Portfolio Annual Report 2009: Environment and Natural Resources

United States Department of Agriculture
Cooperative State Research, Education, and Extension Service

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Portfolio Annual Report

Executive Summary

The importance of maintaining and preserving natural resources and the environment could not be overemphasized. It requires urgent attention. This need is accented as we see the affect of pollutants on air quality, forests, and the depletion of natural resources on which we rely daily. The necessity for a clean, safe water supply for human consumption, agricultural production, industry, and aquatic/terrestrial ecosystems; quality air for the maintenance of human, insect, and animal life; and availability of quality soil for improved agricultural productivity and carbon sequestration; is becoming increasingly challenging.

The objective of the Environment and Natural Resources portfolio involves transforming the ways that working lands are managed. Successful land stewardship, especially under climate change, and changing land use scenarios such as biofuels production and urbanization, requires an understanding of the complex interrelationships among physical, ecological, and social drivers. The strategy for achieving this goal is to use our understanding of coupled human-natural systems to help lead our stakeholders to solve problems and make better decisions in their personal and professional endeavors focused on working lands and ecosystems.

Novel and innovative approaches to education are needed to equip individuals with the skills to work on complex, interdisciplinary and cross-cultural teams. Public education and extension programs that we help to fund can inform and educate a new generation of decision makers, landowners, and engaged citizens.

The portfolio has made significant progress in many areas covered by its components. In the area of invasive species for example, five ecological-economic models have been developed. Three are currently used by producers for management of invasive species. About 20 control technologies have been developed. Eight technologies are currently used for assessments of priority and high consequence agriculture-related particulate, odor, and gaseous emissions for cost effective management approaches for regulators, commercial firms, and livestock and crop producers of varying scope and scale developed and used.

Additional challenges remain. These challenges necessitate research, education and extension to focus on the increased number of forest fires, the threat of invasive species, loss of open space and unmanaged recreation, all supported by this portfolio's strategic objectives 6.1 – 6.4, entitled "Ensure Clean, Abundant Water and Clean, Healthy Air," "Enhance Soil Quality to Maintain Productive Working Lands," "Protect Enhance and Manage Forests and Rangelands," and "Protect and Enhance Wildlife Habitat to Benefit Desired, At-Risk and Declining Species."

Section I: Portfolio Overview

Portfolio Planning

Portfolio Mission: Promote and support research, education, and extension programs that optimize the production of goods and services from working lands while protecting the nation's natural resource base and environment.

Portfolio Vision: Healthy watersheds, clean air, high quality soils, sustainable ecosystems and people better informed in their personal and professional endeavors about working lands and the environment.

Portfolio Introduction:

High-quality soils and abundant supplies of clean air and water are the essential building blocks for production agriculture and forestry, rural economies and all forms of life. America's soils, water supplies and range and forest ecosystems produce the raw materials for food, clothing, shelter, and energy. They also provide the settings for recreation and other activities highly valued by Americans. CSREES portfolio activities under the Environment and Natural Resources Portfolio are designed to help ensure that the Nation's natural resources meet the long-term needs of a dynamic society with an increasing population.

In order to adequately implement and manage the mission and vision of the Environment and Natural Resources Portfolio under the CSREES Strategic Plan for 2007-2012 the portfolio needs to involve all NPLs whose programs are related to many environmental and natural resources issues of the nation and link that to personal interest, skills, knowledge and experience in the area. A formal collaborative effort, cutting across boundaries has begun and is making progress in terms of breaking down the administrative boundaries of the agency in ways that enhance CSREES's effectiveness in dealing with its mission to serve the public and its partners. This collaborative effort, called the Environment and Natural Resources (*enr*) Enterprise, will use research, education, and extension programs to improve the management of natural resources in working lands and expand economic growth in the rural and urban, and ex-urban communities.

The goal of the Environment and Natural Resources (*enr*) Enterprise is to support research, education, and extension programs that optimize the production of goods and services from working lands while protecting the environment. Working lands face many opportunities and challenges in the 21st century. Current demographic and economic forces are changing how working lands are managed. Improved knowledge of how behavior, decisions, and choices affect natural resources at the local, regional, national and global scale can identify vulnerabilities and options that enhance agricultural sustainability and provide a basis for the necessary structures (legislation, administration, financing) for change.

The core portfolio is composed of 20 related topical Knowledge Areas (KAs) that integrate research, education, and extension activities, depending on funding line and authority. The portfolio and its related KAs demonstrate the complementary nature of research, education, and extension that is integrated to solve national problems and to ensure that public investment is effective and efficient. This portfolio report provides detailed descriptions of KA activities. Some of the KAs are subject-linked and discussed as one topic area, while others are addressed individually. For example, KAs 101 – 104 focuses on soils and is grouped for discussion purposes as Soil Resources. Similarly, KAs 111 – 112 focuses on water and is grouped for discussion purposes as Water Resources. The portfolio's knowledge areas have been organized under the following strategic goal objectives.

Goal 3: Support Increased Economic Opportunities and Improved Quality of Life in Rural America

Objective 3.1: Expand Economic Opportunities in Rural America by Providing Research, Education and Extension to Create Opportunities for Growth

- Recreation Knowledge Area
  - KA 134 – Outdoor Recreation

Goal 6: Protect and Enhance the Nation's Natural Resource Base and Environment

Objective 6.1: Ensure Clean, Abundant Water and Clean, Healthy Air

- Water Knowledge Areas
  - KA 111 - Conservation and efficient use of water;
  - KA 112 - Watershed protection and management;
  - KA 405 - Drainage and irrigation systems and facilities;
- Air Knowledge Area
  - KA 141 - Air conservation and management;
- Land Use Knowledge Area
  - KA 131 - Alternative uses of land;
- Global Change and Climate Knowledge Area
  - KA 132 - Weather and climate;

Objective 6.2: Enhance Soil Quality to Maintain Productive Working Lands

- Soil Resources Knowledge Areas
  - KA 101 - Appraisal of soil resources;
  - KA 102 - Soil, plant, water, nutrient Relationships;
  - KA 103 - Management of saline and sodic soils and salinity;
  - KA 104 - Protect soil from harmful effects of natural elements;
- Pollution Management Knowledge Areas
  - KA 133 - Pollution prevention and mitigation
  - KA 403 - Waste disposal, recycling and reuse

Objective 6.3: Protect, Enhance, and Manage Forests and Rangeland

- Rangeland Knowledge Area

  - KA 121 - Management of Range Resources
- Forest Knowledge Areas
  - KA 122 - Management and Control of Forest and Range Fires
  - KA 123 - Management and Sustainability of Forest Resources
  - KA 124 - Urban Forestry
  - KA 125 - Agroforestry
- Natural Resource Economics Knowledge Area
  - KA 605 - Natural resource and environment economics.

Objective 6.4: Protect and Enhance Wildlife Habitat to Benefit Desired, at-Risk and Declining Species.

- Wildlife Knowledge Area
  - KA 135 - Aquatic and Terrestrial Wildlife
- Ecology Knowledge Area
  - KA 136 - Conservation of Biological Diversity

Portfolio's Linkage to CSREES Strategic Plan

CSREES Supported Goal:
In support of USDA's agenda, CSREES and its partners provide high-quality, science-based, and site-specific technical assistance to enable good stewardship of billions of acres of non-Federal lands in the U.S. Agency activities are designed to help ensure that the Nation's natural resources meet the long-term needs of a dynamic society with an increasing population. This portfolio supports these efforts through strategic goal number six, entitled "Protect and Enhance the Nations' Natural Resource Base and Environment" and through strategic goal number three entitled "Support Increased Economic Opportunities and Improved Quality of Life in Rural America."

Through strategic goal three the Agency promotes the well-being of America through research, education, and extension to better understand the economic, demographic, and environmental forces affecting regions and communities, and using knowledge to develop strategies that make maximum use of local assets. CSREES supports the education and training of residents and community and business leaders to help their communities thrive in the global economy. Education programs strengthen the foundation for this goal by building capacity in the agricultural research and extension system and training the next generation of scientists and educators.

Through strategic goal six the Agency supports the development of scientific and policy knowledge base and educational and extension efforts to achieve maximum sustainable benefits from both private and common property natural resources. Education programs strengthen the foundation for this goal by building capacity in the agricultural research and extension system and training the next generation of scientist and educators.

CSREES Supported Objectives:

CSREES efforts in KA 134 (Outdoor Recreation) supports the generation, dissemination, and use of research-based information and knowledge to support new and innovative economic opportunities for communities and to assist public and private sector leaders in their decision making of rural issues. This portfolio supports these efforts through strategic objective 3.1 entitled "Expand Economic Opportunities in Rural America by Providing Research, Education, and Extension to Create Opportunities for Growth."

The key outcomes, long term performance measures and performance criteria to support Strategic objective 3.1 follow in the table below. These objectives, key long-term outcomes, performance measures and criteria and actionable strategies, are taken from the CSREES Strategic Plan for 2007-2012.

Key Long-Term Outcome: Expanded economic opportunities in rural America and increased knowledge pertaining to economic diversification, community planning, service infrastructure, local planning, service infrastructure, local government, youth/adult workforce planning, and civic engagement through innovative integrated research and extension projects targeted to regional business, economic and business development
Performance Measure: The number of farmers and ranchers that gained an economic, environmental or quality of life benefit from a change in practice learned by participating in a SARE project
Performance Criteria (Objective 3.1): • Improve management of physical resources and socioeconomic relationships for recreation
Actionable Strategies (Objective 3.1):
• Support application of geographic information systems and other information technologies for problem solving and strategies for local community and socioeconomic development

CSREES sponsors basic and applied research integrated with education and extension to better understand the complex environmental interrelationships affecting agricultural, forest, and rangeland ecosystems to improve scientific and lay understanding of water and air for improved management of working lands, and to minimize adverse environmental impacts of resource management. This portfolio supports these efforts through strategic objective 6.1 entitled "Ensure Clean, Abundant Water and Clean, Healthy Air."

CSREES sponsors integrated education, research, and extension work to better understand the complex environmental interrelationships affecting agricultural, forest, and rangeland production practices, to improve scientific and lay understanding of soil for better production management, and to minimize adverse environmental impacts. This portfolio supports these efforts through strategic objective 6.2, "Enhance Soil Quality to Maintain Productive Working Lands."

CSREES and its partners collaborate with public and private landowners, industry, non-governmental organizations, citizens and other interested stakeholders to understand, improve, and develop best management practices for rangeland and forest that support clean water, clean air, climate change mitigation, and abundant ecosystems goods and services. Knowledge and decision-making tools are disseminated to help communities to sustain natural resources and harness ecosystem goods and services. This portfolio supports these efforts through strategic objective 6.3,

CSREES chiefly partners with land grant universities, providing funds and coordination for wildlife habitat research and education/outreach programs. Through research, relevant science-based knowledge is obtained, organized and shared with the natural resources management community. Through instructional programs, students are prepared for careers as professional wildlife conservationists and managers. Through extension/outreach, science-based information is used to achieve public understanding and support of wildlife conservation and management principles and procedures. This portfolio supports these efforts through strategic objective 6.4, "Protect and Enhance Wildlife Habitat to Benefit Desired, At-Risk and Declining Species."

The following table describes the key long-term outcomes, performance measures and criteria, and actionable strategies for each objective of Goal 6. These objectives, key long-term outcomes and performance measures, are taken from the CSREES Strategic Plan for 2007-2012. Performance criteria and actionable strategies were developed to produce outcomes for changes in knowledge, actions and conditions described in the Environment and Natural Resources Strategic logic model.

Key Long-Term Outcome: Expanded and disseminated science-based knowledge and information for management of the nation's natural resources and environment, including soil, air and water, in agricultural, forest, and range working lands and ecosystems.
Performance Measure: Development and adoption of science-based technologies, education and management procedures such that production of agricultural goods and services are optimized while protecting our natural resources and environment.
Performance Criteria (Objective 6.1): • Increase efficiency in collecting, storing, conveying and using water • Improve soil and water management at whole watershed level • Improve knowledge and understanding of alternative uses of land • Increase knowledge and understanding of the impact of weather and climate on agriculture and natural resources • Prevent and mitigate pollution from agricultural and forestry practices and its effects on plants, animals, soil, air, water and humans • Improve knowledge, understanding and management or emissions, fate and transport, and practices to mitigate agricultural and forestry emissions • Develop and improve equipment, systems, operation and maintenance of drainage and irrigation systems

Actionable Strategies (Objective 6.1):

- Expand research that addresses they measurement, transport and fate of agricultural pollutants in working land ecosystems and the policy, social and economic aspects
- Provide information and options to mitigate adverse impacts to watersheds and terrestrial systems from air pollution and atmospheric deposition
- Support airshed and watershed monitoring, inventories and assessments to better understand opportunities for improved natural resource management
- Support the development of measurement and monitoring protocols for characterizing agricultural emissions to the atmosphere and to ground and surface waters
- Provide methods to evaluate, improve, and restore terrestrial, riparian and aquatic habitats in agricultural, forested and grassland airsheds and watersheds
- Develop analytical systems, process-based ecosystem models and tools to evaluate the effects of conservation practices in improving and protecting air and water quality
- Develop and implement outreach/educational practices and materials to assist individuals, agricultural producers, and communities in making air and water resource management decisions to support locally defined environmental goals
- Support research and education/outreach that promotes adoption of best available management practices to improve air and water quality and expand water availability
- Support creation and implementation of interdisciplinary curricula needed to train the next generation of scientists, engineers and practitioners needed to solve complex environmental issues
- Support interdisciplinary research and education needed to inform natural resource policy making and resource management decision-making
- Support research and education/outreach to assist the agricultural community in mitigating agricultural emissions of air and water criteria pollutants
- Support the development of strategies to create air and water emission reduction targets from agricultural sources

Performance Criteria (Objective 6.2):

- Identify soil parameters for crop production, forest and rangeland management, housing, zoning, planning and other land uses
- Understand chemical and physical relationships among soils, plants, water and nutrients to improve or restore soil production capability
- Improve the management of saline and sodic soils
- Protect soils from harmful effects of natural elements
- Improve the effectiveness of collecting, storing, transporting, treating and utilizing waste products from agriculture, forestry, and other origins

Actionable Strategies (Objective 6.2):

- Develop understanding of the relationships between soil parameters and ecosystem function and services that inform best management practices and strategies for landowners, farmers, foresters, and ranchers
- Support the recruitment, retention, training, graduation, and placement of the next generation of research scientists, educators, and practitioners in the food and agricultural sciences
- Support the development, dissemination, and implementation of science-based knowledge, tools and technology to assess the consequences of land use and climate change on soil and ecosystem function Support the development and implementation of multi-disciplinary and inter- disciplinary training for the next generation of educators, scientists and resource personnel to better manage natural resources for both ecological and economic sustainability
- Support research, education and extension-outreach activities that serve to inform policy and decision-making relative to working lands, including crop, forest and rangeland ecosystems

Performance Criteria (Objective 6.3):

- Identify and understand biological processes and ecological relationships to improve rangeland management techniques and improve appraisals of range conditions for production of livestock forage, wildlife habitat and water yield
- Develop new wildfire prevention methods, technology for fuel hazard reduction, improved systems for wildfire prediction, detection and effective attack, and suppression technologies
- Improve management of forest plants and trees, forest ecosystem ecology, breeding, forest nursery practices and silvicultural techniques
- Improve urban and suburban environments and enhance visual screening, noise suppression, air quality improvement, shade and beautification through tree plantings
- Improve the integration of trees in farmland and rangeland to improve the production system
- Preserve, enhance and restore natural biodiversity to levels compatible with societal uses of natural resources
- Define and understand relationships between agricultural production and processing and the environment and natural resource use
- Define and understand the social, economic and human perspectives associated with natural resources management

Actionable Strategies (Objective 6.3):

- Sponsor research and education/outreach to aid local and regional communities in understanding and possible abatement of habitat fragmentation, and promoting renovation and restoration on degraded forests and rangelands
- Fund research and technology development to better manage forest and rangeland ecosystems
- Expand and strengthen partnerships with other Federal, State, Tribal and local governments and nongovernmental organizations to develop collaborative strategies to address forest and rangeland ecosystem health at watershed scales
- Coordinate and work to improve methodologies to measure and monitor rangeland health and partner to measure and document the benefits of conservation practices on rangelands
- Sponsor research and education/outreach that promotes adoption of best available management practices to improve rangeland health and address issues of invasive species, wildfire, fragmentation and accelerated erosion for forests and rangelands
- Support research and education/outreach to identify, quantify, and actualize ecosystem and other non-market services and amenities, such as carbon sequestration, that derive from forests and rangeland
- Sponsor research and education to produce Economically feasible, environmentally friendly, and socially acceptable decision support tools that inform forest and rangeland policy, decision-making, and management at all levels
- Support forest resources research that addresses emerging technologies and issues in production and utilization that enhance the industry's competitiveness, such as genomics, biotechnology, bioprocessing, and nanotechnology
- Develop extension and outreach programs that educate citizens and public officials in the conservation and wise use of forest resources and rangelands
- Sponsor research and education/outreach for utilization of wood-based bioenergy and products to reduce dependency on petroleum
- Support the development of multidisciplinary curricula that enable solving complex natural resource problems and insure the recruitment, retention, graduation and placement of the next generation of research scientists, educators and practitioners in forest and rangeland sciences
- Fund research, education and outreach efforts to assess the effects of climate change, land use and management practices on sustainability of forest and rangeland health and productivity, and the protection of water and air quality
- Sponsor research, education and outreach that analyze and assess the effects of changing natural resource and environmental economics and policies for supporting rural community resilience, conserving open space, and enhancing quality of life

Performance Criteria (Objective 6.4):

- Determine biological and ecological needs of species, factors affecting population dynamics, maintaining and enhancing habitats, and managing for sustained wildlife harvest, population, species and community viability

Actionable Strategies (Objective 6.4):

- Determine biological and ecological needs of species, factors affecting population dynamics, maintaining and enhancing habitats, and managing for sustained wildlife harvest, population, species and community viability
- Remove redundancies and streamline and improve efficiencies in interagency consultation and overall species conservation
- Support research and education/outreach to improve habitat, especially for at-risk species
- Support the recruitment, retention, training, graduation, and placement of the next generation of research scientists, educators, and practitioners in the food and agricultural sciences
- Assess the causes of decline of rare and at-risk species, and provide recommendations for reversing declines
- Cooperate with stakeholders in the public and private sectors to develop watershed and landscape plans to restore, protect and manage habitat for wildlife
- Cooperate with Federal, State, Tribal and local governments and nongovernmental organizations to develop and adopt standard, science-based resource indicators to assess the condition of fish and wildlife resources
- Enhance technology to measure and document the benefits of conservation efforts on wildlife habitat condition

Performance Measures Progress Table

Performance Measure Description: Cumulative number of ecological-economic models developed and used for management of invasive species.		
Explanation of Measure: Development and use of comprehensive interdisciplinary (ecological and economic) models critical to the assessment of management strategies related to priority invasive species on forest and range lands. No such integrated models currently exist, making it difficult to conduct meaningful cost-benefit analyses of either the threats of invasive species, or of the efficacy of prevention and mediation actions. It is anticipated that model development will occur in stages over four to five years.		
Baseline (FY 2004): 0	**Target**	**Actual**
Fiscal Year 2005	1	0
Fiscal Year 2006	1	1
Fiscal Year 2007	2	2
Fiscal Year 2008	3	2
Fiscal Year 2009	5	
Fiscal Year 2010	7	

Performance Measure Description: Assessment and Control Technologies for Agricultural Emissions.		
Explanation of Measure: Number of assessments of priority and high consequence agriculture-related particulate, odor, and gaseous emissions control technologies for cost effective management approaches for regulators, commercial firms, and livestock and crop producers of varying scope and scale developed and used.		
Baseline (FY 2004): 3	**Target**	**Actual**
Fiscal Year 2005	5	5
Fiscal Year 2006	7	7
Fiscal Year 2007	8	8
Fiscal Year 2008	10	8
Fiscal Year 2009	12	
Fiscal Year 2010	14	

Portfolio: Environment and Natural Resources Logic Model

Situation	Inputs	Activities	Outputs	Outcomes		
				Knowledge	**Actions**	**Conditions**
Communities depend on a clean, safe, reliable fresh water supply for industrial and human consumption, food/fiber production, sustaining aquatic/ terrestrial ecosystems. Air quality depends on measurement, control, fate, and transport of odor, gases, particulate matter, emissions to lessen production and transport of pollutants. Soils store and receive compounds that enhance or impair resource quality. Unmanaged recreation has increased impacts on the biophysical environment.	**Resources:** Authorities Mission Strategic Plan Leadership Management Oversight Assessment **Financial Resources** Formula Competitive Special **Human Resources:** NPLs Administrative Other Gov't. Faculty Practitioners Para-professionals Industry	Develop and disseminate management practices and strategies that maintain or enhance soil resources while ensuring sustainable production and environmental quality Develop improved technology for on-site detection of viable pathogens and other bacteria in water Identifying methodological advances to improve land use and land-cover change analyses, including strategies for integrating ground-based data, socioeconomic statistics (e.g. census information), and remotely sensed measurements.	Natural Resource Use and Management • Publications • Citations • Disclosures • Patents • Curriculum • Products • Tools • Technology • Practices • Methods • Measures • Polices • Regulations • Models	Increased knowledge of scientists, educators, extension personnel, practitioners and producers through sharing of information in various formats and media Increased scientific knowledge to document changes in air and water quality Increased knowledge regarding improved use of satellites for monitoring forest and natural systems to determine land cover and land use through the increased availability of imagery and ground truthing methods. Recreation providers aware of the relationships among use, impact and management parameters.	Better strategies, plans and guidelines for managing soil resources that lead to: reduced risks of land applying wastes and residuals and cost effective remediation and restoration of degraded soils Documented the presence of pharmaceuticals in stream waters Combine satellite-based land-cover data and ground-based agricultural census data to derive global, spatially explicit data sets of agricultural land cover land-use practices. Providers establish impact parameters, monitor impacts, and respond to areas near or beyond limits of acceptability.	Improved productivity and reduced environmental degradation Reduced nitrogen, hormones, and antibiotics in rivers and watersheds Quantify, understand, model, and project natural and human drivers of land-use and land-cover change Prediction of precipitation and drought on time scales of months to years and longer Reduced forest and rangeland fire hazards Preserved open spaces Improved monitoring and conservation of natural resources through implementation of decision support tools. Physical impacts of recreation within management parameters.

Assumptions: Pressures on natural resources and land use are increasing, competing, and more frequently, conflicting. Demographic changes and changing social values bring new challenges. Ecosystems have become increasingly fragmented for production of food and forest products. Urbanization and fragmentation have major impacts on ecosystem structure and function.	**External Factors:** Scientific advancements; changing priorities; producers' and consumers' attitudes; weather, natural disasters; economic conditions; coordination w/ other government entities; public policy.

Portfolio Inputs

Portfolio Level Funding Table and Bar Chart

The budget for this portfolio has remained steady over the past years and reflects the overall budget of CSREES (Table 1). There was a significant increase in the total CSREES funding for 2005 and most individual programs in 2005 were generally funded at the same level or with slight increases. There was a major increase in NRI funds for the portfolio which contributed to half of the total increase in the portfolio's funds. Industry and non-federal grants also increased in 2005 (Figure 1). All knowledge areas under the portfolio have generally been steady over the past years with changes in specific areas of interest reflecting increase in certain parts of the portfolio while drawing from other programs. This also reflects the operational aspect of the general portfolio which follows programs rather than specific knowledge areas which overlap between and among programs. Knowledge Area 136 (Conservation of Biological Diversity) although presented in this portfolio was not used as a classification until 2005 and projects under this KA were previously included in other KA's in the portfolio. KA 141 (Air Resource Conservation and Management) is also a new knowledge area which was initiated in late 2004 and funds reported under this code began in 2006. This KA is presented to show that the portfolio continues to grow by adding knowledge areas and is making progress in addressing important environmental issues.

A decrease in overall funding for the portfolio occurred in FY 2006 primarily from a decrease in competitive funds from the National Research Initiative. The competitive nature of the NRI will result in variability in funds expended by the programs based on the number and quality of the proposals received. Competitive funding remains high I quality and impact and continues to provide the research and integrated programs for natural resources and environment research, education and outreach activities. An overall decrease in non-CSREES funding also occurred in FY 2006 and is a reflection of a decrease in state resources and other federal funding sources (Figure 2).

Considering only the CSREES and non-CSREES funding for 2007, the total funding increased to slightly over $650,000, primarily due to an increase in non-CSREES funding sources. On the other hand, CSREES funding decreased significantly, as shown in Figure 1. This is because of the elimination of specials grants in 2006 resulting in no special grants reported in 2007. Formula funding through Hatch and McIntire-Stennis, slightly increased as a result of the elimination of the special grants. In contrast, state funding of portfolio projects in 2007 increased significantly as seen in Figure 2. Overall, the percentage of CSREES funding remains close to 20% over the past 5 years.

No single knowledge area has stood out as been consistently the highest funded over the past years (Figure 3). The top five KAs reflect forestry, watershed, wildlife, soil/plant/water relations and pollution management. What is also notable is that the top five knowledge areas come from all 4 objectives of the portfolio. The variability in funding is also due to the competitive nature of the funds for these programs and the quantity and quality of proposals are reflected in the fluctuations.

