

-- FINAL --

High-Level Analysis of Agency Vulnerability to Climate Change

Introduction: Climate Change Adaptation and the U.S. Department of Agriculture:

Overview: Role and Mission of the U.S. Department of Agriculture

The mission of the U.S. Department of Agriculture (USDA) is to “provide leadership on food, agriculture, natural resources, rural development, nutrition, and related issues based on sound public policy, the best available science, and efficient management.” USDA is unique among many Federal departments in the broad spectrum of its agency missions, including research, applications and technology transfer; public land management; disaster, other financial assistance, and technical assistance to private landowners; and communications and delivery. These agency missions center on people and land, both private and public, rural and urban, and include fish and wildlife habitats, forest lands, croplands, grasslands, wetlands, agro-forest ecosystems as well as agricultural and forest products. Among USDA’s greatest assets is its customer focus: the ability to interact with farmers, ranchers, forest landowners and other stakeholders. USDA has developed trusted partnerships through science-based decision support, programmatic assistance, extramural education, technical guidelines, and methods for natural resource management. With this capacity, USDA is well-positioned to meet the requirements of Federal agency climate change adaptation planning.

USDA’s Strategic Plan (2010-2015) provides a strong foundation for climate change adaptation planning. The vision articulated by USDA’s Strategic Plan calls for USDA “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.”

The USDA Strategic Plan specifically addresses the challenges of climate change and the opportunities associated with addressing efforts to adapt to climate change within its four goals: 1) Assist rural communities to create prosperity, to be self-sustaining and economically thriving; 2) Ensure our national forests and private working lands are conserved, restored and made more resilient to climate change while enhancing water resources; 3) Help promote agricultural products and biotechnology exports to increase global food security; and 4) Protect agricultural health, minimizing major diseases and pests to ensure increased access to safe, nutritious food.

A growing body of evidence shows that U.S. 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

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

-- FINAL --

responsibilities articulated by its mission, and goals. Climate change is central to USDA's strategic planning and is integrated into its strategic plan. Goal 2 above, specifically addresses climate change in its title, 'Ensure our national forests and private working lands are conserved, restored and made more resilient to climate change while enhancing our water resources.' The remaining three goals support various aspects of USDA's mission that are also at risk from impacts of climate change. 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 impact forest and agro-ecosystems at national, regional, and local scales, spatially and temporally. These changes may have significant implications for 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.

Climate Change Impacts on Agricultural Production

Mechanisms for adapting to climate change are critical for continued agricultural production and stewardship of natural resources. An understanding of the impacts 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 impacts are key to formulating management responses. Adaptive responses to climate change must be evaluated for impacts on ecosystem function, potential feedbacks on the climate system and subsequent 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 U.S. is projected to warm by 1-2°C in the next 40 years and as much as 3-6°C by the 2080's¹. Increasing temperatures across the country with the most notable temperature increases are 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. Changes in U.S. precipitation patterns relative to historic trends result in greater climate variability and more intense fluctuations during extreme climate events. Projected increases in the variability of precipitation will additionally impact agricultural production because of the uncertainty in water availability within the growing season.

Global sea level is projected to rise by the end of 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

-- FINAL --

damage. Coastal storms, especially of tropical origin, more frequently could have damaging winds, leading to greater extreme wave heights along the coast. More direct impacts of increasing carbon dioxide levels in the atmosphere may cause changes in plant response, including possible increases in weed pressures, geographic expansion of invasive species, and changes in vegetation productivity.

The agricultural sector has a strong record of innovation and adaptability, but the magnitude of climatic changes projected for the next 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) 4.3² outlined important impacts that a changing climate potentially can have on agriculture and forestry. These impacts present threats to agricultural production systems as well as opportunities to improve and expand production. Anticipated adaptation to climate change in production agriculture includes adjustments to production system inputs, 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 changes due to climate variability and change can lead to volatility in surplus and deficits in regions where food insecurity is common or difficult to obtain due to transportation disruptions. Food assistance programs experience increases in the number of requests for market assistance under severe weather conditions such as flooding, hurricanes, and tornadoes.

Climate Change Impacts on Forests and Grasslands

National forests and grasslands and surrounding farms, ranches, and private timber 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. Climate change will generally reduce ecosystem services because most human enterprises are based on past climatic environments and experience. 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 stands³. Land-use shifts in rural areas could involve conversion of forests to other uses depending on market conditions. The extent of

² 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.

