submitted with the intent that it will be included in the Department's response to CEQ. Per D.R. 1070-001, this plan will support USDA's requirement to:

- (1) Analyze how climate change may affect the ability of agencies or offices to achieve their respective mission and its policy, program, and operational objectives by reviewing existing programs, operations, policies, and authorities to: identify potential impacts of climate change on the agency's or office's areas of responsibility; prioritize, implement, and mainstream response actions, contingent on the availability of resources; and continuously assess and improve the capacity to adapt to current and future changes in the climate.
- (2) Identify to the Office of Budget and Program Analysis, under the Office of the Chief Financial Officer, as part of the annual budget process areas where budget adjustments would be necessary in order to carry out the actions identified under this Departmental Regulation and include this information on the Global Change Cross-Cut that is compiled each year;
- (3) Identify, as appropriate, for USDA's Office of the General Counsel areas where legal analysis is needed to carry out actions identified under this Departmental Regulation; and
- (4) Coordinate actions across the Department through USDA's Global Change Task Force, as appropriate.

I. Policy Framework

ARS Vision: To lead America towards a better future through agricultural research and information.

ARS Mission: ARS conducts research to develop and transfer solutions to agricultural problems of high national priority and provide information access and dissemination to:

- ensure high-quality, safe food, and other agricultural products
- assess the nutritional needs of Americans
- sustain a competitive agricultural economy
- enhance the natural resource base and the environment, and
- provide economic opportunities for rural citizens, communities, and society as a whole.

ARS Goals and Strategic Approaches: ARS is the U.S. Department of Agriculture's chief in-house research agency. It is one of the four component agencies of the Research, Education, and Economics (REE) mission area. Congress first authorized Federally-supported agricultural research in the Organic Act of 1862, which established what is now USDA. That statute directed the Commissioner of Agriculture "... To acquire and preserve in his Department all information he can obtain by means of books and correspondence, and by practical and scientific experiments,..." The scope of USDA's agricultural research programs has been expanded and extended many times since the Department was first created. Today ARS has a workforce of approximately 6,200 employees including 2,200 scientists and post docs representing a wide range of disciplines. ARS has 800 research projects working at 90+ locations, including overseas labs.

To achieve its mission, the agency identifies critical problems affecting American agriculture, plans and executes the strategies needed to address these problems by: mobilizing resources (both human and financial); fostering multi-disciplinary research; linking research to program and policy objectives; and communicating and interacting with customers, stakeholders, partners, and beneficiaries to insure program relevancy. Currently, ARS research is organized into 18 National Programs that provide a coordinating structure that ensures the most important research is conducted with minimal risk of redundancy. ARS also works to ensure the timely transfer of new knowledge and technologies to potential users, and to broaden public understanding of the value of agriculture and agricultural research to ensure the continued primacy of the U.S. agriculture in the 21st century.

ARS's current Strategic Plan is in effect for fiscal years 2012 through 2017. Echoing ARS' National Program structure, the agency's Strategic Plan is organized into four main Goal Areas: Nutrition, Food Safety, and Quality, Natural Resources and Sustainable Agricultural Systems, Crop Production and Protection, and Animal Production and Protection. These Goal Areas—and the goals, performance measures, and actionable strategies identified within them—align with the components of the USDA Strategic Plan Goals as follows:

Each ARS Goal Area includes specific goals that are aligned groupings of ARS' 18 National Programs, derived from the Agency's specific mission, as outlined in each National

Program's five-year Action Plan. In developing their individual Project Plans, each ARS scientist will, in turn, align his or her research objectives with the overarching goals identified in this portion of the ARS Strategic Plan, thereby ensuring continuity with the USDA, REE, and ARS vision for agricultural research.

II. Vulnerability Assessment

ARS is the largest research agency in USDA and has experimental stations and field plots throughout the United States. Extreme weather events have recently and will continue to damage research facilities and infrastructure. Experiments have been disrupted due to plant and animals loss. Heavy snowfall and rain events leading to flooding have impacted ability to care for animals, and greenhouse plants. Flooding of research facilities and fields has occurred. Drought has impacted experimental fields and animal facilities. Energy use has varied considerably from past experience due to prolonged high and low temperatures. Heating and cooling expenses for workers, laboratories, and greenhouses have varied such that projecting needs and costs is increasingly difficult. Increased vigor of weeds and appearance of invasive species have required additional resources to control in experimental plots and fields. Wide temperature and precipitation swings affect work force health and food safety and increase likelihood of pathogens and skin irritants. Water quantity and quality needed to maintain research may become an issue for locations where prolonged drought occurs or where water-treatment plants are compromised by weather events. These occurrences may require a shift in research priorities. Incorporating additional environmental factors related to climate change must be considered in research planning for developing new crop varieties, management strategies, and conservation practices.

Thus, the ability of ARS to meet its mission can be compromised by climate change in several general ways:

- Reduced ability to conduct mission research at some current locations because environmental changes exceed the resilience of the agricultural systems under study at those locations.
- Changes in budget allocations to research topics, made necessary because new environmental conditions have unexpected or unmitigated impacts on agricultural production systems and resources, thus diverting resources from current high-priority research.
- Threats to personnel arising from extreme weather conditions, e.g., extreme temperatures, severe storms, flooding.
- Increased costs of heating, cooling, and other "overhead" costs to mitigating untenable conditions for employees or research material, thus diverting resources from mission research itself.
- Increased costs of buildings and facilities that must withstand extreme and variable conditions, including retrofitting existing facilities and costs of building new ones.

The following examples of these kinds of events and impacts illustrate the risks to ARS's capacity to meet its mission.

Extreme conditions and animal research. Extreme conditions associated with climate change impact livestock, and potential impacts on ARS research may be significant. Direct effects are related to the intensity and frequency of animal summer heat stress. Heat stress in dairy cattle can have an effect lasting weeks to months on reproduction and milk production; milk production declines at temperatures above 24C and is worsened by high humidities. Under severe conditions, milk production may be reduced as much as 20% per day. Poultry also are sensitive to stress from high heat and humidity. Although chickens can acclimate to heat, sudden heat waves significantly lower production (growth rate, egg production, hatching rate) and egg quality (smaller eggs, thinner egg shells, poor internal quality). Increased frequency and severity of heat waves can thus jeopardize ARS research on livestock and require ARS research locations to divert resources into mitigation costs such as increased energy costs for cooling, construction of facilities and equipment designed to keep research animals cool in hot conditions, and even relocation of research to cooler regions. Indirectly, climate change can affect livestock research via increased costs of animal feed, as yields of grain, forages, and silage are suppressed by heat, drought, or heavy or ill-timed precipitation. The need for research on mitigating heat stress will divert resources from research on other aspects of livestock production and health. Already, to better address extreme heat events in confined animal production operations, ARS devotes resources at the U.S. Meat Animal Research Center in Lincoln, Nebraska, to research focused on managing heat stress in confined livestock operations, in partnership with the National Weather Service. A website was developed which incorporates the Geographic Resources Analysis Support System and provides daily heat stress forecasts for livestock producers on line through the ARS USMARC website (<http://www.ars.usda.gov/Main/docs.htm?docid=21306>). Additional research identified as necessary is focused on developing precision animal management technologies to enable livestock producers to monitor the health and heat stress levels of individual animals housed in large groups typical of modern animal production.

Impact of climate change on crop research. There are many ways that climate change and weather extremes may affect ARS crop research and allocation of resources to crop research. Included are the many documented impacts of increasing CO₂ concentrations, heat, precipitation extremes, and the various combinations on crop growth, reproduction, and yield. Greater uncertainties are associated with the effects on pests and pathogens. In general, the geographic distribution of pests is largely dependent upon climate, whereas the incidence and severity of outbreaks are largely dependent upon weather. Consequently, there is broad agreement that climate change will have substantial ramifications for pest control in crop systems. While more rainfall increases the protection needed for cereals and root crops against many pathogens, higher temperatures are likely to increase pesticide applications needed to protect fruits, vegetables, and beans. Under projected climate change, the total external costs over all pesticide classes for U.S. agriculture per hectare could increase up to 70% from 2000 to 2100. Higher CO₂ concentrations provide a “fertilizer effect” to most plants, including crops, but there is likely to be a need for increasing rates of herbicide applications to control weeds because increased biomass of weeds requires more herbicide to kill them; ARS research has already demonstrated this. In addition, climate change is anticipated to result in changes in predominant weed populations within a region as the weather and climate conditions become more favorable for some weed species and not others. In rhizomatous perennial weeds, this could be the result of combinations of CO₂ and

weather conditions favorable for increased carbohydrate storage in rhizomes that may benefit overwintering and vegetative spread. However, ARS research has demonstrated that effects on weeds is not uniform for all weed species and all parts of the country. Plant invasions in pasture and rangeland are often preceded by major disturbances, such as wildfires. The incidence of wildfires is predicted to increase in areas of the south and west as precipitation in these regions declines with climate change. In general, adaptation to climate change probably will require more intensive pest management to protect crops. All this will mean new challenges for ARS in locating, designing, and conducting research programs on improving cropping systems – including the increasing costs of managing pests in research crops – to ensure that production and product quality of U.S. crops meet the needs of our citizens and on preserving our natural resources, while ensuring that our food supply is safe and our environment remains healthy.

Impact on food safety research. Flooding can have a major food safety impact, as has been evident by the many produce-related food safety outbreaks originating in the Salinas area of California. A notable example occurred with a particular ranch, which periodically flooded from overflow water from the Santa Rita Creek that bordered the property. This event led directly to a collaboration of ARS, the State of California, and academic institutions to redirect resources to an environmental study of the impact of flooding. To conduct this work, ARS redirected its produce-related food safety research portfolio at the Western Regional Research Center, Albany, CA, and realigned staff assignments from other research. Studies on significant events in 2003-2005, 2006, and 2011 indicated that flooding of small and major waterways, including the Salinas River, have major consequences to the economy (hundreds of millions of dollars) and public health (hundreds of illnesses and many deaths). A Food and Drug Administration (FDA) rule now considers ready-to-eat crops that have been in contact with flood waters to be adulterated due to potential exposure to sewage, animal waste, heavy metals, pathogenic microorganisms, or other contaminants. The risks may be especially high for areas that have been under drought conditions immediately before flooding, since flood water can wash contaminants directly onto fields. To reduce the effect of seasonal extreme weather events, a significant amount of land susceptible to flooding has been taken out of production. This has affected ARS' ability to continue some of its important produce-related research. This limits ARS' capacity to provide research data to the FDA, which in turn uses such data with the produce industry and the State of California to develop actionable responses and corrective action plans through documents such as the Commodity Specific Food Safety Guidelines for the Production and Harvest of Lettuce and Leafy Greens. Unhindered research that allows the development of Good Agricultural Practices is at the heart of produce food safety, not only for California but for other fresh produce producing States such as Arizona, Colorado and the Delmarva Peninsula. Thus, extreme weather events affect not only food safety itself, but ARS' abilities to conduct research that would mitigate food safety risks.

Implications for natural resources in research. Short and long-term water shortages (drought) and excesses (too much, too fast leading to floods) are expected to increase in frequency with changing climate. Research that has always been based on rain-fed plots may thus require irrigation for the first time, resulting in significant costs for irrigation equipment, energy to pump water, and water itself (if not drawn from wells or surface water). Even among field

plots that have been irrigated all along, greater amounts of water may be required, which can alter or compromise research objectives and/or progress. Water shortages may result in the loss of experimental material (plants, soil, animals). Insufficient moisture may delay planting dates, suppress yield quantity and/or quality, and increase the threat of fire on grazing lands research locations. Water shortages will affect research priorities, especially when reduced water availability for research and industry alters what, where and how a crop or livestock can be grown. Continued shortages of water may dictate a shift of research priorities to emphasize reduced water use, more efficient water use, and gray water use. Conversely, excess water may stress plant research plots via flooding. Excessive moisture during a growing season may shorten available time for field access to plant, manage (treat pests, apply fertilizers, etc.) or harvest. A major concern is the threat of heavy rainfall intensities that exacerbate soil erosion, thus leading to degradation of topsoil and environmental quality as sediment, nutrients and pesticides move offsite with runoff and/or subsurface flow. Such erosion may incur costs associated with mitigation of sediment deposition off-site. The timing of rainfall events may also create pest and pathogen problems, for example, as increased frequency of precipitation lengthens the persistence of free water on leaves, which promotes fungal growth on late-stage crops and/or recently harvested crops. Under such conditions, costs of pest management or even complete loss of experiments may occur. Flooding can also cause serious problems for livestock research units. Storage lagoons for animal waste management are vulnerable to heavy rainfall and may require modification to prevent overflows or collapse. Livestock waste spills cause spread of pathogens and excess nutrients to waterways, resulting in major environmental impacts and significant mitigation costs.

Costs of mitigating weather-related damage to research facilities. A tornado struck the Ohio Agricultural Research and Development Center (OARDC), Wooster, Ohio on September 16, 2010, destroying the University-owned Ag Engineering Building that housed the ARS Application Technology Research Unit. The estimated cost to replace the structure is \$4 million, in addition to the \$260,000 worth of ARS equipment that was lost. The facility has not yet been replaced, and ARS research has been hindered by the loss of equipment and forced relocation to temporary space. In El Reno, Oklahoma, a tornado struck the Grazinglands Research Laboratory on May 24, 2011. Five buildings were destroyed, nine buildings were heavily damaged, ten buildings sustained minor damage, expensive scientific equipment was damaged or destroyed, and more than 10 miles of fences were destroyed. The estimated funding needed to restore El Reno to its pre-tornado condition is \$5.1 million, which has not been appropriated and thus must be diverted from research. On June 11, 2008, a tornado struck Manhattan, Kansas. It damaged or destroyed the ARS Center for Grain and Animal Health Research facilities, the Wind Erosion Research Laboratory, the laboratory's attached greenhouse and a vehicle garage, and a greenhouse used for Hessian fly research. Congress appropriated \$2.8 million to replace the facilities, which took nearly four years. In August 2005, Hurricane Katrina caused extensive damage to the 400,000 square-foot Southern Regional Research Center in New Orleans, Louisiana. A total of \$32.5 million was invested through a Rapid Recovery Phase and subsequent Long Term Recovery to replace major mechanical and electrical systems and equipment, repair buildings, renovate completely flooded and destroyed areas in the basement, and repair damaged areas on upper floors in the Main Building. Although the SRRC became fully operational again in August

2006, a full year earlier than expected, total recovery took six years. Other recent severe weather events that have damaged ARS facilities and incurred aggregate costs of more than \$16 million to the agency include tornadoes in Houma, Louisiana; Beaumont, Texas, and Beltsville, MD; flooding in Grand Forks, North Dakota; and a hurricane in Miami, Florida. In addition to the cost to replace the facilities, there is significant impact on ARS' research capacity through interruption or loss of millions of dollars invested in experiments that have been lost, delays in planned research, and the obstacles inevitable in placing research programs in temporary space.

Impact to personnel and personnel-related costs. As a research agency, ARS' most valuable asset is its personnel, who apply their scientific, technical, and administrative expertise to accomplish the ARS mission. There are many weather and climate related impacts on personnel, and the exact kind and impacts vary across the country. Heat stress, severe cold, flooding, and wind all are examples of hazards to people working at ARS locations. Additional hazards arise from people whose performance may be compromised by such stresses or weather conditions, such as accidents associated with loss of control of heavy equipment, motor vehicles, hazardous chemicals, and others. Damage to ARS research facilities can result in major costs to the agency, diverting resources from research into emergency response. Included among such costs, aside from costs required for repair or replacement of facilities as discussed above, are those associated with personnel. A striking example is the impact of Hurricane Katrina on the personnel associated with ARS facilities in Louisiana, especially the Southern Regional Research Center in New Orleans. Major damage and flooding of the Center occurred when Katrina made landfall in southeastern Louisiana on August 29, 2005, rendering the Center completely unusable. A total of 178 employees, along with their families, had to be relocated to 22 temporary duty stations in 12 states to maintain critical research projects and progress as much as possible. Personnel-related costs arising from Katrina totaled more than \$4 million over three fiscal years.

III. The Adaptation Planning and Evaluation Process

a. Integration – ARS locations and specific operations are highly dispersed and heterogeneous with respect to activities conducted to meet the agency's mission. ARS conducts research to address its mission at more than 90 locations in nearly all 50 states. Many locations have multiple research units with very different research (e.g., crop, livestock, natural resources, and/or post-harvest quality and safety research at a single location). Many ARS research units are co-located on university campuses, and at these locations, ARS research and personnel may be housed in facilities owned by the federal government, by the university, or some combination. Other ARS units are housed in stand-alone, government-owned research facilities that may be in remote locations or in large cities. In addition, resources are allocated by Congress to the agency specific to locations for specific research. Thus, plans for adaptation to climate change must be highly specific and relevant for each research unit's unique combination of resources, research mission, facilities type and ownership, geographic location and environment, and climate change and weather variability/extremes in evidence. Adaptation strategies and plans for a natural resources unit in the desert southwest would not be appropriate for a human nutrition unit in hospital-like facilities in a large eastern city, nor for a crop

breeding program operated by scientists conducting research on a university campus in the Midwest where management plans for university-owned facilities are in place.

Implementation plans for application of congressionally appropriated resources in research are developed annually by the Research Leader of each research management unit in consultation with, and approval by, the relevant Area Director (the most senior line manager in each of ARS' seven multi-state Areas and the Beltsville Agricultural Research Center). The Annual Resource Management Planning (ARMP) process includes allocation of resources for personnel, direct research costs, and indirect research costs (e.g., facilities management; safety, health, and environmental management). Allocation of appropriated resources among these and other aspects of the unit's operations may be affected by climate change and weather variability and extremes.

Accordingly, Research Leaders will allocate resources as required to respond to direct research costs (e.g., pest management in crops, heat stress management for livestock) and indirect costs (e.g., energy costs for buildings, equipment and supplies for personnel safety and health), as affected by climate change within the context of their research activities, facilities, and locale. Allocations of costs to respond to changes in research needs, personnel needs, and facilities management will be reviewed and approved by Area Directors in the ARMP process.

ARS sets its research priorities, develops National and management unit-level research plans, and implements its plans through a highly developed process that includes established procedures for obtaining formal input from a wide variety of customers, stakeholders, and research partners. These include priorities and needs expressed by the Administration and Congress; other departments of the federal government and other agencies within USDA, including action and regulatory agencies; state governments and agencies; non-government organizations such as commodity organizations; universities and other non-government research organizations; individual farmers and land-owners; and others. The five-year research project plans developed by agency scientists in response to input from customers, stakeholders, and partners are peer-reviewed by non-ARS scientists for adequacy of research approaches and likelihood of success in achieving stated objectives. As climate change and weather variability are manifest through changing pressures and needs related to crop production and protection, animal production and protection, natural resources and sustainable agricultural systems, and nutrition, food safety, and quality, we anticipate that the agency's customers, stakeholders, and partners will identify necessary changes to be recommended for research programs and changes in allocations of research resources to address any such issues that increase in importance.

- b. Understanding risks** – One of ARS' 18 National Programs is Climate Change, Soils, and Emissions. Goals of this National Program include adaptation of agricultural systems to climate change and mitigation of greenhouse gases, including mitigating those originating from agricultural production systems and offsetting agricultural and non-agricultural emissions with carbon sequestration in soils. Inherent in this research program is consideration of the likely magnitude of climate change and scenarios of

impacts on crops, livestock, natural resources, and post-harvest product quality and safety. Resources allocated to ARS locations for climate change, soils, and emissions research are applied to research on impacts, adaptation, and mitigation, and results of this work informs all climate and weather related research throughout the agency.

- c. **Performance metrics** – Responses to changing climate and weather extremes and variability will be assessed annually in terms of the effectiveness of meeting expected research milestones as specified in peer-reviewed project plans. The degree of achievement of expected research milestones versus weather and climate related interference with research progress, personnel safety and health, and facilities management and costs will be reflected in the allocation of resources in subsequent years' ARMP process for each management unit. When weather and climate interfere substantially with research, personnel, or facilities, increased resources will be allocated for appropriate mitigation. Assessments and responses are expected to be iterative as required.

IV. Sustained Adaptation Process

This plan will be reviewed during the first quarter of each fiscal year by the ARS Deputy Administrator for Natural Resources and Sustainable Agricultural Systems (NRSAS), in consultation with the other three subject-matter Deputy Administrators of the Office of National Programs, the National Program Leader for Climate Change, Soils, and Emissions, the Director of the Human Resources Division, and the Director of the Facilities Division. Prior to that review, the Deputy Administrator for NRSAS will solicit information from the eight Area Directors to ascertain occurrences of significant interference from climate/weather with research goals, personnel, or facilities during the previous fiscal year. Obvious problems occurring at multiple locations will be identified to all Area Directors and given priority for development of coordinated responses whenever possible to leverage multiple locations' resources to mitigate widespread problems. Knowledge gained from agency-wide, national information will be used to identify priorities and update this plan as necessary.