*Table 1a: Environment and Natural Resources Portfolio Summary Funding Table Combined Research and Extension Funding – Actual Dollars						
	($ in the Thousands)					
Funding Sources	FY 2003	FY 2004	FY 2005	FY 2006	FY 2007	Grand Total
All CRIS Reported CSREES Funding	109,217	103,778	123,830	122,750	96,909	556,484
All Extension Funding Reported in POW	n/a	n/a	n/a	n/a	34,914	34,914
All non-CSREES Funding	407,617	426,267	580,933	443,250	604,443	2,462,510
Total Funding	516,834	530,045	704,763	566,000	736,266	3,053,908
Percentage of CSREES Funding	21%	20%	18%	22%	18%	19%

* *Agency funding data for fiscal year 2007 were collected from the Current Research Information System (CRIS) and the Plan of Work (POW) annual report. Fiscal year 2007 funding data includes Smith-Lever 3(b) and (c) and 1890 extension funding, which were not otherwise accounted for in FY 2003 – 2006. Agency funding data for fiscal years 2003 through 2006 were collected from CRIS only.*

*Table 1b: Environment and Natural Resources Portfolio Summary Funding Table Combined Research and Extension Funding – Constant Dollars						
	($ in the Thousands)					
Funding Sources	FY 2003	FY 2004	FY 2005	FY 2006	FY 2007	Grand Total
All CRIS Reported CSREES Funding	109,217	101,086	116,665	112,033	85,999	525,001
All Extension Funding Reported in POW	n/a	n/a	n/a	n/a	30,983	30,983
All non-CSREES Funding	407,617	415,209	547,320	404,553	536,396	2,311,097
Total Funding	516,834	516,295	663,985	516,587	653,379	2,867,082

* Inflation figures were calculated using Consumer Price Index calculator (http://data.bls.gov/cgi-bin/cpicalc.pl)

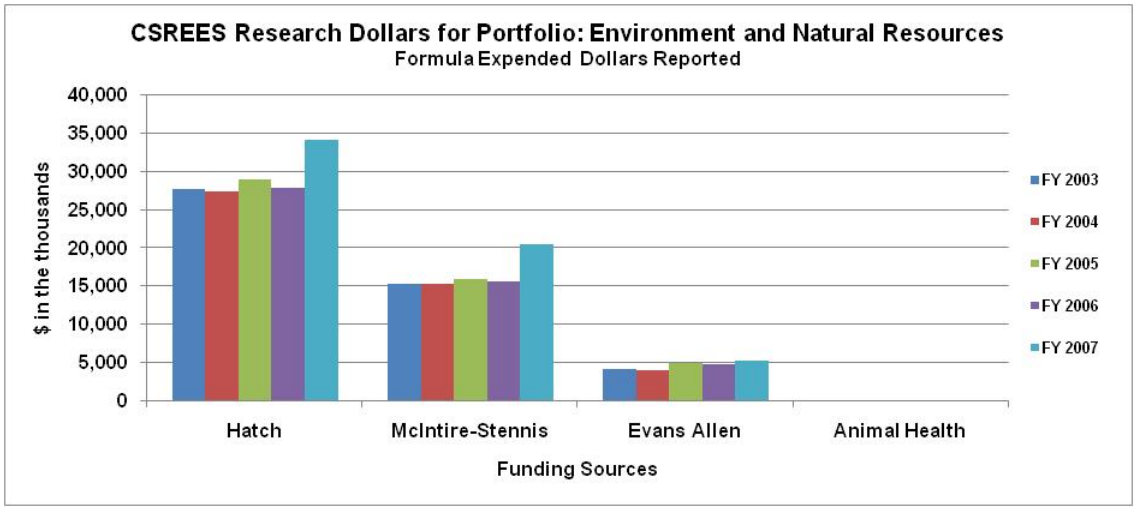

Figure 1: CSREES Expended Formula Dollars for Natural Resources and Environment Portfolio using Actual Dollars

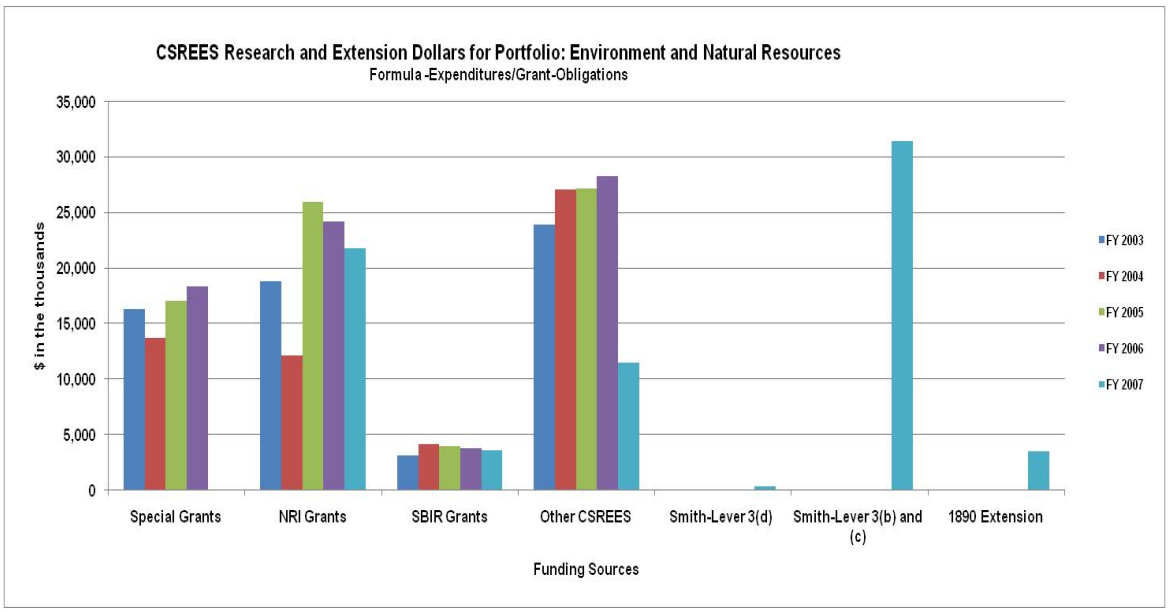

Figure 2: CSREES Research and Extension Formula Expended Dollars and Grant Obligated Dollars for Natural Resources and Environment Portfolio using Actual Dollars

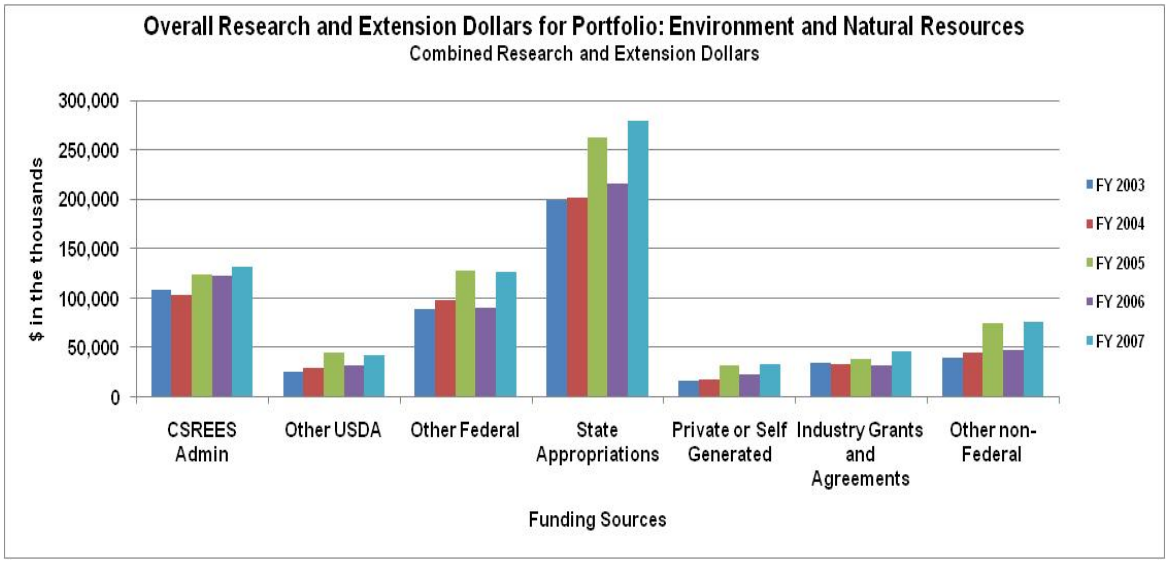

Figure 3: Overall Research and Extension Dollars for Portfolio: Environment and Natural Resources using Actual Dollars

Portfolio Results

Portfolio Outcomes

Through the portfolio's Invasive Species Program, the innovative use of cover crops was developed to control weeds while decreasing the amount of fertilizer and pesticide on farmland while boosting crop production. With funding from the NRI Biology of Weedy and Invasive Species in Agroecosystems program, scientists at Iowa State University developed a model of crop rotation that will reduce fertilizer input by up to 74 percent and reduce pesticide by up to 82 percent, saving money and reducing pollution to

neighboring waterways. The average yield last year in Boone County, Iowa where head-high corn is growing the summer was 181 bushels per acre. The 2007 Iowa average was 171. The national average was 151. Scientists propose to boost corn production to 200 bushels of corn per acre. The results suggest that large reductions in agrichemical use could be compatible with high crop yields and profits

A new computer model has been developed to predict biocontrol agent use. Garlic mustard (*Alliaria petiolata*) has become an invasive species spreading throughout temperate forests across the United States. With funding from the NRI Biology of Weedy and Invasive Species in Agroecosystems program, a consortium of scientists at the University of Illinois, Michigan State and Cornell University have developed and used a computer model that simulates how populations of garlic mustard vary in relation to introduction, growth cycle and environmental stressors. This helped them identify the most effective biocontrol agent for garlic mustard. The identified weevil is scheduled for release into an infested forest once it receives approval from the species evaluation and quarantine arm of USDA's Animal and Plant Health Inspection Service.

Hatch formula funds were used for a project on irrigation feedyard technology developed by Texas A&M to control dust. It has been adopted by NRCS as a standard practice and producers are implementing the control practice through a cost-share program with NRCS. The funds were also used for a project on water management and manure scraping regime to control dust and ammonia emissions in cattle stock yards has been adopted by NRCS as a standard practice and producers are implementing the control practice through a cost-share program with NRCS.

NRI funds were provided for research at Washington State University that has led to reductions of up to half of windblown sediments from summer fallow wheat production through implementation of direct-seed technologies. The practices are in wide-spread use in eastern Washington and have led to a producer run direct-seeding association that has been tremendously successful.

Multi-state funds were used for the Vegetative Environmental Buffers (VEBs) developed at Iowa State and tested in Delaware and Pennsylvania for reducing air emissions. They are being adopted in several States that produce poultry. It has been reported that many poultry producers in Delaware, Pennsylvania and Iowa have adopted the recommended species and planning designs as part of their emission mitigation strategies.

NRI funds were used for a new design process for nut harvest machinery. The concept has been proven feasible and is guiding the design and construction of equipment that can reduce dust emissions, as measured by opacity, by approx. 30% without reducing harvest efficiency or requiring more energy. Industry response has been extremely positive and the method is being adopted by manufacturers.

Renewable Resources Extension Act Program

FY08 RREA Hatch, Popular Reports, and Indicators Reports are still under review and revision, thus the FY07 information remains the source of new information. Authorized at $30 million, the Fiscal Year 2007 RREA appropriation of $4.019 million was allocated to sixty-nine universities. Awards ranged from $46,536 - $10182 for the 1862 land-grant institution and $11,137 for each participating 1890 land-grants, insular areas, and the University of the District of Columbia. Five competitive National Focus Fund projects were also supported from the original appropriation.

The reporting land-grant universities conducted 3,196 educational events supporting the eight strategic goals. Over 171,000 forestry, rangelands, and natural resource stakeholders attended these events over the fiscal year. More that 2.22 million indirect contacts were made via newsletters or websites. More than 22,036 landowners or managers implemented at least one new resource management practice on 32 million acres and saved an estimated $34.71 million.

In communities where natural resources are of great importance to the local economies, RREA programs assisted in expanding or creating 943 income-generating businesses providing 2,394 new jobs with an estimated $199.21 million earned or saved.

Environment and Natural Resources Enterprise Research

With Hatch formula funds, Virginia scientists are making strides in protecting soils from the harmful effects of natural elements. Through this simulated rainfall project, they demonstrated that compared to newly tilled plots, the continuous no-till plots reduced water runoff by 74%, reduced sediment loss (erosion) by 99%, reduced nitrogen loss by 94%, and reduced phosphorus loss by 92%. Further, it was discovered that the nitrogen and phosphorus were not being leached through the soil with water infiltration but rather, were being bound to the organic matter that had increased in the top two inches of the long-term no-till plots. This means that by controlling erosion, nutrients and sediments become less available to contaminate tributaries in the Chesapeake Bay watershed and the Bay itself.

<u>Portfolio Leadership and Management</u>:

This portfolio addresses issues, needs and priorities related to the critical natural resources on the local, regional and national levels. Extension and education programs are driven by knowledge and information garnered from the conduct of research. Just as research programs are required to demonstrate relevance, quality and performance standards, this is also a requirement for extension and education programs. The Environment and Natural Resources National Program Leaders (NPLs) have close working relationships and links to various stakeholder partners including research, education and extension scientists and educators at universities and colleges, other federal agencies, county agents, advocacy organizations, professional societies, advisory groups, and Congress. Portfolio NPLs use formal and informal processes to gather stakeholder

input, including but not limited to stakeholder listening sessions, workshops, symposia, peer panel recommendations, Request for Applications solicitations, white papers, Presidential directives, and regulatory policies that impact natural resources and the environment. It is through these stakeholder interactions that portfolio NPLs obtain and use feedback to identify needs and establish priorities relevant to the Mission and to the Portfolio. Portfolio NPLs also ensure stakeholder relevancy through requirements that research and extension plans of work and annual reports address specific processes through which the funding recipients solicit and consider stakeholder input. These reports are reviewed by NPLs, thus providing continuous monitoring and dialogue to ensure that interactions with stakeholders occur and that top priority issues are being addressed. Similarly, relevant emerging issues are identified and subsequently addressed through this process. These FY08 university partnership plan of work (POW) updates and annual reports were not available at the time this portfolio document was prepared. Activities, outputs and potential outcomes from FY08 POWs and annual reports will be used to inform our FY10 portfolio document.

A few examples of portfolio leadership and management are described on the following pages.

SOIL RESOURCES

CSREES sponsored and participated in a three-part series of international (Germany, California, Australia) soil organic matter conferences, each resulting in special issues of the journal *Biogeochemistry*. Another portfolio leadership included NPL participation in the North American Carbon Program, the CarboNA international program, and strategic planning for the CCSP, chapter authorship in the CCSP Strategic Plan 2003 and planning for the next, and chapter authorship of the annual report to congress on Climate Change: Our Changing Planet.

LAND USE

CSREES initiated and partnered with the National Association of State Universities and Land-grant Colleges (NASULGC), (ICA), the Association for European Life Science Universities (ICA), Farm Foundation, and other land-grant universities to organize an international conference entitled, “the Science and Education of Land Use: A Transatlantic, Multidisciplinary, and Comparative Approach,” in September 2007. Over 130 scientists, educators, and policymakers from many countries in the US and Europe participated in this conference. The conference explored the causes and consequences of current land use trends and dynamics related to society, economics and environment, as well as policy implications of land cover/land use changes. A study tour to Montgomery County, Maryland, was included as part of the conference. Tour participants witnessed on-site the effect of government policies on land use on conservation and housing development. The conference proceedings were published and widely circulated. The conference provided an environment to foster international knowledge exchange, future collaboration, and student exchange. International scholars gained and increased knowledge by comparing methodologies (based on various cultural, geological, and

ecological backgrounds) that address human-induced environmental, ecological, land use, and land care issues.

AIR QUALITY

As part of the post award management strategy of the NRI Air Quality Program, An annual workshop held as part of the request for applications. One of the primary goals of the workshop is to bring together the science and experiences from researchers and stakeholders to produce two documents: a compendium of updates and additions to the emission inventory for U.S. agricultural production practices; and a catalogue of best practices for reducing and mitigating agricultural emissions. These two needs represent two of the emphasis areas in the NRI solicitation and have received substantial research investments. Participants in the Workshop will play a critical role in providing data, technologies and practices, and review of these documents.

The “Workshop on Agricultural Air Quality: State of the Science” represents a significant milestone for air quality research and technology transfer at the United States Department of Agriculture (USDA). Until several years ago, research on air quality at USDA and its partner institutions was a very loose collection of projects scattered about the country with very little programmatic and institutional support. Environmental concerns and increasing regulatory pressures on agriculture related to air quality led to the formation of the USDA Agricultural Air Quality Taskforce (AAQTF) in 1996. The AAQTF provided recommendations to the Secretary of Agriculture regarding priority research areas. The AAQTF also recommended the allocation of more resources to air quality research. These recommendations, coupled with increased awareness by the land-grant university community, have resulted in steadily increasing resources for agricultural air quality research and extension. Resources have grown almost ten-fold in the past decade, from $2-3 million per year in 1996 to approximately $20 million per year since 2006.

LOGIC MODEL TRAINING

Training on Logic Model, Program Evaluation and Multi-state Programming was conducted in January 2008 as a joint effort between NRE and the CSREES Office of Planning and Accountability. Eighteen Faculty members from land grant and non-land grant representing urban forestry and outdoor recreation were trained. This training resulted in the formation of 2 multi-state projects in urban forestry and outdoor recreation with funding from McIntire-Stennis. The participants eventually formed their own network which facilitated their collaborative work in their respective multi-state project and also in grants application. A second similar training was conducted in April, 2008. Nineteen participants from 1890 and 1862 land grants, Forest Service and Agricultural Research Service were trained. A multi-state project in agroforestry is being developed led by the University of Missouri and co-led by Auburn University and University of Virginia. The University of the District of Columbia and 4 1890 institutions (Alcorn State University, Southern University, Tennessee State University and Alabama A&M) are participating using Evans-Allen funds. The University of the District of Columbia has initiated agroforestry projects in forest farming and alley cropping on its University farm.

Programmatic or Management Shortcomings:

1) CSREES requires substantial resources to support climate change research, education and extension programs to address the need for agricultural and forest producers to adapt to and mitigate the impacts of climate change on the environment and its natural resources. Resources are not always adequate to satisfy the needs.
2) There is a need to develop and adopt a system science approach that incorporates the social sciences as an integral part of investigating the impacts of climate change on agroecosystems and the human. Little is known about human behaviors and interventions for adapting to and mitigating these impacts. New paradigm is needed to develop and implement management strategies that maximize agricultural productivity under changing climate.
3) Education and extension programs need new and fresh approaches and resources to engage individuals and communities with science-based information to clearly demonstrate to the public the linkages between individual actions and the impact of those actions on the environment. New tools will also help to determine how behavioral changes can mitigate environmental degradation and at the same time improve productivity and economic viability.
4) While much progress has been made to improve the efficiency and promptness of project reporting, there are still challenges for the agency in improving quality of the reports, especially with non-competitive funds which the agency has least control over.
5) It is difficult to coordinate formula and competitively funded programs because formula funds are generally used to initiate research, education and extension projects under discretion of the Dean and Directors.
6) The National Research Initiative (NRI) does not coordinate its programs with the rest of the agency's other funding mechanisms. Current portfolio structure does not adequate integrate the NRI into other programs. Efforts are needed in this regard. The inclusion of NRI NPLs into portfolio analyses is helpful.
7) Current portfolio management has not progressed from simply responding to current needs compared to taking a pro-active leadership role in emerging natural resource and environmental issues. However the *enr* Enterprise was an attempt to overcome those shortcomings.
8) CSREES does not adequately utilize and coordinate all its available resources, e.g. SERD, NRI, to better integrate the mission of the agency and create a more comprehensive research, education and extension portfolio that targets national and regional emerging issues. New ways are needed to overcome these shortcomings.

Key Future Activities and Changes in Direction:

- Working lands face many opportunities and challenges in the 21st century. Current demographic and economic forces are changing how working lands are managed, in a world that is more populated, urbanized, and highly interconnected.
- A more integrated system approach to better understand the complex interactions among human societies, ecosystems of working lands, and natural areas is needed. Improved knowledge of how behavior, decisions, and choices affect natural resources at the local, regional, national and global scale can identify vulnerabilities and options that enhance agricultural sustainability and provide a basis for the necessary structures (legislation, administration, financing) for change.
- New partnerships among a wide range of institutions and stakeholders are needed to seize these opportunities and surmount the challenges of the "new rural economy"
- Strong partnerships both within and outside the land-grant system are needed. The full engagement of strong partners with national and international communities, government agencies, and society at large are critical to addressing the complex issues involved with managing working lands.
- Our educational system must develop a diverse workforce with the transdisciplinary knowledge, skills, and values required to solve complex problems in agroecosystems.

What are Others Doing?

This section identifies other agencies and private organizations research, education and extension activities that are responding to similar needs as this portfolio. The following provides a brief description of a few programs:

USDA Agricultural Research Service's Natural Resources and Sustainable Agricultural Systems National Programs support researchers at seventy locations developing the technologies and strategies needed to help farmers, ranchers, and other managers effectively steward the diverse agricultural throughout nation. Emphasis is given to developing technologies that are economical to use and systems that support profitable production and enhance the Nation's vast renewable natural resource base. Issues are addressed that affect both private and public lands, because together these are the foundation of a healthy and vibrant agricultural industry that not only provides food, feed, fiber, and renewable energy to the nation, but also abundant and high quality supplies of fresh water and clean air, as well as healthy ecosystems.

Environmental Protection Agency's (EPA) National Pollutant Discharge Elimination System (NPDES) Stormwater Program regulates stormwater discharges from three potential sources: municipal separate storm sewer systems, construction activities, and industrial activities. This program's permitting mechanism is designed to prevent stormwater runoff from washing harmful pollutants into local surface waters such as streams, rivers, lakes or coastal waters.

The National Science Foundation (NSF) supports research and education to enhance understanding of the complex dynamics among natural and human systems; to generate knowledge needed to preserve, manage, and enhance the environment; and to support national and international policymaking activities.

Sustainable Agriculture and Natural Resource Management Collaborative Research Support Program (SANREM CRSP) is sponsored by the **U.S. Agency for International Development's Economic Growth, Agriculture, and Trade Bureau (USAID/EGAT)** and participating U.S. and host country institutions around the world. This program support sustainable agriculture and natural resource management decision makers in developing countries by providing access to appropriate data, knowledge, tools, and methods of analysis; and by enhancing their capacity to make better decisions to improve livelihoods and the sustainability of natural resources.

USDA Natural Resource Conservation Service's Environmental Quality Incentives Program (EQIP) assists private landowners in addressing natural resource problems which threaten environmental quality. EQIP compensates landowners for the lack of market incentive to invest in public goods, such as watershed and wildlife protection and it encourages landowners to make long term investments in maintaining the natural resource base. This program targets watersheds, regions, and areas of special environmental sensitivity or other areas facing significant soil, water or related natural resources concerns. Natural Resources Conservation Service (NRCS) representatives in each state are responsible for establishing the particular conservation practices which EQIP supports on a state by state basis.

Natural Resources Conservation Service's (NRCS) Wildlife Habitat Incentives Program (WHIP) is a voluntary program for people who want to develop and improve wildlife habitat primarily on private land. Through WHIP USDA's Natural Resources Conservation Service provides both technical assistance and up to 75 percent cost-share assistance to establish and improve fish and wildlife habitat. By targeting wildlife habitat projects on all lands and aquatic areas, WHIP provides assistance to conservation minded landowners. http://www.nrcs.usda.gov/programs/whip/

US Fish and Wildlife Service through the **District of Columbia's Fisheries and Wildlife Division** supports an In-School Program on various topics related to the local aquatic environment to students in their classrooms. The primary benefit of the in-school module is to supplement educators' needs while promoting aquatic education and conservation concepts. http://doh.dc.gov/doh/cwp/view,a,1374,Q,584748,dohNav_GID,1835,.asp

This educational outreach activity is made possible through a grant from the **US Fish and Wildlife Service** and the Government of the District of Columbia. This program presents topics in the following areas:

- General Introduction to DC Fisheries and Wildlife
- Fish Biology
- Water as an Environment

- The Chesapeake Bay
- Wetlands
- Aquatic Ecology

The Mendocino Redwood Company (MCR) was created in July 1998 with a long-term investment by the Fisher family of San Francisco and their investment partners. MRC consists of approximately 350 square miles (228,800 acres) of forestland spanning across over 75 Northern California coastal watersheds with 1500 miles of year-round streams. The forestlands are located about two hours north of the Golden Gate Bridge in Mendocino and Sonoma counties. This company works to restore industrial forestlands and their long-term goal is to restore its property to a Redwood and Douglas-fir dominated selectively-harvested forest. http://www.mrc.com/about.html

The **Wildlife Trust** Edge of the Sea program was created in 2001 to address urgent conservation issues in coastal areas. The program strives to promote better management of coastal habitats to help ensure that ecosystems remain intact, endangered species survive, and coastal people and their descendents benefit from their lives at the edge of the sea. http://www.wildlifetrust.org/edge_of_the_sea/

The **Council for Environmental Education (CEE)** is a 501(c)3 non-profit educational organization founded in 1970. CEE provides environmental education programs and services that promote stewardship of the environment and further the capacity of learners to make informed decisions. Each year CEE's benchmark programs provide materials and training for more than 50,000 educators, who reach millions of young people with essential information about conservation and the environment. http://www.councilforee.org/

The CEE programs below are among the most long-lived and successful environmental education efforts in the nation.

- *Wet in the City*
  WET in the City is a national urban environmental education program that focuses on water resources. The program provides an opportunity for young people to participate in engaging, hands-on activities that creatively explore the science of water, its cultural context, and the complex issues surrounding its management and stewardship.

- *Team Wet Schools*
  Team WET Schools is a companion program to WET in the City, bringing urban water issues to the forefront of environmental education in school buildings. A network of community and corporate partners grows around each Team WET School supporting teachers to advance water education while encouraging students to participate in active water stewardship and community improvement.

- *Project WILD*
  Project WILD is one of the most widely-used conservation and environmental education programs among educators of students in kindergarten through high school. It is based on the premise that young people and educators have a vital interest in learning about our natural world. A national network of State Wildlife Agency Sponsors ensures that Project WILD is available nationwide --training educators in the many facets of the program. Emphasizing wildlife because of its intrinsic value, Project WILD addresses the need for human beings to develop as responsible citizens of our planet.

- *Flying WILD*
  Flying WILD, introduces students to bird conservation through standards-based classroom activities and environmental stewardship projects. Flying WILD encourages schools to work closely with conservation organizations, community groups, and businesses involved with birds to implement school bird festivals and bird conservation.

Section II: Primary Knowledge Areas

OBJECTIVE 6.1: Ensure Clean, abundant Water and Clean, Healthy Air

WATER RESOURCES KNOWLEDGE AREAS

KA 111: Conservation and Efficient Use of Water
KA 112: Watershed Protection and Management
KA 405: Drainage and Irrigation Systems and Facilities

Introduction:

Cities, communities, and rural areas across the nation depend on a safe, reliable, healthy supply of water for human consumption; the production of food, fiber, and other products; and sustaining aquatic and terrestrial ecosystems. The science and management of water requires consideration of both the quantity and quality of water resources and the land management activities that affect these water resources. Over the past decade, drought conditions have worsened in virtually every state in the nation. These circumstances have resulted in serious impacts to agricultural production, natural resource health and welfare, and rural community development. Due to a combination of drought cycles and impacts of global change, Western states are experiencing critical drought – similar circumstances exist in the East.