³ Vose, J.M. et al., National Climate Assessment – Forest Sector Technical Report. U.S. Forest Service General Technical Report

-- FINAL --

wildland-urban interface areas 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 diverse ecosystems within forests and grasslands are 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 also 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 trade enhances global food security, but provides conduits for geographic expansion of invasive species. Increased impacts from catastrophic wildfire despite attempts to restore fire to appropriate landscape locations are additional threats from climate change. Recent trends indicate increased fire occurrence and severity will impact 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 control efforts.

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 impacts and effects is relatively new³. Risk assessments need to be tailored to particular regions and time frames and modified by an estimate of confidence in climate projections made. For example, management strategies for Alaska, where climate change impacts on longevity of permafrost and the effects of changing disturbance regimes are quite different from the strategies needed for the Northwest U.S. where climate projections indicate a future unfavorable to parts of the current range of Douglas-fir; different again from the strategies for low-lying islands such as those of the Pacific territories where increased storm activity, sea level rise, and population demands create stressors; and different from strategies for the Southeast where 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.

-- FINAL --

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 U.S. 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.

Climate Change Impacts on USDA Other Functions

Climate change also 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 and human health associated with many animal and plant diseases, invasive species, and agricultural 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 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. Associated excess moisture, drought, pest infestations, heat stress and other severe weather and climate-related events place pressure on the capacity of agencies to meet demands.

Shifts in climate may also impact USDA infrastructure, particularly in areas of rising sea level and in areas of increased recurrence of extreme, damaging storms, tornadoes, and hurricanes. USDA facilities and operations may be increasingly and less predictably impacted by these events. Rising temperatures impact the ability to manage energy costs associated with aging structures or buildings constructed when energy costs were a less significant portion of agency budgets. The ability of the workforce to cope with these events while commuting, in the course of their work, and at home may impact their performance.

Economic Effects of Climate Change on U.S. 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 U.S. are sensitive to yield impacts and adaptation opportunities, as well as constraints in the U.S. and abroad. Although domestic producers and consumers are likely to fair well with existing adaptation strategies, future climate scenarios with

-- FINAL --

even mild to inconsequential net global impacts from climate change may result in more severe implications for food security for the very poor and vulnerable populations worldwide.

Adaptive behavior can occur at any level in highly diverse systems such as agriculture and forestry that include consumption, production, education and research. The aggregate impacts of changing climate ultimately depends on a network of adaptive responses to climatic stressors from the local producer level 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. Management costs associated with changing biophysical stressors, the impacts of variability and extreme weather events, and potential credit or resource constraints affect producers' financial viability. Regional capacity for expanding agriculture, forestry or irrigated production will depend heavily on resource constraints particularly availability of land and water. Because agricultural and forestry system are complex, the manner in which production and consumption systems adapt to biophysical impacts will determine the overall impacts from a changing climate.

Adaptive behavior can mitigate the potential effects of climate change on food production, agricultural and forestry 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)⁴ find that with adaptation, the production effects of climate change are reduced to one-fifth to one-sixth of initial yield impact. Attempts to quantify the economic effects of climate change are dependent on number of elements as well as scale and include climate and yield projections, scope of an assessment, treatment of adaptation constraints and the methods and models used. For example, if global yields are generally negative, global prices rise regardless of domestic yield increases. The resulting price increases could benefit U.S. producers but not necessarily the U.S. consumer. Uncertainty in climate projections is also a critical element in assessing economic impacts. Although many climate models exist, none are considered more reliable than others and there has been little effort to account for the many sources of uncertainty associated with climate change impacts to date.

Federal Government Activity 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

⁴ Reilly, J, et al., (2007) Energy Policy, 35(11): 5370-5383

-- FINAL --

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 U.S. 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.

U.S. 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 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.

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 and forestry, and co-leading or authoring sections of reports on land use, biogeochemical cycling, rural communities, and regional sector studies. 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 impacts 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

-- FINAL --

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 U.S. National Forests in SAP 4.4, 'Preliminary Review of Adaptation Options for Climate-Sensitive Ecosystems and Resources'.

Council on Environmental Quality (CEQ) and Adaptation

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. By Executive Order in October 2009, the Interagency Climate Change Adaptation Task Force (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 impacts on select sectors, institutions, and agency responsibilities, and ultimately to develop recommendation reports. To facilitate the effort, multiple workgroups, that included USDA scientists, 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

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.

