USDA Agricultural Research Service
Climate Change Research

ARS is currently setting its priorities for the next five years of climate change research, building on its climate change research that began nearly 20 years ago. The existing priority of understanding how climate change and agricultural systems interact will be shifting to an emphasis on *predicting* how agricultural systems will respond to a changing environment, and applying predictions to *managing* agricultural systems to society's benefit in a changing environment. Central to this effort will be research to develop methods for reducing greenhouse gas (GHG) emissions from agricultural systems, and creation of information and technologies to adapt agricultural production systems to global changes. An overarching principle of the ARS Climate Change National Program is recognition that decisions and policy making for climate change will be sound if they are the product of scientific knowledge developed from the integration of information from many sources. ARS Global Climate Change researchers respond to this need by coordinated efforts to synthesize and integrate information from our own work and that of the broader scientific community. The program will address the following key needs for solving problems, supporting decisions, and reducing risks.

Managing Carbon in Agricultural Systems

Predicting and managing the fate of carbon in agricultural systems, and how long it stays there, will be based on our understanding of how different land management practices (tillage types, crop rotations, fertilizer applications, grazing practices, etc.) affect carbon storage in the land. Research will lead to accurate predictions of rates of carbon accumulation and duration of storage in different kinds of production systems in the wide range of environments across the Nation. The ability to predict carbon storage will be a powerful tool that will enable producers to make environment-enhancing decisions on the choices they face regarding crop, livestock, and land management. Policy makers will be able to make decisions and manage risks based on reliable data. These data will be generated from the kinds of long-term, multi-location experiments that are a unique element of ARS capabilities (e.g., GRACEnet, the Greenhouse gas Reduction through Agricultural Carbon Enhancement network, involving 31 ARS locations across the U.S. studying carbon sequestration in different systems and environments).

Sustaining Agricultural Production While Minimizing Emissions of Trace Gases (CH_4 and N_2O)

ARS and its research partners are clarifying agriculture's role in emitting and absorbing GHGs. The next phase of this research will be to develop cropping systems, pastures, rangelands, livestock nutrition, and animal waste systems that preserve productivity while minimizing nutrient losses via trace gas emissions, erosion, and leaching; estimating agricultural emissions on large geographic scales and putting them in a context of sources of these gases from other parts of the environment and sectors of the economy; and coordinating with research on alternative fuels and on-farm fuel consumption to further reduce agriculture's GHG emissions.

Creating Resilience in Agricultural Systems as Environment Changes

ARS research that has explained key aspects of how agricultural systems respond to climate change provides the foundation for research to project and manage these responses to minimize adverse impacts and take advantage of beneficial changes of temperature, water, and carbon dioxide in the production environment. Crops and livestock are not alone in the environment, so projecting how pathogens, weeds and insects respond to global change will be critical to managing systems to maintain or even enhance producing agricultural commodities. Research will lead to recommendations for crop and livestock varieties that are adapted to changing conditions, as well as a basis for new varieties that improve production of food, fiber, and fuel. Improved management systems will be developed to minimize economic and environmental uncertainties while maximizing the positive aspects of climate change for agriculture.

Adapting to Changes in Weather and Water in Agricultural Systems

ARS research on understanding changes in weather and the water cycle at scales ranging from the farm to large watersheds provides a foundation for adapting to changing conditions. Modifying and using weather generation models enables projection of the effects of increased weather variability on agriculture, hydrologic cycles and natural environments under varying carbon dioxide, climate, and management scenarios; and incorporating spatial variability and weather uncertainties to project and manage local water supplies. Improved data, models, and decision support systems will be developed to project and manage the effects of global change on vegetation response, environmental response, and economic returns. A sound science basis will help reduce risks inherent in management and policy decisions by water supply districts, farmers, other resource managers, and policymakers on issues relating to water and energy balances at various scales.