Within the broad context of Water Resources, CSREES funds research, education, and extension work that address Water Conservation (KA 111) and Watershed Protection (KA 112) and Drainage and Irrigation Systems and Facilities (KA 405). The Water Program is an outgrowth of the President's Water Quality Initiative of 1989. This was established to evaluate the impacts of agricultural pesticides on drinking water supplies in rural and agricultural communities. Three sets of projects were established through this initiative: the Management Systems Evaluation Area (MSEA) projects and the subsequent Hydrologic Unit Area (HUA), and Demonstration (DEMO) Area projects. Overall, the research, education, and extension activities of these projects demonstrate that the impact of sediment and nutrient contamination on surface water quality was greater than the impacts of agricultural pesticides on surface and groundwater quality.

CSREES is addressing water resources issues under KA 111 and 112 through a broad array of programs and funding sources. Research, education, and extension funding for water resources consisted of formula funds for research (Hatch) and extension (Smith-Lever 3d), competitive research grants in the NRI Watershed Processes and Water Resources program, directed research and extension projects administered outside competitive programs (including congressionally or non-competitive directed projects) and limited funding provided through SBIR and Higher Education Programs.

The implementation of Section 406 of the Agricultural Research, Education, and Extension Reform Act (AREERA) of 1998 led to the elimination of Smith-Lever 3d funds for water quality and the consolidation of agency directed research and extension

projects within a single, competitively awarded funding source - the NIWQP in 2000. This competitive grant program now forms the cornerstone of the research, education, and extension efforts in water resources funded by the agency.

Agency efforts cover a broad range of activity on water quality and water quantity through research, extension and education. Research funded by CSREES provides the basic knowledge needed to address water quality and quantity issues in rural and agricultural watersheds. Extension and other outreach programs apply this knowledge to protect and improve water quality and assure the continued supply of safe and healthy water resources to communities across the nation. Education activities provide state-of-the-science learning opportunities for future leaders who will be addressing water resource issues.

The research, extension, and education programs funded by the agency also form the nexus for partnerships with other federal, state, and local agencies and organizations working cooperatively to protect and improve the Nation's water resources. Through these partnerships, scientists, educators, and extension specialists combine their knowledge and expertise to address locally defined water resource issues supported through the Water Resources program.

KA 405, Drainage and Irrigation Systems and Facilities, focuses on water management, including surface and subsurface drainage and all irrigation systems. Specifically, this involves drainage and irrigation equipment, system design, theory, modeling, installation, operation and maintenance for more efficient use of land, water and capital resources. Example topics are theory of water flow for more efficient water management system design, methods of automated water management systems to reduce labor and increase efficiency, and improved technology to measure and control losses of agri-chemicals from irrigated lands.

KA 111, 112, 405: Water Resources Logic Model:

Situation	Inputs	Activities	Outputs	Outcomes		
				Knowledge	Actions	Conditions
Communities depend on a clean, safe, reliable fresh water supply for industrial and human consumption, food/fiber production, sustaining aquatic/ terrestrial ecosystems.	USDA Working Group on Water Resources, Drought Team, and Partnership Management Team, and CEAP Steering Committee; CENR Subcommittee on Water Availability and Quality; NRC Reports: Confronting the Nation's Water Problems; Valuing Ecosystem Services, Hydrologic Sciences: Taking Stock and Looking Ahead CENR Report: Science and Technology to Support Fresh Water Availability in the U.S.	Identifying the mechanisms and processes responsible for the maintenance and variability of the water cycle, how the characteristics of the cycle change and to what extent are human activities responsible for those changes	Natural Resource Use and Management - Publications - Citations - Disclosures - Patents - Curriculum - Products - Tools - Technology - Practices - Methods - Measures - Polices - Regulations - Models	- Improve our understanding of how agricultural practices and urbanization in rural watersheds impact riparian, wetland, riverine, and estuarine ecosystems. - Improve our understanding of how management practices buffer or protect surface and ground waters within the landscape of a watershed - Improve our understanding of human behavioral decision-making and cultural or institutional factors that determine water use.	- Improve our understanding of the linkages between hydrology, geomorphology, and ecology in aquatic ecosystems (rivers, streams, lakes); - - Explore/identify the keys to successful, effective restoration - Improve our understanding of the buffering capacity of riparian, wetland, riverine, and estuarine ecosystems - Demonstrate increased adoption of water resources improvement and protection practices and strategies.	Develop and disseminate the knowledge necessary to reduce the negative impacts and promote the positive effects of agricultural practices. - Reduce nutrients in surface water and groundwater - Reduce N by 20% in surface/ groundwater - Decrease agricultural water use without affecting agricultural production. - Improve our understanding of behaviors that relate to water use.

Assumptions: Pressures on natural resources and land use are increasing, competing, and more frequently, conflicting. Demographic changes and changing social values bring new challenges. Ecosystems have become increasingly fragmented for production of food and forest products. Urbanization and fragmentation have major impacts on ecosystem structure and function. Public demand for natural resources products and services – timber, recreation, fish and wildlife, soil and water, open space, and the beauty of the land – continues to grow.	**External Factors:** Scientific advancements; changing priorities; producers' and consumers' attitudes; weather, natural disasters; economic conditions; coordination w/ other government entities; public policy.

KA Key Activities for 2009:

The WateReuse Association and USDA CSREES presented a unique specialty conference with the theme of Water Reuse in Agriculture: Ensuring Food Safety. This event was a follow up to the highly successful conference held in 2006 on the same topic, which attracted 220 attendees to hear an outstanding array of speakers discuss success stories with respect to water reuse in agriculture and to explore areas of challenge that require additional research and investigation. The overarching twin goals were: 1) to provide an adequate supply of high quality water for growers and to 2) ensure food safety. The objectives of Water Reuse in Agriculture: Ensuring Food Safety are to highlight success stories and to focus on the many challenges the agricultural community must strive to successfully confront to ensure food safety. This conference covered regulations, the health aspects of recycled water use on edible and nonedible crops, economics, technology, public perception, and the federal government's role in water management.

KA Key Outputs for 2009:

In response to the 2006 Agricultural Water Reuse Conference, CSREES and the Agricultural Research Service (ARS) recently released a final conference report, "Opportunities and Challenges in Agricultural Water Reuse." Explore the links below to learn more about how CSREES and ARS address recycled water issues in agriculture, one of the portfolio expansion areas identified for USDA's Research, Education and Economics mission area's Agricultural Water Security Initiative. The entire report is available for viewing on screen. Each section is also available in high resolution for printing (http://www.csrees.usda.gov/newsroom/news/2008news/water_reuse.html).

KA Key Activities for 2008:

CSREES is mobilizing land grant universities, focusing research and extension efforts on determining the effects of conservation practices on water quality. The 13 watershed projects jointly funded by CSREES and NRCS serve as examples of collaborative work between land grant universities and NRCS. These watershed projects are unique in that they combine evaluation of the biophysical effects of conservation practices and the socio-economic context of the watershed location. The watershed projects also combine research and extension/outreach activities – involving agricultural producers in project outcomes. The CEAP Project has developed substantial capacity within the land grant university system to increase the understanding of effects of conservation practices and the effectiveness of conservation programs. CSREES continues to fund watershed scale projects that explore how "targeting" practices (focusing on critically sensitive lands or key producers) can improve water quality impacts. We also are developing educational materials to assist agricultural producers in adopting and maintaining appropriate practices. CSREES also is continuing to focus on water availability for agriculture – we envision that "Agricultural Water Security" will continue to be a defining issue over the next decade.

KA Key Outcomes for 2008:

- Drought is perhaps the single greatest threat to agriculture. Efficient water conserving alternatives for agricultural production are needed to protect regional water resources and maintain productivity. A project was funded through the Special Research Grants program to determine the feasibility of subsurface drip irrigation and other alternative irrigation systems in western Kansas. Over a fourteen year period, the investigators found only small fluctuations (less than 5 percent) in flow rates, and concluded that it is economically feasible to irrigate lower value crops like corn. Also, over a four year period, they found that drip line depths ranging from 8 – 24 inches had no appreciable effects on corn yields, so that producers can apply less water to their crops. Because of the direct involvement of extension, the results have been shared with producers through publications and oral discussions and new management practices are being implemented.

- Another Special Research Grant funded project is targeting efficient irrigation in Texas and New Mexico, since the waters of the Rio Grande River are a critical resource for the region. The major problem is that total water management does not exist, so that water is released on demand. Excessive ground water pumping increases salinity and the potential for crop damage. Research progress is having significant impact in the region, including: 1) seepage loss tests have formed the basis for irrigation districts' guidelines for canal lining, noting that for every mile of canal lined, the region may save about 400 acre-feet of water; 2) five native and one introduced shrub's soil water extraction and pattern of transpiration formed the basis for a Web site detailing native shrub water use; 3) a model to estimate the economic values of water in alternative uses and locations in New Mexico river basins, useful for projecting the consequences of different management plans, was developed; 4) at least one-fourth of homeowners are now willing to assume responsibility for selecting climate appropriate landscapes.

AIR KNOWLEDGE AREA

KA 141: Air Resource Conservation and Management

Introduction:

Agricultural producers face a growing array of regulatory pressures, including those related to air quality. The Air Resource Protection and Management problem area seeks to provide sound science that protects the environment while maintaining a viable agricultural production system. This problem area focuses on developing emission data for agricultural production practices and improving what we know about the measurement, control, fate, and transport of odor, gases, and particulate matter. This research also studies emissions and reduction of other greenhouse gases, such as nitrous oxide and methane. Its outreach activities include transferring technologies and best practices to producers and the regulatory community to lessen the production and transport of air pollutants and greenhouse gases.

Because of the lack of relevant research and monitoring of these pollutants from agricultural production facilities, thresholds from other industries form the basis of enforcement. To address these concerns, CSREES has created and funded a comprehensive, integrated air quality program to provide the research and outreach necessary to assist regulatory authorities in developing and implementing appropriate permit options for agricultural producers under the Clean Air Act and other legislative authorities. The research should enable the development and evaluation of emission control technologies that are both effective and economical for producers.

Developing sound research for agriculture in an increasingly regulated environment is a particularly challenging opportunity. The immediacy of policy and laws to protect people and resources contrasts with the much slower process of problem solving based on hypothesis testing and technology transfer. The mission of this problem area--to foster sound science, enhance stakeholder education and competencies, and transfer this knowledge through high-impact extension programs – is critical in developing effective agricultural air quality policies.

Knowledge Area 141 is relatively new in CSREES classification and was developed to address an emerging issue that is critical to protecting the environment, while enhancing productivity and sustainability. Knowledge Area 141 is closely linked to and overlaps with others portfolio KAs, specifically KA 101,112, 132 and 133. This demonstrates that CSREES and its partners are proactive in identifying and addressing critical agricultural-related problems.

The agricultural community is increasingly coming under scrutiny for practices that can potentially degrade air quality. A number of trends in agriculture are driven by economic incentives and competitiveness that possess serious environmental ramifications. For example, the adoption and widespread use of nitrogen fertilizers and the concentration of animal feeding operations have led to dramatic increases in emissions of reactive forms

of nitrogen to the atmosphere (NH_3, N_2O, and NO_x). Because agriculture tends to be "leaky" and inefficient with respect to nitrogen, these reactive forms of nitrogen can build to unsustainable levels in air, soil and water. They form greenhouse gases, aerosols/fine particulates and, through wet deposition as NO_3 and NH_4. Additionally, fine particulate matter ($PM_{2.5}$) and coarse particulate matter (PM_{10}) can be emitted from controlled burning to manage crop residues, from pre- and post-production practices such as tillage and cotton ginning, and from livestock production facilities. Odors from agricultural production and processing can also have serious consequences not only as a public nuisance but odor can contain compounds that are regulated as hazardous substances.

The immediacy of the subject matter contained in this problem area is driven primarily by regulation and legislative authority. Federal and state agencies are being sued by citizen groups to enforce regulation that may or may not have targeted agriculture and forestry. Legislation that created reporting requirements for hazardous substances and the Superfund to clean up those hazardous substances probably did not have agriculture in mind. Nevertheless the authorities are now being used to regulate agriculture and precedence is being set successfully in many states. Agriculture, to a certain extent, has been a victim of its own success. Research has demonstrated the need for fertilizer to increase crop production but the relationships to determine the rates were based on production rather than on environmental consequence. Similarly research has demonstrated the economic production advantages for concentrating the feeding of livestock but has mostly neglected the impacts of waste streams on the environment. The research community now understands the need to protect the natural resources that underpin agricultural production and USDA is responding to those externalities. In this context, policy and legislation are the primary drivers of this

KA 141: Air Resource Conservation and Management Logic Model:

Situation	Inputs	Activities	Outputs	Outcomes		
				Knowledge	Actions	Conditions
Many agricultural sectors are subject to increased regulation under the Clean Air Act. Science-based knowledge and education to improve and protect air resources while maintaining a viable agricultural production system are needed.	**Resources:** - Authorities: Clean Air Act - Mission - Strategic Plan: Goal 6 - Leadership - Management - Oversight - Assessment **Financial Resources** - CSREES - Formula: $1.5 M/yr - Competitive: $5M/yr - Special:$2.5 M/yr **Human Resources:** - NPLs - Administrative - Support - USDA Taskforce - Faculty - Practitioners - Para-professionals - Industry - NGOs - Volunteers Partners	- Annual project director's meeting - International conference on agricultural air quality - Animal emission mitigation conference - Joint USDA/EPA workshop on defining emissions estimating methodologies - USDA Agricultural Air Quality Taskforce participation - Stakeholder workshops - Coordination of federal air quality research and monitoring	Publications: Two special journal issues on agricultural air quality Patents: hand held device to monitor activities in a cattle feed yard - Technology : 12 control technologies developed to reduce agricultural air emissions - Practices:3 new NRCS standard practices to reduce agricultural air emissions - Methods: improvements in measurement of gases and particulates	- Measure emission rates and factors and develop improved measurement and monitoring protocols - Identify and develop mitigation practices to reduce emissions - Understand farm component emission processes - Better understanding of environmental fate of agricultural atmospheric emissions	Development of a comprehensive emission inventory for agriculture Development of mitigation practices and implementation of outreach programs Develop process-based models to describe emissions, fate and transport at the farm-scale	Establishing emission reduction targets, based on sound science, that will significantly improve air quality and protect human and environmental health Better environmental protection from nitrogen deposition Improved air quality by reducing ammonia a precursor to fine particulate matter Increase farm adoption of one or more best management practices to reduce agricultural emissions

Assumptions: Urban expansion will continue placing increasing pressures on agricultural production systems to reduce odors and emissions of dust and gases. Greenhouse gases will be regulated under the Clean Air Act and air quality standards will be tightened	**External Factors:** Environmental groups will continue to place pressure on agriculture via litigation. Increasing commodity prices will create new opportunities to pay for emission reductions and increased pressure to use agricultural wastes differently will add to agricultural emissions

KA Key Outputs for 2009:

- Small grain farmers in the Pacific Northwest are benefiting from research conducted at Washington State University. Agronomists at WSU evaluated tillage implements for reducing windblown dust in low rainfall wheat production areas. They found that by using a subsurface cutting implement in fallow fields they could control weeds, conserve soil moisture, and keep residue on the soil surface to control wind erosion. The practice was found to reduce wind-borne dust by more than 50% over conventional wheat-fallow production systems. The practice was also more profitable than standard practices of rod-weeding. As a result of the research, the Washington Association of Wheat Growers was successful in getting a Conservation Innovation Grant from the USDA's Natural Resource Conservation Service to cost-share the purchase of the subsurface cutting implement. Thirty-four farmers have purchased the equipment and will be required to use the practice on 160 acres for three years.

- Over the past six years, CSREES has funded research at Texas A&M and Kansas State to measure air emissions from confined cattle stock yards and to evaluate practices to mitigate those emissions. Texas and Kansas account for 42 percent of the cattle fed in the U.S. Particulate matter emissions from cattle stock yards can be a significant source of air pollution.

KA Key Outcome for 2009:

- After six years of monitoring, sampling, and testing, several practices have been developed that significantly reduce dust from stock yards. Eighty Texas stock yards have received USDA-Natural Resource Conservation Service cost-sharing for dust-control measures developed by the research project and now available for funding under the Environmental Quality Incentives Program. About 53 percent of Texas stock yards so far have adopted some form of feedlot dust-control measures such as solid-set sprinklers, traveling-gun sprinklers or frequent manure harvesting.

KA Key Outcomes for 2008:

- Agriculture is the primary source of ammonia emissions to the atmosphere in the US. Once in the atmosphere, ammonia can be converted to fine particulate matter, a criteria pollutant, or deposited by either wet or dry deposition to water bodies leading to water pollution. National Research Initiative competitive funds funded a group of researchers to evaluate the effect of feeding reduced crude protein diets on air emissions from swine and broiler chickens. Emission data were developed from these studies for both common feeding practices in the industry and for diets that employ mitigation strategies focused on source reduction of air emissions. The impact was a 40 to 50 percent reduction in ammonia emissions with no negative performance effects in either species. The most costly diet added $8 per ton of feed. A lower cost diet that is fed already by a small portion of the industry resulted in a 22% reduction in ammonia emissions. The broiler chicken work demonstrated that slight

modifications to the diet in the first 17 days of a 42-d flock could produce a 15 percent reduction in ammonia emissions. As availability of synthetic amino acids increases and costs are reduced, producers will be better positioned to maintain animal numbers while decreasing air emissions without economic roadblocks. The combination of these two animal studies demonstrates that animal performance can be maintained when reduced protein feeding strategies are implemented. Adoption of such source reduction strategies will likely help meet emission reduction targets.

- A National Research Initiative Integrated Project was funded to provide information to poultry producers in Delaware, Pennsylvania and Iowa to help adopt the recommended species and planning designs as part of their emission mitigation strategies. Research from this project showed that atmospheric emissions from animal production can create environmental pollution as well as nuisance issues (odor) for the public. Vegetative environmental buffers (VEBs) were evaluated on their efficacy to reduce ammonia, odor and particulate matter emissions from poultry barns. Eastern red cedar, arborvitae, cypress, honey locust, limber pine, white spruce, "Austree" willow, and hybrid poplar were tested in VEBs to determine their effectiveness to tolerate the ammonia, particulates and capture odor. As expected there are species differences with Eastern red cedar and honey locust being the best in terms of particulate capture and NH_3 tolerance respectively. Particle size capture by VEBs indicate a greater efficacy to reduce $PM_{>10}$ and PM_{10} vs. $PM_{2.5}$. Conifers were better for particulate capture. Difference in species was not significantly different in terms of their tolerance to ammonia. Hybrid poplar and willow are negatively impacted by atmospheric ammonia (NH_3), for example, so separation distance from the poultry houses is very important. A mixed species VEB provided producers with a cost-effective mitigation of particulate and ammonia emissions.

LAND USE KNOWLEDGE AREA

KA 131: Alternative Uses of Land

Introduction:

According to the Economic Research Service (ERS), the U.S. has 2.3 billion acres of land, 97 percent of which is classified as rural, and 3 percent is classified as urban. Major land uses include forest (28 percent), pasture and range (26 percent), cropland (20 percent), special use such as parks, wilderness and wildlife refuge (13 percent) and other miscellaneous lands such as deserts, wetlands, barren land (10 percent).

Evolving public and private land management questions call for new data and knowledge, and improved scientific bases for decision making. They require long-term commitment to data collection, and acquisition from local, regional, and national sources. While progress has been made in mapping land cover characteristics, ability to accurately map the wide range of landscape attributes, including land use and biomass, requires effort especially in acquiring data and algorithms for detection of local changes and their characteristics. Data integration is a particularly important research strategy so that *in situ*, remotely sensed and other forms of data can be merged to derive needed land use and land cover information. As scientific demands and needs for land use and land cover information change, parallel innovation in resulting data products and means to communicate knowledge are essential components of this portfolio. Improvements are needed in process models of land use and land cover change spatial and temporal dynamics, combining field-level case studies for analysis of processes, statistical studies for large regions, and empirical analyses using remote sensing change detection. Process-level understanding of land use and cover dynamics will aid analysis of land use and land cover change across scales. Work will be required to understand how one agent or cause of change influences another. Comprehensive understanding of land use and cover change processes considers interactions between socioeconomic and biophysical factors, including synergies between land use dynamics and climate change and variability.

CSREES funds research, education and extension on evaluation of alternative uses of land to determine short- and long-term consequences of how changes in land use, management and cover affect local, regional and national environmental and socioeconomic conditions. Changes in response to population growth, urban and suburban growth, recreational needs, and other factors affecting the supply of land are included in this portfolio. Knowledge gained from scientific inquiry educates industry, scientists, students, policy makers, managers, and specialists in the state of science and technology help maintain the balance of providing goods and services in agriculture, forest, range and urban ecosystems. Extension integrates science and educational resources into clear and effective decision support systems and communicating knowledge in a timely, user-friendly manner.

KA 131: Alternative Use of Land Logic Model:

Situation	Inputs	Activities	Outputs	Outcomes		
				Knowledge	**Actions**	**Conditions**
The interaction between land use and climate variability and change is poorly understood. Evolving public and private land management questions call for new data and information and improved scientific bases for decision making. Poor forecasting of land-use and land-cover change to predict the consequences of change,	**Resources:** - Authorities - Mission - Strategic Plan Leadership - Management - Oversight - Assessment **Financial Resources** - Formula - Competitive - Special **Human Resources:** - NPLs - Administrative - Other Gov't. - Faculty - Practitioners - Para-professionals - Industry	Research activities for generating scenarios of land-use and land-cover change, and making projections of change that take into account the various influences of human-managed systems. Contemporary impacts of land-use and land-cover change on ecosystem goods and services; Process models of land-use and land-cover change New techniques and tools that integrate understanding of human behavior.	Natural Resource Use and Management - Publications - Citations - Disclosures - Patents - Curriculum - Products - Tools - Technology - Practices - Methods - Measures - Polices - Regulations - Models	Understand how primary drivers of land use and land management decisions are likely to change over the next few decades. Analysis of existing databases and theories about climate-related processes that affect land-use change, including uncertainty analysis. A new suite of models that combine climatic, socioeconomic, and ecological data.	Identification of the regions in the United States where land use and climate change may have the most significant implications for land management. Multidisciplinary cooperation to develop land use and land cover projections. Partnerships with state and regional assessment and research efforts, to ensure comparability between national/global and state/regional models.	Improved land management options associated with different climate change scenarios Public awareness of social, economic, and ecological impacts of urbanization on other land uses. Landholders, land managers, and decision makers formulate land use and land management decisions and practices at various scales in order to mitigate negative impacts of, and take advantage of any new opportunities due to, climate change.

Assumptions: Key issues to be addressed by this research element include the spatial and temporal dynamics of land-use change, the role of fragmentation and degradation, the role of multiple drivers, the role of institutions, and the interactions among drivers and types of land-use change. Methodological advancements have been made that improve our capability for and strong reliance on remote sensing and land-cover databases for multi-scale environmental studies.	**External Factors:** Changes in land use and land cover are likely to affect ecosystems and the many important goods and services that they provide to society. Determining the effects of land-use and land-cover change on the Earth system depends on an understanding of past land-use practices, current land-use and land-cover patterns, and projections of future land use and cover.

Key Activities for 2009

- Scientists at Auburn University use funds from the National Research Initiative to examine three critical, but understudied aspects associated with land use change--the role of public policy, especially property tax policy, land use change within the forestry and agricultural sectors respectively, and the determinants of land use change at the watershed level.
- Scientist at the University of New Hampshire use Hatch funds to study intensive rotational grazing and integrated crop/livestock agriculture as a centerpiece of both agricultural sustainability and a new societal relationship with local food of great nutritional value.
- Scientists at Clemson University use McIntire-Stennis funds to study the interactions between disturbances and forested wetlands in order to aid in the conservation of this important ecosystem and in the development of the very best management plans for these wetlands.
- Scientists at the University of Washington received a special research grant to conduct coordinated research and technology transfer designed to develop and implement erosion control practices for agriculture in the Pacific Northwest (PNW) Washington-Idaho-Oregon area

Key Outputs and Outcomes for 2009:

- With a McIntire-Stennis grant, scientists at Purdue University examined the role of stakeholders in environmental decision making and land use planning. Six collaborative watershed groups in Indiana are using data about social dimensions to improve their collaborative planning efforts. Reports provided to watershed groups have helped them address some internal problems and develop education programs.

- Scientists at Michigan State University used Hatch funds to evaluate how recreation uses and activity patterns influence natural resource land management in Michigan. Information on landowner and recreational user attitudes was instrumental in designating the upper Manistee River as a state natural river by the Michigan Natural Resources Commission. The research also identified 180,000 acres of locally owned parkland available to Michigan residents, with the largest acreage per 1,000 populations in heavily populated southeastern Michigan.

- The University of Connecticut received an extension grant to integrate Forest Cover and Forest Fragmentation issues into educational programs for local land use decision-makers in the US. Twenty-five educators representing NEMO programs in eleven states participated in the Forest Resource Education for Municipal Officials. Some of these programs have begun work to adapt these materials to their states.

KA Key Activities for 2008

- Portfolio funded research on land-use and land-cover change have focused on: 1) the processes that determine temporal and spatial distributions of land-cover and land-use

at local, regional, and global scales; and how and how well land-use and land-cover can be projected over time scales of 5 to 50 years; and 2) how changes in land-use, management, and cover affect local, regional, and global environmental and socioeconomic conditions, including economic welfare and human health, taking socioeconomic factors and potential technological change into consideration.

- The program has also invested in research on human contributions and responses in agroecosystems; specifically on: 1) how natural and human-induced environmental changes interact to affect the structure and function of ecosystems (and the goods and services they provide) at a range of spatial and temporal scales, including those ecosystem processes that influence regional and global environmental changes; and 2) how society can enhance and sustain desirable ecosystem goods and services, in the context of still uncertain regional and global environmental changes.