Appendix: Actions to address risks and opportunities

Appendix (Agricultural Research Service): Actions to address risks and opportunities

Action	Agency Lead	Risk or opportunity	Scale	Timeframe	Implementation Methods	Performance metrics
<p><i>Additional training and animal care responsibilities for employees.</i></p> <p><i>Additional ventilation, cooling, shade and management capacity for laboratories, feedlots, transportation and animal handling.</i></p> <p><i>Revised handling and data collection protocols to avoid heat stress, ensure</i></p>	ARS	<i>Heat stress to animals in confined research facilities.</i>	Location	ongoing	<i>At individual research locations as required</i>	<i>Climate and weather-related animal morbidity and mortality are unchanging. Animal welfare and performance in research trials are not compromised.</i>

Agricultural Research Service

<p><i>welfare and address emerging health, performance and parasite implications.</i></p>						
<p><i>Employees assigned additional training and animal care responsibilities. Additional non-traditional work hours (early and/or late). Additional shade or cooling for animal handling facilities and pasture and range systems. Revised handling</i></p>	<p><i>ARS</i></p>	<p><i>Heat stress to animals in non-confinement research facilities.</i></p>	<p><i>Location</i></p>	<p><i>Ongoing</i></p>	<p><i>At individual research locations as required</i></p>	<p><i>Climate and weather-related animal morbidity and mortality are unchanging. Animal welfare and performance in research trials are not compromised.</i></p>

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<p><i>and data collection protocols to avoid heat stress, ensure welfare and address emerging health, performance and parasite implications.</i></p>						
<p><i>Additional training for heat stress adaptation , possible relocation or redirection of skilled technicians.</i></p> <p><i>Additional ventilation, cooling, and management capacity for laboratories and handling facilities.</i></p>	<p><i>ARS</i></p>	<p><i>Increased infestations of livestock pests</i></p>	<p><i>Location</i></p>	<p><i>ongoing</i></p>	<p><i>At individual research locations as required.</i></p>	<p><i>Program objectives are not compromised by pests. Research programs continue to be effective and deliver impact for stakeholders.</i></p>

Agricultural Research Service

<i>Areas of infestation and impact on agriculture may expand or contract necessitating the relocation or redirection of research programs and experiments.</i>						
<i>Increase water cooling capacity.</i>	<i>ARS</i>	<i>Heat stress in fish research facilities</i>	<i>Location</i>	<i>Ongoing</i>	<i>At individual research locations as required.</i>	<i>No increased animal morbidity, no compromised reproductive performance and health of confined fish populations</i>
<i>Installation of irrigation equipment.</i> <i>Altered planting dates.</i> <i>Alternate research locations.</i>	<i>ARS</i>	<i>Heat/drought stress of crops in field plots</i>	<i>Location</i>	<i>ongoing</i>	<i>At individual research locations as required.</i>	<i>Crop losses in field plots due to extreme weather events or variability do not increase over years. Research objectives are met as planned. Impact of research for stakeholders is uncompromised.</i>
<i>Increase cooling</i>	<i>ARS</i>	<i>Heat/drought stress of plants in greenhouses</i>	<i>Location</i>	<i>ongoing</i>	<i>At individual research locations</i>	<i>Losses of plants and experiments being conducted in greenhouses</i>

Agricultural Research Service

<p><i>capacity of greenhouses.</i></p> <p><i>Change time of year to conduct research.</i></p> <p><i>Alternate research locations.</i></p>					<p><i>as required.</i></p>	<p><i>do not increase over years. Research objectives are met as planned. Impact of research for stakeholders is uncompromised.</i></p>
<p><i>Install flood control structures.</i></p> <p><i>Install soil drainage.</i></p> <p><i>Delay field management activities, including planting and harvesting, as necessary.</i></p> <p><i>Alternate research locations.</i></p>	<p><i>ARS</i></p>	<p><i>Flooding of crops in fields</i></p>	<p><i>Location</i></p>	<p><i>ongoing</i></p>	<p><i>At individual research locations as required.</i></p>	<p><i>Crop losses in field plots due to flooding do not increase over years. Research objectives are met as planned. Impact of research for stakeholders is uncompromised.</i></p>
<p><i>Possible relocation or redirection</i></p>	<p><i>ARS</i></p>	<p><i>Increased pest infestations in field plots</i></p>	<p><i>Location</i></p>	<p><i>ongoing</i></p>	<p><i>At individual research locations as required.</i></p>	<p><i>Crop losses in field plots due to pest risks exacerbated by climate and weather do not increase over</i></p>

Agricultural Research Service

<p><i>of skilled technicians.</i></p> <p><i>Increased pesticide applications.</i></p> <p><i>Alternate research locations.</i></p>						<p><i>years. Research objectives are met as planned. Impact of research for stakeholders is uncompromised.</i></p>
<p><i>Install barriers to movement of wastes into field plots.</i></p> <p><i>Drawdown holding ponds to reduce release of nutrients and pathogens at times of high risk.</i></p> <p><i>Improve waste confinement facilities.</i></p> <p><i>Alternate</i></p>	<p><i>ARS</i></p>	<p><i>Contamination of crop research by animal wastes</i></p>	<p><i>Location</i></p>	<p><i>ongoing</i></p>	<p><i>At individual research locations as required.</i></p>	<p><i>Waste in confinement facilities is not released into the environment due to extreme weather events.</i></p>

Agricultural Research Service

<i>research locations.</i>						
<p><i>Ensure access of employees to shelter from heat, cold, wind.</i></p> <p><i>Training of employees to recognize weather-related hazards and for access to shelters, proper maintenance of body fluids and salts, how to respond to severe and possible sudden conditions.</i></p> <p><i>Pest repellents in areas where weather/climate favor</i></p>	<i>ARS</i>	<i>Weather related injuries and stress of employees</i>	<i>Location</i>	<i>ongoing</i>	<i>At individual research locations as required.</i>	<i>Incidence of employee stress or injury due to weather extremes does not increase.</i>

Agricultural Research Service

<p><i>increased pest incidence.</i></p> <p><i>Require employee breaks with adequate fluid replacement.</i></p> <p><i>Improve cooling and heating of facilities, and allocate energy costs accordingly.</i></p> <p><i>Telework as appropriate.</i></p>						
<p><i>Construct and retrofit buildings and facilities to withstand high winds, extreme heat and cold, high rates of precipitation</i></p>	<p><i>ARS</i></p>	<p><i>Damage to facilities</i></p>	<p><i>Location</i></p>	<p><i>ongoing</i></p>	<p><i>At individual research locations as required.</i></p>	<p><i>Buildings meet or exceed weather resistance related building codes in effect at each location.</i></p> <p><i>Building condition and energy use maintain a proper environment for employees and do not compromise research.</i></p>

Agricultural Research Service

<p><i>Take projected weather and climate projections into account in siting and designing facilities, including on flood plains.</i></p> <p><i>Monitor and maintain building condition as required for current and projected weather and climate, including flood plains.</i></p> <p><i>Assess needs for backup utility services and allocate resources accordingly.</i></p> <p><i>Raise</i></p>						
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Agricultural Research Service

<p><i>critical equipment above flood level.</i></p> <p><i>Provide permanent or temporary protective measures for facility and utility systems.</i></p> <p><i>Alternate research locations.</i></p>						
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USDA Animal and Plant Health Inspection Service
Climate Change Adaptation Plan
May 31, 2012

**Animal and Plant Health Inspection Service
Climate Change Adaptation Plan
May 31, 2012**

Policy Framework: Describe your agency vision, mission, goals, and strategic approaches

APHIS Vision Statement

Advance the well-being of U.S. consumers by ensuring the health and availability of affordable food products and protecting forests and private working lands against devastating pests and diseases so that U.S. farmers, ranchers, and other citizens of our rural communities thrive and prosper.

APHIS Mission Statement

Protect the health and value of U.S. agricultural, natural, and other resources.

Goal 1: Support rural communities

- Objective 1.1 – Implement agricultural pest and disease management programs, including those in affected rural areas
- Objective 1.2 – Protect and promote animal welfare

Goal 2: Protect forests, rangelands, and private lands

- Objective 2.1 – Reduce threats to forests and private working lands

Goal 3: Expand opportunities to develop and trade safe agricultural products, including biotechnology-derived agricultural products

- Objective 3.1 – Enhance the regulatory framework that allows for the safe development of genetically engineered organisms
- Objective 3.2 – Facilitate safe agricultural trade through international standard setting and effective management of sanitary and phytosanitary (SPS) issues

Goal 4: Minimize and prevent damage to the U.S. food supply caused by plant and animal pests and diseases

- Objective 4.1 – Monitor the health status of U.S. agricultural resources
- Objective 4.2 – Develop and implement programs to address plant and animal pests and diseases of concern
- Objective 4.3 – Provide diagnostics and technical support to enhance pest and disease programs, including emergency response capabilities for these pests and diseases

APHIS' strategic approaches to climate change are captured in its current strategic plan¹. APHIS fully recognizes that climate change presents a threat to its ability to advance its above goals. Its plan describes activities that acknowledge climate change factors and incorporate response and adaptation strategies.

¹ http://www.aphis.usda.gov/about_aphis/downloads/APHIS_Strategic_Plan_2015.pdf

Animal and Plant Health Inspection Service

The APHIS strategic plan identifies climate change as a key external threat to its ability to meet its mission critical goals and thus constitutes a key challenge. Specifically, climate change will influence the level of risk to food security and human health associated with a suite of animal and plant diseases, invasive species, and agricultural pests. Changes in environmental conditions will increase the likelihood of shifts in the distribution and nature of current domestic diseases, invasive species, and agricultural pests. It will influence the dynamics of invasion and establishment of exotic diseases and agricultural pests. It will require that APHIS develop appropriate predictive risk and epidemiological models, domestic and offshore surveillance and mitigation strategies to respond to changing climatic conditions that may affect disease and pest biology. Appropriate diagnostic tools and response strategies will afford APHIS's ability to maintain accurate situational awareness to support regulatory responses and sound decision making.

APHIS, in coordination with Customs and Border Protection, monitors weather, pest trends and outbreaks throughout the world to target pest exclusion activities that enhance protection at ports and airports. Experience has demonstrated that short term climate disruptions (e.g. drought, heat waves, hurricanes) can strongly influence pest and disease incursion; in some instances exacerbating and in others actually minimizing pest pressure. In anticipation that climate change will strongly influence invasion biology, pest/disease epidemiology and ecosystem dynamics, APHIS is developing strong analytic systems and predictive models to protect agriculture and natural resources, commerce and trade.

APHIS does not anticipate that climate change will require a modification of its regulatory authority; however, climate change will likely require new regulations and policies to address new or shifting pest and disease scenarios.

Vulnerability Assessment: Describe both the risks and opportunities associated with changing climate that your agency will face.

Risks Include:

Food Distribution and Aid

- APHIS regulations prohibit the importation of agricultural and food products that pose risk to plant, animal and human health. Disaster relief (including food distribution) efforts associated with increased frequency of extreme weather events resulting from climate change will require enhanced coordination with other federal, state and local agencies to protect public and agricultural resources.
- Novel patterns in the distribution and movement of regulated agricultural products may create new or increased risk for introduction of pests and diseases. APHIS will work with federal and state partners to enhance capacity to meet the challenges encountered with export and import requirements related to food distribution and aid.

Animal and Plant Health Inspection Service

U.S. Agricultural Production and Trade

- Climate change and associated shifts in disease and pest prevalence may overwhelm the current ability of off-shore programs to provide real-time information regarding pest and disease potential and may increase risk to U.S. agriculture.
- Existing surveillance and diagnostic networks for animal and plant health diseases (e.g., avian influenza, foot and mouth disease, agricultural and forest and pests, etc.) could be overwhelmed.
- Increased requirements for commodity and pathway risk analyses may overwhelm existing capacity.

Emergency Response Systems

- APHIS has established animal and plant health emergency frameworks to facilitate coordinated timely responses to disease and pest emergencies. APHIS also has established frameworks to address all hazards (e.g., hurricanes, floods, wildfires) both for impacts on plant and animal health, and on the needs of individuals with household pets and service animals. Climate change has the potential to overwhelm existing frameworks as a result of increases in extreme weather events, wildfires, and pest and disease outbreaks.
- In the event of wide-ranging climate disruption events, capacity could be overwhelmed and assistance from other USDA and DHS emergency response resources would be required. State, local, tribal, industry and other stakeholders with key roles in threat mitigation may also be overwhelmed.
- Changes in pest and disease biology will require APHIS to ensure that its emergency response strategies and capabilities are updated and coordinated with the DHS National Response Framework.

Shifts in Geographic Distribution of Wildlife, Weeds, Pests and Diseases

Climate change impact on ecosystem and habitat characteristics will result in shifts of animal and pest populations into new or expanded habitats. This movement can result in enhanced spread of diseases and other pests and increased encounters with wildlife in populated areas potentially increasing disease transmission among wildlife, livestock and people. APHIS will direct and coordinate its surveillance, reporting and mitigation initiatives with federal, state, tribal and stakeholders to maintain human, animal and plant health.

Increase in Demand for Genetically Engineered (GE) Crops and Related APHIS Services

APHIS expects an increase in the demand for GE crops that are modified to adapt to the effects of climate change and a commensurate increase in the numbers of permit and notification applications, risk assessments, field trials, inspections, compliance issues, and petitions for deregulation, thereby increasing demands on APHIS resources.

Animal and Plant Health Inspection Service

- Adapting to climate change will likely require innovations in agricultural technology, including the introduction of novel traits. These innovations may create the need to revise and update protocols and approaches to risk assessments.
- Response to pest and disease outbreaks may require the increased use of multiple pesticide combinations and could therefore increase the complexity of environmental and risk analyses such as those required under the National Environmental Policy Act (NEPA).
- The increased desire for genetically engineered plants to resist pests or pests engineered to prevent the transmission of plant pathogens is expected to result in increased complexity of assessments

Opportunities Include:

Predictive Modeling Important to Preparedness

- Increased coordination and collaboration with international partners developing predictive models will enhance APHIS's ability to prepare for pest/disease incursions and other changes driven by climate change.
- Partnering with others, such as the Department of Commerce's National Oceanic and Atmospheric Administration on the development of predictive models related to climate change would afford APHIS increased capacity to protect the flow of trade.

Regulatory Strategies

- Develop regulatory strategies that focus on risk pathways in lieu of specific pests.
- Ensure that climate change adaptation is incorporated into the APHIS decision making framework.

Leverage Resources

- APHIS will partner with federal, state, local and tribal agencies, academic institutions, industries and other stakeholders to ensure a well-informed understanding and coordinated response to climate change.
- APHIS will leverage its research capabilities and program and response resources to enhance preparedness and the ability to mitigate and adapt to impacts related to climate change. The Agency will do so by adopting an infrastructure that enables rapid modification of policy and standard operating procedures.

The Adaptation Planning and Evaluation Process: Integration into policies, programs, and operations; includes coordination with stakeholders including local, state or tribal entities and private landowners

APHIS will integrate climate change into all emergency preparedness activities to enhance our ability to anticipate, mitigate and adapt to emerging threats to animal and plant health.

APHIS actions will:

- Incorporate climate change modeling into bio-security hazard characterization associated with known and anticipated threats to U.S. agriculture including animal and plant diseases, invasive species, and agricultural pests;
- Enhance protection of agriculture, natural resources and trade through the use of risk analysis models that are informed by most recent advances in climate change science. Models should include climate shift-based scenarios that allow for improved prediction of spatial and temporal influences of threats;
- Engage international, federal, state, local and tribal partners as well as other stakeholders to gather relevant information to support decision making and, where applicable and appropriate, to partner in program delivery;
- Implement regulatory frameworks, operational practices and policies that are informed by the most recent advances in climate change science;
- Develop guidance to evaluate the impacts of climate change in NEPA analyses consistent with draft guidance issued by the Council on Environmental Quality (2010) and;
- Work with other state, federal and tribal entities to ensure impacts associated with Agency actions in response to climate change provide for the continued existence of other fish, wildlife and plant communities consistent with the National Fish, Wildlife and Plant Climate Adaptation Strategy.

Understanding Risks: Actions APHIS will take to better understand risks and opportunities.

To better understand risk, APHIS will:

- Adapt risk analysis models (both epidemiological and forecasting) to incorporate changes in the distribution of environmental and biological attributes predicted under different climate change scenarios. APHIS will use the output from these models to prioritize the likelihood and severity of threats and to focus subsequent activities on specific high-likelihood, high-impact diseases or agricultural pests or pest categories².

² This corresponds to the second element in USDA's Climate Change Science Plan (http://www.usda.gov/oc/climate_change/science_plan2010/USDA_CCSPPlan_112910.pdf): "to develop knowledge, institutional models, and tools to enable adaptation..."

Animal and Plant Health Inspection Service

- Develop or revise surveillance and detection strategies for detection of changes in the distribution, transmission potential, or outbreak of diseases, invasive species, and known agricultural pests associated with animal and plant-based food security and human health, which are informed by epidemiological and forecasting models³.

Sustained Adaptation Process: To ensure that this Climate Adaptation Plan is current APHIS will address the following issues:

Priority Setting

APHIS Programs will define program elements that can be strongly influenced by climate change by establishing clear science/programmatic-based criteria and evaluate the importance of the information using an analytical process to evaluate the relative importance of the potential impacts associated with climate change on APHIS' ability to meet its mission.

Sources of information APHIS will use to further develop the Plan through time

APHIS will review and apply information from federal agencies, international initiatives and academic institutions with demonstrated expertise in climate change (predictive modeling, basic and applied research on pest/disease biology, ecology and environmental impacts) and integrate the relevant information into its Climate Adaptation Plan and program performance measures.

Performance Metrics

APHIS programs will identify performance metrics that demonstrate climate change adaptation is integrated into each program's policies, response plans, risk assessments, and environmental analyses.

Methods APHIS will use to evaluate progress

APHIS Leadership will review program operational plans and policies to ensure that adaptation to climate change is factored into our planning, implementation and evaluation of program performance.

³ This corresponds to the second and third element in USDA's Climate Change Science Plan: "to develop knowledge and tools to ..."

Actions to address risks and opportunities:

Action	Agency Lead	Description	Scale	Timeframe	Performance metrics
1. Integration of APHIS climate change adaptation plans	Wendy Hall	Ensure APHIS wide resource optimization, including data and systems sharing to support climate change initiatives	APHIS	CY 2012	Updated APHIS climate change roadmap document
2. Develop APHIS climate change vs. strategic plan crosswalk	Randall Levings	Identify linkages between climate change related activities and the 2011-2015 APHIS strategic plan	APHIS	CY 2012	Completion of crosswalk document
3. Coordinate the development of epidemiological forecasting tools	Tom Kalaris	Develop joint development efforts with USGS' FORT labs to integrate state of the art epidemiological models into APHIS operations	Inter-agency	Training sessions started Spring 2012; development ongoing	Adaptation of VIS-TRAILS and SAHM simulation environments
4. Work towards APHIS IT protocols that permit the use of interagency tools and data	Ron Sequeira	Coordinate with APHIS IT to establish a "development space" to test and integrate state of the art simulation systems	APHIS	Review of IT systems began April 2012; a strategy white paper planned by CY 2012	Protocols for IT interagency communications to support climate change simulation systems and database support

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<p>5. Integrate climate change considerations into international sanitary and phyto-sanitary regulatory guidelines</p>	<p>Michael Watson Michael David</p>	<p>Harmonize regulatory responses that include climate change factors under the major international regulatory coordinating bodies</p>	<p>International with focus on IPPC and OIE</p>	<p>Ongoing but need to establish specific representation within appropriate committees</p>	<p>APHIS leadership identifies representation for factors that include climate change adaptation guidelines within IPPC and OIE</p>
<p>6. Integrate climate change related metrics into ongoing program studies</p>	<p>Steve Weber Others</p>	<p>Integrate data elements into ongoing surveillance studies to assist in determining if climate change may be affecting disease distributions</p>	<p>APHIS ARS</p>	<p>Ongoing</p>	<p>Periodic analysis of study data, expansion of studies if necessary to characterize potential climate change relationships identified</p>
<p>7. Develop Agency guidance on how to address impacts of climate change in environmental compliance documents</p>	<p>Allan Auclair David Bergsten</p>	<p>Develop an analytical frameworks to assess impacts associated with climate change for Agency actions subject to the National Environmental Policy Act</p>	<p>APHIS</p>	<p>Ongoing</p>	<p>Agency environmental compliance documents address impacts of climate change</p>

USDA Climate Change Program Office
Climate Change Adaptation Plan

**USDA Climate Change Program Office
Climate Change Adaptation Plan**

I. Policy Framework

The Climate Change Program Office (CCPO) functions as the USDA-wide coordinator of agricultural, rural, and forestry-related climate program and policy issues. The CCPO ensures that USDA is a source of objective, analytical assessments of the effects of climate change and proposed response strategies both within USDA and among our Interagency and other partnerships. CCPO manages USDA's Department-wide directive to integrate climate change adaptation planning and actions into USDA programs, policies, and operations. Located within the Office of the Chief Economist coordinates participation of USDA agencies and offices in USDA's Climate Change Adaptation Planning and its updates, including issuing guidance and developing interim deliverables:

CCPO's responsibilities include

- Analysis, long-range planning, coordination of scientific research, and the development of climate change response strategies;
- Providing liaison with other Federal agencies;
- Informing the Department of scientific developments and policy issues relating to the effects of climate change on agriculture and forestry;
- Recommending alternative courses of action with which to respond to such scientific developments and policy issues; and Ensuring that recognition of the potential for climate change is fully integrated into USDA's research, planning, and decision-making processes.

II. Vulnerability Assessment

As a small staff office located in Washington, DC, the direct consequences of climate change on the functions and operations of CCPO are limited. As the Department moves to integrate climate change considerations into planning and program management, demands on CCPO staff will increase. To position the office to meet these challenges, CCPO focuses on the following core functions: coordination, communication, assessment, and analysis. Improving the Department's understanding of climate change and building the capacity to anticipate and respond to climate change risks are a core function of CCPO. Specific responsibilities and activities of CCPO are addressed in Section IV.

USDA is unique among many Federal Departments in the broad spectrum of its agency missions, including research, applications and technology transfer, public land management, technical assistance, and communications and delivery. These missions revolve around people and land—private and public owners, rural and urban communities, fish and wildlife habitat, forestlands, croplands, grasslands, wetlands, agro-forest ecosystems, and agricultural and forest products. The issue of climate change is complex and affects multiple USDA mission areas and agencies. Several agencies within the Department have a role conducting research and supporting climate change science. These agencies include all of the agencies within the Research Education, and Economics Mission Area – Agricultural Research Service (ARS), Economic Research Service

Climate Change Program Office

(ERS), National Agricultural Statistics Service (NASS), and National Institute of Food and Agriculture (NIFA). The Forest Service also has a significant research program on climate change. Each of these agencies will prepare a Climate Change Science Implementation Plan that will include specific performance measures and will build on the elements and priorities outlined in this document. Other USDA agencies are important clients for climate change research. These agencies include: the Agricultural Marketing Service (AMS), Animal and Plant Health Inspection Service (APHIS), Climate Change Program Office (CCPO), Farm Service Agency (FSA), Foreign Agricultural Service (FAS), Forest Service (FS), Natural Resources Conservation Service (NRCS), Risk Management Agency (RMA), and Rural Development (RD).

