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,

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 CO_2 concentration increases on plants (CO_2 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

- 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.

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

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

- 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.