KA Key Outputs and Outcomes for 2008

- CSREES initiated and partnered with the National Association of State Universities and Land-grant College, the Association for European Life Science Universities, Farm Foundation, and other land-grant universities for an international conference entitled, “The Science and Education of Land Use: A Transatlantic, Multidisciplinary, and Comparative Approach”. Over 130 scientists, educators, and policymakers from numerous countries in the US and Europe participated in this conference. The conference explored the causes and consequences of current land use trends and dynamics related to society, economy and environment, as well as policy implications of land cover/land use changes. The conference provided an environment to foster international knowledge exchange, future collaboration, and student exchange.

- The University of Idaho received funds from the National Research Initiative to examine modeling trends in forest management, exurban development, and biodiversity conservation under alternative policy portfolios in northern Idaho. This model has developed land use policies and regulations for Idaho that promote long-term sustainability in mixed forest and agricultural landscapes and assisted local landowners with their land use and conservation goals.

- Rutgers, The State University of New Jersey, New Jersey Agricultural Experiment Station (NJAES) used Hatch funds for research worked towards estimating the magnitude of the impact that sprawl has on forest cover, the greenhouse emissions attributable to the conversion of forest land into residential subdivisions, and the regional variations in the sprawl-forest cover relationship. This research provided a more complete accounting of the costs of sprawl by investigating one possible set of costs, deforestation, that have been ignored. If sprawl does has a significant effects on forest cover, information about this relationship could make a useful contribution to debate about policies for containing suburban expansion.

CLIMATE CHANGE KNOWLEDGE AREA

KA 132: Weather and Climate

Introduction:

The vision of the Cooperative State Research, Education, and Extension Service (CSREES), in addressing the nation's issues on Global Change and Climate, is resilient and sustainable ecosystems and human communities for the production of agricultural goods and services, which optimize mitigation potentials and adaptive capacities under a changing climate and environment. CSREES had funded research, extension and education projects addressing issues on weather and climate since the inception of the agency in 1994 and even before that. It was in 2004, however, that a separate and distinct program on Global Change and Climate with its own National Program Leader was established. This program uses an interdisciplinary approach to address the impacts of global change and climate (including weather) and mitigate their adverse effects on agricultural production, and the forest and rangeland resources.

Agriculture producers and natural resource managers need climate information at the regional and local levels to address short and long term challenges posed by a variable and changing climate. Risks posed by climate variability include hurricanes, droughts, floods, freezes, heat stress and fire. Risks posed by climate change include changes in frequency and intensity of extreme events and agricultural emissions of greenhouse gases. In addition to risks, climate change offers new economic opportunities in agriculture and forestry, such as bioenergy production and carbon sequestration.

CSREES weather and climate projects focus on determining the effects of global change and climate on land-based systems and the global carbon cycle and on identifying agricultural and forestry activities that can help reduce greenhouse gas concentrations. Research can help identify, describe, and quantify processes involved in the cycling of organic and inorganic carbon in soil. Global change extension programs focus on 1) technologies and practices to reduce carbon in the atmosphere and 2) risk management practices to anticipate natural and human impacts on agricultural ecosystem dynamics. Education and extension activities provide robust scientific information for learning and decision support systems for citizens and public officials to evaluate the environmental and socioeconomic impacts of policy options for sustainable resource management.

For example, the agency supports research to determine the influence of irrigation practices and water management on carbon storage in land-based systems. Irrigation schedules and best practices are then communicated to stakeholders for implementation. Contributions from research programs include new tools for accurately measuring greenhouse gases, methods for measuring and estimating carbon in ecosystems at different scales, and effective ways to sustain productivity in a changing environment. Mitigation steps to reduce carbon dioxide or methane emissions are then taught to industry professionals and education specialists to achieve national goals of greenhouse gas reductions.

KA 132: Weather and Climate Logic Model:

Situation	Inputs	Activities	Outputs	Outcomes		
				Knowledge	**Actions**	**Conditions**
Seasonal to annual variability in climate has been connected to impacts on almost every aspect of human life: agricultural yields, water resources, energy demand and supply, transportation, price fluctuations, fishery yields, forest fires, human health and welfare, and many others. Agriculture producers and natural resource managers need climate information at the regional and local levels to address short and long term challenges posed by a variable and changing climate.	**Resources:** - Authorities Mission - Strategic Plan Leadership - Management - Oversight - Assessment **Financial Resources** - Formula - Competitive - Special **Human Resources:** - NPLs - Administrative Other Gov't. Faculty Practitioners Para-professionals Industry	Conduct and analyze decision support experiments using observations, integrated data sets, forecasts of seasonal climate variability, and longer-term model projections. Engaging in integrated planning that assembles the pieces of the earth system science research approach and fosters problem-driven interdisciplinary research. Establish research programs that foster integration across research elements and disciplines.	Natural Resource Use and Management Publications Citations Disclosures Patents Curriculum Products Tools Technology Practices Methods Measures Polices Regulations Models	Scenario-based analysis of the climatological, environmental, resource, technological, and economic implications of different atmospheric concentrations of greenhouse gases. Spatially explicit ecosystem models at regional to global scales.. Linking agricultural management to seasonal climate predictions to provide adaptation options which are integrated with resources from the private sector and government.	Understanding of adaptation options will support improved resource management Increased partnerships with existing user support institutions, such as state climatologists, regional climate centers, agricultural extension services, resource management agencies, and state and local governments to accelerate uses of climate. Improve stakeholder involvement in articulating and framing all aspects of policy support.	Improving our ability to assess potential vulnerability and resilience to future variations and changes in climate and environmental conditions. Improve the nation's and global community's understanding of the nature and extent of the challenges inherent in climate change. Public knowledge of climate variability and global change so that individuals may exercise responsible stewardship for the environment.

Assumptions: Future human contributions to climate forcing and potential associated environmental changes will depend on rates and levels of population change, economic growth, development and diffusion of technologies, and other dynamics in human systems. These developments are unpredictable over the long timescales relevant for climate change research. Evaluation of the potential impacts associated with different atmospheric concentrations of greenhouse gases and aerosols is an important input to weighing the costs and benefits associated with different climate policies.	**External Factors:** Changes in land use and land cover, especially when coupled with climate variability and change, are likely to affect ecosystems and the many important goods and services that they provide to society. Determining the effects of land-use and land-cover change on the Earth system depends on an understanding of past land-use practices, current land-use and land-cover patterns, and projections of future land use and cover, as affected by human institutions, population size and distribution, economic development, technology, and other factors.

KA Key Activities for 2009:

- Scientists at the New York Agricultural Experiment Station received funds from the National Research Initiative (NRI) to provide weather-based tools that will give agencies and specialists the ability to retrospectively analyze conditions that prevailed prior to detection for plant pathogens that are biosecurity risks and whose development and spread are influenced by weather.

- Scientists at Rutgers University use NRI funds for analysis and climate modeling to study how climate change and local land use decisions will affect water resources and citizen's activities in New Jersey and the northeast U.S.

- Scientists at the University of California Berkeley use Hatch funds to develop scenarios of future climate and ecosystem change for California so that sound management and adaptation policies can be implemented.

- Scientists at the University of Alaska Fairbanks use McIntire-Stennis Funds to investigate various aspects of the evaporation process in the boreal forest environment for a better understanding of climate change, land use change, and wildfire on stream flow, lake levels and forest landscape productivity.

KA Key Outputs and Outcomes for 2009

- The University of Missouri, Columbia used McIntire-Stennis funds to determine the need for rapidly growing tree species for carbon sequestration and bio-energy purposes. These results are being used in clone selection for plantations by private woodlot owners. The data are also being used by policy makers related to decisions regarding greenhouse gas emissions.

- Colorado State University scientists received NRI funds for research focused on developing and expanding the use of spatially explicit landscape-scale probability models of key insect pests to monitor climate change. This research has been used to predict the areas most prone to damage caused by climate change and allow land-managers to proactively implement special management regimes.

- A special grant was provided to the University fo Nebraska, Lincoln to establish the National Integrated Drought Information System. This project has improved the level of drought preparedness in the U.S. by placing more emphasis on drought planning at the community, state, regional, tribal, and national level. Currently, 38 states have drought plans and more emphasis is being given to drought mitigation and risk management in these plans.

KA Key Activities for 2008:

- The CSREES Global Change and Climate portfolio has funded projects that focus on determining and adapting to the effects of global change and climate on land-based systems and on identifying agricultural and forestry activities that can help reduce greenhouse gas concentrations. Research identifies, describes, and quantifies processes involved in the cycling of organic and inorganic carbon in working lands and forests.

- Research on agriculture and urban water usage will focus on 1) how climate and human activities influence the distribution and quality of water within agroecosystems and human communities and whether changes in consumption and replenishment are predictable; and 2) the effects of variability and change in the water cycle in US watersheds and freshwater systems.

KA Key Outputs and Outcomes for 2008

- Portfolio NPLs contributed to the production and review of the U.S. Climate Change Science Program report on the analysis and synthesis of the scientific literature on the effects of climate change on U.S. land resources, water resources, agriculture and biodiversity. The overarching conclusions are:

    1. Climate changes – temperature increases, increasing CO2 levels, and altered patterns of precipitation – are already affecting U.S. water resources, agriculture, land resources, and biodiversity *(very likely)*.
    2. Climate change will continue to have significant effects on these resources over the next few decades and beyond *(very likely)*.
    3. Many other stresses and disturbances are also affecting these resources *(very likely)*.
    4. Climate change impacts on ecosystems will affect the services that ecosystems provide, such as cleaning water and removing carbon from the atmosphere *(very likely)*, but we do not yet possess sufficient understanding to project the timing, magnitude, and consequences of many of these effects.
    5. Existing monitoring systems, while useful for many purposes, are not optimized for detecting the impacts of climate change on ecosystems.

- The University of Minnesota used Hatch formula funds to examine the complex alteration of our natural and managed vegetation by climate, atmospheric chemistry, disturbance, land use and biotic invasions. This information has been used to develop models to predict change for various climatic scenarios and is the basis for informing the policy process about the full impacts of climate and other change and for developing adaptive resource management strategies in the state.

- The University of New Hampshire received NRI funds to examine how soil warming and nitrogen additions interact to influence microbial community

composition, especially the relative abundance of bacteria and fungi, and if there is a correlation between the fungal: bacterial biomass ratio and the metabolic efficiency of the microbial community in soils exposed to chronic warming and nitrogen deposition. This research is determining how these two environmental changes are interacting to alter key ecosystem services provided by forest soils, including carbon storage, decomposition, and nutrient cycling.

OBJECTIVE 3.1: Expand Economic Opportunities in Rural America by Providing Research, Education and Extension to Create Opportunities for Growth

OUTDOOR RECREATION KNOWLEDGE AREA

KA 134: Outdoor Recreation

Introduction:

"*Farm-Based Recreation: A Statistical Profile*" (Economic Research Service, 2007) reveals that farm-based recreation, or agritourism (including hunting, fishing, bird-watching, horseback riding, and other on-farm activities diversify and increase returns on the farm investments. While in 2004, only about 2.5 percent of total U.S. farms are engaged in farm-based recreation, more American farmers may consider moving into farm-based recreation. Agritourism will then play a more important role in the U.S. economy, both as an alternative source of farm income and as a way for rural communities to diversity and stimulate their economies.

In addition to farm-based recreation, rural communities that are abundant with beautiful scenery, such as rivers, lakes, mountains, or forests, also attract people through different kinds of recreation activities, e.g., canoeing, kayaking, rafting, snow sports, or wildlife-viewing. These outdoor recreation and tourism activities usually stimulate local, state, and regional employment opportunities and economic growth, as well as enhance quality of life. According to the Economic Research Service (Reeder and Brown, *Recreation, Tourism, and Rural Well-Being*, 2005), average population growth in rural recreation counties increased by 20 percent in the 1990s, nearly three times as fast as that of other rural/non-metropolitan counties. However, outdoor recreation and tourism development may also contribute to higher rural housing costs; cause excessive traffic and congestion; increase crime rates and public service costs; cause conflict among user groups or between humans and wildlife, and deplete natural resources, if not managed properly.

CSREES supports research, education, and extension activities in KA 134, Outdoor Recreation, through formula, competitive, and other educational grants programs.

KA 134: Outdoor Recreation Logic Model:

Situation	Inputs	Activities	Outputs	Outcomes		
				Knowledge	Actions	Conditions
- Increased public health concerns from inactive lifestyles, including obesity - Increasing demand for new recreation activities - Increased impacts on the physical environment - Changing demographics of recreation participants, non-participants, public land managers, and private landowners - Decreasing unstructured connection and contact with nature - Declining environmental literacy, especially youth - Changing quality of life & livability in recreation-resource proximate communities - Inadequate resource and tourism planning in communities - Increased need to diversify rural community economies - Lack of science-based strategies to address these situations	What we invest: - Faculty - Staff - Students - Infrastructure - Study sites - Federal, state and private funds - Partners - Time - Knowledge - The collection of stakeholder opinions (i.e., federal and state R&D, land-grant universities, public)	- Design and conduct research - Publish scientific articles - Develop research methods, procedures, and theory - Teach students - Conduct non-formal education - Develop products, curriculum & resources - Engage communities and other stakeholders	- New fundamental or applied knowledge - Scientific publications - New methods & technology - Practical knowledge for policy and decision-makers - Information, skills & technology for individuals, communities and programs - Participants reached - Workshops and programs - Students graduated in outdoor recreation -Private/public partnership	- Understand the relationship between health and active recreation - Identify recreation participation trends & conflict among competing uses - Comprehend interaction among rec. use, impact & mgmt parameters - Know rec. demographic trends & short & long-term responses - Identify barriers in connecting people with active recreation - Enhance curricula for education & outreach - Value active recreation benefits in QOL - Identify parameters for effective rec. planning - Assess opportunities & dynamics of recreation & community development - Strengthen the role of rec. in health, youth development, conservation, & economic viability	- Increase participation in active recreation - Improve infrastructure & conflict management - Monitor resource use & apply adaptive management - Provide training for managers to increase opportunities for diverse populations - Improve build environment & link technology with rec. opportunities - Promote education, including K-12 - Include active rec. as an indicator in QOL - Educate local officials in holistic planning approach - Document successful models & characteristics - Foster partnerships with non-traditional stakeholders	- Outdoor recreation contributes to active lifestyles - Rec. areas implements sustainable management techniques - Rec. mgmt parameters incorporate potential resource impacts - Inclusive & tailored rec. opportunities for a diverse population - Increased attachment with natural environment & a sense of place - Increased knowledge in benefits of active rec. & environmental stewardship - Improved QOL with accessible active rec. opportunities - Enhanced community resilience - Capitalized & marketed natural amenities for community economic vitality - Improved cross-disciplinary sciences in addressing contemporary rec. issues

Assumptions: These are the premises based on theory, research, evaluation, knowledge, etc. that support the relationships of the elements shown above, and upon which the success of the project rests: Collaborative efforts are likely to find better solutions than single investigator, single state approaches; Without a multi-state research approach, research in this area will be hindered.; and Multi-state project provides an effective forum for building collaboration among multidisciplinary researchers and educators. scale environmental studies.	**External Factors:** These are variables that have an effect on the project, but which cannot be changed by managers of the project: Funding is needed to conduct the research; Cooperation from federal, state, and private funders is required; and Society – from economic conditions to social values – is not steady state

KA Key Activities for 2009

- The Ohio tourism team transitioned to new leadership and participated in Ohio State University's high-performance team training for a diverse statewide multi-institutional tourism team. Members of the tourism team and direct marketing team collaborate on special educational projects focused on emerging topics such as local foods and culinary tourism, heritage tourism, and agriculture and nature-based tourism. The team now has members representing various industry perspectives. Several working groups are addressing education, research and outreach opportunities. The team is planning a new industry gateway to be launched in 2008. A new partnership is developing with the Ohio Division of Travel & Tourism, the Ohio Travel Association, and various educational entities throughout the state. Through this partnership a joint educational event will be held in 2008 to link these groups to improve networking, resource development, and impacts. Local leaders and businesses perceive tourism as a viable economic development strategy for their community. The projects are expected to help increase civic engagement, build community pride and image, increase community economic vitality, and improve quality of life.

- Community-based natural resources management has not been applied widely in the Northeast U.S. Based on the implementation elsewhere, however, it shows potential to be able to address complex Northeastern natural resource management problems related to locally-abundant wildlife, human risk issues, and species restoration challenges. The Community-based Natural Resources Management Program project was designed to improve understanding of the potential for community-based management in New York and the Northeast. Researchers are using spatial analyses to conduct research to understand the dynamic interaction between human and wildlife. Research results will be incorporated into the education programs. Cooperative Extension and the local parks department may use the results to assist with their communication with the public. Current work has influenced the St. Regis Mohawk Tribe Environmental Division in developing an Integrated Resource Management Plan, and helped the Wildlife Conservation Society's Adirondack Communities and Conservation Program establish priorities. Research and consultation services were used by Cornell University to design an impacts-management approach to deer management on Cornell lands, enabling the university to proceed with deer management actions and improving university-community relationships.

KA Key Outcomes for 2009

- CSREES: Outdoor Recreation Strategic Plan: CSREES garnered stakeholder inputs through a systematic planning process by (1) convening a National Steering Committee comprised of 30 multi-disciplinary cross-section leaders in land-grant universities and federal agencies, and conducted a 2-day workshop; and (2) conducting roundtable discussions at various national professional conferences, including Northeast Recreation Research Symposium, International Symposium on

Society and Resource Management, and Society of American Foresters. The strategic plan not only institutionalized and broadened the scope of CSREES Outdoor Recreation Program but also fostered an environment to enhance collaboration in trans-disciplinary research and intellectual capacity building.

- Multi-state research committee members cooperated and collaborated to quantify the economic benefits of ecosystem services, including recreation. These researchers collaborated on research issues related to valuing changes in recreational access. One research project made general recommendations for recreation managers to: (1) support close-to-home non-motorized trail development, because research results showed that the more hiking and urban trail miles per household, the higher rates of physical activity; (2) target at-risk people and communities by identifying their preferences for trail attributes, supply gaps in trail networks, and their barriers to participating in physical activity or recreation. To understand the interrelationship of growing population from immigration and housing development, especially in rural areas, researchers in Wyoming in 2007 continued to conduct statewide survey to assess citizen opinions on issues such as water and preserving family farms and ranches, open spaces, wildlife habitat, and scenic vistas. Preliminary results showed that citizens were concerned about (1) the availability of water for recreation and wildlife; (2) natural areas and ranch lands being split up by new housing development; and (3) decline in number of big game animals, e.g., elk, moose, and mule deer. These survey results provided basis for further research addressing the implications on local and state economies and long-term sustainability. Land managers and policy makers in several state and national agencies, such as Bureau of Land Management, US Forest Service, and National Park Service, used research results to assist in the determination of optimal resource allocation when making policy decisions.

- The Wildlife Habitat Stewards Program aims to restore the altered landscape to ecological productivity and reverse negative trends. The program provided fact sheets, consultations, and workshops that guide people to manage their landscapes differently. Since 2003, volunteers have expanded outreach in southern Maine, the most populated and developing area of the state. Habitat Stewards™ is a program of the National Wildlife Federation® and, in Maine, is a joint effort with University of Maine Extension. The program fostered an environment that helped landowners make better decision in natural resource management; landowners adopted appropriate management practices that increased areas managed for wildlife habitat and protected or conserved biodiversity and habitat. In the long-run, it will help increase the economic and social viability and sustainability of Maine communities.

- CSREES partnered with several land-grant universities and Farm Foundation to co-sponsor a pre-conference workshop entitled, “Fundamentals of Spatial Economics” in July at the 2007 American Agricultural Economics Association (AAEA), the West Agricultural Economics Association (WAEA), and the Canadian Agricultural Economics Association (CAEA) Joint Annual Meeting in Portland, Oregon. AAEA and CAEA are the national flagship organizations of the agricultural and resource

economics professionals in the U.S. and Canada, respectively; while WAEA is one of the four regional organizations in U.S. The workshop promoted cutting-edge knowledge and education in integrating the Geographical Information Systems (GIS) technology with economic theories. The workshop helped foster an environment in which not only broadened the scope of agricultural economics field studies, but also developed new cross-disciplinary collaboration.

OBJECTIVE 6.2: Enhance Soil Quality to Maintain Productive Working Lands

SOIL RESOURCES KNOWLEDGE AREAS

KA 101: Appraisal of Soil Resources
KA 102: Soil, Plant, Water, Nutrient Relationships
KA 103: Management of Saline and Sodic Soils and Salinity
KA 104: Protect Soil from Harmful Effects of Natural Elements

Introduction:

Soil is a complex and dynamic natural resource on the Earth's surface. It supports plant growth, affects water and air quality, and helps to clean up natural and human-made wastes. We depend on soils for the food we eat, the water we drink, and the environment in which we live and play. CSREES is involved in a diverse range of research, education, and extension activities that will ultimately lead to development of practices, techniques and methodologies that will enhance productivity, while also protecting environmental quality.

For the purpose of this review, KAs 101-104 will be addressed as Soil Resources because of cross-cutting and inter-relatedness of the Knowledge Areas. The goal of CSREES Soil Resources portfolio is to "provide science-based knowledge and education to improve management of soil to support production and enhance the environment."

Research has shown that proper rates and timing of nutrients to coincide with plant demand can reduce the risk of environmental degradation. Similarly, efficient methods of nutrient application and soil conservation practices can reduce erosion and runoff. Understanding the processes controlling retention and transport of nutrients can improve guidelines and recommendations for managing soil inputs based on soil type, crop species and external factors. CSREES addresses these concerns through activities focusing on KA 101, Appraisal of Soil Resources.

Nutrient availability varies considerably from soil to soil depending on numerous internal and external factors and processes. Under a given situation, the system of farming, soil management and soil amendment practices influence productivity of soil and crop yields. Uptake and utilization of nutrients, especially the macro nutrients (N, P, and potassium (K)) are tied to crop species grown, which are in turn affected by soil and external environmental factors. This vital resource sustains all live forms. KA 102 focuses on Soil, Plants and Water to Enhance the Environment.

Saline and sodic soils can significantly reduce the value and productivity of affected land. Soil salinity and related problems generally occur in arid or semiarid climate where rainfall is insufficient to leach soluble salts from the soil. In general, insufficient water or irrigation water, which contains salts, can also lead to accumulation of salts. It is estimated that the salinity of more than 25 percent of irrigated land in the United States is higher than normal. Saline and sodic soils fall into three distinct groups (saline, sodic and

saline-sodic). Understanding these differences is critical to designing strategies for management and reclamation. This is the focus of KA 103 (Management of Saline and Sodic Soils and Salinity).

Population growth and climatic variations continue to impact societies' health and well-being. The dust bowl of the 1930's is an example of climatic variation that had global impact. Without proactive measures, it is conceivable that a similar event related to soil management and practices could occur in the future. Arid and semiarid regions of the southwestern United States are amongst the most sensitive regions to changes in climate and land use, yet, the interactions between land use and climate change are largely unknown. To Protect Soil from Harmful Effects of Natural Elements (KA 104) while enhancing crop productivity, it is important to understand how past climate changes affect soil processes.

KA 101 – 104: Soil Resources Logic Model:

Situation	Inputs	Activities	Outputs	Outcomes		
				Knowledge	Actions	Conditions
Soil is a complex natural resource covering the earth's surface. Soil receives organic/inorganic inputs that enhance or impair soil, air and water quality. High-quality soils support efficient production of crops for food, fiber and energy; the cycling of nutrients and other inputs through ecosystems; sequestration of carbon and contribute to improved water and air quality and overall environmental quality.	**Resources:** - Authorities - Mission - Strategic Plan - Leadership - Management - Oversight - Assessment **Financial Resources** - CSREES - Formula - Competitive - Special **Human Resources:** - NPLs - Administrative - Support - Other Gov't. - Faculty - Practitioners - Para-professionals - Industry - NGOs - Volunteers - Partners	Scientists are establishing: quantity, quality and value of ecosystem services including carbon sequestration; criteria for application of nutrient and pesticides that enhance productivity while protecting our environment and natural resources Undisturbed long-term continuous no-till farming reduced water (rainfall) run off, sediment and nutrient loss, while increasing organic matter content, over time.	Natural Resource Use and Management - Publications - Citations - Disclosures - Patents - Curriculum - Products - Tools - Technology - Practices - Methods - Measures - Polices - Regulations - Models	Increased knowledge and understanding that/about: Science –based methods/techniques/ tools for reducing sediment loss (erosion) and nutrient and pesticide load in waterways Conservation practices (e.g. EQIP) that protect natural resources and environment including soil, air and water quality Encourage, supported and guided producer to transition from one enterprise to more profitable horticulture enterprise	- Developed partnerships and secured funding to conduct rainfall simulation in continuous no-till operations - Trained nutrient and pesticide applicators in proper tools/techniques/ methods (Best Management Practices – BMPs) to reduce negative environmental consequences - Conducted workshops; developed websites and generated Fact Sheets to educate/train clientele	- Reduced sediment (erosion), nutrient and water loss - Protected ecosystem services that provide clean air and water - Reduced lawsuits and tension amongst farmers and regulators - Increased knowledge of adults and youths to enhance decision making related to food and fiber production while protecting the environment

Assumptions: Pressures on natural resources and land use are increasing, competing, and more frequently, conflicting. Demographic changes and changing social values bring new challenges. Ecosystems have become increasingly fragmented for production of food and forest products. Urbanization and fragmentation have major impacts on ecosystem structure and function. Public demand for natural resources products and services – timber, recreation, fish and wildlife, soil and water, open space, and the beauty of the land – continues to grow.	**External Factors:** Scientific advancements; changing priorities; producers' and consumers' attitudes; weather, natural disasters; economic conditions; coordination w/ other government entities; public policy.