CCPO works closely with all USDA research and program agencies within the Department to deliver accurate research and assessments and provide guidance and support to the research community and interested public.

III. Adaptation Planning and Evaluation

Under Departmental Regulation 1070-001, issued on June 3, 2011, the CCPO is charged with preparing the Department's Climate Change Adaptation Plan. CCPO prepared guidance to USDA agencies in preparing sections of the plan and will be responsible for coordinating updates and revisions to the plan. CCPO will also lead the Department's efforts to communicate elements of the plan to the public and solicit public input on the plan, including potential revisions and improvements.

CCPO represents USDA on the Interagency Climate Change Adaptation Task Force. USDA is working with the Interagency Climate Change Adaptation Task Force to implement a strategy for ensuring scientific information about climate change and adaptation options is accessible and support decision makers in their work.

IV. Sustained Adaptation Process

Specific CCPO activities that support USDA's adaptation to climate change include:

USDA Strategic and Science Planning – CCPO coordinates contributions to strategic and science planning within the Department, as well as evaluating linkages between ecosystem services and climate change adaptation and mitigation. CCPO oversaw the production of the USDA Climate Change Science Plan, which was issued in 2010. This plan provides a framework for research coordination on climate change impacts, adaptation, mitigation and decision support.

Global Change Task Force (GCTF) – The GCTF is comprised of the twenty USDA agencies that have research or programmatic responsibilities for some aspect of climate change. The GCTF coordinates Departmental activities and provides a venue for information sharing related to climate change impacts, adaptation, and mitigation responses. The Director of CCPO serves as the Chair of the GCTF.

Coordination with the U.S. Global Change Research Program (USGCRP) - As an active member of the USGCRP, USDA can leverage the work of the twelve other Federal USGCRP

Climate Change Program Office

agencies and departments. The CCPO Director serves as the USDA representative to the USGCRP. The CCPO coordinates the participation of USDA personnel in USGCRP Interagency Working Groups, the National Climate Assessment, and related Inter-agency activities.

Coordination of USDA contributions to the National Climate Assessments – CCPO coordinated production of *SAP 4.3: The Effects of Climate change on Agriculture, Land, Water, and Biodiversity* in preparation for the 2009 National Climate Assessment (NCA). CCPO coordinated the lead/co-lead of six technical inputs to the 2013 NCA, and supports the ongoing process through participation in the Interagency National Climate Assessment Task Force, the National Climate Assessment and Development Advisory Committee.

USDA Climate Change Web Site - CCPO provides online up-to-date developments on climate change as it relates to agriculture and forests, maintains reference materials for internal and external stakeholders, and documents events to help keep USDA’s constituency well-informed.

Communication of Information on Climate Change to USDA Staff and Stakeholders – CCPO regularly organizes forums for educating agricultural and forestry professionals regarding meeting mission goals under a changing climate. For example, CCPO has organized regional meetings with stakeholders in the Midwest on behalf of CEQ, and held an internal educational climate change science seminar in June 2012 to inform USDA’s technical staff of the relevance of climate to each agency’s objectives.

V. Actions to Address Risks and Opportunities

Action	Scale	Completion Date	Collaborating Agencies
National Climate Assessment	National, with Regional breakdown	Ongoing. Next full product will be released December 2013	13 USGCRP Agencies, ARS, ERS, FS, NIFA, NRCS
Improving Access to Climate Change Information	National, Regional, Local	Ongoing. USDA Climate webpage will be completed in July 2012.	USGCRP Agencies, NIFA, Extension Service
Contributions to the USGCRP Climate Change Portal	National/Regional	FY 2013-14	
Improved Access to Climate Forecasts and Projections	National/Regional	2014 (proposed)	NOAA/DOI

Climate Change Program Office

Stakeholder Capacity Building and Education on Climate Change Adaptation, including soliciting input on the USDA Climate Change Adaptation Plan	Regional – 4-6 regional workshops in FY 2013-14	On-going	CEQ, USDA agencies
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USDA Farm Service Agency
Climate Change Adaptation Strategy

Farm Service Agency Climate Change Adaptation Strategy

In accordance with Executive Order (E.O.) 13514, all federal agencies must have a climate change adaptation plan submitted to the Council of Environmental Quality (CEQ) no later than June 29, 2012. USDA Departmental Regulation 1070-001 calls for the Climate Change Program Office (CCPO) to develop the USDA Climate Change Adaptation Plan with the full support and participation of USDA agencies and offices. To accomplish this, each agency within USDA should prepare its own adaptation strategy that addresses how it is going to integrate climate change into its programs, policies, and operations. These individual agency plans will be included in the Department's response to CEQ.

Background

FSA's mission is to deliver timely, effective programs and services to America's farmers and ranchers to support them in sustaining our Nation's vibrant agricultural economy, as well as to provide first-rate support for domestic and international food aid efforts.

FSA's vision is to transform into a more diverse and innovative agency.

To assist the country in addressing today's challenges, FSA has four strategic goals:

- Provide a financial safety net for America's farmers and ranchers to sustain economically viable agricultural production,
- Increase stewardship of America's natural resources while enhancing the environment,
- Ensure commodities are procured and distributed effectively and efficiently to increase food security, and
- Transform and modernize the Farm Service Agency.

A particularly relevant Goal 2 objective is for FSA to "lead efforts to mitigate and adapt to climate change." Strategies that have been identified in the Plan to achieve this objective include the following:

- Promote planting of trees, shrubs, grasses and forbs.
- Collaborate with partners to develop planting and management specifications that are adaptive to climate change.
- Provide financial incentives to mitigate the upfront cost of establishing practices adopted to adapt to climate change.
- Educate producers on the impact of climate change.
- Partner with external agencies to expedite extension and technical assistance.

Vulnerability to climate change

Given the sensitivity of crop and livestock production to climate, the agricultural sector and producers will be disproportionately impacted by climate change. Assuming current climate change predictions are borne out, producers will face increased average temperatures, more frequent temperature extremes, and changes in precipitation patterns. Scientists predict the severe heat experienced during summer 2003 in Western Europe, while exceptional for the past century, to be typical, if not mild, in the next (Battisti and Naylor 2009). Climatic change may also pave the way for weed and insect pests and plant and animal disease vectors, increasing

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their spatial distribution. Even if producers are not directly impacted by climate change, they will feel its effects on other producer through the interconnected global market for agricultural commodities.

On one hand, producers most vulnerable to climate change will be those unwilling or unable to respond to changing agronomic and market conditions by changing their production systems. The reaction by such producers to climate change (e.g., exiting the sector) will be more costly than what it would take to meaningfully adapt.

On the other, meaningful adaptive strategies undertaken by producers are likely to include one of more of the following:

- Switching crops and varieties to those more conducive to changing conditions,
- Diversifying crops,
- Integrating livestock production and/or forestry (agroforestry) with crop production,
- Increasing water use efficiency and conserving soil moisture,
- Altering the timing of cropping activities, and
- Using climate forecasting to support farm planning.

As they respond in the short term and adapt in the long term to climate change, producers may become more reliant on the financial and disaster assistance programs that FSA administers. Federal programs and policies can influence what producers do, and should be designed to ameliorate, rather than exacerbate, the impact of climate change on producer, as well as National, well-being. Put another way, programs and policies can either facilitate adaptation or impede it. A nimble and resilient agricultural sector will adapt optimally and swiftly to changes in agronomic and market conditions.

Adaptation to climate change

FSA delivers financial assistance through a host of programs associated with commodity crops, conservation, disaster, and farm loans. FSA programs will affect the climate change adaptation process to varying degrees and in various ways:

- Commodity programs: FSA supports farm livelihoods by supplementing farm income, particularly when revenue or crop prices fall to relatively low levels.
- Conservation programs: The Conservation Reserve Program (CRP) is the largest conservation program administered by FSA. By taking marginal lands out of production for at least 10-15 years and restoring their ecological integrity, the CRP can help to transition lands no longer suitable for crop production out of it while reducing greenhouse gas emissions.
- Farm loans: Because adaptation is likely to involve significant investment in new technologies and infrastructure, producers least able to cope with climate change may be those with limited access to credit, such as beginning and disadvantaged farmers. These

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populations are also more likely to be farming marginal lands that are more susceptible to climate change impacts.

- Disaster programs: This assistance can be a lifeline to farmers who suffer losses from extreme weather events. The short term support offers farmers the opportunity to adapt.

FSA has identified three actions related to climate change adaptation that it will initiate in FY 2013, assuming that funding, as well as input from partners, is forthcoming:

Action 1: To ensure that FSA programs encourage farmers to adapt to climate change, FSA will review programs and policies—with the assistance of Research, Education, and Economics (REE) mission area as necessary—to ascertain whether and the extent to which there is room for improvement in terms of facilitating an optimal response by producers to climate change. Opportunities identified will be flagged according to whether they require a change in policy, a regulatory change, or an act of Congress. Changes in policy can be effected in the relatively short term. Regulatory changes will trigger regulatory processes. Issues that require statutory changes can inform Farm Bill discussions.

Questions to consider during this review include the following:

- Commodity crop programs: Do the programs encourage adaptation or maintenance of the status quo?
- Conservation programs:
 - Can CRP target enrollment toward marginal lands with an unacceptable pattern of crop loss? CRP would be a means by which the land is transitioned to other uses and/or to replenish the organic matter in the soil that is essential for moderating climate impacts.
 - Can the process by which CRP land is made available for field trials made simpler? Research would be conducted in a more realistic setting and opportunities for producers to participate in the research process would be created, which is conducive to higher rates of adoption (McKinley et al. 2012).
- Farm loans: Can the programs emphasize investments that reduce water and heat stress on crops and livestock, such as hoop houses, tillage and harvest technologies that enhance soil organic matter, and water conserving technologies including intermittent irrigation?
- Disaster programs: How quickly can assistance be provided if losses are widespread? Do the programs encourage adaptation or a return to current practice?

Action 2: FSA will partner with the REE mission area, as well as NGOs, to publicize and/or make available decision support tools at field offices, facilitating their outreach. An example of

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such a tool to encourage use of seasonal climate information in farm management decisions is Agroclimate, a project of the Southeast Climate Consortium (Agroclimate 2011).

Action 3: FSA will conduct “continuity of operations” exercises to better understand the administrative implications of and prepare headquarters, state, and field office staff for large-scale crop failure, which will be increasingly likely with climate change.

FSA will generate and make available an annual report that discusses the extent to which each of the 3 actions has been undertaken. In particular, the report will highlight instances in which climate change adaptation considerations identified by Action 1 impacted policy.

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Appendix

Actions to address risks and opportunities

Action	Agency Lead	Risk or opportunity	Scale	Timeframe
Policy review	FSA	Opportunity to highlight to Administration and Congress policy changes to facilitate adaptation	National	2012-2013
Outreach efforts	FSA	Opportunity to use field offices as conduits for research to producers	National	Ongoing
Continuity of operations exercise	FSA	Opportunity make sure agency can adequately deal with / respond to large-scale climatic events	National	Annually

**USDA Foreign Agricultural Service
Climate Change Adaptation Plan 2012**

USDA Foreign Agricultural Service Climate Change Adaptation Plan 2012

I. Policy framework

- a. Describe your agency vision, mission, goals, and strategic approaches

The USDA Foreign Agricultural Service (FAS) has defined its mission and vision in its 2012-2016 strategic plan as, “Linking U.S. agriculture to the world to enhance export opportunities and global food security.”⁴ To do so, FAS works around the globe building new markets for US agricultural exports, sustaining and expanding existing markets, improving the competitive position of U.S. agriculture, and ensuring food security and building agricultural capacity in fragile and developing markets.

Various U.S. laws define specific duties that FAS is obliged to undertake. These include: (1) Acquiring information pertaining to agricultural trade; (2) Implementing market development programs; (3) Providing agricultural technical assistance and training; and (4) Carrying out specifically authorized food aid programs. Furthermore, USDA departmental regulations state that FAS is responsible for coordinating Department agencies’ functions involving foreign agriculture policies and programs and their operations and activities in foreign areas.

To achieve its mission and fulfill its statutory duties, FAS has aligned its operations under three core activity pillars: (1) Trade Promotion; (2) Trade Policy; and (3) Trade Capacity Building and Food Security. Each activity pillar has specific program objectives that have been evaluated for their vulnerabilities to climate change. This process of considering vulnerabilities and planning climate change adaptation strategies aligns to FAS management initiatives that aim to incorporate new strategies and policies to improve FAS performance and efficiency.

II. Vulnerability Assessment:

- a. Describe both the risks and opportunities associated with changing climate that your agency will face. For example, how will climate change affect: assets, operations, worker health, natural or cultural resources, security infrastructure, economic activities, or coordination. In this discussion you should consider physical factors such as temperature shifts, hydrological changes, extreme events, sea level rise, etc.

A changing climate poses a number of vulnerabilities for FAS to address in order to continue to fulfill its mission. In addition to creating vulnerabilities, climate change may provide new opportunities that FAS should prepare to capitalize on. These vulnerabilities and opportunities can be mapped to multiple FAS activity pillars and objectives, which are defined in the FAS 2012-2016 Strategic Plan.

⁴ [http://sharepoint.fas.usda.gov/fasadmin/Lists/FASNews/Attachments/4312/FAS%20SP_2012-2016%20Final%20\(4-11-12\).pdf](http://sharepoint.fas.usda.gov/fasadmin/Lists/FASNews/Attachments/4312/FAS%20SP_2012-2016%20Final%20(4-11-12).pdf)

Foreign Agricultural Service

Pillar #1: Trade Promotion

	Vulnerability	Opportunity
Objective 1.1: Increase effectiveness of FAS market development programs and outreach activities	Increased frequency of extreme weather events may destabilize import markets and increase the volatility of prices. Increasingly volatile trade conditions may make it more difficult to develop long term strategies to build markets for U.S. products. Also, increased variability in U.S. product supply and quality may make it more problematic to consistently promote U.S. products.	Climate change may cause geographic shifts in production that create new markets and/or less competition for U.S. agricultural exports
Objective 1.2: Manage FAS credit programs to yield the greatest benefit to U.S. agriculture	NA	NA
Objective 1.3: Maintain a global market intelligence information system that supports policy and program objectives	Changing climates and more extreme weather may increase market volatility and make predictions more difficult.	NA

Pillar #2: Trade Policy

	Vulnerability	Opportunity
Objective 2.1: Negotiate and enforce market-expanding trade agreements for U.S. exporters of agricultural, fish, and forest products	Climate change may lead to production shortfalls and export bans abroad, undermining FAS efforts to promote free trade.	Climate change may require some countries to rely more on agricultural trade and imports from the U.S. to make up for domestic production shortfalls.
Objective 2.2: Prevent or resolve foreign Technical Barriers to Trade (TBT) or Sanitary/Phyto-Sanitary (SPS) measures that hinder U.S. agricultural exports	Warmer average temperatures may increase the range and severity of disease outbreaks in the U.S. raising TBT and SPS concerns abroad.	NA
Objective 2.3: Pursue the	Climate change may be	1.Climate change may

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<p>development of rules-based international systems that facilitate global trade</p>	<p>used as a pretext for implementing new labeling standards or trade rules that make claims about “sustainability” or “climate-smart” but are not based on sound science.</p>	<p>increase international demand/adoption of genetically engineered (GE) crops and products of other emerging technologies for sustainable agricultural intensification and innovation.</p> <p>2. Increasing international awareness of agriculture and climate change creates opportunities in international fora to promote science-based free trade rules.</p> <p>3. Climate change mitigation policies may create demand for USDA stakeholders to sell verified carbon credits.</p>
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Pillar #3: Trade Capacity Building and Food Security

	Vulnerability	Opportunity
<p>Objective 3.1: Address food security challenges by building food and market systems that expand trade and economic growth through food assistance programs</p>	<p>Climate change may lead to an increased number of countries that request FAS administered food assistance, and, thereby collectively intensify pressure on FAS’ limited resources.</p>	<p>NA</p>
<p>Objective 3.2: Enhance partner countries’ capacity for agricultural development and participation in international trade</p>	<p>Climate change may disrupt and stymie agricultural development in some countries.</p>	<p>Increasing demand for FAS to coordinate USDA capacity building for climate change mitigation and adaptation may be supported by more interagency funding agreements.</p>

III. The Adaptation Planning and Evaluation Process

- a. Integration: Describe agency plans to integrate climate change adaptation into policies, programs, and operations. This includes coordination with stakeholders including local, state or tribal entities and private landowners, as applicable.

FAS relies on its Climate Change Working Group to raise awareness and disseminate information across FAS about emerging climate change issues that may impact the mission, activity pillars, and objectives of FAS. The group meets quarterly and on an *ad hoc* basis and is charged with developing the FAS climate change adaptation plan. The Climate Change Working Group is led by the Office of Agreements and Scientific Affairs (OASA) and has representation from each FAS program area.

FAS is developing the internal capacity to tackle emerging climate change issues and is receptive to stakeholder concerns about climate change. Each summer, FAS Foreign Service Officers attend an Attaché conference in Washington DC for briefings on emerging policy and trade issues, which may include climate change. FAS also participates in many regular stakeholder meetings and ad hoc consultations with cooperators. Regularly scheduled stakeholder meetings include:

Pillar Focus	Meeting	Stakeholders
Trade Promotion	U.S. Agricultural Export Development Council Annual Workshop	Commodity and food export interests
Trade Promotion	Data Users Meeting	Agricultural traders and exporters
Trade Policy	Agricultural Technical Advisory Committee (ATAC)	Private industry representatives
Trade Policy	Agricultural Policy Advisory Committee (APAC)	Private industry representatives
Trade Capacity Building/Food Security	The annual International Food Aid and Development Conference	Private voluntary organizations and US farmer associations

- b. Understanding risks: Briefly describe actions that your agency will take to better understand risks and opportunities. This may include methods to assess vulnerability, to monitor climate impacts, or to project impacts based on scenarios.

FAS is *currently engaged* in assessing the risks and opportunities associated with climate change. There are various means by which FAS understands and evaluates these risks and opportunities. They include engaging in climate change related intra- and inter-departmental working groups (e.g. USDA’s Climate Change Task Force, and Feed the Future working groups). FAS also relies on the extensive intelligence gathering of Foreign Service Officers, who are the “on-the-ground” source of information for over 100 countries. FAS also monitors and advises the work of various international organizations (e.g. FAO, OECD, World Bank) and participates in several United Nations negotiations (e.g. Framework

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Convention on Climate Change, Committee on Trade and Development, Sustainable Development Council).

The FAS Climate Change Working Group will further consider *additional actions* to better understand the risks and opportunities that may affect its key pillars:

Trade promotion.

Proposed Actions: Participation in interdepartmental climate change modeling groups that can inform the integration of climate change projections into USDA agricultural production and trade models utilized by FAS' Office of Global Analysis.

Trade policy.

Proposed Action: Continued leadership in key international negotiations, especially the United Nations Framework Convention on Climate Change. Active engagement will ensure that the interests of USDA stakeholders are adequately considered and that emerging policies are based on sound science.

Trade Capacity Building & Food Security.

Proposed Actions: (1) The USDA Climate Change Task Force is coordinating an assessment on climate change & food security. FAS will participate in the assessment steering committee to ensure that agricultural trade is addressed in the report. (2) Collaboration with other U.S. agencies through cooperative agreements for USDA agricultural development and trade capacity activities related to climate change mitigation and adaptation.

Cross Cutting.

Proposed Action: Engagement with FAS Foreign Service Officers to better inform them about how to report information related to climate change into the Global Agricultural Information Network (GAIN) system. The GAIN system is a compilation of intelligence from FSOs about the agricultural situations in our trading partner countries.

IV. Sustained Adaptation Process

- a. What steps will your agency take annually in order to ensure that this Plan is current

FAS will continue to rely on its Climate Change Working Group to coordinate annual reviews and updates to the Climate Change Adaptation Plan. The review process will include in-depth discussions with each FAS program area and final approval at the administrator level. Additionally, the input of stakeholders and FSOs will be considered when developing updates to the plan.

- b. How will you prioritize (actions)

The following are the most important considerations for prioritizing climate change adaptation actions:

- (1) Impact on FAS mission and potential to improve services to stakeholders;
- (2) Financial resources and the availability of trained personnel;

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(3) USDA priorities for foreign affairs associated with climate change

- c. What sources of information will your agency use to further develop the Plan through time

FAS will rely on a diverse set of information sources to aid in developing the Climate Change Adaptation Plan over time. As mentioned, FAS will consider the needs and input of stakeholders, the intelligence gathered by FSOs, as well as technical information on climate change impacts reported in the National Climate Assessments. FAS relies on the USDA Climate Change Task Force to provide linkages to cutting-edge scientific developments about climate change and agriculture. Additionally, FAS employees can subscribe to the National Agricultural Library’s climate change and agriculture newsfeed to receive weekly updates on current events.

- d. Performance Metrics
 - i. Describe the methods your agency will use to evaluate progress
 - ii. Roadmap, Scorecards, etc.