II. 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 preliminary responses are broad and address risks and vulnerabilities at global, national, regional, and local scales as they relate directly to a particular agency mission.

-- FINAL --

A. What major impacts or vulnerabilities have been identified for USDA?

Physical and Biological Climatic Concerns: USDA agency missions are impacted 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.
- Animal and Plant Health Inspection Service (APHIS) – APHIS protects and promotes U.S. agricultural health, regulates genetically engineered organisms, administers the Animal Welfare Act and carrying 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. The approach rate and probability of establishment for invasive alien species will also be impacted by climate change.
- 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 impacts 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.
- Foreign Agricultural Service (FAS) – One of the missions 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.

-- FINAL --

- Forest Service (FS) – FS administers public forests and grasslands and works with state and private landowners to restore, sustain and enhance forests and grasslands. Changes in key climate variables affect the seasonality of hydrological regimes and the length of the fire season. In the west, fire season has 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 disrupt ecosystem processes and functions. These effects challenge the objectives of: reducing risk to communities and natural resources from uncharacteristically severe wildfires; reducing adverse impacts from invasive species; and restoring and maintaining healthy watersheds and diverse habitats. The changing climate is already altering species ranges and has the potential to alter ecosystem structure in the future. Management may require forward-looking approaches to novel ecosystems instead of depending on past historical ranges of variability on the landscape.
- 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 stressor 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.
- 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 drought frequency, precipitation changes, flood frequency and intensity, higher night-time temperatures, higher annual or extreme minimum temperatures, and more intense storms. Conservation planning in coastal regions should anticipate sea level rise, increased hurricane intensity, and the associated increases in coastal erosion and damage.
- Risk Management Agency (RMA) - 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 and final planting dates and other program dates) as needed to reflect such changes.

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

Marketing 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.
- 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.

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 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.
- Forest Service (FS) – Open space and recreation: 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 and managed under a changing climate. Additionally, the projected increase in U.S. population and the continual decline of public access to privately-owned land will increase pressure to provide more recreational opportunities on public land.

-- FINAL --

- 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 faculties, businesses and agricultural producers to respond to weather related events, mitigate the environmental effects of climate change and adapt to changing conditions.

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, to stakeholders, and to customers the need to elevate the importance of changing climate as a factor affecting agency operations and research results.
- Animal and Plant Health Inspection Service (APHIS) – APHIS is working with ARS to develop a list of research needs that ARS scientists can address to adapt to climate change. APHIS has international partners in climate modeling and closely follows research in universities. 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). ACEP does not have expertise to directly analyze the impact of climate change scenarios on disasters. ACEP can follow information provided by NOAA, FEMA, and other subject matter experts in the impact of climatic data on disaster risk. Many of these analyses are in developmental stages and their resolution too coarse to precisely predict 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.
- 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 impacts and adaptation, including gathering, improving and disseminating climate-related data in support of climate change and adaptation research, as well as developing improved in-house modeling and analysis capacity to implement the most up-to-date science and methodologies available.
- Foreign Agricultural Service (FAS) - FAS does not presently have appropriated programs specifically designated for international exchanges or capacity building related to climate change. Instead, eligible applicants who are interested in climate change must compete against applicants with other priority issues for these FAS programs. FAS will need to anticipate these requests and negotiate cost-reimbursable interagency agreements to secure adequate resources.

-- FINAL --

- Forest Service (FS) – FS promotes conservation education to 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. Increasing extreme events and more climatic variability will challenge stewardship programs that directly benefit urban dwellers, such as managing landscapes to reduce risks from wildfire and maintain critical environmental services like water quality and availability.
- National Agricultural Statistics Service (NASS) - NASS provides the information necessary to facilitate research needed to address issues related to climate change. NASS operations are not directly impacted by climate change conditions. However, change in climate conditions does influence crop variability and will have an impact on information NASS collects and publishes, such as crop yields and production data. Farmland use and conservation practices also impact 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 also 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.
- Natural Resources Conservation Service (NRCS) – NRCS will examine human capital, expertise areas and levels and other agency infrastructure components relative to climate change impacts. 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 is assessing the agency’s infrastructure and capacity for addressing climate-related issues, and is developing a climate change adaptation plan to guide future agency planning.