KA Key Activities for 2009:

With funding from the CSREES National Research Initiative program, The Tri-Societies of America (Agronomy Crop Science and Soil Science Societies of America) hosted a Stakeholder Listening Session at their annual meetings in Houston, Texas. The primary goal of the workshop, titled "21st Century Frontiers in Soil Science: Solutions to Critical Problems" was to identify emerging issue areas and knowledge gaps in the soil science and associated disciplines that are critical at the national level. Participants from academia and the public and private sectors, in research, education and extension explored and identified priorities in soil and related disciplines that could be used to inform funding decisions by federal agencies. The knowledge gaps that were identified included: High resolution soil information; Sustainable Agriculture; Managing for extreme events; Quantifying greenhouse gases; Agricultural water use ; and Urban water use efficiency. Additional information can be found at: http://cris.csrees.usda.gov/cgi-bin/starfinder/12907/crisassist.txt

KA Key Outcomes for 2009:

- A watersheds project in the Tongass National forest in southern coastal Alaska, combined with Forest Service resources, has demonstrated that the most likely cause of the die off of large stands of yellow cedar is climate change, as earlier warming periods in spring leads to premature root growth in soils no longer insulated by snow cover such that subsequent heavy freezing kills the trees. This project also showed that the export of dissolved organic carbon per hectare from Tongass watersheds is the highest reported in the world, 10 times more than the Yukon River watershed. Changes in climate in southeastern Alaska are expected to alter the distribution of wetlands and salmon within coastal watersheds and they found that the distribution of wetland soils within watersheds is the primary factor determining the concentration of dissolved organic carbon (DOC) in streamwater within the temperate rainforest of southeast Alaska. This important wetland function will help inform the City and Borough of Juneau's Coastal Zone Management Program because the information provides evidence, recognized by the State of Alaska, that wetlands exert a significant influence on surface and coastal waters in southeast Alaska.

- The discovery that nitrogen plays a key role in carbon cycling and soil carbon decomposition and the result that old growth forests can continue to be carbon sinks, has lead to a rethinking of models and estimates for the impact of climate change and increasing CO_2. These findings have been instrumental in the IPCC including nitrogen as a factor in modeling the effects of increasing CO_2 on ecosystems and their feedback to the atmosphere and climate change.

KA Key Outputs for 2009:

- The regional sampling approach the USFS developed through the Alaskan project provides a tool for discriminating important watershed characteristics over a large

and diverse geographic area and will benefit management planning and the prioritizing of restoration efforts within the Tongass.

- Several projects funded through the NRI Soil Processes program have lead to high impact articles and discoveries regarding carbon and nitrogen cycling in forests and cropping systems.

- One series of grants has lead to a network of sites in eastern and western forests as well as a site in Eastern Europe to study forest litter and soil carbon and nitrogen cycling.

- Another team funded by the Soil Processes program has looked at the processes under increased atmospheric CO_2 conditions. A major finding was that increased carbon inputs as litter or roots, via management or through increased atmospheric CO_2, can have a priming effect on soil carbon decomposition, releasing greater amounts of CO_2 than is fixed through photosynthesis or added via management practices. Both teams of researchers have shown the key role of nitrogen in controlling these processes.

- Colloid transport influences the movement of chemicals, pollutants, viruses, and pathogens in the environment, affecting agroecosystem and human health. Grants from the Soil Processes program to two independent research teams has improved our understanding of the transport of these particles in the environment, leading to a new theoretical model of particle transport in both saturated and unsaturated soils. New visualization techniques used by these researchers have demonstrated the need to rethink the assumptions previously used in predicting colloid and solute transport in soils.

- Cornell researchers funded by Soil Processes recently developed methods for improving the technique of ^{13}C and ^{15}N DNA stable isotope probes (SIPs). This has far reaching implications for studying microbial processes in soils and indentifying new and non-culturable microorganisms involved in major environmental processes. This method overcomes previous constraints on the use of ^{15}N labeled compounds in nucleic acid SIP. They were able to use $^{15}N_2$-SIP of DNA to show that noncultivable free-living atmospheric nitrogen (N_2) fixers in soil can carry out nitrogen fixation in soils in situ, and that 15N-DNA-SIP can be used to gain access to DNA from these organisms in particular. They identified three groups of free living (non-sybiotic) diazotrophs that are actively involved in N2 fixation and provide for the first time, evidence for N2 fixation by previously unknown orders of microorganisms. They then set out to examine their response, to experimental manipulation in situ, beginning with carbon and energy sources as these are thought to be major constraints on N fixation in soil. They were able to use of $^{15}N_2$-DNA-SIP to explore carbon sources used by specific populations of N_2 fixers exposed to three carbon sources (including methane) under both aerobic and anaerobic atmospheres. Their results showed for the first time nitrogen fixation by a specific group of methanotrophs (bacteria that use methane as their

only source of carbon) and that methane stimulates N2 fixation by these organisms, demonstrating the potential of using different carbon sources to manage this process. It also explains the observations of increased total nitrogen concentrations in soils surrounding gas pipeline leaks.

KA Key Outcomes for 2008:

- Soil resources projects have evaluated 1) risks posed by applying residuals to baseline soils, 2) the impact of residuals on chemical, biological and physical characteristics and processes in the soil environment, 3) availability and impact of nutrients on water quality remediation of contaminated land, 4) ecosystem restoration; and 5) soil management effects on C sequestration, productivity and quality. Education and extension components are included through management of research sites by farmers, which translate into immediate application of results and knowledge obtained from participating in the projects.

- CSREES funded projects have impacted government environmental policies and regulations, more specifically with EPA because EPA regulations and public policy decisions are based on scientific knowledge obtained through collaboration with the land grant system. Some of the results can be seen in EPA's current regulatory policies regarding use of residuals for land application. CSREES funded researchers have worked closely with several private sector entities (e.g., Water and Environment Federation, and the Northwest Biosolids Management Association), ensuring that findings are reported directly to industry cooperators.

KA Key Outputs for 2008:

- With Hatch formula funds, Virginia scientists have provided new information to Virginia farmers in protecting soils from the harmful effects of natural elements (KA104). By the year 2010, Virginia will significantly reduce the amount of sediment, nitrogen and phosphorus entering Chesapeake Bay waters. To reach the targeted goal, the State government has developed strategic partnerships, and secured funding to study how rainfall affects undisturbed long-term no-till soil versus newly tilled soil. Through this simulated rainfall project, the continuous no-till plots will reduce water runoff by 74%, reduce sediment loss (erosion) by 99%, reduce nitrogen loss by 94%, and reduce phosphorus loss by 92%. Furthermore, nitrogen and phosphorus will not be leached through the soil with water infiltration but rather will be bound to the organic matter in the top two (2) inches of the long-term no-till plots. This means that by controlling erosion, there are less nutrients and sediments available to contaminate tributaries in the Chesapeake Bay watershed and the Bay itself.

- Given increases in gas prices and concomitant cost-of-living, many sectors of our society are calling for research targeting alternative fuels. Production of energy crops for biofuels is now the focus of numerous investigations. It is anticipated that long-term biomass energy demands will come from cellulosic biomass,

requiring more crop residues to be removed from the land. One concern is that this shift in land use and cropping practices will have detrimental effects on soil processes and soil properties, including soil carbon, nitrogen and microbial activities.

- Scientists at Washington State University have secured NRI funding to assess soil, plant, water, nutrient relationships (KA102) as they relate to production of energy crops and residue removal from soils. The project will quantify differences among major cropping systems for carbon and nitrogen budgets and microbial activity over a range of productivity to assess if these differences are linear with respect o biomass inputs." This project should provide science-based knowledge that will be critical for proper management and use of our soil resources while protecting and conserving our natural resources.

- Organically produced foods and food products are perceived among consumers as better for them and the environment than are those produced with conventional inorganic inputs. However, there is a potential for inadvertently contaminating food produced in amended soil with food borne pathogens. Organic soil amendments include biosolids, animal and plant wastes. These amendments can enhance soil quality – including water holding capacity, bulk density and carbon sequestration.

- A Special Research Grant to the University of Hawaii provides funds for investigators to study organic production of sweet corn as a means of reducing the high cost of importing farming materials and supplies so they are utilizing locally made compost materials and arbuscular mycorrhizae. The scientists have determined the most beneficial rate and type of amendment and microbial interactions for crop production. On the other hand, scientists in Delaware (NRI funded) are using molecular techniques to determine the fate and transport of the foodborne pathogens in amended soil. This is critical because understanding the survival behavior of foodborne pathogens will help determine the factors controlling the fate and transport of viruses in agricultural systems. These two studies demonstrate the interconnected of soil and water quality and therefore the importance of appraising soil resources (KA101), watershed protection (KA112) and management and waste disposal, recycling and reuse (KA403). Use of organic amendments must be weighed against, and steps must be taken to prevent, contamination of our organically produced food and food products.

POLLUTION MANAGEMENT KNOWLEDGE AREAS

KA 133: Pollution Prevention and Mitigation
KA 403: Waste Disposal, Recycling and Reuse

Introduction:

Pollution from agriculture first became a national issue in the 1930's with the air pollution effects of the Dustbowl. Soil erosion by wind and water were severe enough to lead to the formation of a new USDA agency, the Soil Conservation Service (now Natural Resources Conservation Service (NRCS)). However, NRCS has no research authority to study the problem or develop control methods. Universities and the USDA Agricultural Research Service (ARS) have continued to develop new tillage, crop rotation and engineering measures to prevent pollution from soil erosion. Sediment continues to be the biggest pollutant by volume, in rivers and lakes according to the U.S. Geological Survey.

CSREES supports a diversified portfolio of research, education and extension activities addressing KA 133. Pollution arising from agricultural and forestry-related activities affects soil, air, water, plants, animals, and humans. Potential pollutants include organic pesticides, radio-nuclides, fertilizer chemicals, growth regulators, animal and crop wastes, mulching materials, pathogenic microorganisms, heavy metals, salts, allergens, airborne particulates, dust, ozone, volatile compounds, gases, combustion products, smoke and smog.

Waste is generated by every segment of society, which is causing a disposal dilemma and creating challenges for those concerned at the local, regional national and international levels. Production agriculture creates large volumes of animal and plant wastes. In addition, society must contend with municipal and industrial wastes including sewage sludge and biosolids. As the system copes with this deluge of waste, those concerned are focusing on the benefits of reusing and recycling waste products for use in the urban and rural landscape. There has been an increasing interest in the concept of recycling and reuse in all aspects of the U.S., both in the private sector and in the industrial sector. This is due to a general concern about protecting the environment and conserving our natural resources.

CSREES is involved in a diverse range of research, education, and extension activities that focus on collecting, storing, transporting, treating, recycling and utilizing agricultural, non-agricultural and forestry generated waste products. KA 403 is primarily research oriented, but there are some extension and education stand alone projects, or extension and education are a part of the research project.

Many waste products are generally applied to soil to improve the biological, physical, and chemical characteristics and processes. As such, waste management is now viewed from the perspective of resource recycling and reuse to enhance productivity and sustainability. While there are environmental benefits to recycling and reusing wastes,

environmental degradation is also taken into consideration because of the potential for pathogen, metals, and other types of contaminants. If not properly handled, this leads to soil contamination and eventually to air and water pollution, which ultimately affects the health and well-being of society. In KA 403, CSREES funded projects address the development of value-added or alternative products, such as bio-fuels from biomass and development of granular activated carbon made from peanut shells and corncobs, as well as modifying a livestock facility to flush water in manure management.

New techniques have been developed in the forest industry to collect/harvest timber. New modifications of lagoons with liners and use of dry storage in deep stacks for poultry operations have been also developed in the storage of waste products. There has been minimal development in new technology for transport of waste products, based on the results of a CRIS search. Numerous projects have focused on treatment technologies (e.g., anaerobic, aerobic, lagoons, composting, constructed wetlands, and land application). Recycling and reuse includes projects including use of biogases and kenaf, sawmill waste, land applied biosolids, conversion of municipal solid waste, recovering fiber from dairy manure solids. CSREES, through its unique partnership with public and private sector organizations, works to explore and develop techniques and methodologies to solve the waste disposal problem in ways that are sustainable, environmentally friendly and cost-effective.

KA 133 & 403: Pollution Prevention and Mitigation Logic Model:

Situation	Inputs	Activities	Outputs	Outcomes		
				Knowledge	Actions	Conditions
crops-sediment, dust, fertilizer, pesticides -livestock-manure, dust, odor, hormones and pharmaceuticals, waste plastics -greenhouse/nursery-waste plastics, fertilizer, pesticide -farmstead- oil, chemicals, toxics -rural homesite-lawn care, septic, toxics, trash -communities-landfills, recycling,	**Resources:** - Authorities - Mission - Strategic Plan - Leadership - Management - Oversight - Assessment **Financial Resources** - CSREES - Formula - Competitive - Special **Human Resources:** - NPLs - Administrative - Support - Other Gov't. - Faculty - Practitioners - Para-professionals - Industry - NGOs - Volunteers - Partners	- nutrient management plan development -pesticide management plans -hazmat pickup/collection -livestock feed management to reduce pollutant output -yard waste composted -install rain gardens to prevent storm runoff -onsite septic inspection and rehab -install backflow valves on wells -publish journal articles	Natural Resource Use and Management - Publications - Citations - Disclosures - Patents - Curriculum - Products - Tools - Technology - Practices - Methods - Measures - Polices - Regulations - Models	-Farmers understand permits and legal requirements for pollutants -communities maintain septic systems, capture storm runoff	-Farmers understand permits and legal requirements for pollutants -communities maintain septic systems, capture storm runoff	-soil, water and air quality are improved -water treatment costs are reduced -hazmat is reduced or eliminated in landfills -volume of landfills is reduced.

Assumptions: Assumptions: Pressures on natural resources and land use are increasing, competing, and more frequently, conflicting. Demographic changes and changing social values bring new challenges. Ecosystems have become increasingly fragmented for production of food and forest products. Urbanization and fragmentation have major impacts on ecosystem structure and function. Public demand for natural resources products and services – timber, recreation, fish and wildlife, soil and water, open space, and the beauty of the land – continues to grow.	**External Factors:** Scientific advancements; changing priorities; producers' and consumers' attitudes; weather, natural disasters; economic conditions; coordination w/ other government entities; public policy.

KA133 Key Outputs for 2009:

- The Livestock and Poultry Environmental Stewardship eXtension project was funded through the National Integrated Water Quality Program and the National Research Initiative Air Quality program to provide an online database of fact sheets, archived webinars, and newsletters regarding livestock and poultry pollution issues. The project conducts monthly webcasts on livestock and poultry pollution prevention issues for both air and water resources. A recent webcast had the most google hits of any eXtension program to address new EPA regulations on livestock. Agricultural producers, consultants, other federal, state, local and even international agencies access the webpage. The project's live webcasts attract large audiences, and an additional ten times that number access the archived webinars. The Livestock and Poultry Environmental Stewardship website (www.lpes.org) had a quarter million page views in its first year.

- Antibiotic resistance of microbes to pharmaceuticals is a growing concern to human health. Colorado State University scientists are exploring the potential of animal waste lagoons to reduce antibiotic resistance genes (ARG) in manure prior to land application. The lagoons of four dairies, two beef feedlots, one poultry farm, and one swine operation were monitored to capture possible lagoon treatment impacts on antibiotic resistance. Scientists developed and delivered a webcast through the National Livestock, Poultry and the Environment Learning Center (NLPE) to explain research findings and discuss the issue of antibiotic resistance with the livestock community. A scientist also co-authored a book on the topic of Pharmaceuticals and CAFOS. This book is currently out for peer-review.

KA403 Key Outputs for 2009:

- An innovative project originally funded by USDA's Sustainable Agriculture Research and Education (SARE) program and then commercialized under USDA's Small Business Innovation Research (SBIR) grant program is the development of CowPots from composted dairy manure. The horticultural flowerpots were featured on "Dirty Jobs" television show and CNN's Larry King Live. The flowerpots are manufactured in various sizes, are biodegradable, and use a waste product from dairy farms to make a value-added product. CowPots replace the use of plastic flowerpots that are made from petroleum products and need to be placed in a landfill. The pots are in commercial production and received the 2007 Mail Order Gardening Association Green Thumb Award for outstanding new products.

- Rapid changes occurred in the carcass-disposal landscape brought on by three events of regional or national scope: 1) hurricane Rita struck the Gulf Coast, causing widespread loss of beef and dairy cattle on pasture and rangeland in east Texas and Louisiana; 2) favorable conditions for extreme wildfires in the Texas Panhandle, consuming 725,000 acres of rangeland and killing nearly 2,000 cattle by the end of March 2006; and 3) legislation to outlaw the slaughter of horses for human consumption. Those three events brought short-term pressure to bear on Texas

AgriLife to propose disposal and meta-disposal options for premature mortalities of large livestock. This demonstration and education project promoted the adoption of sound composting techniques such as a meta-disposal method for large livestock carcasses, including beef and dairy cattle, horses, and wild game. In retrospect, this project was well timed by CSREES to allow us to respond quickly and substantively to both the long-term trends and the short-term demand for carcass-disposal and meta-disposal alternatives.

KA133/403 Key Outputs for 2008:

- The Environmental Management Systems (EMS) was funded under the Initiative for Future Agriculture and Food Systems (IFAFS) as an integrated research/ extension/ teaching program to develop livestock and poultry systems that will develop continuous improvement plans for pollutant reduction in animal systems.

- Short term outcomes include curriculum development and training for pilot programs in nine states for beef, dairy and poultry farmer pollutant prioritization and remediation. Worksheets and record-keeping documentation for producers were developed to reduce air emissions, nutrients, and other potential pollutants while coming into compliance with current regulations. The project directors included one pilot program in Iowa with 19 producers who have developed policy statements and documented nutrient management improvements, built clean water diversions and constructed new storage facilities for operations ranging from 600 to 8000 animals each. An additional 19 farmers are participating in training. The Idaho pilot featured a web-based nutrient plan that was completed by all 846 dairies in the state to meet regulatory requirements, with intensive follow-up on 11 farms in a regulated watershed to affirm implementation. The dairy EMS pilot was presented at a national conference attended by more than 200 dairy farm advisors. The Georgia and Pennsylvania poultry pilot projects resulted in the identification of pollution risks and strategies for nutrients, petroleum storage, septic systems, mortalities, biosecurity and pathogens, dust and odor, pesticides, noise pollution, and emergency spill response.

- Michigan Extension used Smith-Lever funds in conjunction with Sustainable Agriculture Research and Education (SARE), state, and county funds in phosphorus pollution prevention through improved manure management strategies. Short term outcomes include training 29,500 farmers, agribusiness and agency staff to develop nutrient management plans. Medium term outcomes resulted in the average producer reporting nearly $7,000 each in fertilizer savings by crediting phosphorus and nitrogen from manure, and stopped adding manure to fields testing high in phosphorus that could become a pollutant source. Long term outcomes include farmers keeping records of manure application that will keep them in compliance with new regulatory inspections, while reducing pollutant loads of P and N to local drinking water supplies and recreational waters.

- In the late 1990's, as state regulations for animal feeding operations were being modified and EPA was preparing for new legislation, the need for educational

materials for producers has also been identified. The Livestock and Poultry Environmental Stewardship (LPES) project delivered a national curriculum and supporting educational tools to U.S. livestock and poultry industry advisors, who in turn, will help producers, acquire certification and achieve environmentally sustainable production systems. Producers will also benefit directly from the information and assessment tools that the curriculum provides. The LPES educational materials were developed with support from CSREEES, EPA's National Agriculture Assistance Center and University of Nebraska CES at Lincoln. Educational materials developed for the LPES curriculum were nationally developed and regionally piloted. The curriculum included 26 lessons grouped into six modules. The modules included: animal dietary strategies, manure storage and treatment, land application and nutrient management, outdoor air quality, and other related issues. Each module included environmental stewardship and/or regulatory compliance assessment tools for most lessons; and PowerPoint presentations for each lesson. It was a collaborative effort of individuals representing 15 land-grant institutions, Midwest Plan Service, EPA Ag Center, and USDA.

KA 133/403 Key Outcomes for 2008:

- Long term outcomes include producers who avoid violations and fines while improving farm management and saving costs through evaluation of their whole production system. Some producers can continue to certify under ISO (International Standards of Operation) 14000 (environmental certification) that becomes a “green label” for international exports and premium prices for greater profits.

OBJECTIVE 6.3: Protect, Enhance, and Manage Forests and Rangelands

RANGELAND KNOWLEDGE AREA

KA 121: Management of Range Resources

Introduction:

This problem area is comprised of research, education and extension programs that address current and emerging issues related to the management and sustainability of the nation's rangeland resources. Rangelands are those areas which are unsuited to intensive cultivation for reasons of soil, climate, or location. Yet, they provide a vast array of products, services and benefits for society, including: water and watershed values, forage for herbivores, timber, wildlife habitat, and recreational opportunities.

About 40 percent of the United States of America's land base is classified as rangeland. Roughly 50 percent of the rangelands are privately owned. The other half of the nation's land is public rangeland, managed as part of the public domain by the USDI Bureau of Land Management (160 million acres), USDA Forest Service (96 million acres), and various state agencies. Historically, rangelands were viewed as marginal lands which were to be "passed over" by immigrants and settlers on their way west in search of more promising futures. In the past century, however, society has learned to value these harsh and often fragile landscapes for the reasons noted above.

Land ownership patterns have often resulted in unique issues and challenges in managing the nation’s rangelands. Generally, homesteaders and ranchers claimed and patented those lands which had available water, resulting in a pattern of private lands being those associated with hay meadows and flowing rivers, creeks, and springs. The publicly-owned lands were most frequently those areas which were rocky, dry, cold, and/or otherwise inhospitable. Complicating the situation, in some areas this pervasive pattern is coupled with a "checker board" pattern of every other section (one square mile) in private ownership. This seemingly odd pattern of early land allocation is based upon land grants made to the railroads during the period of railroad expansion as an incentive to railroad executives to risk the capital and labor necessary to establish railways across hundreds of miles of isolated and uninhabited lands. Today, these complex and convoluted land ownership patterns create management problems for rangeland managers. Perhaps the most obvious and one of the most vexing problems associated with mixed ownerships is that of habitat fragmentation. As roads, human access, and subdivision development occur erratically across what was once wildlife habitat, migration and habitat patterns are disrupted; wildfires, often human-caused, are more frequent and economically more devastating; weed and invasive species problems are increased; and watershed, water quality, and water quantity issues are exacerbated.

Despite these issues and challenges, the nation's rangelands are in better condition today than they have been in a century. At the turn of the last century, the rangelands had been overused and abused to the point that wildlife habitat was nearly lost, the Dust Bowl and

its subsequent wind and water borne soil losses were beginning, and water quality particularly that associated with high sediment loading, was severely degraded. Because of forward-looking programs such as the establishment of the USDA Soil Conservation Service (now Natural Resources Conservation Service), public education, continuing education of rangeland resource professionals, land-based research into rangeland ecosystems, and the establishment of the Cooperative Extension System, the ecological condition of these lands is now improving. The question at the moment is whether or not this positive trend can continue in the face of increasing human population, greater demands for resources, increasing consumption patterns, habitat fragmentation, wildland fires, and invasive species.

The role that CSREES plays in the sustainability of rangeland resources is critical. The agency and its program partners are involved with land resource (including rangeland) issues in all states, territories and protectorates. Each land grant university partner, through program coordination and funding from CSREES, is able to bring a combination of research, education and extension programs to local land owners/managers, citizens and policy makers. These programs take the form of: classic, scientific inquiry to explore the physical and biological aspects of ecology; non-formal education programs and demonstrations of research-based findings conducted with youth and adult learners; and formal academic preparation of future land owners/managers and natural resource professionals.

KA 121: Management of Range Resources Logic Model:

Situation	Inputs	Activities	Outputs	Outcomes		
				Knowledge	Actions	Conditions
Rangeland ecosystems and their managers/ owners are facing increased pressures as both the population and demands for clean water, recreation, wilderness experiences, and wildlife habitat grow simultaneously. Catastrophic wildfire, urban encroachment and habitat fragmentation, weed and invasive species encroachment, erosion resulting from inappropriate off-road vehicle & other recreational uses are major challenges.	**Resources:** - Authorities - Mission - Strategic Plan - Leadership - Management - Oversight - Assessment **Financial Resources** - CSREES - Formula - Competitive - Special **Human Resources:** - NPLs - Administrative - Support - Other Gov't. - Faculty - Practitioners - Para-professionals - Industry - NGOs - Volunteers - Partners	Oregon State University Cooperative Extension Service assisted ranchers in solving problems related to rangeland ownership and management Four agencies assisted in the revitalization of Coyote Creek Arizona has implemented two websites which educate users on rangelands history, characteristics, and uses	Natural Resource Use and Management - Publications - Citations - Disclosures - Patents - Curriculum - Products - Tools - Technology - Practices - Methods - Measures - Polices - Regulations - Models	Increased knowledge and understanding about/that… - marketing hormone-free, low fat beef product - establishing of one major RPM properly managed animals could effectively control leafy spurge - preservation & wilderness Science-based monitoring techniques for land use - Classified state's wildland streams	- Cooperative generated $50M Regained much revitalized hydraulic wildlife habitat - Sites received over 1.1M hits since 2003 - Restored habitat, received economic value, initiated rebound of sustainability & biodiversity of native plants - Reduced lawsuits & rancor - Increased trust and cooperative efforts among students - Extension service conducted workshops & field days demonstrating criteria for classification	- Restored habitat at low cost - Reduced lawsuits - Saved money - Improved habitats - Sustained rangeland resources as measured in: Biological diversity, Soil stability, Resource production, Human welfare

Assumptions: Pressures on natural resources and land use are increasing, competing, and more frequently, conflicting. Demographic changes and changing social values bring new challenges. Ecosystems have become increasingly fragmented for production of food and forest products. Urbanization and fragmentation have major impacts on ecosystem structure and function. Public demand for natural resources products and services – timber, recreation, fish and wildlife, soil and water, open space, and the beauty of the land – continues to grow.	**External Factors:** Institutional commitment; amount of volunteer and nonprofit participation; national initiatives; USDA forest service and the National Urban Forest Community Forest Council's direction of research; decrease funding; changing priorities; farmers' attitudes; natural disasters; economic conditions; coordination and cooperation with other government entities

KA Key Activities for 2009:

- Grazinglands Conservation Effects Assessment Project (CEAP) was inaugurated as part of the National Integrated Water Quality Program (NIWQP) across the Research, Education and Economics (REE) and Natural Resources Environment (NRE) Mission Areas. Initial activities included the review of and suggestions for modeling efforts and documents by ARS and National Resources Inventory monitoring efforts by NRCS, all in support of CEAP. CSREES worked with the NRCS, Texas A&M University, and ARS to inform the priorities for and structure of the Eastern Pasture and Rangeland CEAP literature syntheses, modeling strategies and potential experimental watersheds.

KA Key Outputs for 2009:

- The schedule and activities of the CSREES CEAP portfolio is reported to the CEAP Steering Committee, and nationally through the *CEAP Highlights* publication.