The FAS Climate Change Working Group will be the coordinating body for evaluating FAS performance on climate change adaptation. As part of the annual review process, each FAS program area will be asked to provide input on progress towards addressing the vulnerabilities and opportunities related to each FAS activity pillar. In addition to the performance metrics associated with specific activities listed in the Appendix, FAS will consider the following aggregate metrics:

Pillar Focus	Performance Metric
Trade Promotion	# of interagency partnerships or working groups that improve FAS access to technical resources related to climate change
Trade Policy	# of issues related to climate change negotiated in bilateral and multilateral fora
Trade Capacity Building & Food Security	# of countries engaged, and # of formal implementing arrangements (e.g. interagency agreements) for USDA agricultural development and trade capacity building activities related to climate change
Cross-Cutting	# of employees informed about climate change issues

V. Actions to address risks and opportunities (include as Appendix).

- a. This section should include pilot activities, the formal integration of adaptation into agency policy, the modification of programs or activities, or capacity building. It should be in tabular format and include the following:

FAS ACTIONS TO ADDRESS RISKS AND OPPORTUNITIES

Pillar #1: Trade Promotion

Proposed New Actions	Agency Lead	Description	Scale	Time-frame	Performance Metrics
Providing guidance for Global Agricultural Information Network (GAIN) reporting on climate change	FAS	FAS has a section within GAIN for voluntary reporting on “climate change/global warming/food security” and clear reporting guidance about climate change issues will be provided to FSOs	Global	Once per Year	# GAIN reports related to climate change/global warming
Advising in the National Climate Assessment on Food Security	USDA-OCE	The USDA Climate Change Task Force is coordinating an assessment on climate change & food security. FAS will participate in the steering committee to ensure that agricultural trade is considered in the report	Global	Publish 2013	# FAS employees who rank the report as useful

Pillar #2: Trade Policy

Current Actions	Agency Lead	Description	Scale	Time-frame	Performance Metrics
Integrating climate change considerations into Country Strategy Statements (CSS)	USDA-FAS	Each year FAS develops country strategy statements to further the Mission of FAS. FAS will integrate climate change into the general guidance for future country strategy statements	Global	Once per Year	# CSS that reference climate change
Monitoring International Organizations	State Dept., EPA, USTR	FAS Promotes the importance of agriculture in international organizations and discourages trade restricting agreements	Global	Ongoing	# meetings or reports reviewed by FAS that are related to climate change
Negotiating for agriculture at the UN climate change negotiations	State Dept., USDA-Forest Service,	FAS has been participating in the UNFCCC negotiations since 2009 and seeks to ensure that agricultural issues are	Global	Ongoing	-# stakeholders groups engaged -establishment of a climate

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	USDA-FAS USDA-OCE	considered in the negotiations and do not hamper free trade			change & agriculture work program
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Pillar # 3: Trade Capacity Building & Food Security

Current Actions	Agency Lead	Description	Scale	Time-frame	Performance Metrics
Managing interagency acquisition agreements (IAAs) for climate change activities related to agricultural development, trade capacity building and food security	USDA-FAS, State Dept., USAID, Land-Grants	FAS-administered scientific exchanges and capacity-building programs are flexible, critical tools for USDA to engage countries on climate change priorities. These activities enable U.S. and international counterparts to jointly promote economic development and environmental quality in the agriculture sector and, overall, promote global food security.	Global	Ongoing	-# IAAs -countries served -total \$
Participating in Feed the Future (FtF) working groups	State Dept., USAID, USDA-OSEC, USDA-NASS, USDA-ERS, USDA-OCS	These working groups seek to assess prevailing conditions, define priorities and accordingly align USG resources that can develop the agricultural sectors of food insecure countries. Increasing the food security of FtF partner countries will help them to be more resilient to possible climate change related food shortages.	Global	Ongoing	-# projects implemented by USDA that are part of FtF initiatives

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Cross-Cutting

Current Actions	Agency Lead	Description	Scale	Time-frame	Performance Metrics
Convening FAS Climate Change Working Group & Managing the Climate Change Adaptation Plan	USDA-FAS	This Working Group acts to quickly communicate about climate change issues throughout FAS. Likewise, the Working Group may be quickly mobilized to help coordinate agency-level responses or tasks related to climate change.	DC and select FAS posts	Ongoing	# meetings / year
Developing internal FAS capacity on climate change issues	USDA-FAS	Climate change is a relatively new issue for FAS to consider and therefore internal capacity building is needed to best support the mission and objectives of FAS	Global	Ongoing	# FAS employees trained on climate change issues, impacts, and/or opportunities

USDA Forest Service
Climate Change Adaptation Plan
May 24, 2012

**USDA Forest Service Climate Change Adaptation Plan
May 24, 2012**

I. Policy Framework

a. *Describe your agency vision, mission, goals, and strategic approaches*

Mission

The mission of the Forest Service (FS) is to sustain the health, diversity, and productivity of the Nation's forests and grasslands to meet the needs of present and future generations.

Americans rely on their forests and grasslands for a wide range of benefits—for provisioning services such as water, wood, and wild foods; for regulating services such as erosion, flood, and climate control; and for cultural services such as outdoor recreation, spiritual renewal, and aesthetic enjoyment. These services are connected and sustained through the integrity of the ecosystems on these lands.

Goals and Strategic Approach

FS policies, developed over many years, were mostly devised before the agency took climate change into account in its programs for public land management, private forest landowner assistance, and research. Such policies might not provide the most effective means for guiding actions to address climate change across broad landscapes, jurisdictions, and resource areas; however, these policies did consider establishing and maintaining resilient forests and rangelands in light of stressors. The FS is identifying shortcomings in its current policies, procedures, and program guidance. The goal is to reformulate them where necessary to align resources with an effective climate change response and to more effectively collaborate with other Federal agencies, States, Tribes, and other stakeholders for landscape-scale conservation.

The FS approach for adapting to climate change encompasses a) climate-specific strategies across the agency and b) direct program-by-program efforts to integrate climate-related policies and guidance, where climate change is one of many drivers of change to be considered in sustaining forest and grassland ecosystems.

Climate-specific goals and strategies include:

- ***USDA 2010-2015 Strategic Plan - Goal 2***
Ensure our national forests and private working lands are conserved, restored, and made more resilient to climate change, while enhancing our water resources.
 - Objective 2.2 - Lead efforts to mitigate and adapt to climate change.
- ***FS National Roadmap for Responding to Climate Change (Roadmap).***
In October 2008, the FS had introduced a *Strategic Framework for Responding to Climate Change*. The Roadmap builds upon the strategic framework and lays out three types of actions for the FS to employ in a continuous cycle of adaptive management informed by monitoring and evaluation:

- **Assess** current risks, vulnerabilities, policies, and gaps in knowledge.
- **Engage** internal and external partners in seeking solutions.
- **Manage** for resilience, in ecosystems as well as in human communities, through adaptation, mitigation, and sustainable consumption strategies.

All three modes of action are dynamic and mutually reinforcing. They are interconnected through monitoring and evaluation, forming a continual feedback loop to allow opportunities for adjustment in direction or tactics.

- ***FS Climate Change Performance Scorecard (Scorecard)***

Individual National Forest System (NFS) field units apply the Scorecard to facilitate implementation of the Roadmap and USDA Strategic Plan. The Scorecard is completed annually in fiscal years 2011-2015. By 2015, each field unit is expected to answer *Yes* to at least seven of the Scorecard's 10 elements (questions), with at least one *Yes* in each of the four dimensions outlined below. The Scorecard's multiple dimensions ensure that each Unit works toward a balanced response to climate change. The four dimensions and ten elements are:

- Organizational capacity - *Engage employees through training and integrate climate change into program of work.*
 1. Employee Education
 2. Designated Climate Change Coordinators
 3. Program Guidance
- Engagement – Develop partnerships and transfer knowledge.
 4. Science and Management Partnerships
 5. Other Partnerships
- Adaptation – Assess impacts of climate change and manage change.
 6. Assessing Vulnerability
 7. Adaptations Actions
 8. Monitoring
- Mitigation and Sustainable Consumption – Assess carbon stocks and reduce our Agency footprint.
 9. Carbon Assessment and Stewardship
 10. Sustainable Operations

- ***Executive Order 13514 – Federal Leadership in Environmental, Energy, and Economic Performance***

Directs each agency to not only develop a sustainability strategy and reduce greenhouse gas emissions but to develop policies and practices to support the Federal Adaptation Strategy. The Scorecard will simplify accomplishment reporting for this order.

- ***Forest Service Global Change Research Strategy 2009-2019***

In keeping with the research goals of the U.S. Global Change Research Program, the FS Research and Development mission area helps define climate change policy and develop best management practices for forests (both rural and urban) and grasslands in order to sustain ecosystem health and services (adaptation), and increase carbon sequestration (mitigation), all under changing climate conditions. The fundamental research focus of the FS Global Change Research Strategy is to increase understanding of forest, woodland, and grassland ecosystems, use this information to project potential futures. This information and the resulting tools will facilitate vulnerability assessments and the development of management practices to increase the probability of achieving projected futures that best meet the needs of the Nation.

The FS is also incorporating climate considerations into program- or resource-specific policies and guidance. Examples include:

- ***New Planning Rule***

The new rule provides improved ability to respond to climate change and other stressors through an adaptive framework of assessment, planning and monitoring and new provisions intended to improve resilience of ecosystems on each unit. Examples include:

- 219.6(b)(3): “Identify and evaluate existing information relevant to the plan area for...the ability of terrestrial and aquatic ecosystems on the plan area to adapt to change.”
- 219.12(a)(5)(vi): Monitoring programs must include monitoring questions and indicators that address “...measurable changes on the plan area related to climate change and other stressors that may be affecting the plan area.”

- ***Genetic Resource Management and Climate Change: Genetic Options for Adapting National Forests to Climate Change***

Provides an overview of current climate change knowledge and potential implications for forest tree species, as well as goals, principles, and recommendations for enhancing forest resilience and resistance through a re-aligned “climate-smart” National Forest System (NFS) Genetic Resource Management Program.

II. Vulnerability Assessment:

- a. Describe both the risks and opportunities associated with changing climate that your agency will face.*
- b. This section should build on the agency responses provided for the USDA Final Vulnerability Assessment in March 2012.*

Physical and Biological Climatic Concerns: The FS mission is impacted by shifts in temperature and precipitation patterns and amounts, extreme events, and climate variability. The FS manages public forests and grasslands and works with States, Tribes and private landowners to restore and sustain the health, diversity and productivity of the Nation's forests and grasslands. Changes in key climate variables affect the seasonality of hydrologic regimes, reproduction cycles of pests and pathogens, and length of fire seasons. Fire seasons in the West have increased by 78 days since the mid-1980s.⁵ Disturbance facilitates the introduction and spread of invasive species, which increase extinction risks for native species and other alterations of ecosystem processes and functions. The changing climate is already altering species ranges and has the potential to alter ecosystem structure in the future as evidenced by the mountain pine beetle (a native insect) epidemic in the West. Management will require forward-looking approaches to novel ecosystems instead of depending on historical ranges of variability. These impacts pose challenges to sustaining forests and grasslands and the supply of goods and services upon which society depends, such as clean drinking water, forest products, recreation opportunities, and habitat.

Marketing Concerns:

Climate change may influence the demand for energy and its mix of sources. Woody biomass is gaining attention as a renewable energy source. An increasing demand for renewable energy may affect how forests are managed and influence a wide range of ecosystem services, such as water quantity and quality, wildlife habitat, and carbon sequestration. Changes in forest management objectives could affect the price of traditional forest products and downstream products such as housing.

Management options to maintain healthy ecosystems include thinning stands to reduce moisture stress and regenerating stands where they have been decimated by insects or disease. Having a market for products from these operations is important to offset management costs and improve local/rural economies. Because of the demise of the forest industry in many areas, a major marketing effort will be necessary to reestablish mills and processing plants.

Potential impacts to other ecosystem services also may affect social and economic sectors. For example, climate change may adversely affect river-based outdoor recreation opportunities through changes in the timing and volumes of streamflow; thereby impacting many rural communities dependent on favorable water flow and a river based economy.

The economic benefits of outfitting and guiding and river-related recreation use are large contributors to local and rural economies where rivers are large enough to support such economies. They should be recognized just as are reservoir operations and other developed recreation opportunities (campgrounds) along riverways.

Infrastructure Concerns:

Transportation System: With increasing heavy rain events, the extensive road system on NFS lands will require increased maintenance and/or modification of infrastructure (e.g. larger culverts or replacement of culverts with bridges).

⁵ Westerling, Hidalgo, Cayan, and Swetnam. 2006. Science 313: 940-943.

Open Space and Outdoor Recreation: Recreation infrastructure, including ski areas, reservoirs and campgrounds, is strongly influenced by past and current climate. Preserving high-quality outdoor recreation experiences will depend not only on the condition of the land, facilities, and transportation infrastructure but also on where such opportunities can be accommodated safely and managed under a changing climate. The projected increase in U.S. population and the continual decline of public access to privately-owned undeveloped land will increase demand for recreation opportunities on public land.

Capacity Building: The FS provides a wide variety of climate change communication materials and training opportunities for its employees, other agencies, and the public. These range from basic awareness education to highly technical seminars, workshops, and courses for conducting vulnerability assessments and developing adaptation and mitigation strategies.

Partnerships between scientists and land managers are being strengthened to improve the focus of research and technology to address current and emerging science and information needs. Resource inventory, monitoring, and assessment activities and decision support tools are being better aligned and coordinated across FS programs and with partner agencies at multiple scales. Examples of ongoing and newly initiated capacity-building efforts are:

- **Conservation Education Programs** - Increase environmental literacy through partnerships with groups who educate urban populations on the value of well-managed public and private forested lands and, through natural resource stewardship, improve the public's quality of life. Frequency of extreme events and more climatic variability will challenge stewardship programs that directly benefit urban dwellers.
- **Climate Change Resource Center** – The primary web-based science delivery portal for FS employees and partners who need information and tools to address the impacts of climate change in land management decision making.
- **Environmental Threat Assessment Centers** (Eastern Forest Environmental Threat Assessment Center and Western Wildland Environmental Threat Assessment Center) - Provide interdisciplinary resources that are actively developing new technology and tools to anticipate and respond to forest threats, including climate change.
- **Inventory, Monitoring and Assessment Strategy** – FS has developed a strategy to improve broad and national scale inventory, monitoring, and assessment (IM&A) activities across a gradient of landscapes. Implementation of the strategy will provide resource managers across jurisdictions and ownerships the data they need for managing in light of climate change.

III. The Adaptation Planning and Evaluation Process

Integration

- i. Describe agency plans to integrate climate change adaptation into policies, programs, and operations.*

The FS has a number of comprehensive efforts underway to integrate climate change adaptation into agency-wide policies, processes, programs, and operations. Examples include:

The *National Roadmap for Responding to Climate Change, Climate Change Performance Scorecard*, and the new Planning Rule for the national forests and grasslands.

The *Planning Rule* (36 CFR 219) establishes a framework consisting of an iterative process for NFS administrative units that includes assessment; developing, amending, or revising a land management plan; and monitoring. The intent of this framework is to create a responsive planning process that informs integrated resource management and allows the FS to adapt to changing conditions, including climate change, and improve management based on new information and monitoring.

The agency is improving its capability to deliver science, resource information, and tools for better informing and coordinating climate change adaptation strategies and land management decisions at broader landscape scales across jurisdictions and land ownerships. Examples include the *Watershed Condition Framework* and the *Inventory, Monitoring and Assessment Strategy*.

Tools developed by FS scientists and partners, such as i-Tree urban forest assessment tools, assist managers to assess and monitor the structure, function and value of urban and community forests, including water and air quality, carbon sequestration, and energy conservation benefits. This information is used to manage urban forest resilience in response to climate change stresses.

The *2010 Resources Planning Act (RPA) Assessment* reports on the status and trends of the Nation's renewable resources on all forests and rangelands, including National Forest System lands. The RPA Assessment includes analyses of forests, rangelands, wildlife and fish, biodiversity, water, outdoor recreation, wilderness, urban forests, and the effects of climate change upon these resources. The RPA projects a number of different future scenarios 50 years forward to explore potential impacts of climate change.

The FS is reviewing and revising resource management policies, technical guidance, and procedures to ensure they are climate-smart.

State and territorial partners are encouraged through financial assistance to focus financial, educational and technical assistance on helping localities improve the resilience of their urban and community forests in response to climate change stresses. Assistance to communities include strategic tree planting and active management of the urban forest to 1) increase carbon sequestration, 2) reduce energy consumption and reduce greenhouse gas emissions from power plants, 3) reduce the forest's susceptibility to insects and disease, 4) improve the forest's ability

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to contribute to clean water quality and quantity needs, and 5) generate biofuels from urban wood waste products to off-set fossil fuel usage.

The Forest Service is also providing technical assistance to private and family forest owners to improve the resilience of these forest landscapes.

Understanding Risks

- ii. Briefly describe actions that your agency will take to better understand risks and opportunities.*

Management of forests and grasslands and associated resources involves making long-term commitments of resources and investments. The FS continues to refine its planning and decision making processes regarding the consideration of climate change risk and uncertainty. In January 2009, national guidance was developed for the NFS to address climate change in land management planning and project-level National Environmental Policy Act (NEPA) analyses. The Planning Rule and forthcoming directives and guidance are updating that initial guidance.

Agency scientists work closely with land managers to downscale climate projections to better understand the range of potential ecosystem impacts, conduct vulnerability assessments for key resources, and develop localized adaptation approaches and options. For example, vulnerability assessments for water resources and aquatic ecosystems were recently completed on 12 national forests, representing each of the nine FS regions. Likewise, two regions have completed risk assessments of their forest tree species. These serve as pilots for completing additional assessments. Also, comprehensive risk assessments are being completed when planning recreation infrastructure projects; and a risk assessment of all developed recreation sites was conducted recently to identify and mitigate public safety issues related to extreme weather events.

In cooperation with national, state and local partners, urban forest health monitoring efforts of the FS are underway to identify existing and potential pest and disease threats to our urban forests and to help understand the impact of climate change on the vulnerability of urban forests to infestations.

All NFS unit level land management planning and project planning involves collaboration with the public and key partners such as Tribes and local governments. The FS is engaged with Department of Interior and State agencies in using the newly formed Landscape Conservation Cooperatives (LCCs) to coordinate sharing of resource information and science and developing adaptation strategies across these broader landscapes.

IV. Sustained Adaptation Process

- a. What steps will your agency take annually in order to ensure that this Plan is current*
- b. How will you prioritize*
- c. What sources of information will your agency use to further develop the Plan through time*

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The Climate Change Advisor's Office will lead the Adaptation Plan's annual review, monitoring of actions listed in the appendix, and Plan update. Monitoring of resource conditions and trends with input from FS Research and Development, field units, other agencies, and stakeholders will inform prioritization or adjustment of national policies and programs.

d. Performance Metrics

- i. Describe the methods your agency will use to evaluate progress*
- ii. Roadmap, Scorecards, etc.*

Climate Change Performance Scorecard annual reporting will track progress on implementing major actions of the Roadmap and this Adaptation Plan. Improvement in Scorecard results will reflect effectiveness of agency strategic approaches, policies, this Adaptation Plan, and other efforts within the FS and by partners. The Scorecard itself will also be reviewed regularly to ensure it continues to meet the agency's needs, with potential to expand its application to other mission areas.

National and regional assessments will continue to monitor the health and productivity of the nation's forests and rangelands. Examples include:

- Forest and Rangeland Renewable Resources Planning Act (RPA) Assessment
- Southern Forest Futures Project
- Northern Forest Futures Project.

The Planning Rule requires national forests and grasslands to monitor progress towards their desired conditions and including key indicators of ecosystem status and measurable changes on the plan area related to climate change and other stressors that may be affecting the plan area.

V. Actions to address risks and opportunities (include as Appendix).

This section should include pilot activities, the formal integration of adaptation into agency policy, the modification of programs or activities, or capacity building. It should be in tabular format and include the following:

Appendix: Actions to address risks and opportunities (not all-inclusive)

Action	Agency Lead	Description	Scale	Timeframe	Performance metrics
USDA-Forest Service (FS) Climate Change Roadmap and Performance Scorecard	Climate Change Advisor's Office	Roadmap identifies ongoing actions and establishes short and longer term strategic actions and investments to respond and adapt to climate change. Performance Scorecard tracks progress implementing the Roadmap by individual national forests and grasslands.	Local, summarized at Regional and National levels	Ongoing	Annual reporting by field units on implementing at least seven of ten scorecard elements by end of FY2015.
Forest Service Global Change Research Strategy 2009-2019	Research & Development	Fundamental research focus of the FS Global Change Research Strategy is to increase understanding of forest, woodland, and grassland ecosystems so that they can be managed in a way that sustains and provides ecosystem services for future generations.	National	2009-2019	Broad diversity of research products including peer-reviewed publications, number of tools developed, customer-satisfaction surveys and science delivery efforts, such as workshops.

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Action	Agency Lead	Description	Scale	Timeframe	Performance metrics
New Planning Rule (FS)	Ecosystem Management Coordination	Revised process for establishing, amending and revising land management plans for national forests and grasslands. Incorporates consideration of climate change into land management plans through assessments and monitoring.	Local, Regional National	Approved March 2012. Implementation is ongoing.	Planning Rule was approved on March 23, 2012. Directives are being written and 8 “early adopter” field units are developing new approaches, tools, etc. New rule will be implemented as forests and grasslands revise their plans.
Revision of National Forest and Grassland Land Management Plans	Ecosystem Management Coordination	As land management plans are being revised, climate projections, vulnerability assessments, and climate adaptation strategies are being developed and incorporated as needed.	Local	Ongoing	Number of plans revised annually.
National Cohesive Wildland Fire Management Strategy (FS)	Fire and Aviation Management	Addresses the nation's wildfire problems by focusing on three key areas: Restore and Maintain Landscapes, Fire Adapted Communities, and Response to Fire. It is being implemented in three phases.	National, Regional	Phase I completed in March, 2011. Phase II started.	Link to <u>Cohesive Strategy Goals and Performance Measures</u> . Five-year review cycle to provide updates to Congress.