-- FINAL --

This is expected to be the start of an sustained effort to better integrate changing climate 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 land owners and managers to plan and manage resources. Because climate and natural resource conditions are changing rapidly, existing decision support tools and their supporting databases need to be reviewed and new approaches to decision support must be developed to enhance managers' 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.

B. What process is used to assess USDA vulnerability to these climate change impacts?

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

- Agricultural Marketing Service (AMS) – AMS gathers information internally for evaluation and it 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. A field scientist is scheduled for a detail during fall, 2011 to assist the ARS Office of National Programs with an assessment of ARS research that contributes to climate change adaptation for agriculture. The Office of National Programs has assisted the ARS Facilities, Operations and Maintenance Unit during development and preparation of greenhouse gas management and reporting efforts.
- Animal and Plant Health Inspection Service (APHIS) - Researchers at the Wildlife Services National Wildlife Research Center (NWRC) use various analytical tools and statistical modeling approaches (e.g. Monte Carlo Simulation, Analytical, Bayesian) to conduct risk assessments related to transmission of wildlife diseases to domestic animal and human health and threats posed to agriculture, natural resources, and U.S. infrastructure by invasive species. Scientists from NWRC conduct risk assessments related to preventing the

-- FINAL --

transmission and spread of Bovine Tuberculosis, Salmonella, West Nile Virus, Avian Influenza, E. coli 0157, and other zoonotic diseases on the farm-side environment. They evaluate transmission risks of diseases from shorebirds and waterfowl to U.S. poultry operations on a continental scale and model the secondary hazards of vertebrate pesticides in the environment. NWRC researchers from several disciplines work with staff from other APHIS programs to complete risk assessments for invasive species and wildlife disease in Micronesia to address biosecurity issues related to U.S. troop buildups in Guam. APHIS climate change concerns extend globally, well beyond continental boundaries.

- ARS and APHIS held a joint workshop during 2011. Topics included climate adaptation impacts on APHIS' mission and potential research that ARS can conduct to assist APHIS with adaptation focused on decision support for risk management. ARS, APHIS and NASA are also discussing the possibility of collaborative research to develop a pest population dynamics early warning system for APHIS.
- 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 analysis of how changes in the climate, and associated changes in the resource base, will affect farmer decision-making. This effort involves a comprehensive integration into ERS analyses of key data sets from FSA and NASS as well as close collaboration with other Federal agencies such as U.S. Department of Energy and U.S. Environmental Protection Agency.
- Foreign Agricultural Service (FAS) – FAS gathers market information and commodity analysis. It monitors and responds to international requests for programs and services. FAS represents USDA in key international organizations concerned with climate change.
- Forest Service (FS) – The FS has a number of comprehensive processes underway throughout the agency including a Roadmap for Responding to Climate Change, Climate Change Performance Scorecard, a Forest Service Planning Rule, and a Watershed Condition Framework and Terrestrial Condition Framework. 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 works closely with other USDA Agencies, such as ERS to identify and collect the data needed to assess impact of climate change on farming operations. For example, tillage practices questions were added to the 2012 Census of Agriculture and The Agriculture Resource Management Survey (ARMS) questionnaires to collect information to help assess carbon sequestration in soils. NASS works with NRCS to collect data for the Conservation Effects Assessment Project (CEAP), FAS for satellite imagery and FSA to ground truth the Cropland Data Layer (CDL). The CDL Program annually produces digital categorized geo-referenced products using satellite

-- FINAL --

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. CropScape, the dissemination portal for the CDL is a state-of-the-art portal featuring a web-service based interactive map visualization, dissemination, and querying system.

- 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 which includes a portfolio planning, assessment, and quality improvement plan.
- Natural Resources Conservation Service (NRCS) – An integrated team is developing a process for assessing vulnerability to climate change impacts. The vulnerability assessment will incorporate an examination of conservation practices and systems most vulnerable to short and long-term changes in climate and how they will affect operations using existing conservation assessments. NRCS collects snow data for water supply forecasts and soil moisture and temperature data with its automated Snow Telemetry and Soil Climate Analysis Network. These data play a critical role in assessing trends in climate variability and change, and are the only such national snow and soil climate observational databases of their kind in the U.S.
- Risk Management Agency (RMA) – Continues to monitor premium rating methodology (see table), 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.
- Risk Management Agency (RMA) –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. PRISM is also building an 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, it can be used by producers 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

-- FINAL --

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.