- CSREES NPL Jim Dobrowolski co-authored "CEAP: The First Five Years" *in press, J. Soil and Water Conservation* and senior authored "Efforts to Reduce Wind Erosion from Unpaved Roads Cut Through Environmentally Sensitive Alaskan and Hawaiian Rangelands" *in Multifunctional Grasslands in a Changing World*, Volume I, Guangzhou: Guangdong People's Publishing House, PRC, 922 pages. CSREES co-sponsored the International Grassland and Rangeland joint congresses in Hohhot, Inner Mongolia to present the paper and coordinate and discuss rangeland health indicators as part of a workshop near Xillinhot, PRC.

- At the Society for Range Management/American Forage and Grassland Council (SRM/AFGC) meetings, CSREES moderated two of the most controversial and most well attended symposia, State-and-Transition Models: Triggers, Feedbacks and Thresholds, and The Multi-Agency Oregon Pilot Project: A Roadmap for Indicator-Based Rangeland Assessment. NPL Jim Dobrowolski organized with Program Specialist Daniel Cassidy the all-day symposium also at the SRM/AFGC meetings, Energy from Biomass - Agronomic and Economic Considerations.

KA Key Outcomes for 2008:

- With funds from the Renewable Resources Extension Act (RREA), thirteen universities hosted more than 300 rangeland educational events. Over 24,000 rangeland owners and stakeholders, representing 18.5 million acres attended events focused on topics ranging from grazing and foraging to the growth and nutrition of native grasses. Landowners and managers estimated saving or earning $15.77 million while implementing nearly 600 new practices and 129 new stewardship plans.

KA Key Outputs for 2008:

- RREA funds were provided to eleven universities to reach nearly 7,000 stakeholders at 227 educational events to discuss issues of urban sprawl, management of natural resources along the wildland-urban interface, and how to maintain family forests and rangelands. There were 775 landowners who acted on the information provided and protected over 130,000 acres from conversion, fragmentation, or parcelization.

- In Montana, Smith-Lever funds were used by their Cooperative Extension Service to embark on an educational program called "Undaunted Stewardship". This program is essentially a conflict resolution approach which encourages land owners, grazing permitees, agency personnel and members of the public who are interested in preservation and wilderness to gather together, learn from one another, and plan for the future in a rational, logical manner. Lawsuits and rancor have been reduced in this atmosphere where mutual trust and respect are gained.

- With Smith-Lever funds, Oregon State University Cooperative Extension Service worked with a group of struggling ranchers in central Oregon. The struggles dealt with low commodity prices, high cost of production, and a public perception that livestock grazing is ecologically unsustainable. After numerous meetings and conflict resolution processes based upon understanding other people's perceptions of rangeland resources and livestock production, a rancher organization called Oregon Country Beef (OCB) was formed. OCB decided to base its premise on two fundamental concepts: 1) the idea of a hormone-free, antibiotic-free, low fat product for which they charged a fair price that included cost of production and a reasonable rate of return, and 2) if the OCB monitored its members and certified that all livestock under their control was raised in a humane way and grazed using sustainable rangeland management practices, the members would have a marketable product of which they could be proud. The public has embraced this concept and this past year the Burgerville hamburger chain contracted to use OCB exclusively---joining upscale markets and restaurants who prior to that marketed the beef. Oregon Country Beef is currently a $50 million dollar cooperative that gives extensive credit to the OSU Cooperative Extension Service for increasing their understanding of marketing, management, and ecology, all of which they have blended to create a healthful, sustainable, and profitable product.

- James Dobrowolski, National Program Leader co-authored “Which Direction Is Forward: Perspectives on Rangeland Science Curricula” (*Rangelands 29:40-51*), addressing national curricular issues and future scientist training—both part of the critical issue portfolios of CSREES’s Rangeland and Grassland Ecosystems Program and the Society for Range Management. Jim Dobrowolski and Michael O’Neill co-authored as part of a multi-agency writing team “A Strategy for Federal Science and Technology to Support Water Availability and Quality in the United States” (*NSTC CENR OSTP*). Dobrowolski authored “Putting Science into Action: From Washington State Community-based Outreach to National Programming in Washington DC” (*National Research Council, National Academy of Science Agricultural Water Management Report*). The widely circulated Federal Strategy will guide water research priorities and formulates a federal science strategy for the next decade. The Agricultural Water Management Report was distributed world-wide.

FOREST KNOWLEDGE AREAS

KA 122: Management and Control of Forest and Range Fires

Introduction:

This knowledge area is comprised of research, education and extension programs that address current and emerging issues related to the management and control of forest and range fires. Forest and range fires are phenomena that can be either beneficial or catastrophic, depending on the size, intensity and duration of the fire. Aggressive fire suppression policies has resulted in ecosystems that are burdened with excessive fuels, stagnant forest stands, fire-prone invasive species, and dead standing trees resulting from insect and disease infestations. Compounding the potential for catastrophic fires has been a continuing severe drought throughout the West during the last 5 to 7 years. When ignited by lightening or human activity, what would normally be a fire of “typical” intensity explodes into a conflagration that destroys millions of acres of forests and ranges and hundreds of structures, and often results in loss of life.

Although the number of fires remains reasonably constant from year to year, the burned acreage has been double the 10-year average in three of the last four years. The trend is toward increasingly larger annual burn area. The increasing volume of fuel combined with the severe summer droughts is a critical factor in the spread of wildland fires and their resistance to control. Coupled with the increasing number of primary and secondary homes that are being built with little regard to fire safety in fire-prone forests, the scenario is complete for catastrophic and life-threatening fires.

There is an urgent need to identify new solutions and answers for addressing the immediate and long-term consequences of catastrophic wildfire. Research inquiries are needed in order to produce decision-support tools for natural resource managers and to better understanding the barriers to individual and community readiness to deal with wildfires. New issues continually arise that need systematic inquiry to develop scientifically sound wildfire prevention and suppression programs.

KA 122: Management and Control of Forest and Range Fires Logic Model:

Situation	Inputs	Activities	Outputs	Outcomes		
				Knowledge	Actions	Conditions
Wildfire is an increasingly catastrophic event that is occurring with greater frequency, size and intensity. Fire suppression polices have resulted in ecosystems that are burdened with excessive fuels, stagnant forest stands, fire-prone invasive species, and stands of dead and dying trees resulting from insect and disease infestations. Severe drought conditions and the large number of homes and related structures that are being built in and around forests.	**Resources:** - Authorities - Mission - Strategic Plan - Leadership - Management - Oversight - Assessment **Financial Resources** - CSREES - Formula - Competitive - Special **Human Resources:** - NPLs - Administrative - Support - Other Gov't. - Faculty - Practitioners - Para-professionals - Industry - NGOs - Volunteers - Partners	- Living with Fire – Extension education programs teach homeowners about living in forested areas at risk of wildfire. - Fuel inventory, Mapping & Treatment: A study investigated controlled grazing of sheep to reduce wildfire fuel **- Post-fire restoration:** A study to develop new processes to improve the restoration of fire-impacted landscapes. **- Fire behavior, prediction & modeling:** A study to develop new tools using remotely-sensed data	Natural Resource Use and Management - Publications - Citations - Disclosures - Patents - Curriculum - Products - Tools - Technology - Practices - Methods - Measures - Polices - Regulations - Models	Homeowners learned to create fire-defensible space - A new t-RFLP identification assay was developed for ectohycorrhizal fungi - New tools led to better understanding & ability to predict fire behavior	New knowledge should encourage…: - use of proper landscaping and building materials. - improved the establishment of trees - a relatively inexpensive approach to evaluating fuel loading.	Saved lives and property - Reduced damage - Prevented forest fires - Increased ability to rehabilitate - Improved economic opportunity for producers - Reduced fire hazards - Sustained and improved natural resources and environmental conditions of national forests - Regeneration of seed and vegetation

Assumptions: Pressures on natural resources and land use are increasing, competing, and more frequently, conflicting. Demographic changes and changing social values bring new challenges. Ecosystems have become increasingly fragmented for production of food and forest products. Urbanization and fragmentation have major impacts on ecosystem structure and function. Public demand for natural resources products and services.	**External Factors:** Institutional commitment; amount of volunteer and nonprofit participation; national initiatives; USDA forest service and the National Urban Forest Community Forest Council's direction of research; decrease funding; changing priorities; farmers' attitudes; natural disasters; economic conditions; coordination and cooperation with other government entities

KA Key Activities for 2008:

- McIntire-Stennis funds were used to update National Monument Fire Plan. The research findings from an Oregon State University project related to woodland expansion, fire history and plant community response following fire have been directly implemented into National Park Service, Bureau of Land Management, Forest Service and U.S. Fish and Wildlife Service operations in southeast Oregon, northeast California, and northwest Nevada; this affects millions of acres. Examples are: 1) The Lava Beds National Monument has incorporated the findings into their 10-year fire plan. The work is being used to develop fire prescriptions for different plan communities, 2) The Paisley district of the Forest Service has implemented an aggressive fuels reduction program based on the fire history findings. Although the Winter Fire threatened the area, treated areas were easy to defend and would have burned at low intensity and 3) BLM in Oregon has implemented a fire program on Steens to enhance aspen recruitment and reduce the abundance of young juniper.

KA Key Outputs for 2008:

- A Prescribed Fire Burning Association was created from a research project funded by McIntire-Stennis funds. Findings from a Texas A&M research project have been used to increase the use of prescribed fire on Edwards Plateau rangelands. A prescribed fire burning association has been established to allow landowners to pool their labor, equipment and experience when conducting prescribed fires. Over 100 land owners who represent over 500,000 acres of rangeland are now members of the association. The integration of prescribed fire and goats have provided an effective, sustainable method to manage noxious brush.

- Northern Arizona University researchers used McIntire-Stennis funds to demonstrate the role fire regimes have played across the native range of ponderosa pine in the southwest. By sampling and cross-dating pines from the Centennial Forest, researchers were able to reconstruct the extensive fire regime dating back prior to 1890. This work confirmed earlier studies and provided a more comprehensive understanding of natural management and restoration practices in the region. Through a study of past policies, the policy-making process, and comparative case studies researchers are identifying recent trends in improving public participation while maintaining timely and effective planning decisions.

- With McIntire-Stennis funds, scientists at Colorado State University examined landscape to regional scale mapping of forest fuels critical for predicting fire hazards and for choosing the most important sites to mitigate fuel hazard. Techniques have been developed for mapping fuel structure with hyperspectral remote sensing imagery. Forest managers in two districts have been provided with detailed forest fuel maps, which they have been able to use to generate fuels mitigation projects.

Humboldt State University used its McIntire-Stennis funds to examine the fire regime in northwestern California forest types by using a standardized format and nomenclature, as

well as defining fire intervals, cycles, sizes, and causes. This research assisted land managing agencies to better understand the impacts of fire prevention and suppression on forest conditions and assist them in deciding on remedial fuel treatment activities.

KA 123: Management and Sustainability of Forest Resources

Introduction:

This problem area is comprised of research, education and extension programs that address current and emerging issues related to the management and sustainability of the nation's forest resources. These forests provide a vast array of products, services and benefits to society. Those which are most relevant to the work that is accomplished in this problem area include: source of wood and non-wood products (e.g., medicinals, foods, decorative flora); diverse habitats for flora and fauna; climate stabilization and carbon sequestration; recreational opportunities and aesthetic enjoyment (e.g., vistas, solitude); genetic reserves; watershed functions; and physical, biological and chemical processes that undergird ecosystem processes. Thus, the management and sustainability of America's forest resources are critical components of the nation's environmental quality, economic vitality, and quality of life for its citizens.

The forests of the United States are vast, diverse, and dynamic. Forests are a dominant land cover (749 million acres) that comprise one-third of the land area. Conifer forests cover 412 million acres in the U.S. and are found predominantly in the West (315 million acres) and South (67 million acres). Broadleaf forests cover 273 million acres, and are located predominantly in the North and South (223 million acres). These forests continue to undergo radical changes as a result of human and natural disturbances. Native Americans burned the forests to clear land, harvest game, and rid it of pests; 200 million acres were cleared for agriculture between 1850 and 1900 and millions of additional acres were severely degraded as they were cut over for fuelwood to support the Industrial Revolution. More recently introduced invasive pests (plant, diseases and insects) have changed forest ecosystems. During the 1999-2003 period, 29,495,000 acres were burned, much of it by catastrophic wildfires.

Land ownership patterns result in unique issues and challenges in managing the forest resource in a sustainable manner. Private, non-industrial ownerships make up 58 percent (291 million acres) of timberland (capable of producing in excess of 20 cubic feet per acre per year and not legally withdrawn from timber production) and are the predominant ownership category in the East and South. Public forest land is the dominant holding in the West. As a result of changes in public policy, timber harvesting on public lands has nearly ceased while harvesting on private lands has increased by about 46 percent between 1986 and 2001. Industrial private forests account for 13 percent of timberland and public forests comprise 29 percent of timberland.

Despite the increase in harvests, the national data indicate that wood and fiber growth have exceeded removals for both softwoods and hardwoods. In 2001 the Nation's forest inventory accrued 33 percent more volume than was lost through mortality and harvest. However net growth rates have not been increasing as rapidly as in the past, while harvest levels have remained relatively stable since 1986. The result is that additional forest product demands have been met by increased imports.

The role of CSREES in sustainable forest management is to support independent, peer-reviewed research, the transfer of new knowledge generated by research to other scientists, natural resource professionals, and lay audiences who own or otherwise influence the condition of the forest resource. National leadership by the agency includes:1) identification, development and funding of priority issues for research, education and extension; 2) review and assess programs in the context of nationwide forest resource issues; 3) active participation in multi-state and regional research and extension activities; and 4) administration of formula, competitive and Congressionally-directed line items.

Continuous research findings are needed to inform the management and sustainability of the nation's forests. Increasing human population with its subsequent demand for more goods and services requires intensive inquiry into the impacts of these demands on the ability of the resource to meet those demands in the context of sustainability. New knowledge answers the immediate questions of professional foresters and loggers, policy makers and forest landowners; provides early indications of conditions and trends that need further inquiry; and provides the discovery mechanism for new processes that produce the desired goods and services in an environmentally-benign or enhancing manner.

KA 123: Management and Sustainability of Forest Resources Logic Model:

Situation	Inputs	Activities	Outputs	Outcomes		
				Knowledge	Actions	Conditions
The nation's forests are under many pressures, both natural and human induced, that cause policy makers and natural resource professionals to seek and apply new knowledge in order to ensure the sustainability of the resource. The most pressing issues are: Catastrophic wildland fires result in the devastation of ecosystem processes, loss of property and life, and severe economic consequence Encroachment and invasion of highly competitive non-native plants	**Resources:** - Authorities - Mission - Strategic Plan - Leadership - Management - Oversight - Assessment **Financial Resources** - CSREES - Formula - Competitive - Special **Human Resources:** - NPLs - Administrative - Support - Other Gov't. - Faculty - Practitioners - Para-professionals - Industry - NGOs - Volunteers - Partners	- A study investigates the concept of "miniature plantations" - A study to develop new gene transfer techniques - A study investigates fire regimes on the Kaibab Plateau - Landowners receive education on stewardship processes - A study investigates one time application of silvicultural herbicide in mature pine systems in the southeast	Natural Resource Use and Management - Publications - Citations - Disclosures - Patents - Curriculum - Products - Tools - Technology - Practices - Methods - Measures - Polices - Regulations - Models	Increased knowledge and understanding about/that… - trees can be grown with seedlings being spaced as close as 4 inches - Breeding genetically improved loblolly pine trees - the impact of cessation of fire regimes - how to develop individual stewardship plans - processes that can be used to renovate forest stand cond. & improve habitat	Shortened timeline from 20-30 years to 3-5 years to obtain research results New lines had insect & disease resistance Concluded a more natural fire regime would likely reduce aspen recruitment Helped land-owners make informed decisions meeting forest mgmt goals & objectives. Resulted in no needed spraying & savings of $2 M to taxpayers in a single state	- Maintain species diversity - Reestablishment of forest canopy cover - Protect water quality - Saved money - Improved habitat

Assumptions: Pressures on natural resources and land use are increasing, competing, and more frequently, conflicting. Demographic changes and changing social values bring new challenges. Ecosystems have become increasingly fragmented for production of food and forest products. Urbanization and fragmentation have major impacts on ecosystem structure and function. Public demand for natural resources products and services – timber, recreation, fish and wildlife, soil and water, open space, and the beauty of the land – continues to grow.	**External Factors:** Institutional commitment; amount of volunteer and nonprofit participation; national initiatives; USDA forest service and the National Urban Forest Community Forest Council's direction of research; decrease funding; changing priorities; farmers' attitudes; natural disasters; economic conditions; coordination and cooperation with other government entities

KA Key Activities for 2009:

- CSREES provides a significant support to the national Roundtable on Sustainable Forests. Through a grant to the university-based Sustainable Forest Partnership (SFP) which serves as a Co-Chair for the roundtable, CSREES is engaged in a open and inclusive process that has a goal of promoting and advancing sustainable forest management on the nation's forest resource (public and private). The Roundtable's primary activities to date has been the implementation of an internationally agreed upon, 12-country protocol, the Montreal Process Criteria and Indicators (C&I), for the purpose of developing a shared understanding of current forest conditions and a baseline against which to mark future progress toward sustainability. The SFP has co-led the discussion in the roundtable on the process for developing and reviewing the DRAF 2010 National Report on Sustainable Forests. The C&I is a set of seven criteria and 64 indicators with supporting scientific data coming from a number of sources and data bases. The data for Indicator 6.2.b – Annual Investment and Expenditure in Forest-Related Research, Extension and Development, and Education was provided by CSREES. Additionally, the SFP, with support from CSREES and the Forest Service has provided the leadership in developing a process to implement a new Indicator: 6.5.b – The Importance of Forests to People. This data along with the data from the other indicators will be published and released at the 2009 XIII World Forestry Congress in Buenos Aires, Argentina.

- In addition to providing data for this report, CSREES National Program Leader serves as the Co-Chair, Communications and Outreach Work Group of the roundtable. Support and involvement in this role as included the development of factsheets; planning and conducting a webinar series; and hosting a national technical workshop on the draft report.

KA Key Outcome for 2009:

- Dr. Daniel Cassidy was hired to fill the new position of National Program Leader for Forest-based Bioenergy. This position provides leadership for the critical review, analysis, and guidance in developing the Administration's position and policies on emerging issues, legislation, and programs impacting forest-based bioenergy and related communities.

KA Key Outputs for 2009:

- Cassidy conducted a nation-wide webinar entitled "Forest-based Bioenergy: A National Perspective" that reached 75+ stakeholders. This program heightened the awareness of forest-based bioenergy efforts within the Agency and served as a listening session as stakeholders were encouraged to provide input regarding critical issues and needs across the full spectrum of the portfolio.

- National Program Leaders across the unit have been instrumental in implementing the "Strategic Energy Science Plan for Research, Education, and Extension". The goals of the strategic plan include: sustainable bioeconomies for rural communities, sustainable natural

resource-based energy production, efficient use of energy and energy conservation, and workforce development for the bioeconomy. The goals have been reflected in existing and new Requests for Applications across the unit's purview.

- Women in Forestry: The University of Arkansas Cooperative Extension Service, working with partners including the Arkansas Forestry Commission and a landowner organization developed workshops and presentations specifically targeting women forest landowners. In 2008, four workshops were held and attended by over 70 women, most of them forest landowners. Participants learned about tree physiology, forest ecosystems, forest management plans, GPS applications, invasive species, carbon credits, bio-energy, and timber tax basics.

KA Key Outcomes for 2008:

- With funds from the Renewable Resources Extension Act, forty-two universities provided nearly 1,500 educational events attended by over 80,000 stakeholders. These events focused on topics from tropical forest restoration to maintaining sustainable small-acreage woodlots. Nearly 55 percent of the attendees left these events with an increased knowledge of the topic covered. Over 1,500 forest stewardship plans were developed and more than 15,000 landowners implemented at least one new practice. RREA programming impacted the decisions made on more than 12 million acres of forested land and earned or saved landowners an estimated $17 million. Newsletters, websites, and other media reached nearly 940,000 forest landowners and managers during this period.

- New Hampshire Cooperative Extension used Smith-Lever funds to provide on-site assistance to 1, 853 landowners who collectively control 42,950 acres. Over 2,000 forest stewardship plans have been developed since 1990. These plans cover 520,000 acres or approximately 15% of the private forestland in the state. Extension provided over 310 forestry or forestry-related seminars, workshops and programs throughout the state, reaching nearly 14,000 people. Forty-seven of these programs were conducted for natural resource professionals who, in turn, reach another 2,300 forestland owners. Additional educational information was provided via 10,000 website inquiries, a newsletter that reached 4,000 natural resources professionals and newsletters that collectively targeted 35,000 to 40,000 people.

KA Key Outputs for 2008:

- As a result of Washington State Extension programs use of Smith Lever funds on special forest products, 38 new family businesses were organized in Washington, Idaho, Oregon, Alaska, Montana, California, and British Columbia. Using mushrooms, greenery, wild edibles, craft materials and native landscape plants, entrepreneurs have developed a wide array of products, including holiday wreaths, wild berry juices, dog beds, preserved floral products, fresh mushrooms, fence rails, carving stock, and essential oils. The gross annual income of these firms exceeds $1.3 million. An organization, the Northwest Research and Harvesters Association with 51 full-time members working with 11 researchers was

established. The members have produced over $210,000 of raw products and established 26 permanent research plots. Association members entered into an export agreement with a Korean food buyer to supply 60 tons of fiddlehead ferns as part of an eventual purchase of 560 tons per year.

- The Connecticut Agricultural Experiment Station used Hatch funds to examine the effects of precommercial crop-tree releases of oak saplings. Research focused on determining the effects of precommercial releases on growth and survival of saplings and identifying individual tree characteristics that are best correlated with increased growth and survival following release. Preliminary results suggest that a 5-cm tree will require an average 123 years to reach sawtimber size without release, compared with 98 years for trees released once. Tree released multiple times to maintain diameter growth would require only 65 years to reach sawtimber size. Thus, a carefully timed series of crop tree releases could effectively double regional forest productivity by halving rotation periods.

KA 124: Urban Forestry

Introduction:

Urban forestry is the art, science and technology of managing trees, forests and open spaces to support healthy cities and towns. It is, in essence, bringing the forest to the people. The principal purpose of urban forestry is preservation, as opposed to traditional forestry's main purpose of production.

The nation's 69 million acres of urban forests provide environmental, economic and social benefits. Environmentally, a primary benefit of healthy urban trees is clean air and water. Trees absorb air pollutants and act as natural filters to deliver clean air. Trees soften and filter rainfall to reduce storm water flow and modulate the urban environment's air temperature. Economically, urban trees and forests increase property values and reduce city maintenance. Trees around homes and buildings reduce energy use and costs. The cooling effects of trees help reduce the need for utilities to increase power generation capacity to meet peak energy load demand. Nationally, about 900 million metric tons of carbon is stored in the country's urban forests --- contributing to the reduction of greenhouse gases responsible for global warming. Socially, healthy urban trees and forests help strengthen communities by reducing crime and revitalizing neighborhoods. Trees enhance our quality of life and make our cities and towns better places to live, work and play.

One of the most important but least recognized benefits of the urban forest is its power to improve physical and mental health. There is evidence that the urban forest helps combat obesity, improves cardiovascular health, increases longevity and enhances physical development in children. Healthy trees deliver powerful environmental benefits for 45,000 communities where 80 percent of Americans call home. Can we afford to risk the benefits of our urban forests valued at over $400 billion? The urban forest is an integral part of city infrastructure and requires budget and research attention similar to health, utilities and education.

Urban forestry is a relatively new research program area (1998), but it is gaining significant interest in federal, state and local government sponsored programs. Many academic institutions are adding urban forestry to their instructional and research portfolio. Additionally, many private organizations and non-profits are increasingly engaged in the practice of urban forestry, including establishment, maintenance, restoration, design, protection and growing of urban trees and forests. The discovery of new knowledge is essential to enhance the health and sustainability of urban forests.

The vitality of this resource is at risk. Urban trees have been shown to have significantly shorter life span than their counterparts in the rural forests. This may be due to environmental stresses (pollution, flooding, drought, high temperature), biological stresses (injuries inflicted by humans, pests, diseases, invasive species), and site factors (limited soil volume, poor soil quality, soil contamination, etc). Research attention is needed to increase our understanding of how this

resource can be sustained to its highest vitality. Extension programs are needed to deliver this information to the appropriate audience.

A key factor limiting the progress of urban forestry work is the low number of people working in this discipline; scientist years range from ten to sixteen per year, with personnel scattered across universities and private institutions. Support for graduate students is minimal; thus the next generation of researchers and educators is not being trained.

KA 124: Urban Forestry Logic Model:

Situation	Inputs	Activities	Outputs	Outcomes		
				Knowledge	Actions	Conditions
Urban forestry is a relatively new research program area, but the discovery of new knowledge is essential to enhance the health and sustainability of urban forests. The vitality of urban forests is at risk. Urban trees have been shown to have significantly shorter life spans than their counterparts in the rural forests. A key limiting factor of progress in this area is the low number of people working in the discipline with limited funding.	**Resources:** - Authorities - Mission - Strategic Plan - Leadership - Management - Oversight - Assessment **Financial Resources** - CSREES - Formula - Competitive - Special **Human Resources:** - NPLs - Administrative - Support - Other Gov't. - Faculty - Practitioners - Para-professionals - Industry - NGOs - Volunteers - Partners	- A study to determine the particle matter (PM) 2.5 trapping ability of tree foliage & human health relationships - An investigation for control of euonymus scale - Various applied studies evaluate which species perform best under local conditions - Conduct research on disease resistance - Basic & applied research of gibberllin synthesis inhibitors & their effect in controlling height growth of trees near power lines & structures	Natural Resource Use and Management - Publications - Citations - Disclosures - Patents - Curriculum - Products - Tools - Technology - Practices - Methods - Measures - Polices - Regulations - Models	- Discovered that tree foliage was ineffective in trapping PM2.5 - Showed high pressure horticulture oil spray gave the best control. - Identified 2 separate genes for Dutch elm disease resistance in American elm - Identified new antigibberllin synthesis compounds to regulate tree growth - Determined that minorities in urban forestry have higher incomes than white males	- Developed and delivered extension programs - Findings will improve pest control & decrease pesticide use in urban trees - Results were provided to communities & nurseries to guide species selection. - Results may lead to re-introduction of these trees into landscapes - None identified yet - Achieved a more diverse workforce - Results can be used to assist land use planners in decision making - Evaluated 750 trees for urban plantings	Healthy, livable, and sustainable Urban Forest Ecosystem

Assumptions: Pressures on natural resources and land use are increasing, competing, and more frequently, conflicting. Demographic changes and changing social values bring new challenges. Ecosystems have become increasingly fragmented for production of food and forest products. Urbanization and fragmentation have major impacts on ecosystem structure and function. Public demand for natural resources products and services – timber, recreation, fish and wildlife, soil and water, open space, and the beauty of the land – continues to grow.	**External Factors:** Institutional commitment; amount of volunteer and nonprofit participation; national initiatives; USDA forest service and the National Urban Forest Community Forest Council's direction of research; decrease funding; changing priorities; farmers' attitudes; natural disasters; economic conditions; coordination and cooperation with other government entities

KA Key Activities for 2009:

- Using McIntyre-Stennis funding, Auburn University's Forestry and Wildlife Sciences Department estimated the impacts of the impacts of urban trees and landscaping on tourism. They identified research methodologies and effective approaches to address this issue. The attributes of trees and landscape contributing the esthetics of cities have been investigated and analyzed. Personal perceptions and attitudes to city beatification also were evaluated. Some theoretical and philosophical aspects on the relationship between aesthetics, landscape ecology and culture have been explored. Surveys gathered important information concerning the perception and attitudes towards aesthetics of landscaping and the natural environment throughout Alabama. Results reflected the contribution of aesthetics on tourism and community sustainable development.