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Action	Agency Lead	Description	Scale	Timeframe	Performance metrics
Inventory, Monitoring, and Assessment Strategy (FS)	Ecosystem Management Coordination	Implement strategy for improving resource inventory, monitoring, and assessment activities. Strive for information to be comprehensive, inclusive, credible, and responsive and adaptive to changes.	National	Complete strategy June 2012 Implement 2012-14	Establish IM&A Strategy scorecard metrics
Forest and Rangeland Renewable Resources Planning Act (RPA) Assessment (FS)	Quantitative Sciences	The 2010 RPA Assessment includes climate projections and potential impacts.	National, Regional	2012	<u>2010 RPA Assessment Reports and Data</u>
Increasing the Pace of Restoration and Job Creation on Our National Forests	Forest Management	Report lays out a series of ongoing and future actions related to the use of active forest management as one important tool to accomplish needed restoration work to maintain the functions and processes characteristic of healthy, resilient forests and watersheds..	Local	2012-2015	FS annual performance metrics

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Action	Agency Lead	Description	Scale	Timeframe	Performance metrics
Watershed and Terrestrial Condition Frameworks for integrated resource restoration. (FS)	Watershed, Fish, Wildlife, Air, and Rare Plants	WCF and TCF are agency-wide processes and tools for characterizing and prioritizing watersheds and landscapes for restoration and developing adaptation strategies.	Local, Regional, National	Annually over the next 3 years	Watershed Condition Framework is now operational.
Climate Change Education	Climate Change Advisor's Office	Develop introductory short course: Climate Change for Natural Resource Managers. For FS employees and partners.	National	2012	Course developed and deployed (Scorecard metric)
<u>Climate Change Resource Center</u> (FS) (www.fs.fed.us/ccrc)	Research & Development	Enhance web-based science-delivery portal for Forest Service employees and partners who need information and tools to address climate change in project planning and implementation.	National	2012-2015	Annual monitoring of website improvements completed.
Synthesis of climate change adaptation across all federal land management agencies (FS)	Climate Change Advisor's Office, Research & Development	Document the state of science and management on adaptation for each agency, develop overarching inferences regarding adaptation, and emphasize the consistency among agencies.	National, Regional, Local	2012-2013	Publication
Climate Projections FAQ (FS)	Forest Management Sciences		National	2011 Post on web 2012	Published

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Action	Agency Lead	Description	Scale	Timeframe	Performance metrics
Workshop on adaptation for Tribes (FS)	Resource Use Sciences		National, International	2012	Completion of workshop
National Strategic Tree Planting Initiative	Cooperative Forestry	Establish tree planting projects in urban and community forests to increase the amount of carbon sequestered and carbon emissions avoided. ,	National	2012-2015	Amount of carbon sequestered and avoided per federal dollar invested
Forest Tree Gene Conservation	Forest Health Protection	Prioritize forest trees for gene conservation, develop conservation plans, carry them out	National	2012-2015	Ensure at least 20 unrelated individuals (or seed) collected per seed zone.
National Fish, Wildlife and Plants Climate Adaptation Strategy (NFWPCAS) and FS goals	Watershed, Fish, Wildlife, Air, and Rare Plants	FS goals in alignment with NFWPCAS goals	National	2012-2013	% alignment of FS goals with NFWPCAS goals
Wood as a Green Building Material	Research & Development	Promote and seek recognition by the U.S. Green Building Council and others of the environmental benefits of wood building products.	National	2012-2014	Percent completion of Life Cycle Inventory (LCI) wood database update for Life Cycle Assessment (LCA) use and EDP establishment for wood products to meet Green Building standards

USDA National Agricultural Statistics Service
Climate Adaptation Plan

**USDA – National Agricultural Statistics Service
Climate Adaptation Plan**

I. Policy framework

a. Describe your agency vision, mission, goals, and strategic approaches

The National Agricultural Statistics Service's (NASS) mission is to provide timely, accurate, and useful statistics in service to U.S. agriculture. To achieve this, NASS administers USDA's program of collecting and publishing current national, State, and county agricultural statistics. The Census of Agriculture, conducted every 5 years, provides comprehensive, local level data about agricultural communities across America. The statistical data provided by NASS are essential to both the public and private sectors for making effective policy, production, and marketing decisions on a wide range of agricultural commodities.

Each month, the USDA publishes crop supply and demand estimates for the Nation and the world. These estimates are used as benchmarks in the marketplace because of their comprehensive nature, objectivity, and timeliness. The statistics that USDA releases affect decisions made by farmers, businesses, and governments, by defining the fundamental conditions in commodity markets.

NASS forecasts U.S. crop production based on data collected from farm operations, field observations, and remote sensing. Forecasts for each crop season begin with a winter wheat seedings report in early January followed by a March report that gives a first look at what farmers intend to plant for other major crops. This is followed in late June by a report of the acreage actually planted. Monthly yield and production forecasts begin in May for winter wheat, in July for spring wheat and other small grains, and in August for other spring-planted crops. NASS also publishes estimates of actual production at the end of the harvesting season. NASS conducts quarterly surveys of grains and oilseeds stored on and off farms. NASS also conducts several livestock surveys at various frequencies on an annual, quarterly, or monthly basis.

The World Agricultural Outlook Board (WAOB) coordinates an interagency process that prepares monthly forecasts of supply and demand for major crops, both for the United States and the world, and follows a balance-sheet approach to account for supplies and utilization. Whereas forecasts of U.S. crop production and estimates of U.S. stocks on hand are independently prepared by NASS, U.S. and foreign supply and demand forecasts are developed jointly by several USDA agencies. The NASS *Crop Production* report and the *World Agricultural Supply and Demand Estimates (WASDE)* report are prepared simultaneously in a secured area and released at 8:30 a.m. Eastern Time between the 8th and 12th day of each month. Joint preparation enables USDA analysts to incorporate the new NASS production forecasts of U.S. crops into world supply and demand estimates. These estimates provide an overview for more detailed analyses published by other agencies of USDA, especially the Foreign Agricultural Service (FAS) and the Economic Research Service (ERS).

II. Vulnerability Assessment:

- a. *Describe both the risks and opportunities associated with changing climate that your agency will face. For example, how will climate change affect: assets, operations, worker health, natural or cultural resources, security infrastructure, economic activities, or coordination. In this discussion you should consider physical factors such as temperature shifts, hydrological changes, extreme events, sea level rise, etc.*
- i. A review of the wide body of climatological, meteorological, and biophysical research on climate variability for the conterminous U.S. points to multiple scenarios, many of which may impact NASS operations related to crop and livestock monitoring and assessment. These include:
- **In the near term**, rapidly developing and extreme weather events (persistent rainfall, flooding, hail, tornadoes, hurricanes, and heat waves) nationwide have stressed NASS' current resources and abilities to respond with timely and accurate monitoring and assessment of major crop (corn, soybeans, wheat, cotton, etc.) production and increased burden on survey respondents.
 - Extreme and often quickly developing drought, intensified by summer heat waves, expanding from the Southwest U.S. into the Deep South and western Corn Belt will pose a challenge to NASS monitoring and reporting capabilities. Increased probabilities of a persistent "heat dome" over much of the U.S. mid-section is a subject of current interest in climatic research.
 - **Over the longer term**, warmer and wetter climate regimes in the upper Great Plains and Midwest pose significant ecological, agronomic, and management challenges, threaten current farm sustainability, crop dislocation, and food and fiber processing/transportation infrastructure. Such scenarios could alter current NASS data collection strategies, sampling methodologies, and list and area frame infrastructure.
 - Warmer and drier climate regimes in the Southwest and South will impact water resources, irrigated and dryland crop production, vast grazing lands, and lead to more dislocation of crop areas and livestock and facilities.
 - More intense heat, droughts, and increasingly scarce water resources in California and throughout the Southwest will threaten future commercial fruit and vegetable production and the sustainability of survey respondents.
 - Warmer temperatures in the Northwest have already impacted heavily relied upon spring snowpack and water resource availability for the summer growing season. Competition for scarce water supplies may lead to disruption/dislocation of current fruit, vegetable, and potato production and facilities, leading to additional changes to NASS data collection strategies.
 - Animal agriculture generally responds to weather variability through stress, which reduces physical health and immune response. Adverse weather could impact feed availability, especially in areas that depend heavily upon pasture and hay.

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- ii. Recent research suggests that extreme weather events over the past decade are likely related to global climate change. Evidence of impact on NASS assets, operations, worker health, natural or cultural resources, security infrastructure, economic activities, or coordination over the past decade follows:
 - NASS has, for each of the past six years, had to conduct a reinterview survey for one or more time periods. Reinterviews add additional respondent burden to previously sampled and enumerated farm operators and agribusinesses and result in additional costs and delayed information to the public for affected crops and states.

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Year	Surveys	States	Comments
2006	June Ag Yield	KS, OK, TX	Drought
2007	June Ag Yield	AR, GA, IL, IN, KS, KY, KY, MO, MS, NC, SC, TN	Hard freeze
	August Ag Yield	KS, OK	Late Plantings
2008	JAS List & Area	IL, IN, IA, MT, MO, WI, MN	Flooding, persistent rain. Remote Sensing support implemented.
	Dec. Ag Survey	GA, IL, MI, MN, NC, ND, SC, SD, VA, WI	Delayed harvest North, drought in Southeast.
2009	June Area	IL, IN, KY, MO, ND, OH, PA	Flooding, persistent rain.
	Sept. Ag Survey	ID, MN, MT, ND, WY	Delayed harvest, unharvested small grains.
2010	Sept. Ag Survey	ID, MT, ND, OR, WA, WY	Delayed harvest, unharvested small grains.
	Dec. Ag Survey	ND, SD	Unharvested corn due to heavy snowfall. Resurveyed 4/11. Remote Sensing support implemented.
2011	JAS Area (only?)	MN, MT, ND, SD (IL, KY, TN & Delta states?)	500 year flooding in Delta+, & persistent rain in Northern Plains. Remote Sensing support implemented.
	Sept. Ag Survey	ID, MT, MI, ND, OR, WA	Delayed harvest, unharvested small grains.

- An increasing demand for quick response, ad hoc requests to the NASS Remote Sensing unit to support the monitoring and assessment of extreme weather impacts on agency operations and agricultural production.
- Following extreme weather events, requests for information (often demanding a quick response) increase significantly from news media, businesses, and government officials

seeking additional information. Any increase in frequency and/or intensity of such events poses an additional burden on NASS staff responding to the information demands.

- Commodity price swings and market variability has generated comprehensive research, commentary, and negative publicity of NASS' reporting capabilities. Such market volatility can result in market instability, poor and inefficient market decisions, and increased risk.
- Corn and soybean crop plantings in 2010 and now 2012 occurred faster than normal. Comparison of changes to average planting dates, as compiled by NASS from the last two publications (1997 and 2010), reveal earlier plantings, with a 3.9 days earlier average planting date noted for corn for the 10 major states. This suggests that the NASS *Crop Progress* reports, now beginning on the first week in April, may need to be started in the future to adapt to an earlier seasonal climate regime. This would result in increased cost to the agency and an increase in respondent burden.

- iii. Survey analysis is challenging if we are experiencing weather unlike any other year. We rely heavily on time series charts and models and when data fall outside the normal ranges it is risky extrapolating models beyond the normal range. This scenario happens when the crop is 3 weeks ahead or behind normal phenological development or growing degree days is record high or low.

III. The Adaptation Planning and Evaluation Process

a. Integration

Describe agency plans to integrate climate change adaptation into policies, programs, and operations. This includes coordination with stakeholders including local, state or tribal entities and private landowners, as applicable.

NASS programs and policies are regularly reviewed both internally and externally. Adapting to the dynamic agricultural industry requires constant vigilance and assessment of the statistical and informational needs of the entire food and fiber sector. As demand for food and fiber increases with the world's population, the magnifying glass that NASS products fall under intensifies, and public scrutiny of NASS reports and services demands adaptation to constantly changing environments. NASS plans to integrate climate change adaptation into policies, programs, and operations follow:

- i. NASS, along with other USDA agencies, conducts annual "Data User" meetings with public users of USDA and NASS data. NASS also has an Advisory Committee on Agriculture Statistics. NASS will propose Climate Change Adaptation Planning to be a topic for discussion for either one or both of these meetings with our stakeholders.
- ii. Internally, NASS senior executives will be briefed on past and potential impacts of the changing climate.
- iii. As educational opportunities become available, NASS employees will be offered opportunities to "learn from the experts," how the changing climate may affect agriculture and possible impacts on their work and employment.
- iv. NASS currently has no resources specifically dedicated to address, study or otherwise adapt to the impacts of climate change. Pending the outcome of the above-mentioned

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meetings and reviews, it is expected that resources will be needed in the following areas:

- Continue to develop the science and operational capacity of the NASS Remote Sensing program to support agency natural disaster response, produce time-sensitive monitoring and assessment data and products, and expand support to the NASS Mission.
- Plan for resources to allow adequate agency response to extreme weather events, especially during critical survey periods.

b. Understanding risks

Briefly describe actions that your agency will take to better understand risks and opportunities. This may include methods to assess vulnerability, to monitor climate impacts, or to project impacts based on scenarios.

NASS will continue participation in USDA's Global Change Task Force. Task force members will be tasked with reviewing and staying abreast of current climatic research and activities, recommending strategies to assess the impact of climate change on agency activities, and identifying appropriate sources and methods of training for NASS staff.

IV. Sustained Adaptation Process

a. What steps will your agency take annually in order to ensure that this Plan is current
NASS conducts a full program review every 5 years based on results of the Census of Agriculture. If needed, estimating program changes are made to specific crop, livestock, poultry, prices, and survey programs. These Program Reviews will identify and/or account for the impact of climate change.

b. How will you prioritize

Priorities will be established based on the overall impact and value of changes to stakeholders and the user communities.

c. What sources of information will your agency use to further develop the Plan through time
NASS will rely on the latest scientific information available to modify or enact new strategies for adaptation. The National Climate Assessment for Agriculture will be the primary resource, but public response to NASS meeting its mission and responsibilities will be integral to any changes.

d. Performance Metrics

Describe the methods your agency will use to evaluate progress

- Agency has reserve resources for necessary recontact and reinterview surveys.
- Agency has completed assessments for the Agricultural Statistics Board to adequately evaluate disasters for report preparations.
- Agency has modified surveys and publications when needed based on the demands of data users.

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e. Roadmap, Scorecards, etc.

- NASS will identify and record annual resources expended due to the effects of extreme weather events. Specifically, we will maintain records of all recontact or reinterview surveys conducted to assist in planning.
- NASS will also begin tracking extreme weather events and their affect on agency assets, operations, and mission deliverables. This will include documentation on specific events, respondent burden, affects on quantity and quality of data published, staff response to additional burdens, follow-up activities, etc

V. Actions to address risks and opportunities (include as Appendix).

a. This section should include pilot activities, the formal integration of adaptation into agency policy, the modification of programs or activities, or capacity building. It should be in tabular format and include the following:

Appendix: Actions to address risks and opportunities

Action	Agency Lead	Risk or Opportunity	Scale	Time-frame	Implementation Methods	Performance Metrics
• Data User’s Meetings or Advisory Committee on Agriculture Statistics	Agricultural Statistics Board	Opportunity-Outside review to identify ways to adapt	National	2012	Document, research, funding requests for implementation	Success of implementing recommendations
• Internal Meetings of Senior Leadership	Senior Executive Team	Opportunity – internal assessment and reallocation	Agency-wide	2012	Document, research, funding requests for implementation	Success of implementing recommendations
• Agency Training	Global Change Task Force Member	Opportunity-expanding knowledge	Agency-wide	Begin FY 2013	Ag Learn, personal research, seminars & conferences	Completion
• Continue participation in USDA GCTF	Global Change Task Force Member	Opportunity-develop internal expertise	Agency-wide	FY 2012	Select, meet, communicate, implement	Implementation
• Document additional resources for re-interviews	Program Administration Branch	Opportunity-document	Agency-wide	FY 2012	Record keeping and Budgeting plans	Agency resources expended in response to extreme weather events

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• Document extreme weather and their impact	Geospatial Information Branch	Opportunity-document	Agency-wide	FY 2012	Record keeping	Agency resources expended in response to extreme weather
• 5-year Program Review	Statistics Division	Opportunity-reprioritize agency programs	Agency-wide	FY 2014	Senior leadership	Program changes initiated due to climate change

USDA National Institute of Food and Agriculture
Agency Climate Change Adaptation Plan

**USDA - National Institute of Food and Agriculture
Agency Climate Change Adaptation Plan**

I. Policy framework

NIFA's unique mission is to advance knowledge for agriculture, the environment, human health and well-being, and communities by supporting research, education, and extension programs in the Land-Grant University System and other partner organizations. NIFA doesn't perform actual research, education, and extension but rather helps fund it at the state and local level and provides program leadership in these areas.

NIFA's two key mechanisms for accomplishing its mission of "advancing knowledge" are:

- **National program leadership.** NIFA identifies and supports research, extension, and education priorities in areas of public concern that affect agricultural producers, small business owners, youth and families, and others.
- **Federal assistance.** NIFA provides annual formula grants to land-grant universities and competitively granted funds to researchers in land-grant and other universities, and other eligible institutions identified by law.

NIFA's National Program Leaders and other program staff are empowered to carry out the mission of NIFA. To accomplish this mission, these senior staff members perform critical tasks under the authority of the NIFA Director and report to NIFA Assistant Directors and Division Directors. These tasks fall into four general categories:

- Network and collaborate with partners and stakeholders to identify mission-relevant problems, opportunities, and issues requiring federal attention and support;
- Conceive, formulate, and direct programs and activities to respond to existing or emerging problems, opportunities, and issues through the development and application of science-based knowledge;
- Administer and manage programs and activities to develop and apply science and knowledge; and,
- Evaluate and assess the quality, outcomes, and impacts of these programs.

NIFA supports the base programs of state Agricultural Experiment Stations and the Cooperative Extension System nationwide at land-grant universities. As USDA's primary extramural research agency, NIFA provides working funds to researchers at institutions of higher education all over the United States. These research programs benefit all Americans. NIFA helps ensure that a high-quality higher education infrastructure will be available at the nation's land-grant universities to address national needs, and it uses the infrastructure of scientific expertise from these and other colleges and universities, and also of public and private laboratories, to partner in addressing national priorities.

National Institute of Food and Agriculture

NIFA collaborates or has formal working partnerships with many institutions and individuals. NIFA's key partners are the institutions of higher learning making up the Land-Grant University System. However, NIFA also partners with other federal agencies, within and beyond USDA; non-profit associations; professional societies; commodity groups and grower associations; multistate research committees; private industry; citizen groups; foundations; regional centers; the military; task forces; and other groups. NIFA and its partners focus on critical issues affecting people's daily lives and the nation's future. The advanced research and educational technologies supported by NIFA empower people and communities to solve problems and improve their lives on the local level.

II. Vulnerability Assessment

NIFA will face both risks and opportunities associated with changing climate from an operational and mission perspective and impacts to its infrastructure and personnel. Physical factors associated with climate have the potential to disrupt the grant review and award process that is critical to the progress of agricultural science and the infrastructure of the land-grant system. NIFA's climate adaptation strategic plan will focus on two major areas of vulnerabilities, NIFA's Science Programs and NIFA's infrastructure and personnel. Both these areas will be impacted by extremes and wide variations in temperature, precipitation, and the secondary impacts of these events on transportation, communication, information technology systems and coordination with other federal, state, municipal, county and non-government partners, including industry.

Impacts to Science Programs

NIFA's mission is to support exemplary research, education, and extension. As USDA's primary extramural research agency, NIFA provides funds for research, education and extension activities through the AFRI Climate Challenge Area. NIFA will need to balance the increasing demand for scientific research, modeling, educational programs, and extension activities to address climate change issues with other research, education, and extension needs for agricultural. For example, investigations of climate stressors and tipping points will become more essential to climate adaptation science research and will need to be balanced with vulnerable areas of crop and livestock production research and formal and informal state educational programs. There will also be a need to establish more long-term collaborations with federal funding agencies to provide research support to understand complex climate issues and develop the models and decision-making products essential for the sustainability of economic and natural resource systems.

NIFA collaborates or has formal working partnerships with many institutions and individuals. NIFA's key partners are the institutions of higher learning making up the Land-Grant University System, however, NIFA also partners with other federal agencies, within and beyond USDA; non-profit associations; professional societies; commodity groups and grower associations; multistate research committees; private industry; citizen groups; foundations; regional centers; the military; task forces; and other groups. NIFA and its partners focus on critical issues such as climate change that affects people's daily lives and the nation's future. NIFA will need to

advance research and educational technologies that empower people and communities to solve problems and improve climate adaptation and mitigation efforts at the local level. NIFA also supports the base programs of state Agricultural Experiment Stations and the Cooperative Extension System nationwide at land-grant universities with support from formula funds. NIFA needs to foster a high-quality higher education infrastructure will continue to be available at the nation's land-grant universities to address national needs, and uses the infrastructure of scientific expertise from these and other colleges and universities, and also of public and private laboratories, to partner in addressing national priorities, such as climate change.

Impacts to Infrastructure and Personnel

A changing climate can result in more frequent, severe and longer term weather related disasters in the national capital region. There will be a future need to increase the agency's resiliency to short and medium term weather events. NIFA should strive toward improvements in employee notification, increased productivity of unscheduled telecommute workdays, as well as decreased panel impacts of weather related travel delays.

NIFA is unique with respect to its infrastructure and personnel management. All of the approximately 320 employees of NIFA report to the Waterfront Centre, the Whitten and South Buildings in Washington DC and reside in the metro DC area (DC, Maryland, Virginia). Impacts of a variable and changing climate will require an adaption plan assessment that focuses on the ability to maintain primary operations when personnel are unable to report to the primary duty station. This also includes impacts to panels who are invited to DC to conduct reviews of proposals. Transportation and building infrastructure will also be impacted by climate and the safety of personnel travelling to and from the primary work site will need to be addressed. Climate will also impact the technological infrastructure at the Waterfront Centre where information systems are housed and require a controlled temperature and humidity environment. This also applies to NIFA's back-up systems located outside Washington D.C. Heating and cooling systems will also impact the performance of personnel in the building.