C. What challenges are faced by USDA in identifying climate change impacts and vulnerabilities?

The challenges faced by USDA and its agencies in identifying climate change impacts 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 agencies missions and their stakeholders. These 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 impacts are exceedingly difficult to predict.
- Lack of effective tools to identify and predict climate change impacts on different time and different spatial scales. It is difficult to definitively decouple the impacts that can be attributed to climate change from other factors that traditionally impact operations.
- Challenges in precisely forecasting how and where climate change is most likely to influence risk pathways for pests, notably agricultural diseases, and food-borne pathogens that could potentially affect global food and agricultural systems.
- Uncertainties in methodologies (empirical and process-based) used to evaluate any changes in climate with specific resource impacts.
- Climate dynamics are extremely complex, and predicted 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 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 impact 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

-- FINAL --

stakeholders tend to identify and accept more easily. Climate variability when addressed in an environmental context, can illustrate these societal challenges more readily.

III. Actions

Several agencies within USDA plan to perform vulnerability assessments. This approach will lead to additional actions once assessments are completed. Some uncertainty issues are being addressed both through development of a more robust baseline of historical climate conditions and resource use and through increased awareness of and participation in efforts to develop, standardize, and disseminate climate change scenarios that have the appropriate variables for economic analysis and projections. The following are actions identified by USDA agencies:

-- FINAL --

PRELIMINARY -- USDA-LEVEL ACTIONS

Action	Scale (National, Regional, Local)	Completion Date	Other Agencies Collaborating With (if applicable)
Interagency acquisition agreements that enable FAS to help partner countries' food and agriculture systems prepare for and respond to climate change	Global	2011-2014	USAID, USDA-ARS, USDA-NASS, USDA-NRCS, State USDA-Forest Service USDA-NIFA and Land-Grant Universities <u>Note (Contribution to alleviating key vulnerabilities):</u> <i>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.</i>
Participate in Feed the Future (FtF) working groups	Global	Ongoing	State, USAID, USDA-OSEC, USDA-NASS, USDA-ERS, USDA-OCS <u>Note (Contribution to alleviating key vulnerabilities):</u> <i>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.</i>
Maintain market intelligence and analytical capabilities	Global	Ongoing	ERS and WAOB <u>Note (Contribution to alleviating key vulnerabilities):</u> <i>Maintaining market analysis capacity will allow FAS to begin to incorporate climate change information as tools become available.</i>

-- FINAL --

PRELIMINARY -- AGENCY-LEVEL ACTIONS

Action	Scale (National, Regional, Local)	Completion Date	Other Agencies Collaborating With (if applicable)
USDA-Forest Service (FS) Climate Change Performance Scorecard	Local, summarized nationally	Annual	Requires partnerships with state, tribal, or local landowners or private organizations to increase capacity
Watershed and Terrestrial Condition Framework for integrated resource restoration. (FS)	Local and Regional	Annually over the next 3 years	An all-lands approach to resource restoration that involves federal, state, tribal and local landowners
Cohesive Wildland Fire Management Strategy (FS)	Regional	Phase I complete	Department of Interior, Wildland Fire Leadership Council (Federal, state, tribal and municipal stakeholders)
New proposed planning rule (FS)	Local and national	December 2011	Requires collaboration with state, tribal, and local stakeholders
Integrated inventory, monitoring, and assessment system (FS)	National	January 2012	Department of Interior, other Federal agencies, Tribes, and States
Climate Change Resource Center (www.fs.fed.us/ccrc)	National	complete	Provides information and tools to public and private land managers
Workshop on adaptation for Tribes (FS)	National, international	2012	EPA, Canada Centre for Indigenous Environmental Resources
Economic Research Service (ERS) Research on economic impacts and adaptation strategies for climate change	National	Periodic	N/A