- Auburn University's School of Forestry and Wildlife Sciences studied southern forest ecosystem growth and function as affected by stresses induced from changes in both the physical and chemical climate of the Earth, especially in urban areas. Determining the extent and magnitude of damage caused by atmospheric pollutants is thus extremely important. The study quantified the structure, function, and economic value of the urban forest in a small, rapidly expanding municipality (Auburn, Alabama) in the southern United States. Results provided a fundamental understanding of the structure and functioning of several ecosystem types in the southern U.S. and also responses to various environmental stresses such as air pollution and climate change. In addition, certain ecosystem services were to be quantified. These results also provided information to decision makers so adequate protective standards could be developed.

KA Key Activities for 2008:

- With McIntire-Stennis funds, Cooperative Forestry Research Program created its strategic plan which establishes the guiding principles for forestry research, education and extension. The strategic plan identified seven new areas of knowledge and specific action and performance measures that cover science integration, ecosystem services, human interactions, decision making technology, forest products and urban ecosystems. This is unique for a formula funded program that was established over 45 years ago.

- The Urban and Community Forestry Program of the Arkansas Forestry Commission has successfully launched a "Shade Trees on Playgrounds (STOP) Skin Cancer" program with funds from the McIntire-Stennis program. Through STOP, nine schools welcomed new trees with hundreds of school children, and many local leaders participated in the school-based events. Schools were selected for this program based on their lack of shade trees and their participation. A curriculum was prepared for the teachers and used for designing posters, and in some schools incorporated into benchmark education programs. Students were also assigned the responsibility of caring for the trees, ensuring a lasting achievement for which they can be proud.

- The program has invested on research projects on biological damage and urban forest health. Numerous studies have been conducted regarding pests, diseases, invasive species, and the effect of human activity of urban trees. For example, a study to compare two different treatments for fungicide injections in live oak show that a high volume and low concentration injection performed best compared to low volume and high concentration injection. An investigation for control of euonymus scale showed that a high pressure horticultural oil spray gave the best control. These research findings will result in improved pest control and decreased pesticide use in urban trees.

- The University of Georgia, Warnell School of Forestry and Natural Resources used McIntire-Stennis funds to examine the influences of forest landscape dynamics on species persistence. Theoretical models were constructed to demonstrate relationships between past landscape changes, current landscape patterns, and forest community composition and habitat structure under human-influenced management. The important theoretical result indicated that patterns of habitat dynamics in both time and space can lead to complex effects; sometimes including counterintuitive results. This information will assist natural resource managers in developing new management regimes to maintain production while supporting diverse populations of plant and animal species.

KA 125: Agroforestry

Introduction:

This Problem Area consists mainly of research and technology transfer programs with limited education and extension components. This is a relatively new discipline in the U.S. and a new area of forestry/agricultural research. In fact, agroforestry did not exist as a reportable Problem Area in the CSREES Manual of Research Classification until 1999. Its value as an alternative management system can be seen in the benefits it can bring to landowners such as reduced soil erosion, improved water quality, wildlife habitat and a variety of high value products harvestable at different times in addition to the timber that will come years later. Its sustainability and viability dimensions at any size scale make it very attractive to many landowners.

Agroforestry as defined by the International Center for Research in Agroforestry (ICRAF) is a collective name for land use systems and technologies where woody perennials (trees, shrubs, palms, bamboos, etc) are deliberately used on the same land management unit as agricultural crops and /or animals, either in some form of spatial arrangement or temporal sequence. It is intensive land use management that optimizes the benefits when trees are combined with crops or livestock. The four key "I" words that characterize agroforestry principles and practices are: intentional, intensive, integrated, and interactive. Agroforestry in its many forms has been practiced in the Tropics and Southern hemisphere for a long time but only recently has been getting greater attention in North America and, in particular, the United States. Agroforestry in the United States can be traced back to 1870 when the U.S. government first recognized the planting of trees on the prairies under the Timber Culture Act of 1870. In the 1930's the conservation benefits of windbreaks were widely touted and landowners were encouraged to plant them following the "Dust Bowl" of the 1930s. The driving forces behind the adoption of agroforestry practices around the world can be summed up in two factors: improved economic gain, and environmental protection.

In the US, there are five recognized agroforestry systems (practices) that have found their niches in specific geographic regions of the country. These five systems are:

- Alley cropping (Midwest)
- Silvopasture (Southeast)
- Riparian Buffers (Midwest and West)
- Windbreaks (Great Plains)
- Forest Farming (Northeast)

The application and adoption of these practices are limited and scattered in a few states despite their attractiveness as land use options. Their contribution to national food and fiber needs has not been quantified nor has the extent of their application on forest, range and open lands been assessed. Many basic and applied research questions have not been addressed to provide bases for greater application of the different agroforestry systems.

The last decade is characterized by an intensive investigation of the different agroforestry practices relative to their performance in specific sites and regions. But there remains a tremendous amount of knowledge to be gained in order to enhance profitability, usefulness and sustainability, not to mention its environmental advantages.

KA 125: Agroforestry Logic Model:

Situation	Inputs	Activities	Outputs	Outcomes		
				Knowledge	Actions	Conditions
In the US, there are five recognized agroforestry systems (practices) that have been found their niches in specific geographic areas of the country. The application and adoption of these practices are limited and scattered in few states in the country despite its attractiveness as a land use option. Its contribution to national food and fiber needs has not been quantified nor its extent as a land use been assessed.	**Resources:** - Authorities - Mission - Strategic Plan - Leadership - Management - Oversight - Assessment **Financial Resources** - CSREES - Formula - Competitive - Special **Human Resources:** - NPLs - Administrative - Support - Other Gov't. - Faculty - Practitioners - Para-professionals - Industry - NGOs - Volunteers - Partners	- A study to determine the effect of spacing to optimum crop production - Riparian management system developed to address non-point pollution in an intensively cultivated & heavily grazed Midwestern Landscape - A study to evaluate the effect of root pruning to control competition for soil moisture at the windbreak interface - A study to evaluate shade tolerance of several warm and cool season grasses over several years	Natural Resource Use and Management - Publications - Citations - Disclosures - Patents - Curriculum - Products - Tools - Technology - Practices - Methods - Measures - Polices - Regulations - Models	- Discovered grasses grown with hardwood trees compete aggressively & better with trees than legumes with respect to moisture - Riparian forest buffers trapped over 80% of the sediment from surface runoff - Cool season grasses produced 47% & warm season grasses 14-20% more dry weight at 50% shade than those grown in full sunlight - Liming increased first season emergence of ginseng, pH and Ca in soil.	- Results should help in species selection Buffers reduced nitrate by as much as 90% - Results provide basis for new technique for controlling soil moisture - Inc. foliage for grasses grown in combination with trees - Results indicate liming to be needed for ginseng emergence from acid soils. - Showed that soil moisture increased 2-3% & crop yield 12-40%	- Improved economic opportunity for producers and communities - Successful integration of trees on farms - Increased value added products - Sustainable Agroforestry Systems

Assumptions: Pressures on natural resources and land use are increasing, competing, and more frequently, conflicting. Demographic changes and changing social values bring new challenges. Ecosystems have become increasingly fragmented for production of food and forest products. Urbanization and fragmentation have major impacts on ecosystem structure and function. Public demand for natural resources products and services – timber, recreation, fish and wildlife, soil and water, open space, and the beauty of the land – continues to grow.	**External Factors:** Decrease funding, changing priorities; farmers' attitudes; natural disasters; economic conditions; coordination and cooperation with other government entities

KA Key Outputs for 2009:

- Auburn University evaluated the costs and spatial issues of conservation, and the mechanism to engage small land owners using the Cahaba River, the main source of drinking water for one out of four Alabama citizens, as a demonstration watershed. The river water quality and freshwater life are in severe decline. A Digital Elevation Model (DEM), watershed, land use and soil maps have been constructed for water quality modeling in the upper Cahaba river basin. The SWAT model was used in this project. The estimates of the opportunity costs of various land use changes provide some information on both costs and water quality change.

- With McIntyre-Stennis funding, the Cooperative Extension Service of Alabama A&M University evaluated the effects of the drought in the southeastern US that devastated the shiitake mushroom production on logs in natural woodland conditions. Drought and even normal climatic conditions inhibit fruiting. Other agroforestry producers are also having trouble establishing crops and obtaining profitable production levels and yields. On-farm demonstration of growing shiitake mushrooms with rainwater collection systems for irrigation was accomplished with CSREES funding. The inclusion of rainwater collection in this program has made shiitake production more viable and the potential for significant returns more realistic. The Alabama A&M program created awareness of the opportunities of agroforestry crops and to promote rainwater collection for irrigation of new and existing woodland crops. One new shiitake producer harvested 7 pounds of shiitake mushrooms (from 50 logs on the first harvest) worth $100.00 during the fall harvest.

- The Agronomy and Soils Department at Auburn University studied the influence of agroforestry on environmental sustainability and the potential to increase farmer income. They identified keys to successful implementation that included 1. competition between the crop and trees must be managed, 2. the species and varieties of trees and crops and their management must be adapted to local conditions, and the objectives of the farmer. This project focused on alley cropping and other agroforestry practices as a means to reduce soil erosion, improve soil fertility and sustainability and to increase farmer income in subtropical and tropical environments, through research on tree species and varieties and management of tree-crop interactions. The use of high biomass cover crops and organic mulches including prunings from the mimosa tree (*Albizia julibrissin*) enhanced the fall production of collards in Tallassee, AL. The experiment utilized forage soybean as a summer cover crop, followed by collards that are mulched with organic residues, comparing mimosa prunings with hay straw and *Sericeale spediza.* A paper was presented at the American Society of Agronomy meetings.

KA Key Outcomes for 2008:

- The Renewable Resources Extension Act provide funds to universities to promote the adoption of new harvesting technologies and the improvement and introduction of new value-added markets through education and support to communities and

individuals. These practices have an estimated combined earnings and savings of $199.2 million. There were over 900 new businesses created or expanded and more than 2,000 jobs created. Twenty-two Universities provided 350 educational and support opportunities for 12,000 stakeholders and reached over 442,000 indirect contacts through mailings and newsletters.

KA Key Outputs for 2008:

- The establishment of a Center for Subtropical Agroforestry was supported by CSREES funds through the IFAFS program. The Center was established and operated as a consortium effort of several land grant universities: University of Florida, University of Georgia, Auburn University, Florida A&M and University of the Virgin Islands. The outreach objectives of the Center are: 1) to provide relevant information and tools regarding agroforestry practices, economics, and funding opportunities for extension agents, natural resources professionals, educators and landowners, 2) to facilitate communication among agroforestry stakeholders through an interactive agroforestry network and 3) to increase dissemination of agroforestry awareness through the establishment of various demonstration sites on public and private properties for field tours.

- With funds from the McIntire-Stennis program, researchers at North Carolina State University examined how low nutrient availability limits growth rates on many forest plantations in the southeastern United States. Scientists established nutrition research on southern pine plantations, spanning some 80 field trials throughout the southeastern United States. Active trials encompassed three major areas of research: 1) tillage, fertilization, and weed control applied at time of planting; 2) nutrient rates and frequency of beginning in 3- to 6-year-old plantations; and 3) nutrient additions and/or vegetation control in established stands. More than 1.5 million acres of southern pine plantations are now fertilized annually. One year of fertilization will result in the production of at least an additional 30 million tons of southern pine wood. Diagnostic tools, prescriptions, and response information now play a key role in the adoption of and wise use of fertilizers as a silvicultural tool.

NATURAL RESOURCE ECONOMICS KNOWLEDGE AREA

KA 605: Natural Resource and Environmental Economics

Introduction:

Economists examine tradeoffs in allocating limited resources for producing goods and services that will meet individual, community, and societal needs. In the agricultural sector, farmers and ranchers use natural resources, such as land, soil, air, and water, for producing food, feed, fiber, fuel, and timber. Not only do farmers and ranchers have limited access to these natural resources in producing goods and services, the economy as a whole has various needs and activities besides agriculture that compete for their uses. With population increase and economic growth, these natural resources have increasingly converted to non-agricultural uses. On the other hand, the general public is increasingly aware of the multi-functionalities of agriculture. Namely, in addition to provisioning services such as water for drinking or irrigation purposes, agricultural landscapes also provide cultural services such as aesthetic or recreational values. Moreover, agricultural production, while generating positive benefits for society and human well-being, it may simultaneously create negative impacts on the environment, if natural resources are not managed sustainably.

Agricultural economists design tools to illustrate effective allocation of natural resources. They develop methodologies to estimate the economic values of environmental attributes or to assess comparative advantages. They also evaluate decision-making processes among alternative or competing uses so as to protect and minimize adverse impacts on natural resources and the environment. Traditionally, tools developed or suggestions made by economists have been most helpful to individual producers in understanding the potential effects and consequences of alternative management strategies to the environment. However, use of natural resources and its environmental impacts vary on a spatial dimension. So are the interrelationship among various biophysical and human variables and the cumulative effects over time. Decision-making tools are gradually evolved by taking a systems approach to account for spatial, temporal, and dynamic aspects of the equation. Effective management of natural resources and the environment also need to incorporate economics with biophysical sciences to understand the distributional, long-term cumulative and multi-generation effects on a global scale.

KA 605, Natural Resource and Environmental Economics, is built around an interdisciplinary philosophy by integrating economics with biophysical sciences to study natural resource and environmental problems. CSREES supports agricultural economists at the land-grant universities and other institutions in research, education, and extension activities to address complex natural resource management and the dynamics of that management with the environment. Agricultural economists combine mathematical and statistical tools with economic principles and other biophysical sciences to design and recommend innovative solutions for managing natural resources that are economically viable, socially acceptable, and environmentally responsible.

KA 605 encompasses a broad scope of subject areas, including, but are not limited to, the economics of water resources, climate change, wildlife and fisheries, land use and management, agro-environmental policies, and ecosystem services. For example, agricultural economists develop methodologies to measure economic values of water for competing uses among irrigation, aquatic animals, recreation, or urban water supply. They estimate the important value of public goods and services, such as flood or erosion mitigation, wildlife habitat, scenic vista, and clean air or water, delivered by agriculture. They apply various mathematical and statistical tools to examine how choices made by people in private or public sectors may affect land or water resource allocations or the quality of the environment. They analyze the distributional effects of these choices and recommend alternatives to increase efficiency and effectiveness of the choices.

KA 605: Natural Resource and Environmental Economics Logic Model:

Situation	Inputs	Activities	Outputs	Outcomes		
				Knowledge	**Actions**	**Conditions**
- increasing fragmentation on agricultural, range, & forest lands from urban development - increasing competing demand for various ecosystem services. - insufficient understanding of long-term impact of human activities on landscapes & ecosystems - inadequate knowledge of the relationship between the provision of ecosystem services & the spatial configuration of land use	**Resources:** - Authorities - Mission - Strategic Plan - Leadership - Management - Oversight - Assessment **Financial Resources** - CSREES - Formula - Competitive - Special **Human Resources:** - NPLs - Administrative - Support - Other Gov't. - Faculty - Practitioners - Para-professionals - Industry - NGOs - Volunteers - Partners	- empirical analyses of cost-effectiveness of management practices - collaborate with biophysical scientists to evaluate alternative resource management options - develop & meta-test integrated bio-economic models that assess long-term impact of human activities on agro-ecosystems - assess & quantify both market & non-market values of ecosystem services - analyze the economic, welfare, & environmental effects of public policy implementation	Natural Resource Use and Management - Publications - Citations - Disclosures - Patents - Curriculum - Products - Tools - Technology - Practices - Methods - Measures - Policy alternatives - Regulation options - Models, analytical, empirical, or experimental - human capitals	- improve understanding of spatial implications of land fragmentation - understand trade-offs & potential externalities of alternative resource uses & management practices - increase knowledge in economic, distributional & welfare effects of policy implementation - awareness of & access to decision tools for land owners, managers, & policy makers	- support the design of effective & efficient policies to promote the provision of ecosystem services - help establish public & private markets for landowners & communities to develop & market ecosystem services, - provide life-cycle analyses for various alternative uses of resources - land owners, managers, & policy makers adopt decision support tools for making resource use choices	- protected natural resources that provide ecosystem goods & services for future generations - unbiased bio-physical & bio-economic solutions in public & private choices of resource uses & management that lead to long-term sustainability - increased natural resources & environmental sustainability at various spatial & temporal scales

Assumptions: Pressures on natural resources and land use are increasing, competing, and more frequently, conflicting. Demographic changes and changing social values bring new challenges. Ecosystems have become increasingly fragmented for production of food and forest products. Urbanization and fragmentation have major impacts on ecosystem structure and function. Public demand for natural resources products and services – timber, recreation, fish and wildlife, soil and water, open space, and the beauty of the land – continues to grow.	**External Factors:** Scientific advancements; changing priorities; producers' and consumers' attitudes; weather, natural disasters; economic conditions; coordination w/ other government entities; public policy.

KA Key Activities for 2009:

- Natural Resource and Environment National Program Leaders (NPLs) used program funds to garner stakeholder inputs through a systematic planning process by (1) convening a National Steering Committee comprised of 30 multi-disciplinary cross-section leaders in land-grant universities and federal agencies, and (2) conducting roundtable discussions at various national professional conferences, including Northeast Recreation Research Symposium, International Symposium on Society and Resource Management, and Society of American Foresters. The workshop increased the awareness of the dynamic and complexity of natural amenity-based recreation issues; fostered the interaction among multi-disciplinary researchers, educators, and practitioners; and enhanced cooperation with various federal agencies, including USDA-Economic Research Service, USDA-Forest Service, National Oceanic and Atmospheric Administration's Sea-grant Programs, National Park Service, National Institute of Health, U.S. Fish and Wildlife Service, Bureau of Land Management, and U.S. Army Corps of Engineers. A five-year strategic plan brochure, *Outdoor Recreation Research and Education for the 21st Century* (http://www.csrees.usda.gov/nea/nre/pdfs/orre_strategic_plan.pdf), was developed based on the stakeholder input. One direct outcome of this process is the formulation of a multi-state coordination committee, NECC 1011 (http://www.nimss.umd.edu/homepages/home.cfm?trackID=10676), which will help develop multi-disciplinary research/education/extension activities.

- CSREES provide funds to partner with the National Association of State Universities and Land-grant Colleges (NASULGC), the Association for European Life Science Universities (ICA), Farm Foundation, and other land-grant universities for an international conference entitled, "the Science and Education of Land Use: A Transatlantic, Multidisciplinary, and Comparative Approach". Over 130 scientists, educators, and policymakers from numerous countries in the US and Europe participated in this conference. The conference explored the causes and consequences of current land use trends and dynamics related to society, economy and environment, as well as policy implications of land cover/land use changes. A study tour to Montgomery County, Maryland, was included as part of the conference. Tour participants witnessed on-site the contrast between land conservation and urban development resulted from different institutional land use policies. The conference provided an opportunity to foster international knowledge exchange, future research collaboration, and student exchange. International scholars increased knowledge by comparing methodologies (based on various cultural, geological, and ecological backgrounds) that address human-induced environmental, ecological, land use, and land care issues. Scholars and the general public can access all presentation slides and papers at http://nercrd.psu.edu/TALUC/Presentations.html. One expected outcome of the conference is to increase the number of international student exchange. In 2008, knowledge was synthesized into four policy brief papers (http://nercrd.psu.edu/TALUC/PolicyBriefs.html), addressing topics in carbon

sequestration, agricultural and urban land use policy, improve preservation policy using research on farmland amenity values, and the economic, social and environmental impacts of land use changes.

- Rural/regional economics is inherently spatial and the emerging literature on agglomeration economies and spatial externalities has particular importance in the work of rural economists. The convergence of interest and the development of spatial econometric methods have made the potential gains from collaboration and cross-fertilization across disciplines much greater. Through the efforts of the portfolio NPLs and support from program funds, CSREES partnered with several land-grant universities and Farm Foundation to co-sponsor a pre-conference workshop entitled, "Fundamentals of Spatial Economics" in July at the 2007 American Agricultural Economics Association (AAEA), the West Agricultural Economics Association (WAEA), and the Canadian Agricultural Economics Association (CAEA) Joint Annual Meeting in Portland, Oregon. AAEA and CAEA are the national flagship organizations of the agricultural and resource economics professionals in the U.S. and Canada, respectively; while WAEA is one of the four regional organizations in U.S. This workshop provided a rich environment in which to develop new cross-disciplinary collaboration in spatial economics. Five internationally renowned scholars from the U.S., New Zealand, and Canada were invited to present their long-term research results on spatial dynamic issues, such as migration-induced landscape change, amenity-driven urban/suburban development, and firm location behavior. Over 90 people, including 20 graduate students, attended this workshop. Workshop presentation materials are posted at: (http://ruralstudies.oregonstate.edu/AAEA%20PreConference.htm)

KA Key Outputs for 2009:

- Portfolio funded scientists are evaluating the "Economic Linkages between Coastal Wetlands and Water Quality: A Review of Value Estimates Reported in the Published Literature." They have set out to: 1) document the current status of knowledge concerning the economic value of the water quality services generated by coastal and other wetlands; 2) provide a brief overview of the theoretical economic linkages between wetland ecosystems and water quality as a basic framework for understanding why specific variables and measurement methods are of interest; and 3) outline common methods used to value the water quality services of wetlands, along with their major advantages and disadvantages. An output of the project is a systematic and concise compendium of theoretical and technical information on estimating the economic value of wetlands' environmental services for water quality. The importance of geographic location, and the specific use demand, on water quality service value suggests that coastal wetland benefits should be carefully examined within a spatially disaggregated context. This comprehensive information will help enrich policymakers about the relative benefits and costs of different strategies in natural resource management such as to restore or preserve wetlands for improving water quality.

- Ambient water quality management is critical to meeting the Clean Water Act objectives and is an essential element of the Clean Water Act Total Maximum Daily Load (TMDL) approach, which caps emission levels of both nonpoint and point sources. Resource economists at Cornell University leveraged CSREES formula grants with a much larger EPA-funded grants to evaluate alternatives of water quality management strategies by studying 22 wastewater treatment plants in the upper Passaic River Basin. Research compared an open-market water quality trading system based on a marginal cost trading, with a more contractual-based, bilateral trading program between selected firms. Results show that the former approach provides only nominal watershed-wide cost savings of 1 to 3 percent, while the bilateral approach engenders far greater savings of 16 to 18 percent. The main difference is that in the bilateral trading approach, fixed costs can be allocated across firms, and costly upgrades are directed toward wastewater treatment plants with relatively large flows. Study report (*Selected Economic Aspects of Water Quality Trading: A Primer and Interpretive Literature Review, Boisvert, Poe, and Sado,* Tech Report, Cornell, 2007, www.water.rutgers.edu/Projects/trading/Economic%20Aspect_of_Water_Quality_Trading_final_EPA.pdf) states that there are potential gains in cost-effectiveness from implementing water quality trading programs to meet TMDL regulations at the watershed level. However, these potential gains may be difficult to achieve and it is likely that, because of the specific nature of water quality, watersheds, and the lumpiness of capital investments, any cost savings that actually accrue will not be associated with the establishment of open, exchange-like markets. Instead, savings may simply be realized by dischargers independently taking advantage of the flexibility associated with trading programs and to an extent, structured bilateral negotiations between dischargers. The case-study results have enabled a shift in focus from an open-market-based approach to a bilateral approach and the notion of trading being built into the recently promulgated TMDL for the upper Passaic River Basin. In addition, the project supported one completed (and award winning) Master's thesis (Sado, 2006) and a second Master's thesis to be completed in Spring 2009.

- Water continues to define and influence patterns of human settlement and economic development. Scientists leveraged CSREES formula grants with a grant from the National Commission on Energy Policy and collaborated with a group of researchers to study how climatic changes would likely alter stream-flow patterns, ensuing hydrographs, and thus the potential impacts on economic productivities in the Rio Grande valley in New Mexico. Using a hydro-economic model, i.e., RioGEM, that depicts the physical, economic, and institutional characteristics of the Upper Rio Grande watershed across both time and space, scientists assessed the potential consequences affecting the region's water uses under three climate change scenarios, such as wet, middle, and dry conditions. In their paper, "Climate Change Risks New Mexico's Waterways: Its Byways and Its Flyways" (pp. 5-11, *Water Resources Impact*, 10(4), 2008, http://www.law.arizona.edu/AdaptationConference/PDFs/HurdCoonrodWater%20ResourcesImpact.pdf), scientists concluded that with continued population growth and limited opportunities for new water resources in the Rio Grande, the competition for water would

be exacerbated (even under "wet" scenario) and there would be further increased pressure to transfer water out of agriculture. Climate change poses distinct challenges for both water managers and water users in agriculture, urban population, and industrial sectors.