III. Adaptation Planning and Evaluation Process

A. Science Program Planning:

1. Integration: NIFA will implement a set of enabling activities that will generate novel Ideas, Partnerships, and Tool for Discovery, Learning, and Outreach that will address climate change issues in multiple sectors. This includes plans to integrate climate change adaptation science and resiliency into relevant NIFA policies, programs, and operations. Actionable items are:
 - Prepare a comprehensive Climate Change Portfolio Plan for NIFA: A NIFA Climate Change Science Plan is an essential document for establishing the Institute's goals and outcomes for research, education and extension activities addressing global change and climate. The plan would include adaptation, mitigation, and decision support as the primary components and would identify human, financial, and

- infrastructure resources to achieve goals. The plan would be complementary to the USDA Climate Change Science Plan, and the climate change strategic plans developed by the REE mission area. It would also support the goals of the USDA Strategic Plan and the U.S. Global Change Research Program.
- **Expand National Program Leadership Areas to Address Climate Change Issues:** Current expertise within CSREES national program leadership has gaps in areas relevant to climate change science, especially in economics, social sciences, and behavioral sciences. The complexity of climate change impacts on the environment and society requires a well-coordinated, multidisciplinary approach in arriving at system science methods to address specific climate-related issues. Examples of expertise identified as important for implementing climate change research, education and extension activities include science writing, climate modeling and behavioral science. Social scientists, economists and educators with climate change science backgrounds would complement the current subject matter expertise at NIFA. There is also a need to maintain a standing division level unit within NIFA to address the larger climate portfolio.
 - **Maintain a well-funded competitive challenge area in AFRI focused on Agriculture and Natural Resources Science for Climate Variability and Change:** AFRI provides competitive grants for fundamental and applied research, education and extension projects. AFRI will support climate projects of various scales that promote collaboration, open communication, and the exchange of information; reduces duplication of effort; and coordinates activities among individuals, institutions, states, and regions.
 - **Develop a Plan for Workforce Development and Education:** Educational programs at all levels need to address the critical skills and professions needed to meet the future demands for climate change research, education and extension in agriculture. Non-formal education programs, such as 4-H, and formal higher education curricula need to adopt a specific climate change component. Program developers need to be aware of the impacts of climate change on agricultural production and societal behavior so these can be incorporated into teaching and accompanying materials. Research and teaching capacity also needs to be built with minority serving institutions so they can advance their contributions to climate change science and workforce development.
 - **Collaborate with NOAA Sea-Grant for Climate Extension:** NIFA will work with Cooperative Extension to collaborate with NOAA's Sea Grant program to establish a joint climate extension service, to identify and agree upon common focused goals, outcomes, and targeted audiences. Significant new resources are needed to support a coordinated national effort providing climate information and decision support tools to clientele and stakeholders. This collaboration would contribute to federal government efforts with the National Climate Assessment and the US Global Research Program.
 - **Continue to foster and advance NIFA climate science work through partnerships with other science agencies (e.g., NOAA, NSF, Dept of Energy) in order to capitalize on the resources available to support multidisciplinary work and bring climate science expertise to agricultural and natural resource subject matter.**

2. Understanding risks: NIFA will establish new opportunities and partnerships to better understand risks and opportunities. This includes the development of science-based methods to assess vulnerability, to monitor climate impacts, and to project impacts based on scenarios. Actionable items are:
 - Develop interagency collaborations for funding basic and applied climate science: Multiple interagency collaborations will be established to fund fundamental and interdisciplinary research that better understands the impacts and feedbacks of global and climate change on agricultural systems (including farm, crop, forest, and range lands) and provide potential adaptation and mitigation strategies, as well as discovery and demonstration of decision support tools for land, ecosystem and water resource managers to mitigate carbon and greenhouse gas emissions (i.e., increase carbon sequestration and storage). These projects will develop the science base and infrastructure to support a new generation of coupled agriculture and climate system models to improve attribution and prediction of high-impact regional weather and climate, to initialize seasonal-to-decadal climate forecasting, and to provide predictions of impacts affecting adaptive capacities and vulnerabilities of environmental and human systems.
 - Produce Effective Communication and Marketing Strategies for NIFA Activities on Climate Change: In order to engage stakeholders and elevate the science, a marketing strategy focused on climate change is needed. Marketing strategies would include web site development and other communication mechanisms that reach out to all public sectors for educational and service purposes. A well developed marketing process would also improve post-award management and the quality of reporting to NIFA from funded projects.
 - Organizing and producing syntheses products in Agroclimate Science: Syntheses products will be produced from, a series of project director workshops and symposiums on climate change to address the needs of the portfolio and provide a benchmark for the status of scientific knowledge, technological advances, and producer needs in agriculture and forestry. The syntheses activities would be led by NIFA funded scientists with possible support from NIFA and the USDA Global Change Program Office. The syntheses would include the science needed to implement a carbon trading system and for natural resource management to adapt to and mitigate climate change. The syntheses could also be the starting point for a sustained stakeholder input process.
 - Promote strategic partnerships which will advance community preparedness for climate impacts and events.

B. Infrastructure and Personnel Planning

A changing climate can result in more frequent, severe and longer term weather related disasters in the national capital region. There will be a future need to increase the agency's resiliency to short and medium term weather events. NIFA should strive toward improvements in employee notification, increased productivity of unscheduled telecommute workdays, as well as decreased panel impacts of weather related travel delays.

- NIFA utilizes the MIR3 system to increase its ability to notify employees and gather status information in the event of a disaster in the national capital region. Though registration is voluntary, the agency has approximately 370 MIR3 registrants. This represents over 90% of NIFA employees. Users self register with the following contact information: Work e-mail, work phone, home e-mail, home phone, mobile phone, pager, and/or emergency contact phone. The system can contact any or all of these devices, for any or all employees, and track message retrieval and responses. The agency plans to conduct four limited and two agency-wide MIR3 drills annually.
- The agency will continue to increase the telework capacity and capability of the NIFA workforce and IT system. Capacity is reflected by the number or percentage of employees that have a core or situational telework agreement in place, as well as the capacity of agency information technology resources to support simultaneous users. Capability reflects the ability of individual employees and the organization to be productive in a telework environment, which could include the variety of systems that employees can access and the types of tasks that can be conducted remotely. Regardless of whether conditions require a long term continuity of operations (COOP) plan deployment or a single unscheduled telework day, the ability of the workforce to productively telework will increase the agency's resiliency. Continuity plans will be adjusted to incorporate scenarios for devolution to a majority telework environment.
- Gathering together panels of experts to review funding applications is a significant function of the agency. Historically, these panels have gathered face-to-face in Washington, DC area, which makes them dependent on nationwide travel reliability and the operability of a central facility. NIFA plans to increase the employment of "virtual panels" as a method to decrease the process's dependence on live meetings based in the national capital region.
- Increased temperature extremes have the potential to increase stress on the Heating, Ventilation, and Air Conditioning (HVAC) systems. As a result of this planning process, NIFA has solicited competitive bids to increase preventative maintenance on these systems in order to decrease future breakdown and repair costs.
- Increased weather extremes can lead to a greater variety of safety hazards for the agency's lease facility and the employees it houses. NIFA will increase its all hazards education and safety programming in coordination with the USDA Office of Homeland Security and Emergency Coordination, Office of Operations, and the General Services Administration.
- Current online information technology asset backup on the east coast, coupled with planned server consolidation, will further distribute key data resources.
- Hotter days in summer are likely to lead to increases in air quality warnings and the severity of those warnings. NIFA will continue to promote use of public transportation resources and telework.

IV. Sustained Adaptation Process

A. Agency steps for sustained planning

- **Climate Portfolio Review:** NIFA conducts a portfolio review of its projects and programs to evaluate the program success in achieving goals for the environment and natural resources. The portfolio review makes use of NIFA's established knowledge areas of which Weather and Climate is one. In addition, a knowledge area for Alternative Uses of Land is focused on climate change. A new portfolio review process has been developed by NIFA which includes a portfolio planning, assessment, and quality improvement plan.
- **Continuous Assessment through Post-Award Management of Climate Change Research, Education and Extension Projects to Identify Gaps:** An inventory and assessment of climate change research, education and extension projects funded by NIFA is needed for advancing climate science and its delivery to intended users. The assessment would also include programs conducted by other USDA agencies to identify gaps and how NIFA's unique mission can fill those gaps. A reporting system designed to fit the needs of the inventory and stakeholder groups will need to be created.
- **Expand Climate Change Communities of Practice within eXtension:** Climate change education and outreach has not yet been part of eXtension which has the capacity to reach a broad audience through its communities of practice. Resources related to consumer knowledge, carbon footprints and environmental markets are needed and should be developed. Significant efforts need to be made to soliciting these and other eXtension communities of practice for specific areas such as forest management, climate impacts on health, understanding carbon markets(such as cap and trade), and implementation of a National Climate Service.

B. Process for Prioritization

- **Establish a Core Set of Climate Change Priorities as a Component of multiple NIFA Portfolios:** The portfolio management and competitive grants planning processes have been evolving to improve transdisciplinary approaches to research, education and extension. The portfolio document, in particular, is becoming important for thematic planning purposes, in addition to its very important accountability function. Aligning portfolio outcomes to climate change will identify NIFA's investments in climate change research, education, and extension and facilitate the planning of future competitive and non-competitive grants. The quality of reporting would also improve as expected outcomes will be clearly defined in the solicitation planning process.
- **Establish a NIFA Science Priority-making Process for Climate Change:** A climate science priority-making team with an established management structure and guidance from the NIFA science leadership council is needed to identify and manage a set of core climate change activities that cuts across agency programs and portfolios and would function as the central source of management for climate change research, education and extension activities. The collaborative team would be able to address portfolio goals as well as the planning of all competitive and non-competitive funding lines related to climate change managed by NIFA. A collaborative issue team would be composed of national program leaders, program specialists and support staff representing disciplinary

and mission area expertise from across the agency and would be accountable to the senior leadership within NIFA. The team would be responsible for the development of criteria for competitive solicitations to achieve long-term outcomes. The collaborative issues team would be advised by the advisory group.

- Consultation with the USDA Office of the Chief Scientist, the REE and NRE mission area agencies, the OCE Climate Change Program Office, and APLU.
- Reference to USDA Strategic Plan, NIFA Strategic Plan, USDA Research, Education and Economics Mission Area Action Plan, and the US Global Change Research Program Strategic Plan,

C. Sources of information for plan development

- External Advisory Group on Agriculture and Climate Change
- Diversified Stakeholder Base for New and Emerging Partners from industry and professional organizations
- Open Public Stakeholder Listening Sessions
- NIFA Project Directors Meetings
- NIFA Interagency Collaborations
- NIFA Competitive Proposal Review Process
- State Plans of Work and Annual Reports under the Hatch, and Evans-Allen Acts
- State Plans of Work and Annual Reports under the McIntire-Stennis Act
- State Plans of Work and Annual Reports under the Renewable Resources Extension Act
- State Plans of Work and Annual Reports under the Smith-Lever Act
- Consultation with the USDA Office of the Chief Scientist, the REE and NRE mission area agencies, the OCE Climate Change Program Office, and APLU

D. Performance Metrics

- Climate Portfolio Review: The NIFA portfolio review process includes gap analysis and performance metrics to evaluate progress and improvement of climate projects funded by NIFA.
- External Advisory Group on Agriculture and Climate Change: The external advisory group will be part of an evaluation process of the science program planning.
- NIFA responds to the REE Action Plan on Climate Change progress through a scorecard method that tracks quarterly progress of projected accomplishments.
- NIFA responds to the annual call of agency accomplishments that is published in the Annual Report to Congress of the US Global Change Research Program
- NIFA contributes to the National Climate Assessment which is now a sustained assessment process.

Appendix: Actions to address risks and opportunities

Action	Agency Lead	Risk or opportunity	Scale	Timeframe	Implementation Methods	Performance metrics
Maintain and expand Climate Change as a grand societal challenge for NIFA	NIFA	Opportunity to advance the development of basic and applied science in agriculture to address climate issues	National	Ongoing	Agriculture and Food Research Initiative	Breadth and depth of portfolio of projects covering areas of need.
Maintain and expand priority areas in the Climate Change Challenge Area in AFRI	NIFA	Opportunity to develop regional based research to address regional climate impacts in agriculture and natural resources	National	Ongoing	Agriculture and Food Research Initiative	Amount of funds invested for climate change research, education and extension
Develop Climate Change programs at land-grant institutions	NIFA	Opportunity to develop research, education and extension activities to address state-identified issues	National	Ongoing	Formula funds, Specials grants	Amount of funds invested for climate change research, education and extension
Host and expand stakeholder listening sessions	NIFA	Opportunity to receive input to programs from stakeholders	National	Ongoing	NIFA outreach	Number of participants reached through stakeholder sessions
Maintain Climate as a standing portfolio in NIFA	NIFA	Opportunity to evaluate progress, identify gaps and plan for climate activities funded by NIFA	National	Ongoing	NIFA planning and Accountability Process	Breadth and depth of portfolio
Establish collaborative	NIFA	Opportunity to leverage	National	Ongoing	Interagency Memorandums of	Amount of funds leveraged

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funding opportunities with other federal agencies		funding for agriculture research in climate change			Understanding, US Global Change Research Program	with NIFA resources
Conduct annual Project Director meetings of NIFA funded and interagency projects	NIFA	Opportunity to network and advance science for climate adaptation and mitigation	National	Ongoing	Agriculture and Food Research Initiative, Federal Interagency collaborations	Number of publications and presentations of research projects. Milestones of projects.
Work with extension for the translation and delivery of science to communities and decision makers	NIFA	Opportunity to deliver credible science and decision making tools to users	National	Ongoing	Agriculture and Food Research Initiative, Federal Interagency collaborations (e.g. Sea Grant Extension)	Number of participants reached through outreach sessions
Working with other USDA agencies and offices like the US Forest Service and the Climate Change Program Office on climate change science.	NIFA	Opportunity to better coordinate climate science research within USDA	USDA	Ongoing	NIFA Climate Division core activity	Number of coordinated research activities and opportunities within USDA
Participation in the US National Climate Assessment	NIFA	Opportunity to assess impacts of agriculture science on climate	National	Ongoing	NIFA Climate Division core activity	Reduction in gaps of science and science delivery for agriculture
Support a robust Extension	NIFA	Opportunity for advancing climate	National	Ongoing	NIFA supported activity	Increased preparedness of local

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Disaster Education Network (EDEN) to increase Cooperative Extension's ability to decrease the impact of disasters through education.		science for risk management				communities for disaster management
Increase the agency's ability to notify employees and gather status information in the event of a disaster in the national capital region.	NIFA	Ability to notify employees of hazards associated with workplace impacts of climate change	D.C. Duty Station	Ongoing	NIFA supported activity	Increased preparedness of NIFA to address local climate variability and extreme events.
Continue to increase the telework capacity and capability of the NIFA workforce and IT system.	NIFA	Ability to support continuation of NIFA's activities under extreme weather	D.C. Duty Station	Ongoing	NIFA supported activity	Increased preparedness of NIFA to address local climate variability and extreme events.
Refine continuity plans by incorporating scenarios for devolution to a majority	NIFA	Ability to support continuation of NIFA's activities under extreme weather	D.C. Duty Station	Ongoing	NIFA supported activity	Increased preparedness of NIFA to address local climate variability and extreme events.

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telework environment.						
Increase the employment of “virtual panels” as a method to decrease the process’s dependence on live meetings based in the national capital region.	NIFA	Ability to support continuation of NIFA’s activities under extreme weather	D.C. Duty Station	Ongoing	NIFA supported activity	Increased preparedness of NIFA to address local climate variability and extreme events.

USDA Natural Resources Conservation Service
Climate Change Vulnerability Assessment and
Adaptation Plan
May 2012

**USDA-Natural Resources Conservation Service
Climate Change Vulnerability Assessment and Adaptation Plan
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NRCS Overview

The Natural Resources Conservation Service (NRCS) is the primary federal conservation agency working with private landowners to preserve and enhance our Nation's natural resources. More than 70% of the land surface in the United States is held under private ownership. The Agency is a dynamic, action-oriented agency that has a mission and reputation for helping private landowners adapt to a broad spectrum of natural and human-caused changes. NRCS is accustomed to addressing land management changes that affect the landscape at a range of scales, and this report will help NRCS prepare for current and future changes in the climate that impact all aspects of the environment. Climate changes and associated impacts on private lands in coming years will necessitate that some of the direction and focus of the Agency be adjusted. However, NRCS already is well positioned to embrace many of these changes and the Agency is committed to helping landowners develop coping mechanisms for climate-related impacts in coming years.

The current NRCS Strategic Plan states that "NRCS believes that voluntary, incentive-based conservation is the best way to achieve positive environmental results. To that end, NRCS will build and strengthen partnerships and coalitions and promote an ethic of conservation stewardship among America's private landowners."

Furthermore, the NRCS Strategic Goal is to "Get more conservation on the ground," and as part of this effort the Agency is committed to "design conservation standards and deliver assistance to address emerging resource concerns," and "increase the number of conservation practice standards that address emerging issues (such as energy)." Through these efforts the Agency is helping private landowners become more resilient to future environmental changes.

The Agency has a noted reputation for technical excellence and expertise with regard to natural resource concerns in all sectors (Soil, Water, Air, Plants, Animals, plus Humans and Energy, or SWAPA+H,E). NRCS conservation practices are broadly utilized inside and outside the Agency, owing to the strong scientific and technical base upon which their conservation practice standards are founded. Over the past 25 years NRCS has increasingly provided technical and financial assistance to landowners throughout the entire country. In 2010 the Agency provided \$1.57 billion in technical assistance and \$2.73 billion in financial assistance via various conservation programs. This assistance goes toward the installation and development of on-the-ground conservation practices. Voluntary conservation measures are critical for meeting environmental goals; consequently, their implementation and evaluation are key mission components of NRCS.

NRCS and Climate Change Adaptation Planning

In October 2009 Executive Order 13514 entitled *Federal Leadership in Environmental, Energy, and Economic Performance* was issued with a stated goal "...to establish an integrated strategy towards sustainability in the Federal Government and to make reduction of greenhouse gas emissions a priority for Federal agencies."

In March 2011 the President's Council on Environmental Quality (CEQ) issued *Implementing Instructions for Federal Agency Climate Change Adaptation Planning* that provided guidance on how each Department and Agency should conduct a climate change vulnerability assessment and develop an adaptation plan. Shortly thereafter on June 3, 2011 USDA Regulation 1070-001 established a USDA-wide directive to integrate climate change adaptation planning and actions into USDA programs, policies, and operations. The USDA adaptation and vulnerability actions are to be led by the USDA Climate Change Program Office (CCPO). The Department Regulation directed each Agency within USDA to identify potential impacts of climate change on agency missions, programs, operations, policies and authorities—and also include potential budget and legal impacts. What follows in this report is a fairly comprehensive initial assessment of how NRCS and its work with private landowners may be vulnerable to changes in climate over the next 40 years, and some possible adaptation actions.

In order to adequately prepare the Agency for the future impacts that will likely ensue from climate changes, an NRCS Climate Change Coordination (CCC) Team was formed in December 2011. The initial and primary purpose of the CCC Team was to complete an assessment of the Agency's vulnerability to climate changes, and provide possible adaptation action items to NRCS leadership. Approximately 20 NRCS staff composed the Team, including three from state offices, several others from Technology Centers, and several offices at national headquarters (NHQ). Within the NRCS CCC Team, eight sub-teams were formed to assess potential natural resource impacts from changes in climate, and evaluate how these impacts might affect NRCS operations. Sub-teams were formed around the major SWAPA+H,E conservation resource concerns. Each sub-team investigated the various intersections of resource issues with landuse categories, and the sub-team reports form the basis for this summary report. It should be noted that this report does not encompass aspects of NRCS infrastructure (buildings, energy use, vehicles, etc.), as this is being addressed through a separate effort. This report focuses on NRCS conservation activities (practices, programs, etc.), and how the Agency may best help private landowners adapt to changes in climate over the next 40 years--between now and roughly 2050.

Analyzing Conservation in the Context of Climate Change

NRCS is fortunate to have a rich history of addressing environmental challenges, from wind erosion of the Dust Bowl era to more recent issues like aquatic nutrient loading in sensitive water bodies. Through the years the Agency has refined its analytical problem solving methodologies while viewing challenges as conservation opportunities. Climate change vulnerability and adaptation presents the Agency with a substantial conservation challenge. In order to prepare the comprehensive report of Agency actions and begin evaluating future ecosystem challenges,

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NRCS was able to build on a solid conservation foundation and utilize many of the advantages of the Agency's dynamic conservation legacy.

NRCS conservation practices were examined for 1) inherent climatic assumptions or data in relevant practice standards, and 2) modifications that might be needed in light of possible climate changes. Conservation practice standards are dynamic and are reviewed and updated a minimum of every 5 years. This existing process is seen as a natural advantage for NRCS when evaluating future climate changes. Practices were examined by sub-teams for their ability to "buffer" changes in climate. In many cases sub-teams found that a number of NRCS conservation practices were effective at both mitigation of greenhouse gases (GHGs) and climate change adaptation.

Climate data are utilized for a number of purposes in the Agency, including the design of small dams and lagoons; selection of appropriate plants in a given area; and a multitude of other purposes. An examination of current climate data used in the Agency and likely data updates and enhancements needed over the next 40 years, was also conducted as part of this study.

In order to provide a consistent evaluation framework for examining climate vulnerabilities and providing possible adaptation strategies a standard set of climate scenario assumptions were utilized by the sub-teams. Temperature and precipitation changes used in this report were largely consistent with those from various modeling efforts, including synthesis products from the Intergovernmental Panel on Climate Change (IPCC). If anything the scenarios selected were toward the higher end of the envelope of possible changes in order to provide a more thorough examination of impacts. The assumptions for this analytical exercise were:

- Analytical timeframe of approximately 40 years (2012 – 2050)
- Mean annual temperature 2.0° C (3.8 F) higher than current
- Mean annual extreme minimum temperature (plant hardiness) 2.0° C (3.8 F) higher than current
- Mean annual precipitation -20% and +20% of current
- Precipitation amount 20% greater for all duration-frequency combinations

The direct effects of atmospheric CO₂ concentration increases on plants (CO₂ fertilization) was considered, using a 2050 atmospheric concentration value of 430 ppmv, or approximately 15% increase over current 390 ppmv value. The spatial limits of this assessment were all states and U.S. territories, and all major landuses (crop, range, forest, etc.).

Key Climate Changes: Agricultural and Natural Resource Impacts

Key climate change vulnerabilities in the U.S. over the next 40 years are associated with predicted increases in temperature across the country with the most notable increases expected to occur in coldest winter temperatures over interior and northern Alaska and across the northern tier of interior, continental U.S. states. The coastal regions of the continental U.S. are expected to warm less rapidly than inland regions. Above "normal" temperatures will become more frequent throughout much of the country. Higher nighttime temperatures and higher annual extreme minimum temperatures are the most likely temperature changes, especially in more northern latitudes of the United States. Coastal storms, especially of tropical origin, could more

frequently have damaging winds leading to greater extreme wave heights (storm surges) along the coast. A warming climate is expected to reduce snow cover as well as the timing, duration and magnitude of mountain snow water supply. Climate change is expected to modify the amount, intensity, timing, and location of precipitation, regionally and locally. Increased precipitation intensity is expected to produce more frequent flood-producing storms. Changes in the frequency and duration of drought and flooding may also occur. Sea level is projected to rise somewhat over the next 40 years (6-8"). Hurricane rainfall and storm intensity is expected to increase in response to climate change.