-- FINAL --

Co-organizers of the Forestry and Agriculture Greenhouse Gas Modeling Forum (ERS)	National	September, 2011	USEPA, Forest Service, USDA/OCE,
Representation on the Agricultural Model Inter-comparison and Improvement Project (AgMIP) (ERS)	National/Global	Ongoing	N/A
Participation in Sun Grant Initiative research and data development efforts (ERS)	National	Ongoing	USDOE, US Department of Transportation
Develop risk management tools for APHIS for advanced warning of increased probability of pest occurrence at ports of entry	National/Global	Ongoing	ARS, APHIS, NASA <u>Note:</u> <i>Increase protection of domestic food production against pests, including invasive species, that threaten food supply and production sustainability</i>
International Organizations Foreign Agricultural Service (FAS)	Global	Ongoing	State Dept., USEPA, United States Trade Representative <u>Note (Contribution to alleviating key vulnerabilities):</u> <i>Promote the importance of agriculture in the negotiations and discourage trade restricting agreements and potential barriers to trade.</i>
Global Bioenergy Partnership negotiations to establish sustainability standards for biofuels (FAS)	Global	Ongoing	State <u>Note (Contribution to alleviating key vulnerabilities):</u> <i>FAS promotes scientifically transparent and rigorous sustainability standards that do not unduly restrict trade and promote biofuel production that can reduce greenhouse gas emissions to lessen the impacts of climate change.</i>

-- FINAL --

Negotiate for agriculture at the UN climate change negotiations (FAS)	Global	Ongoing	State, USDA-Forest Service, USDA-OCE <u>Note (Contribution to alleviating key vulnerabilities):</u> <i>FAS has been participating in the negotiations since 2009 and seeks to ensure that agriculture is considered in negotiations and do not hamper agricultural free trade.</i>
FAS Climate Change Working Group	DC and interested FAS posts	Ongoing	N/A <u>Note (Contribution to alleviating key vulnerabilities):</u> <i>This Working Group is a flexible instrument to help quickly communicate about climate change issues among relevant offices and program areas throughout FAS. Likewise, the Working Group may be quickly mobilized to help coordinate agency-level responses or complete critical FAS tasks related to climate change.</i>
National Institute of Food and Agriculture (NIFA) - Agriculture and Food Research Initiative: Climate Variability and Change Challenge area	National	Annual	Collaboration with NSF and DOE for Earth System Modeling.
Land Grant-Sea Grant Climate Extension Workshop (NIFA)	National	December 2011	NOAA Sea Grant Office
Snow telemetry (SNOTEL) and soil climate analysis networks (SCAN) for collecting snow and soil moisture temperature data. Water supply forecasts and snowpack reports (NRCS)	National	Ongoing	In partnership with NOAA, National Weather Service, U.S. Geological Survey, ARS, state climatologists, state and local governments, universities and many other entities

-- FINAL --

Climate Change Coordination Team to develop NRCS adaptation strategy plan (NRCS)	National	Ongoing	NA
National Climate Assessment (CCPO, ARS, ERS, FS, NIFA, NRCS)	National	Ongoing	State, NOAA, USDOD, USDOJ, USHHS, NASA, USEPA, USAID, Smithsonian, USDOE, USDOT, NSF USDA agencies collaborate with other federal agencies of USGCRP in order to provide data and methodologies for the 2013 NCA report.
USGCRP Strategic Planning (CCPO, FS, NIFA, NRCS)	National	December 2011	USDA representatives sit on the Integration Team and writing teams with other USGCRP agencies for the 2012 USGCRP Strategic Plan.

-- FINAL --

PRISM data will be made available to RMA, 16 Approved Insurance Providers and producers through an RMA climate and weather web portal developed in partnership with Oregon State University's PRISM Climate Group	National	December 2012	A collaboration of Oregon State University PRISM Climate Group and the Risk Management Agency PRISM (Parameter-elevation Regression on Independent Slopes Model) http://prism.oregonstate.edu/
RMA contracted Report that used weather and climate data, "Methodology Analysis for Weighting Historical Experience –Report"	National	September 2011	http://www.rma.usda.gov/pubs/2011/weightinghistoricaexperiencei mplementation.pdf Report updated the methodology to set crop insurance premiums, leading to lower insurance premium rates for many corn and soybean producers in the 2012 crop year.
"Climate Change Impacts on Crop Insurance, May 2010" (RMA)* http://www.usda.gov/oce/climate_change/files/ImpactsCropInsurance062010.pdf	National	June 2011	Research Triangle Institute (RTI) International Research Triangle Park, NC. *Note: Recommended by the GAO in a 2007 report entitled, Climate Change—Financial Risks to Federal and Private Insurers in Coming Decades are Potentially Significant.

-- FINAL --