These potential changes in climate will have a variety of impacts on both agricultural production and natural resource management in the United States. Natural resource impacts will be driven by the underlying time scale of phenomena and the physical/ecological changes. For example, changes in the statistically-computed extreme 24-hour precipitation amount with a return interval of 100 years will necessitate changes in the design of water control structures. Risk-based, on-farm preparation for any associated changes in flooding (magnitude and duration) must be evaluated. Changes in mean annual precipitation will be expressed in long-term changes in water supply, perennial vegetation, cropping systems, soil moisture and groundwater recharge.

Impacts were examined for their relevancy to NRCS conservation work on private lands. Those impacts meeting this criterion of relevancy are the focal points of this analysis. These impacts were assessed for their likelihood of occurrence in the next 40 years. Significant agricultural and natural resource impacts identified in this assessment include:

Precipitation Changes and Impacts on Water-related Issues

- increased soil erosion potential due to increased precipitation intensity and amount
- water supply challenges in areas already water-stressed, including the southern Plains and the Southwest where drought is likely to become more frequent
- greater flood potential from increased precipitation frequency, duration, amount and intensity, especially in the East and Midwest
- water management challenges in the irrigated West—including amount and timing of water--due to changes in snowpack and snowmelt, with consequent impacts on water rights, fisheries, hydroelectricity and others
- greater potential water quality impairments in some areas due to increased sedimentation and nutrient loading
- increased salinization of near-coastal waters due to rises in sea level and greater storm activity

Temperature Effects

- changes in plant adaptability in specific locations, such as plant hardiness zone movements and shifts in crops
- increased stream and lake temperatures impacting fisheries and other biological processes
- increased pest and disease pressures in some regions

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- changes in insect activity, including frequency, intensity and location (and including pollinators)
- greater ground-level ozone concentrations due to slightly warmer temperatures, and expansion of ozone nonattainment areas
- increased cooling-related energy demands in the warm months, including confined animal feeding operations
- increased energy demand associated with greater irrigation requirements
- increased melting of permafrost in transition zone regions in Alaska

Other Possible Impacts

- enhanced manure storage and application challenges
- greater drought stress on rangelands used for grazing, putting increased pressure on livestock production
- possible extinction or certainly greater stress on endangered plant and animal species;
- forest adaptability stresses and changes
- heightened invasive plant and weed pressures
- wildlife and fish habitat changes in some regions
- soil health challenges due to erosion increases and changes in soil chemical and biological processes
- increased wildfire risk in some areas due to moisture stress and changes in pest and disease stress

Actions: NRCS Can Help Address Vulnerability and Begin Adaptation

Over the past 75 years NRCS has developed a proficient and robust conservation delivery system to help private landowners address environmental challenges while maintaining economic viability and ecosystem health. With climate changes occurring, sustainable solutions will become even more important to ensure agricultural systems are productive and natural resources are preserved and enhanced. As the climate changes, NRCS conservation practice standards and conservation delivery systems will need to be continually evaluated for relevancy. Underlying climate data and assumptions will need to be regularly refreshed, and latest projections will need to be utilized to assess how impacts may be changing, both in the short-term and over longer time planning horizons. Climate will simultaneously impact many resources that will necessitate comprehensive and holistic approaches to conservation planning. This situation will require many disparate entities within the Agency working together to find solutions.

The NRCS is in an advantageous position to help private landowners adapt to whatever changes in climate occur in the coming years. The Agency is already well positioned to assist because of its existing structure. Conservation planning is a dynamic process where the most relevant and feasible information and technology are employed to address a range of resource concerns. Thus, as climate change impacts agriculture and natural resources, the NRCS delivery system will not need major overhaul to be effective. However, there will be both challenges and opportunities for the Agency as environmental stresses increase in many sectors.

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Many of the conservation solutions that are currently being utilized are effective at addressing climate change mitigation via carbon sequestration or greenhouse gas (GHG) reductions. These existing practices can also be utilized to make agricultural systems more resilient to changes in climate. Thus, many of the traditional NRCS conservation efforts like residue management, forest stand improvement, cover crops and prescribed grazing will be very effective adaptation strategies.

Strategies that effectively integrate adaptation to changes in climate therefore can be developed within the NRCS conservation structure, but will require some adjustments in traditional approaches. There are both technical and programmatic challenges that will necessitate thoughtful approaches so that adaptation goals are met. This means adjustments in conservation technical and financial assistance, including personnel, will likely be necessary, both in the short-term, and especially over the next 40 years. These adjustments will require an even greater focus on holistic approaches to conservation delivery, involving all aspects of SWAPA+H,E.

Farms and ranches will need to become more resilient to climate variability and climate change by adopting locally-relevant adaptation measures. The planning and implementation of conservation practices and conservation systems has typically been done under an assumption of a relatively stable climate; however, operations will have to become more financially and managerially nimble to adapt to plausible changes in temperature, precipitation and other meteorological elements, as well as the direct effects of changes in atmospheric GHGs. This includes preparedness for changes likely to occur with regard to pests, diseases, weeds, crop yields, plant hardiness, livestock stress, etc. There will likely be a need to increase managerial flexibility in the development and application of new conservation planning tools and new, or adaptive, conservation practices and systems. This managerial flexibility will be required in order to adapt to changing agricultural and forestry conditions.

Actions: Getting Started

As a starting point for NRCS, it is very important that all sectors of the Agency thoroughly understand why and how climate is specifically integrated into all relevant aspects of our current conservation activities. NRCS needs to better understand how present-day climate variability is already impacting agricultural and natural resource management. Following this analytical process, the Agency should embark on a thorough and deliberate evaluation of how changes in climate will likely affect each identified major resource impact noted in this report. This self-assessment should include working with research partners to use models and other evaluation tools to identify how and when changes may materialize. Developing a quantitative understanding of the potential impacts will help conservation planners adequately prepare for, and anticipate, changes.

There are several Agency sectors that may need immediate attention with regard to climate impacts. Engineering designs can be particularly sensitive to changes in precipitation statistics. These designs should be evaluated for their appropriateness and ability to deal with future precipitation changes. Increased precipitation intensity and amounts in certain regions of the country may also put increasing pressure on the Agency for Emergency Watershed Protection. Plant Material Centers will serve a critical role in helping landowners adapt to changing plant

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stressors and in developing conservation plants/practices to increase soil water holding capacity (i.e. increased resilience to precipitation extremes through enhanced soil health). The snow and climate monitoring network and historical database that NRCS maintains in the West are a national treasure. These data will become increasingly important as climate changes and water supply pressures increase. NRCS will be called on more frequently in the future to assist producers with meeting increased air quality challenges, such as ozone and particulate matter, brought on by climate changes, as well as in helping make farms and ranches more energy efficient and less GHG intensive. There may be opportunities for agricultural producers within the realm of GHG emission reduction credits and carbon sequestration. With proper preparation NRCS can be helpful in assisting producers to realize these emerging market opportunities.

NRCS will be well-served to work more closely with other federal agencies both within and outside of USDA, appropriate state and local entities, and others that are developing adaptation strategies. NRCS should consider better integration of its work with national, regional, state and local adaptation planning efforts, including regional Landscape Conservation Cooperatives, regional climate planning groups, and other local and regional initiatives.

Other recommended key adaptation actions include:

- Enhance understanding of how to address changes in ecosystem processes and associated plant, wildlife and crop adaptation needs (ecological site descriptions may play a useful role here)
- There will be an increasing need for high quality soils data and soil changes that occur simultaneously with climate changes, including a national soil monitoring network to augment the NRI
- Enhance promotion and implementation of the soil health management system (SHMS) concept that provides the type of holistic conservation planning needed by private landowners, including soil carbon, erosion, nutrient and pesticide management
- Increasing air quality issues, and those specifically related to agriculture, will add pressure for more NRCS assistance with combustion system improvements, including engine replacements and other technologies
- Energy efficiency and renewable energy will continue to grow as issues that NRCS must address, especially as energy demands increase
- Livestock and poultry producers will look to NRCS for more assistance as greater challenges arise, including lack of water in some areas, increasing temperatures, greater and more frequent precipitation in other areas, and stresses on waste storage and application
- Water quality challenges will increase in many areas with changes in climate, and will be accompanied by increasing population. These challenges include sedimentation, stream and lake temperature and turbidity, nutrients, and salinization
- Water supplies will change in many areas. In the West and some north central and northeast states this could mean changing snowpack and timing of snowmelt, lack of water, etc. Elsewhere it could mean more or less water, but there could certainly be more flooding with significant consequences. NRCS work in water supply forecasting, irrigation assistance, structural design, recovery, etc. will necessarily change and be even more critical

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- Increased frequency of droughts may occur, most notably in the southwestern states and southern Plain states—and these water-stressed areas will need to be even more judicious in their use of water. NRCS assistance with irrigation and water management will be even more crucial in future years
- Wildlife and fisheries challenges will be greater than ever as habitat changes occur in areas due to changes in climate and landuse. Landowners will increasingly seek NRCS assistance to know how these changes will occur and how to help wildlife and fish adapt to these changes

Finally, it is recommended that a more cohesive and well-coordinated climate change training effort be developed and initiated for agency employees and partners, and that an agency communications plan be developed once more specific climate change adaptation and vulnerability strategies have been developed.

USDA Risk Management Agency
Climate Adaptation Plan

USDA Risk Management Agency – Climate Adaptation Plan

I. Policy Framework

The central vision of the Risk Management Agency (RMA) is to provide world class agricultural risk management products, crop insurance, tools, education and outreach to farmers and ranchers.

Consistent with this vision, RMA serves America's agricultural growers through effective, market-based risk management tools and solutions to strengthen the economic stability of agricultural growers and rural communities. As part of this mission, RMA operates and manages the Federal Crop Insurance Corporation (FCIC).

With over \$114 billion in Liability in 2011 and over \$10.7 billion paid in losses from natural disasters, RMA is in the business of providing tools to assist growers manage losses due to natural disasters. RMA's crop insurance policies provide financial stability for growers and are frequently required by lenders. Financially stable growers are more likely to obtain the resources and lending they need in order to invest in new growing practices to adapt to climate change. In addition to providing crop insurance coverage to growers, Section 522(d) of the Agricultural Risk Protection Act of 2000 authorizes RMA to enter into partnerships with public and private entities for the development of non-insurance risk management tools. These tools are developed for growers' direct use to assist in mitigating and adapting to increased risks from climate change, drought, and other weather related conditions.

The partnerships are wide-ranging, multi-year, research projects that offer new and innovative approaches to risk management that extend beyond traditional crops. One example of the types of tools developed as a result of this initiative are: Irrigation Management tools that allow growers to determine the yield impacts of reduced water applications and assists growers in maximizing the impact of water applications. (See RMA Fact Sheet on Climate Change for additional tools).

As stated in its strategic plan, RMA's goals are:

- Expand existing crop insurance programs where appropriate.
- Improve the effectiveness of existing programs in southern states and other regional or local areas by refining offers to be better tailored to unique types and practices, and where appropriate, adjusting premium rates, transitional yields, initial and final planting dates, acreage reporting dates, coverage conditions, and high risk or other map areas within each county to recognize structural changes to the risks of growing the crop in those areas.
- Continue to refine and expand the availability of innovative, grid-based, weather-derivative, insurance products to crops and areas that are either uninsured or underinsured.
- Monitor climate change research, to the extent that climate changes emerge over time, and update program parameters such as final planting dates and sales closing dates, to reflect such adaptation or other changes.
- Regional Offices develop and maintain maps used to identify high risk areas, uninsured acreage, and coverage.

-Regional Offices develop special provisions of insurance to address unique crop or regional conditions to enhance the program or address potential program vulnerabilities.

II. Vulnerability Assessment

RMA's principle vulnerability to climate change is through the insurance coverage offered through its crop insurance policies. RMA provides coverage to farmers and ranchers for flood, drought, hurricanes and other natural disasters. Climate change can affect these agronomic risks. Some of the risks, and opportunities, associated with changing climate that RMA will face will likely come from farmers changing their farming practices and approach growing crops differently by adapting to earlier growing seasons, planting new varieties or shifting locations of their farming operations to adapt to climate change.

Risks to RMA from these changing farming practices will generally be low since RMA can update program parameters such as planting dates and what are accepted as good farming practices.

For example, as it gets warmer, some Nursery Hardiness zones may shift (mostly northwards); therefore this could affect our Nursery Crop Insurance programs which are available in all 50 states. RMA insures nursery plants based on county and by hardiness zone and as a consequence of the changes in climate - some nursery plants may no longer be adaptable and therefore no longer insurable in some specific locations and or higher insurance premiums may result. Risk to farmers will be higher, if they decide to plant earlier due to warmer spring weather and the crop insurance program parameters have not been updated. For example, if grower's plant earlier than the crop insurance policy allows, they will be required to carry more risk, as the crop insurance policies will not cover replanting payments.⁶ RMA is educating and providing outreach to growers via interviews with news and other organizations to explain to farmers how planting early would affect their crop insurance coverage:

Planting Crops Too Early-Effect on Crop Insurance Policy: On March 28, 2012, the Midwestern Regional Climate Center in Champaign, Illinois issued a press release on planting too early. A portion of the release stated, "The warm temperatures and relatively dry soil have prompted farmers to think about planting their corn crop early this year. There are reports of farmers planting corn in Illinois, Iowa, and Missouri about two to four weeks early. A majority of Iowa, Minnesota, Wisconsin, Michigan, and Ohio have not experienced a growing season that has started before April. Planting crops right now warrants caution, since there is still a possibility for a 32-degree freeze to occur, or even a 28-degree "hard" freeze, which could kill plants that have emerged."

⁶ A grower signed up for crop insurance on March 15 and plants before the earliest planting date is still covered for the 2012 crop year, however, if they suffer a loss from freeze or any other cause of loss, they would have to cover the cost to "replant" the crop --as replanting payments would not be covered since the farmer chose to plant before the established earliest planting date.

http://mrcc.isws.illinois.edu/news/releases/2012/20120326_EarlyWarmth2012.pdf

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RMA will continue to monitor climate data and research to the extent that climate changes over time, and update program parameters (e.g. sales closing dates and earliest and final planting dates and other program dates) as needed to reflect such changes. In addition, RMA will continue to monitor premium rating methodology, loss adjustment standards, underwriting standards, and other insurance program materials to ensure that they are appropriate for new production regions or for changes in practices within existing regions.

Climate change effect on RMA assets and Operations: RMA predicts that climate change will only have a minor effect on assets and operations in 16 states where RMA has offices. Farmers pay for crop insurance for protection from climate and weather related losses such as flood, drought, hail, etc., so RMA's liability may be increased with additional acreage insured, however, associated premiums will also increase.

In areas where climate changes in a way that is less conducive to growing a given crop, either the growers' insurance guarantee will decrease because of the falling yields or they will stop planting the crop entirely. Either way, the liability exposure of the crop insurance program to climate change is self-limiting.

Security: Disaster preparedness: RMA periodically issues Catastrophic Loss Procedures - Emergency Loss Procedures for Crops Damaged by Hurricanes and other extreme events. On October 24, 2005, Hurricane Wilma made landfall in Florida. The President declared 29 counties Federal disaster areas and directed the Department of Agriculture to assist growers affected by the hurricanes. In Florida, RMA reported that Hurricane Wilma resulted in 2,420 citrus fruit crop loss claims totaling \$60.8 million in indemnity payments. On November 4, 2005, RMA authorized emergency loss procedures via a Manager Bulletin, MGR-05-020,, *Emergency Loss Procedures for Crops Damaged by Hurricane Wilma*, intended to streamline certain loss determinations⁷ on specific crops and accelerate the adjustment of losses, expedite processing of loss claims and payments to growers from Hurricane Wilma. The application of the emergency loss procedures was intended to be limited to those situations where the catastrophic nature of the losses was such that not authorizing these emergency loss procedures would result in unnecessary delays in processing claims.

Climate change effect on RMA Employee Health: RMA employees work inside offices around the U.S. and all employees have heating and air conditioning should the climate change affect indoor working conditions. RMA workforce, as a whole, will not need to be monitored. RMA reinsures 16 approved insurance providers who employ Loss Adjusters (LA) who go out into farmer's fields to assess damages due to weather related losses. RMA employees occasionally accompany the LA in reviewing Large Claims and both could be impacted by extreme weather events, heat, flooding or sea level rise, etc.

Opportunities associated with Climate Change: RMA uses climate and weather services provided through a partnership with Oregon State University's PRISM Climate Group (Parameter-Elevation Regressions on Independent Slopes Model) *climate mapping system* to

⁷ When losses occur, the Standard Reinsurance Agreement requires that approved insurance providers (AIPs) send adjusters into the field to determine the extent of damage and the appropriate losses under the insured's policy.

strengthen RMA's underwriting and oversight of the Federal crop insurance program. PRISM will provide high quality climate and weather data that will assist RMA with its Actual Production History (APH) modernization effort by developing crop suitability maps based on climate and soils to more accurately assess the production potential of land being farmed; to account for variations in climate due to elevation, rain shadows, coastal effects, temperature inversions and other conditions that may affect crop production; and it is assisting RMA in developing nationwide Bio-fuel resource mapping. PRISM is also building a Climate and Weather web portal that will be used by RMA, and by the 16 approved insurance providers that sell and service crop insurance for services, such as adjusting grower's crop losses quickly and accurately. In addition, it can be used by growers to make planting and production decisions every day.

RMA will continue to evaluate and monitor potential risks that climate change presents to the Federal crop insurance program. With over a million crop insurance policies in force (and over \$10 billion paid out in natural disaster claims in 2011) and the world's most extensive database of actual farm yields, RMA will use PRISM and other risk management tools to monitor the effects of climate change on crop yields, provide a reality check for crop yield guarantees and to update program parameters such as the crop planting dates as needed to reflect the changing risks resulting from climate change.

III. The Adaptation Planning and Evaluation Process

Integration

RMA plans to integrate climate change adaptation into Federal crop insurance policies, programs, and operations. RMA will increase its' coordination with stakeholders such as crop insurance policyholders and others with an interest in the Federal crop insurance program to inform them of choices when dealing with climate, and weather related droughts and flood events that may have prevented them from planting insured crops. For example, as production areas shift due to climate change adaptation, RMA has procedures in place for growers to request insurance coverage for insurable crops that is not currently available in a county.

RMA may increase the number of press releases, interviews, factsheets and questions and answers pages on RMA's website to inform stakeholders and others of our policies when dealing with the severe climate and weather events. For example, due to warm weather events in 2012, RMA's Regional Offices worked with the press and University contacts to provide press releases which provided information to farmers about crop insurance restrictions in planting crops earlier than the published dates.

RMA will create a Web Page on the RMA website to inform our stakeholders about climate change and risk management tools available to farmers. Other RMA Procedures to integrate climate change adaptation include:

Revising Key Program Dates – Final Planting Date Criteria: A Final Planting Date (FPD) Criteria⁸ is used by RMA Regional Offices (RO) in determining Final Planting Dates when:

⁸ Final Planting Date is defined in the Federal Crop Insurance Corporation Common Crop Insurance Policy - Basic Provisions, as the date contained in the Special Provisions for the

Risk Management Agency

Reviewing a Request for Change in the FPD; Reviewing existing FPDs on a rotational basis (based on the Actuarial Filing System Schedule); Changing existing FPDs; or creating new FPDs due to New County Crop Program Expansion, or New 508(h) programs.

When setting FPD's, RMA uses the criteria which includes tools such as the U.S. Climate Normals data online (this information can be used to see how farmers make planting decisions) and tools provided by a partnership with Tarleton University, Center for Agricultural Excellence (CAE). CAE provides resources on data warehousing, data mining of agribusiness and agriculture data for agricultural risk management products. CAE also provides the tool, HYDRA which can be used to confirm if weather events on took place on specific dates:

<http://rmcae16.cae.rm.usda.gov/>.

Requesting Insurance Not Available in Your County: As production areas shift due to climate change adaptation, RMA has procedures in place for growers to request insurance coverage that is not currently available in a county. Growers submit a request to their crop insurance agent and Regional Office and provide information to assist RMA in making a coverage offer: In addition, growers must have evidence from Agricultural Experts that the crop can be produced in the county if the request is to provide insurance for practices, types, or varieties that are not insurable. The growers must provide dates by which the crop in the area is normally planted and harvested. For an irrigated practice, the water source, method of irrigation, and amount of water needed for an irrigated practice for the crop.

Evaluating USDA Hardiness Zone Maps for Nursery: RMA has been evaluating the new Hardiness Zone Map published by the Agricultural Research Service. As it gets warmer, some of the zones may shift (mostly northwards); therefore this could affect most of our plans of insurance products, particularly the Nursery Crop plan of insurance. RMA insures nursery plants based on county and hardiness zones. As a consequence of the changes in the climate, some nursery plants may no longer be insurable in specific locations or higher insurance premiums may be necessary.

Processes for Revising Crop Coverages: RMA has a Written Agreement Handbook that provides guidance to the Regional Offices and/or Private Insurance Companies that is used to change or revise coverage. For example, the RO can compare the risk of loss for a similar crop to the requested crop. Although sunflowers may fare better than corn in drought, the RO determines whether the risk of loss would be comparable in both crops. The RO evaluates loss data to adjust the rates and coverage level accordingly for the requested crop.

Working Groups Regarding Climate Change: RMA is monitoring the efforts of the working group on climate change and global warming at the National Association of Insurance Commissioners (NAIC). This group is responsible for reviewing the enterprise risk management efforts by insurance carriers and how they may be impacted by climate change and global warming and investigating and receiving information regarding the use of modeling by carriers and their reinsurers concerning climate change and global warming and its possible impact on

insured crop by which the crop must initially be planted in order to be insured for the full production guarantee or amount of insurance per acre.

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investments. Involvement with this committee allows RMA to be aware of climate change-related activities taking place in other lines of property and casualty insurance.

Premium Rating Methodology: RMA is in the process of reviewing and revising its premium rating methodology. Changes that are under consideration include introducing a process that explicitly considers weather variables in calculating premium rates. Also under consideration is basing premium rates on a shorter historical time frame than is currently used. This would make premium rates more responsive to any changes in agronomic risks due to climate change.

Understanding Risks

RMA will continue to evaluate and monitor potential risks that climate change presents to the Federal crop insurance program. RMA will monitor the Federal crop insurance program and administer it in an actuarially sound manner—planting patterns, agronomic practices, new varieties; varieties that can be planted earlier or we will revise the earliest planting date and final planting dates if planting earlier becomes a common practice.

RMA will monitor the establishment of new practices for new areas/crops such as irrigation, limited irrigation, skip rows, cover crops, organic practices, and other insurance offers. Ten Regional Offices (RO's) will review planting dates periodically and recommend changes to existing planting dates if necessary. Perennial crops issues such as premature pollination have caused concerns: Fruit crops in Michigan have received significant damage in crop year 2012 because of recent frost events that followed an unseasonably warm March, 2012. Pollination has also been a concern this year as crops have attempted to bloom much earlier than normal. Early indications are that apple, blueberry, cherry, grape and peach yields have been greatly reduced. The Springfield RO has been responding to program inquiries related to this year's crop damage. RMA will continue to partner with PRISM who will assist RMA in weather and climate monitoring to see if trends exist in weather data.

RMA will monitor research results from the RMA contracted Climate Change Study, private insurance companies and others, such as universities and other groups which will bring RMA new information on climate change.

With increased movement of insects, diseases, plant materials, and invasive weeds in addition to the pressures of climate change, the scope of pests causing problems continues to widen. RMA may continue monitoring pest developments.

Starting in 2004, RMA has been monitoring soybean rust developments. The threat of soybean rust disease affecting U.S. soybean growers in the near future is of concern to RMA. RMA participates on a soybean rust working group formed to prepare for the arrival of soybean rust by keeping State, commodity, and Federal scientists informed of the recent activity related to soybean rust. Working group members include at least one extension plant pathologist from each soybean state, but also any other representatives from State, Federal, and commodity organizations with an interest in soybean rust. The working group meets as needed to discuss items such as management options, information resources, range of soybean rust, and recent research. The working group is hosted by the USDA Office of Pest Management Policy: www.ipmcenters.org/NewsAlerts/soybeanrust/ (Source RMA website July 2004).

Performance Metrics

RMA has a Summary of Business Report which provides an overview of participation in the Federal crop insurance program on a weekly basis to show RMA has the support of a wide range of stakeholders. Grower participation in the Federal crop insurance program is tracked by state, county, and by crop product. RMA also has other tools, such as the Information Browser which contains coverage information such as the Special Provisions of Insurance which will show new changes to planting dates, program updates and practices. Specific performance metrics are listed in RMA's Strategic Plan FY2011-2015.

The Climate Change Study Report RMA released in May 2010, contains additional recommendations for RMA and can also be reviewed for future areas to evaluate.
<http://www.rma.usda.gov/pubs/>

RMA will use PRISM and other risk management tools to monitor and evaluate the effects of climate change on crop yields, provide a reality check for crop yield guarantees and to update program parameters such as the crop planting dates as needed to reflect the changing risks resulting from climate change.

IV. Sustained Adaptation Process

The Agency's adaptation plan will be reviewed annually. The review process will include:

- Evaluation and review of the published research for any developments on the predicted effects of climate change on agriculture
- Evaluation of the performance metrics in RMA's strategic plan
- Review of any available information on how insurers in other lines of property and casualty insurance are incorporating climate change into their planning processes

Appendix A: Actions to Address Risks and Opportunities

RMA will continue to monitor climate data and update program parameters (e.g. sales closing dates and earliest and final planting dates and other program dates) as needed to reflect such changes due to climate. In fact, we are already doing or have accomplished the following: Catastrophic Loss Procedures- Emergency Loss Procedures for Crops Damaged by Hurricane Wilma: On October 24, 2005, Hurricane Wilma made landfall in Florida. The President declared 29 counties Federal disaster areas and directed the Department of Agriculture to assist growers affected by the hurricanes. In Florida, RMA reported that Hurricane Wilma resulted in 2,420 citrus fruit⁹ crop loss claims totaling \$60.8 million in indemnity payments.

On November 4, 2005, RMA authorized emergency loss procedures via a Manager Bulletin, MGR-05-020, *Emergency Loss Procedures for Crops Damaged by Hurricane Wilma*, intended to streamline certain loss determinations¹⁰ on specific crops and accelerate the adjustment of losses, expedite processing of loss claims and payments to growers from Hurricane Wilma. The application of the emergency loss procedures was intended to be limited to those situations where the catastrophic nature of the losses was such that not authorizing these emergency loss procedures would result in unnecessary delays in processing claims.

RMA has a process for revising Key Program Dates such as Final Planting Date and Earliest Planting Date Criteria:

A Final Planting Date (FPD) Criteria is used by RMA Regional Offices (RO) in determining Final Planting Dates when: Reviewing a Request for Change in the FPD; Reviewing existing FPDs on a rotational basis (based on the Actuarial Filing System Schedule); Changing existing FPDs; or creating new FPDs due to New County Crop Program Expansion, or New 508(h) programs. When setting FPD's, RMA uses the criteria which includes tools such as the U.S. Climate Normals data online (this information can be used to see how farmers make planting decisions) and tools provided by a partnership with Tarleton University, Center for Agricultural Excellence (CAE). CAE provides resources on data warehousing, data mining of agribusiness and agriculture data for agricultural risk management products. CAE also provides the tool, HYDRA which can be used to determine whether weather events happened on specific dates: <http://rmcae16.cae.rm.usda.gov/>

RMA approved the use of a tool for keeping track of records.

Planting Crops Too Early-Effect on Crop Insurance Policy: On March 28, the Midwestern Regional Climate Center in Champaign, Illinois issued a press release on planting too early. A portion of the release stated, "The warm temperatures and relatively dry soil have prompted farmers to think about planting their corn crop early this year. There are reports of farmers planting corn in Illinois, Iowa, and Missouri about two to four weeks early. A majority of Iowa, Minnesota, Wisconsin, Michigan, and Ohio have not experienced a growing season that has

⁹ The Federal Government established the Florida citrus fruit crop insurance program to insure growers against damage due to catastrophic weather events.

¹⁰ When losses occur, the Standard Reinsurance Agreement requires that approved insurance providers (AIPs) send adjusters into the field to determine the extent of damage and the appropriate losses under the insured's policy.

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started before April. Planting crops right now warrants caution, since there is still a possibility for a 32-degree freeze to occur, or even a 28-degree “hard” freeze, which could kill plants that have emerged “ RMA is educating and providing outreach to growers via interviews with news and other organizations to explain to growers how planting early would affect their crop insurance coverage: “Crop insurance policies do not cover “replanting costs” if growers plant before the earliest planting/seeding date, which is April 6 in most of Illinois, Indiana, and Ohio and April 11 in Iowa and Minnesota.”

(Note: A grower that signed up for crop insurance on March 15 and plants before the earliest planting date is still covered for the 2012 crop year, however, if they suffer a loss from freeze or any other cause of loss, they would have to cover the cost to “replant” the crop --as replanting payments would not be covered since the farmer chose to plant before the established earliest planting date).

http://mrcc.isws.illinois.edu/news/releases/2012/20120326_EarlyWarmth2012.pdf

Requesting Insurance Not Available in Your County: As new crops are grown in new areas due to climate change adaptation, RMA has procedures in place for growers to request insurance coverage for insurable crops where insurance is not yet available already in a county. Growers submit a request to their crop insurance agent and Regional Office and provide information to assist RMA in making a coverage offer: in addition to numerous items—they must have evidence from Agricultural Experts that the crop can be grown in the county if the request is to provide insurance for practices, types, or varieties that are not insurable. They must provide dates the grower and other growers in the area normally plant and harvest the crop. For an irrigated practice, the water source, method of irrigation, and amount of water needed for an irrigated practice for the crop.

New Hardiness Zone Maps for Nursery: RMA has been evaluating the new Hardiness Zone Map published by Agricultural Research Service. As it gets warmer, some of the zones may shift (mostly northwards); therefore this could affect most of our plans of insurance products, particularly the Nursery Crop plan of insurance. RMA insures nursery plants based on county and hardiness zone; as a consequence of the changes in the climate, some nursery plants may no longer be insurable in some specific locations or higher insurance premiums may be necessary. It should be noted that no action has been taken. RMA has been evaluating and having informal conversations regarding this.

New Threats to Crop Insurance Program due to Climate Change: With increased movement of insects, diseases, plant materials, and invasive weeds in addition to the pressures of climate change, the scope of pests causing problems continues to widen. RMA monitors soybean rust developments --

RMA Monitoring of Soybean Rust Developments: The threat of soybean rust disease affecting U.S. soybean growers in the near future is of concern to RMA. Some months ago, a soybean rust working group was formed to prepare for the arrival of soybean rust by keeping State, commodity, and Federal scientists informed of the recent activity related to soybean rust. RMA personnel are participating in this work group. The working group members include at least one extension plant pathologist from each soybean state and any representatives from State, Federal,

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and commodity organizations with an interest in soybean rust. The working group meets by teleconference bimonthly or as needed to discuss items of concern to members. Common topics are management options, information resources, range of soybean rust, and recent research. The working group is hosted by the USDA Office of Pest Management Policy, and past meeting summaries as well as other items of interest about soybean rust may be viewed at: www.ipmcenters.org/NewsAlerts/soybeanrust/

Process for Revising Crop Coverages: RMA has a Written Agreement Handbook that provides guidance to the Regional Offices and/or Private Insurance Companies and is used to change or revise coverages as needed. For example, the RO will determine whether a similar crop's loss would be substantially comparable to the crop for which a written agreement is requested. If a grower is requesting insurance for sunflowers because of limited water supply instead of corn, the RO will determine whether the severity of loss would be comparable in both crops.

Appendix B: Actions to Address Risks and Opportunities from Climate Change

Action	Agency Lead	Risk or Opportunity	Scale	Time Frame	Implementation Methods
PRISM is building a Climate and Weather WEB Portal-- http://prism.oregonstate.edu/	Collaboration of RMA and Oregon State University	Recognize changes in climate patterns on a timely basis	National	12/2012	PRISM data to be made available to RMA, and to 16 approved Insurance Providers and growers
Emergency Adjustment Procedures for Catastrophic Loss Events	RMA	Enhance ability to provide timely payments to growers	National	12/2012	Establish procedures for insurance Companies
Revise Key Program Dates	RMA	Ensure that the crop insurance program reflects changes in climate and agronomics	National	Annual	Revise actuarial documents to reflect revised dates
Program Expansion	RMA	Ensure the crop insurance coverage is expanded to new areas where crop are grown due to changes in climate and agronomics	National	Annual	Revise actuarial documents to reflect revised dates

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New Hardiness Zone Maps for Nursery	RMA	As a consequence of the changes in the climate, some nursery plants may no longer be insurable in some specific locations or higher insurance premiums may be necessary	National	12//2013	Revise insurance policy materials to reference hardiness zone maps
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USDA Rural Development
Climate Change Adaptation Planning Document
June 2012

**USDA Rural Development
Climate Change Adaptation Planning Document
June 2012**

This plan has been prepared in accordance with Executive Order (E.O.) 13514, requiring all federal agencies to have a climate change adaptation plan submitted to the Council of Environmental Quality (CEQ) no later than June 29, 2012. USDA Departmental Regulation 1070-001 calls for the Climate Change Program Office (CCPO) to develop the USDA Climate Change Adaptation Plan with the full support and participation of USDA agencies and offices. To accomplish this, the Rural Development agencies (RD) have prepared this adaptation strategy that addresses how it is going to integrate climate change into its programs, policies, and operations. RD's plan is submitted with the intent that it will be included in the Department's response to CEQ. Per D.R. 1070-001, this plan will support USDA's requirement to:

- (1) Analyze how climate change may affect the ability of agencies or offices to achieve their respective mission and its policy, program, and operational objectives by reviewing existing programs, operations, policies, and authorities to: identify potential impacts of climate change on the agency's or office's areas of responsibility; prioritize, implement, and mainstream response actions, contingent on the availability of resources; and continuously assess and improve the capacity to adapt to current and future changes in the climate.
- (2) Identify to the Office of Budget and Program Analysis, under the Office of the Chief Financial Officer, as part of the annual budget process areas where budget adjustments would be necessary in order to carry out the actions identified under this Departmental Regulation and include this information on the Global Change Cross-Cut that is compiled each year;
- (3) Identify, as appropriate, for USDA's Office of the General Counsel areas where legal analysis is needed to carry out actions identified under this Departmental Regulation; and
- (4) Coordinate actions across the Department through USDA's Global Change Task Force, as appropriate.

Policy Framework

RD's mission is to increase economic opportunity and improve the quality of life for all rural Americans. RD's vision is to maximize our program benefits to support a rural America that is a healthy, safe, and prosperous place to live and work.

To assist the country in addressing today's challenges, RD supports the Secretary's Strategic Goals primarily through Goal # 1 *Assist rural communities to create prosperity so they are self-sustaining, re-populating, and economically thriving* and Goal # 2 *Ensure our national forests*

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and private working lands are conserved, restored, and made more resilient to climate change, while enhancing our water resources.

Particularly relevant RD's Goals and programs that focus on Climate Adaptation planning include:

- Rural Utilities Service
 - Water and Environmental Programs providing clean and safe drinking water and sanitary water facilities.
 - Technical Assistance
 - Environmental Water & Waste Studies
 - NEPA requirements on all projects
 - Electric Programs provide reliable and affordable electricity to rural areas and have
 - Improvements to and diversification of base-load power generation.
 - Renewable energy at the utility size & scope
 - Energy Efficiency programs
- Rural Business-Cooperative Service
 - Alternative Energy: America's development and use of alternative energies is good for our country and good for our environment.
 - Energy programs to help lower supply chain GHG emissions due to consumer demand and to help agriculture reduce energy costs to provide cash flow for other adaptation strategies needed on operation.
 - Energy efficiency upgrades to rural business helping to reducing overall energy use to reduce strain of possible high unit energy cost.
 - Agro Forestry - Wood to Energy project finance modeling which may help to lower the cost of forest restoration work due to increased fire, disease and pest damage
 - Bio Fuels/Retail Infrastructure for lower GHG fuels to consumers
 - Bio Based Products
- Rural Housing Service
 - Energy Efficient Homes
 - Multi-family housing improvements
 - Community Facilities Programs

Vulnerability to Climate Change

RD supports rural areas through loans, loan guarantees, and grants. For some of RD's programs, the agency holds liens or other security interests in facilities and related infrastructure in areas that could be affected by hydrological changes and sea-level rises resulting from impacts such as inundation and erosion. Additionally, many climate change models predict increased frequency and severity of weather events such as tornados and hurricanes, which can damage utility facilities and infrastructure. Climate change therefore represents a risk to these agency assets

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and the communities they serve. Damage that may occur to such infrastructure and facilities would create an increased demand on RD to respond to requests for financial assistance to repair, replace, relocate or otherwise improve these assets. The potential for increased demands on financial resources could divert those resources from normal program operations, impacting RD's ability to achieve its mission and goals. An increase in financial assistance requests could burden all aspects of RD operations, including but not limited to underwriting, engineering, and environmental review activities.

Extreme weather events could also have devastating effects on rural communities as well as RD offices and their personnel stationed throughout the Nation. Events that could damage or destroy facilities and utility infrastructure needed to supply water, electricity, and telecommunications to communities and field offices could create significant health and safety problems for the public and for RD employees. Additionally, emergency response can be affected by telecommunications failure, including failure of the Federal Communications Commission's Enhanced 911 (E911) system, which is supported by towers and infrastructure financed by RD programs.

RD provides support to low-income communities and businesses in rural areas. Assuming current climate change trends continue communities in certain geographic regions that are served by RD will face increased average temperatures, more frequent temperature extremes, and changes in precipitation patterns. Scientists predict the severe heat experienced during summer 2003 in Western Europe, while exceptional for the past century, will be more typical of climate patterns expected in this century. Increased temperatures will likely increase the need for energy efficient homes in low-income communities and an increased demand on power generation capacity, which in turn will create a rise in the number of applications for assistance from residential applicants, electric cooperatives, and rural businesses. Drought conditions may also lead to increased requirements for infrastructure to deliver water to areas that no longer have viable water sources as well as to power generation facilities, which may lead to a greater volume of applications for assistance from RD programs. This increased demand would divert resources from normal program operations, impacting RD's ability to achieve its mission and goals.

The Adaptation Planning and Evaluation Process

Through adaptive planning, RD can respond to potential impacts by conducting or utilizing risk assessments for new facilities and utility systems and determining what existing facilities and utility systems may be located in areas more vulnerable to the effects of climate change. Existing tools and available data can be used to consider the effects climate change may have on a proposed RD action, and can assist in contingency planning for existing assets and the communities they serve. One example of a tool in development for this type of risk evaluation is the National Oceanic and Atmospheric Administration's (NOAA's) Sea Level Rise Viewer, available at <http://csc.noaa.gov/digitalcoast/tools/slrviewer/>. This is just one example of tools that RD can use to assess risk. As additional tools become more available, RD can use these tools in decision making to evaluate the feasibility of its proposed actions and prepare for potential threats to areas where RD has existing interests. Additionally, RD can expand tools

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that already exist within the agency. For example, a geographic information system (GIS) program developed by ESRI called “Community Analyst” is currently available through an online portal to a limited number of licenses to RD staff and has the capability for expanded usage and expanded unique RD data sets. Community Analyst can be used to identify a number of community variables in areas impacted by disaster to understand where RD’s assets are threatened or impacted. This GIS assessment tool already has a wide range of environmental data layers and it could be expanded to include climate prediction models and to make this information available to RD program staff.

Sustained Adaptation Process

RD has identified five actions related to climate change adaptation that it will initiate in FY 2013, dependent on funding availability, RD leadership approval, and partner support:

Action 1: RD is in the process of rewriting its environmental regulations at 7 CFR 1970, which will include consideration of climate change in the environmental impact analyses it performs on each request for financial assistance. In addition, to ensure that RD programs have tools to consider how to adapt to climate change, RD will review programs and policies – with the assistance of Research, Education, and Economics (REE) mission area as necessary – to assess the extent to which there may be opportunities to improve RD decision making and prepare for and respond to potential impacts from climate change. Opportunities identified will be flagged according to whether they require a change in policy, a regulatory change, or an act of Congress. Changes in policy can be effected in the relatively short term. Regulatory changes will trigger longer term regulatory processes. Issues that require statutory changes can inform Farm Bill discussions.

A summary of information gathered throughout the year and associated recommendations will be provided to RD leadership annually. Questions RD will consider during this review include the following:

- Water, electric, and telecommunications programs: Do policies and regulations for these programs encourage adaptation to address potential effects of climate change? Are there opportunities to improve climate change adaptation considerations in the policies and regulations that define the management of these programs?
- Rural Business and Rural Housing Programs: Is the state of the art science sufficient to identify areas of the Nation where climate change prediction models suggest higher potential impacts from rising temperatures in the near future? If so, do the available data warrant a consideration of proposals for seeking appropriations to expand or supplement these programs in high risk areas to respond to expected increases in applications for energy efficiency and alternative energy improvements?
- Disaster Response: How quickly can assistance be provided if losses are widespread? How could RD assist the traditional disaster response agencies in responding to widespread disasters? What type of programmatic partnership instruments could RD

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execute with other agencies and NGOs prior to catastrophic events to be poised to assist partner resources in the event of disaster response requirements?

Action 2: RD will partner with the REE mission area and non –governmental organizations (NGOs) to evaluate decision-support tools that are based on sound state of the art science and their applicability to RD programs. When tools are found to meet these criteria, RD will disseminate data to field offices to facilitate their outreach to program applicants. These data and tools will provide practical resources for both agency decision making and to support applicant due diligence in their application assessment processes.

Action 3: RD periodically, as new information becomes available, will prepare briefings or information packets to educate agency staff on the risks of climate change effects as they apply to specific program areas within RD. RD will continue to conduct “continuity of operations” assessments to better understand the administrative implications of climate change impacts to prepare headquarters, state, and field office staff to respond to events such as failures of borrower systems.

Action 4: RD will review mechanisms for improving climate change adaption, for example: evaluating the potential for integrating alternative energy sources in appropriate RD programs; or seeking ways to develop partnerships among regional water supplies to address drought.

Action 5: Evaluate whether through legislation USDA could pool funds allocated for a specific disaster, which are not expended during response to that disaster, and create a contingency fund for future disasters or disaster preparedness. If possible, RD will evaluate budgetary methods by which such funds could be used to address climate change related disasters.

Appendix

Actions to address risks and opportunities

Action	Agency Lead	Risk or opportunity	Scale	Timeframe
1 – Rewrite 7 CFR 1970 and evaluate other areas	RD	Opportunity to highlight to Administration and Congress policy changes to facilitate adaptation	National	FY 2012-2013
2 – Partner with REE and NGOs to evaluate decision tools that incorporate sound climate change science in agency planning	RD	Opportunity to leverage partnership strengths and resources to improve climate change adaptation considerations in RD decision making	National	Ongoing
3 – Prepare briefings or information packets to educate staff as new information on climate change adaptation becomes available	RD	Opportunity to educate staff to encourage agency-wide participation in climate change adaptation efforts	Agency-wide	Periodically
4 – Review mechanisms for improving climate change adaptation	RD	Opportunity to seek ways to apply creative approaches to addressing climate change impacts and improve sustainability	Agency-wide	Annually
5 – Use funding flexibilities to be poised to respond to future emergencies	RD	Opportunity to establish agency emergency responses affecting agency assets and communities served	National	Ongoing