- Global climate change is a forefront issue. Agricultural sector can support climate change risks mitigation by helping reduce greenhouse gas (GHG) emissions. For example, by providing substitute products that can replace fossil-fuel intensive products or production processes. In an outreach paper published in *Choices* (2008, 23(1)), research funded in-part by CSREES discussed "Bioenergy in a Greenhouse Mitigating World" (pp. 31-33, www.choicesmagazine.org/2008-1/2008-1.pdf). Taking into account for the amount of fossil fuel used in the project lifecycle, i.e., from production to end-use, results show that (1) in general, grain-based ethanol provides the least offsets of GHG, then in ascending order, cellulosic, biodiesel, and electricity; (2) there is a high degree of uncertainty about the magnitude of leakage created by market price that induces production change, e.g., expanded production into marginal lands or converting forest lands to crop production; (3) as GHG prices rises, the more desirable bioenergy forms become bioelectricity and cellulosic ethanol, instead of corn- or grain-based ethanol. Moreover, bioenergy and GHG are intertwined in a complex manner and the current U.S. policy of promoting corn ethanol may not be contributing much to GHG reduction. The scientist suggested that U.S. GHG reduction policies need to be carefully formulated by considering global and regional competing land use changes.

- The complexity of bioenergy in a GHG mitigating world was further debated in a CSREES cosponsored workshop, "Linking Biophyscial and Economic Models of Biofuel Production and Environmental Impacts" in November 2008 (http://www.workshops.greatlakesbioenergy.org/linkingmodels2008). This workshop is significant because evidence is growing of unintended effects from first-generation biofules on land use, food prices, and the environment. In order to develop sustainable biofuels, there is the need to bring knowledge from a number of different disciplines to investigate the impacts of biofules along multiple dimensions to explore the prospects of the second-generation biofuels. When lack of historical experiences, modeling can elucidate how production may affect both yield and environmental outcomes (e.g., water quality, carbon sequestration, and biodiversity) under various growing conditions. About 70 modeling experts and scholars participated in the workshop. Discussion focused on the second generation of liquid biofuels that can potentially be produced from cellulosic feedstocks. Six main themes of the workshop were: (1) biophysical models of yields of bioenergy crops; (2) soil carbon modeling with bioenergy crops; (3) linking yield models with economic decision making; (4) water quality and biodiversity impacts of biofuel crops; (5) modeling land use implications of biofuel crops; and (6) integrative modeling approaches. While the keynote speaker quoted George Box's epigram, "All models are wrong; some are useful;" a scientist countered by quoting Art Jeffrey's reminder that, "The purpose of models is insight, not numbers."

- Ecosystem services have been identified as a central link between society, or human systems, and the structure and function of natural systems (Millennium Ecosystem Assessment, 2005.) While almost everyone acknowledges the significant role that ecosystem services play in the quality of life, it is difficult not only to measure the value of ecosystem services, but also to integrate these values into the decisions of businesses and individuals in society. CSREES grants supported a project, which scientists designed an experimental (real) market in Jamestown, Rhode Island, for identifying better methods to measure ecosystem service values and to link available actions to restore or sustain ecosystem structure and functions that yield desirable ecosystem services. In an article, "Ecosystem Services beyond Valuation, Regulation, and Philanthropy: Integrating Consumer Values into the Economy," (pp. 47-52, *Choices* 23(2), 2008, www.choicesmagazine.org/magazine/pdf/issue_4.pdf) scientists described fundamental challenges of ecosystem services, i.e., the nature of "public goods" or "fugitive resources" that can easily create the incentive to "free-ride" or hang back and wait for potential provider, or public (e.g., spirited philanthropists) to do the right thing at their expense. The Jamestown experience showed that an ecosystem service market could eventually enable farmers to expand their operations with services that Jamestown's exurban residents' value. The scientists conclude that if market mechanisms create a closer alignment between individual and collective values and incentives to support the public good (e.g., cap-and-trade for carbon emissions), then markets may create an avenue by which communities can directly influence the key choice of the overall cap on emissions. Namely, individuals and groups who value a further reduction in emission can buy or retire a quantity of permits in the market that effectively lowers the overall cap. Not only has the Jamestown experimental market model raised the interest in the approach by communities in other states (e.g., Grant, Minnesota), but a group of CSREES-supported scientists also provided an outreach webinar on ecosystem service/environmental markets to the Natural Resources Conservation Services in February 2009.

KA Key Activities for 2008:

- Through the efforts of the portfolio NPLs and support from program funds, CSREES partnered with several land-grant universities and Farm Foundation to co-sponsor a pre-conference workshop entitled, “Fundamentals of Spatial Economics” in July at the 2007 American Agricultural Economics Association (AAEA), the West Agricultural Economics Association (WAEA), and the Canadian Agricultural Economics Association (CAEA) Joint Annual Meeting in Portland, Oregon. AAEA and CAEA are the national flagship organizations of the agricultural and resource economics professionals in the U.S. and Canada, respectively; while WAEA is one of the four regional organizations in U.S. This workshop provided an introduction to foundational work in spatial economics. Five internationally renowned scholars from the U.S., New Zealand, and Canada were invited to present their long-term research results on spatial dynamic issues, such as migration-induced landscape change, amenity-driven urban/suburban development, and firm location behavior. Over 90 people, including 20 graduate students, attended this workshop.

OBJECTIVE 6.4: Protect and Enhance Wildlife Habitat to Benefit Desired, At-Risk And Declining Species

WILDLIFE KNOWLEDGE AREA

KA 135: Aquatic and Terrestrial Wildlife

Introduction:

In the United States, wildlife is regarded, culturally and legally, as a publicly-owned renewable resource. As such, the resource serves to supplement the diets of many citizens, affords recreational and aesthetic benefits, and generates income to landowners and businesses. For example, annually more than 80 million Americans fish, hunt, or watch wildlife, spending about $110 billion in the process. Wildlife is an inherent element of natural and managed ecosystems, including those of forestry, range, and agriculture. The fledgling nation utilized wildlife as a seemingly inexhaustible resource. As its human population grew, however, wildlife and societal interests, especially those of agriculture, increasingly conflicted, and many wildlife stocks became threatened by over-harvest, deliberate extirpation, habitat alteration, environmental pollution, and other factors. By the early-20th century, professional wildlife management became established to sustain the resource while minimizing its deleterious impacts on agriculture and other human endeavors. Today, governmental agencies, from municipal to federal levels, share this management responsibility.

CSREES chiefly partners with land-grant universities, providing funds and coordination for wildlife research, education and extension programs. In various ways, it also partners with other federal agencies which have wildlife-related missions, especially the USDA Forest Service, Natural Resources Conservation Service and Farm Services Administration; the U.S. Department of Interior Fish and Wildlife Service and Geological Survey; and the National Oceanographic and Atmospheric Administration Sea Grant.

For organizational purposes, this portfolio report focuses on goals of KA 135 which are:

- To enhance the sustainability of fish and wildlife resources through increased understanding of the natural and human factors that affect them, with emphasis on those inhabiting agricultural, forest, and range ecosystems.
- To influence changes in practices that reduce or ameliorate those factors which are deleterious to the wildlife resource and its societal relationships.

America's wildlife resource affects, and in turn is affected by, its human population in numerous ways, as reflected in the CSREES strategic plan criteria and program areas noted above. These situations cause policy makers and wildlife resource professionals to seek and apply new knowledge in order to ensure the sustainability of the resource. Among the most pressing issues are:

- Maintaining an educated and experienced professional management work force in view of anticipated massive retirements among the current generation
- Ensuring public understanding of wildlife issues among a population that is becoming increasingly urban and isolated from nature
- Resolving conflicts over wildlife values among differing segments of society
- Ameliorating or preventing alteration or destruction of wildlife habitat
- Endangerment of the continued survival of some wildlife stocks and species from such causes as habitat alteration, overharvest, genetic swamping, and competition from invasive species
- Mitigating damage to humans and human property by wildlife
- Controlling spread of diseases that affect both human and wildlife health.

KA 135: Aquatic and Terrestrial Wildlife Logic Model:

Situation	Inputs	Activities	Outputs	Outcomes		
				Knowledge	Actions	Conditions
America's wildlife resource affects, and in turn is affected by, its human population in numerous ways. . Among the most pressing issues are: - Maintaining an educated & experienced professional management work force. - Ensuring public understanding of wildlife issues - Resolving conflicts over wildlife values - Preventing alteration or destruction of wildlife habitat	**Resources:** - Authorities - Mission - Strategic Plan - Leadership - Management - Oversight - Assessment **Financial Resources** - CSREES - Formula - Competitive - Special **Human Resources:** - NPLs - Administrative - Support - Other Gov't. - Faculty - Practitioners - Para-professionals - Industry - NGOs - Volunteers - Partners	- University of California researched the recent declines of Pacific sea otters along the California coast. - University of California scientists studied straying rates between Pacific salmon populations - University of Wisconsin wildlife specialists trained over 125 landowners who control more than 100,000 acres - Oklahoma State University educational program provided Oklahoma landowners information on prescribed fire to restore their land	Natural Resource Use and Management - Publications - Citations - Disclosures - Patents - Curriculum - Products - Tools - Technology - Practices - Methods - Measures - Polices - Regulations - Models	- Determined declines were largely encephalitis from toxoplasma parasites in shellfish eaten by otters - Low stray rates led to more persistence & less likelihood of collapse from oceanic env. shifts. - Landowners gained knowledge on forest stewardship - Over past 5 years there have been more than 200 field days, attended by more than 10,000 people	- Led to dev. of tests & treatments for parasite infections & determination of the source of parasites - Results have been applied to design CA coast marine reserves - Helped landowners make improved land mgmt decisions - Increased number of acres burned by more than 100%, approx. 800,000 acres - Results may encourage adoption of the new approach - Technique now being used in management trials in several states.	- Improved management - Improved environmental quality - Enhanced sustainability - Improved habitat for endangered species - Increased public understanding of wildlife resource issues - Increased participation in community-based conservation and management

Assumptions: Pressures on natural resources and land use are increasing, competing, and more frequently, conflicting. Demographic changes and changing social values bring new challenges. Ecosystems have become increasingly fragmented for production of food and forest products. Urbanization and fragmentation have major impacts on ecosystem structure and function. Public demand for natural resources products and services – timber, recreation, fish and wildlife, soil and water, open space, and the beauty of the land – continues to grow.	**External Factors:** Decrease funding, changing priorities; farmers' attitudes; natural disasters; economic conditions; coordination and cooperation with other government entities

KA Key Outcomes for 2009:

- In 2008, over 3,300 landowners and farmers enrolled 1,240,157 acres in the Acres for Wildlife Program, a cooperative program between the Arkansas Game and Fish Commission and the University of Arkansas Cooperative Extension Service. Nearly 300 of these cooperators requested and received information about developing wildlife management plans.

KA Key Outputs for 2008:

- Written bulletins are a time-tested, effective means of providing Extension information to public audiences. Most state Extension services produce such bulletins and often use those of others which are relevant. For many years, CSREES joined with the US Fish and Wildlife Service and the US Environmental Protection Agency to produce a printed bibliography of Cooperative Extension Service Literature on Wildlife, Fish, and Forest Resources. The current version is produced on-line and provides users with direct access to over 500 on-line bulletins developed by state Extension programs.

- Educators at LGUs are increasingly taking innovative approaches to attract a qualified and diverse student body and prepare them for present and future challenges in their careers in fisheries wildlife management. Historically, the number of African-Americans and other minorities enrolling in natural resource related fields has been low and even declining over the past two decades. This is believed to be partly because of negative perceptions about the career field. In an effort to recruit more minority students to the area, South Carolina Cooperative Extension used Smith-Lever funds to conduct a summer Natural Resource Career Camp for high school students. At camp, students are exposed to a wide variety of environmental and natural resources fields, including that of wildlife management. Pre- and post-testing indicates that the camp is effective in raising student knowledge and interest in obtaining education in natural resources.

- The University of Delaware use McIntire-Stennis funds to examine the decline of forest breeding birds in the mid-Atlantic region. The University maintains the longest demographic study of the Wood Thrush (31 yrs) to monitor the effects of local and landscape variables on forest breeding birds. These data have been used to assess the effects of habitat fragmentation on long-term population persistence and provide valuable information regarding life-time reproductive success for the species. Results indicate a positive relationship between time since fragmentation and degree of relatedness within the population. Maintaining a population of known age individuals with complete reproductive data also allows scientists to integrate this population into a mercury deposition and bioaccumulation monitoring program.

KA Key Outcomes for 2008:

- Controlling nuisance wildlife and the effects of global warming on wildlife and fisheries populations were popular topics this year. Twenty-five universities held nearly 300 educational events attended by nearly 31,000 participants. There were over 900 new wildlife and fisheries management plans written and the RREA program impacted 911,000 acres. Information reached over 234,000 interested stakeholders through newsletters and other indirect media outlets.

ECOLOGY KNOWLEDGE AREA

KA 136: Conservation of Biological Diversity

Introduction:

Biological diversity, or biodiversity for short, refers to the variability of living organisms and the ecological complexes of which they are a part. Human culture has largely prospered on the basis of its ability to utilize biodiversity. Conservation and management of genetic diversity within domesticated plant and animal species, for example, have been improving agricultural production for millennia, but diverse natural biotic populations have been providing food and other products and services to humans for much longer.

A wide range of species provides many products through agriculture and from the harvest of natural populations. High production levels are sustained through maximizing the beneficial impact of ecosystem services for agricultural and natural ecosystems. Moreover, a diverse range of resident organisms contributes to ecosystem resilience -- the capacity to recover from environmental stress and the ability to evolve. Essential functions such as nutrient cycling, decomposition of organic matter, degraded soil rehabilitation, pest and disease regulation, water quality, and pollination are maintained by a wide range of biologically diverse populations in ecosystems.

The significant threat to biological diversity caused by alien invasive species is now acknowledged by scientists and governments globally. The impacts of invasive organisms are immense, insidious, and usually irreversible. They may be as damaging to native species and ecosystems worldwide as the loss and degradation of habitats and of climatic change. Alien invasive species are found in all taxonomic groups: they include introduced viruses, fungi, algae, unicellular and higher plants, invertebrates, and vertebrates. They have invaded and affected native biota in virtually every ecosystem type on Earth. The ecological cost is the irretrievable loss of native species and ecosystems. Invasive weeds reduce crop, livestock, forest and rangeland yields and increase production costs; weeds degrade catchment areas and freshwater ecosystems; tourists and homeowners unwittingly introduce alien plants into wilderness and natural areas; humans and wildlife suffer health impacts, etc. The degradation of natural and agricultural ecosystems and climatic change that has occurred throughout the world has made it easier for alien species to establish and become invasive.

The planet’s ecological system has been kept in balance through a complex and multi-facetted interaction between a huge number of biotic species. It is predicted by many scientists that the situation may eventually precipitate collapses of ecosystems at a global scale, promoting massive disease outbreaks and creating large-scale agricultural problems, threatening the health and food supplies of hundreds of millions of people. Recognizing these potential catastrophic consequences, and the commitment of the environmental science and management communities to stem biodiversity declines, CSREES proposed the addition of Conservation of Biological Diversity as an Agency priority program area (KA136) in 2004.

KA 136: Conservation of Biological Diversity Logic Model:

Situation	Inputs	Activities	Outputs	Outcomes		
				Knowledge	Actions	Conditions
Currently there is great concern over the increasing impact of human actions on biodiversity. Resulting from an array of human-induced threats, rates of biotic species extinction are now estimated to be between 1,000 to 10,000 times greater than in the geological recent past. There are scientific estimates that one-third of all species of plants, animals, and other organisms on the planet may be lost by the end of the next century, if current trends persist.	**Resources:** - Authorities - Mission - Strategic Plan - Leadership - Management - Oversight - Assessment **Financial Resources** - CSREES - Formula - Competitive - Special **Human Resources:** - NPLs - Administrative - Support - Other Gov't. - Faculty - Practitioners - Para-professionals - Industry - NGOs - Volunteers - Partners	- A study at the University of Maine investigates rockweed Entomologists at Washington State University conduct a comprehensive survey of insect diversity - Ohio State University establish an Ornamental Plant Germplasm Center to protect and maintain biodiversity for scientists - Oklahoma Cooperative Extension has assisted ranchers in releasing over 60,000 thistle-eating weevils on about 5,000 infested acres	Natural Resource Use and Management - Publications - Citations - Disclosures - Patents - Curriculum - Products - Tools - Technology - Practices - Methods - Measures - Polices - Regulations - Models	- Discovered rockweed plays key role in maintaining biodiversity - Identified over 40 species of previously unknown insects - Center is collecting conserving & assessing ornamental plant germplasm - Weevils are achieving an 80-95% control rate - Gained information on behavior, movements & survival of captive-bred rabbits released in the wild - Participating youth became more environmentally knowledgeable	- Established state harvest regulations & other conservation measures - Results serve as useful references in more culturally impacted areas - Distributes to scientists & breeders - Estimated savings of $3M annually - Information is being used to plan future releases to enhance individual & population survival - Youth become more inclined to become involved in future citizen conservation efforts	- Improved management - Conserved & enhanced biodiversity - Increased public understanding and support for biodiversity improvement programs - Reduced conflicts over governmental regulations - Enhanced economic & other quality of life benefits - Sustained professional natural resource & ecology cadre that is highly qualified scientifically, technically & socially

Assumptions: Pressures on natural resources and land use are increasing, competing, and more frequently, conflicting. Demographic changes and changing social values bring new challenges. Ecosystems have become increasingly fragmented for production of food and forest products. Urbanization and fragmentation have major impacts on ecosystem structure and function. Public demand for natural resources products and services – timber, recreation, fish and wildlife, soil and water, open space, and the beauty of the land – continues to grow.	**External Factors:** Institutional commitment; amount of volunteer and nonprofit participation; national initiatives; USDA forest service and the National Urban Forest Community Forest Council's direction of research; decrease funding; changing priorities; farmers' attitudes; natural disasters; economic conditions; coordination and cooperation with other government entities

KA Key Outputs for 2009:

- A new program was introduced in the Agriculture and Food Research Initiative (AFRI) entitled Sustainable Agroecosystem Science (SAS) - Long-Term Agroecosystem Program (LTAP). The focus of the program is to seek an improved understanding of the biogeochemical and socioeconomic mechanisms and processes governing soil ecological and carbon dynamics in order to better formulate soil carbon sequestration and production management strategies. Concomitant with this will be an effort to educate farmers and extend this knowledge while also providing valuable feedback to adjust research priorities among many unknowns. There is a need to approach the problem hierarchically: to understand how biogeochemical processes vary spatially and temporally across different management regimes; to understand how carbon sequestration influences and is influenced by the social and economic aspects of farming; and how this collective understanding might be incorporated into best management practices. Two interrelated goals of the SAS-LTAP are to: 1) connect land managers with researchers in the scientific and cultural assessment of current and novel farming practices; and 2) working to educate and extend this scientific knowledge to improve cropping and tillage systems such that they are ecologically, economically and culturally sustainable.

- The University of California, Berkeley funded through the NRI Biology of weedy and invasive species in Agroecosystems established research to identify the effect of native rodents on the restoration of western rangelands. Invasive annual grasses like red brome currently dominate many arid rangelands and are expected to become a more severe problem with climate change, yet little is known about factors that affect their distribution and abundance. The aim of this study is to improve management of red brome in rangelands by determining (1) the effects of cattle and kangaroo rats on red brome distribution and abundance, and (2) the impact of kangaroo rats on perennial grassland restoration efforts. Results will be used to develop grazing prescriptions, restoration protocols, and burrowing rodent management plans that facilitate the control of red brome and other invasive grasses.

- University of Central Florida researchers are investigating the biological and economic impacts of two invasive mussels along the coast of the U.S. in and oyster agroecosystem. This project will study the impacts of two recently introduced tropical marine mussels, the charru mussel, Mytella charruana, and the green mussel, Perna viridis, on the ecologically and economically important oyster agro-ecosystem of southeastern United States coastal waters. Ecological, physiological and molecular studies will be used to infer where each of the species came from and how both were able to obtain a foothold along the coastline and begin spreading north and south of the initial founding location. Additionally, scientists will investigate the interaction these species are having with native eastern oysters. With this knowledge, strategies can be developed to prevent future introductions from the sources and identify areas of potential spread for each of the species.

- The University of Colorado is studying ecosystem management of regionally abundant invasive plants in an era of global environmental change with funding from NRI's Weedy and Invasive Species program. Managers along the Colorado Front Range of the Rocky Mountains identify four invasive weeds as among their highest priority for management: diffuse knapweed, cheatgrass, Dalmation toadflax and Canada thistle. Researchers will test and implement management strategies for these regionally abundant, economically important rangeland weeds, and develop educational and outreach programs to emphasize the rationale and science facts behind sustainable management actions. We will nest this program within K-12 educational needs and an established and popular urban-wild lands outreach and education program that addresses the local manifestations of global environmental change factors.

- With support from NRI's Biology of Weedy and Invasive Species, Montana State University is developing a decision support prioritization framework for non-indigenous lant population management. A prioritization framework will be developed and used to improve management of invasive or non-indigenous plant species (NIS). The basic concept of the framework is that NIS populations lie along a continuum of invasiveness and potential for impact. The development of methods that allow managers to place populations along the continuum forming a prioritization rationale for targeted management will sharply improve the economic efficiency of management and decrease non-target damage.

KA Key Outputs for 2008:

- With support from the National Research Initiative's Biology of Weedy and Invasive Species in Agroecosystems Program, a research team at Mississippi State University has developed a decision support tool that can be used in prioritization of efforts to minimize cogon grass impacts across large expanses of land altered by the storms. The specific aim is to develop a model for predicting occurrence and rates of cogon grass spread as a decision support tool that incorporates remote sensing data and ecological modeling, along with economic valuations, to predict locations most vulnerable to infestation. These locations can then be targeted for prevention, management, or rehabilitation thereby making the most effective use of the limited funds available for recovery. Efforts to fight invasive species have been relatively ineffective, partially because of the large area impacted and the large amount of effort and resources required for control and rehabilitation.

- The Connecticut Agricultural Experiment Station used Hatch funds to examine the hemlock woolly adelgid, an invasive exotic insect, which is killing trees, damaging sensitive ecosystems, and creating hazard situations in forests heavily used for recreation, such as the national parks in southern New England and other areas such as the Great Smoky Mountains National Park, Tennessee/North Carolina. Control methodologies were developed that allow a single soil application of an insecticide to manage the hemlock woolly adelgid over multiple years. The National Park Service has developed a cost

benefit analysis of the hemlock woolly adelgid management program that estimates a benefit over cost of approximately $4 million and a benefit/cost ratio of 8.8 for the Great Smoky Mountains National Park.

KA Key Outcomes for 2008:

- Renewable Resources Extension Act (RREA) funds have provided opportunities for forest and rangeland owners and managers to become knowledgeable about the problems caused by non-native, invasive species on their lands and actively work to control the spread of these species; develop partnerships comprised of private groups such as landowner associations, industry, commodity associations, nongovernmental conversation organizations, and state and federal agencies to develop and deliver educational and technology transfer programs to various audiences. Landowners are recognizing the danger that comes to natural resources from invasive and introduced species. With RREA funds, fourteen universities reached 8,564 participants at 131 events that focused on invasive aquatic plants, the emerald ash borer, and noxious rangeland weeds. Nearly 93 percent of those in attendance left each event feeling as if they had increased their knowledge on the given subject. These landowners represented 107,550 acres where invasive species might impact their resources but over a third of the participants implemented at least one new practice to decrease their susceptibility.

Section III: Secondary Knowledge Areas

Introduction:

The evolving system of environmental and natural resource research encompasses the programs of State Agricultural Experiment Stations, colleges and departments of forestry, 1862, 1890, and 1994 land grant institutions, Hispanic Serving Institutions (HSIs) and other cooperating institutions, including state and private colleges and universities and USDA intramural agencies. These programs are closely linked to and complement the teaching and extension activities of the land-grant and other institutions. At the university level, research programs also are integral to graduate education, through which scientists are prepared to address future scientific natural resources and environment challenges. The agency uses a unique partnership of federal and non-federal, private and public sector and NGOs partners to address issues relating to portfolio programs to ensure the health and well-being of society. Coordination, joint planning and priority setting are accomplished through various national and regional mechanisms to ensure the efficient use of resources, while enhancing productivity and protecting soil, air and water resources quality.

Activities and outcomes described in individual KAs illustrate where the portfolio KAs are contributing to timely, relevant research directed to solving critical problems of national significance. The KA descriptions also point to the interdisciplinary nature of the portfolio and that activities in the portfolio are interlinked with other KAs in the agency, including plant production and protection, food safety, animal production and protection and others.

Among the program areas related to this portfolio, the KA for Economics of Agricultural Productions and Farm Management (KA 601) has had close interactions with the Environmental and Natural Resources Enterprise through the Sustainable Agriculture and Sustainable Development Programs for promoting the concept of sustainability, especially with the Cooperative Extension Systems. Integrated Pest Management Systems (KA 216) through the Manure and Nutrient Management, and Pesticides Programs have partnered with the Water Resources (KAs 111 and 112) of this portfolio in coordinating requests for applications for competitive grants. The Weeds Affecting Plants (KA 213) Knowledge Area has had joint funding collaborations through the Biology of Weedy and Invasive Species programs has partnered with programs under KA 131 (Alternative Uses of Land) , 132 (Weather and Climate) and 136 (Conservation of Biological Diversity. under the competitive grants program. There has also been a strong involvement of the KAs in this portfolio with the Knowledge Area for Communication, education and Information Delivery (KA 903) with interactions between the portfolio NPLs and their colleagues in the Science Education resources Development (SERD) Unit.

Secondary KA Key Activities and Outcomes:

The Environment and Natural Resources (*enr*) Enterprise was created to pull together the secondary knowledge areas into the core portfolio programs form collaborative research

education and extension activities. A highly successful level of interaction has been established between the portfolio and secondary knowledge areas and several strategic initiatives are being planned. The goal of this Enterprise is to support research, education, and extension programs that optimize the production of goods and services from working lands while protecting the environment. Due to complex relationships and feedback among people, ecosystems, and the physical environment, human well-being is inextricably linked to the optimal use and management of the agroecosystems that make up working lands. Relative to space, composition, and functionality, the agricultural, natural, and human components are so highly interdependent that the system of systems has to be studied and managed as an integrated whole. As a result, ecology, socioeconomics, and culture cannot be separated from agricultural, forest, and wildlife productivity, sustainable communities, and environmental health. Viewing working lands as part of an ecological system and a human-dominated, socioeconomic production system yields a broad range of performance criteria, including ecological goods and services, sustainability, resource conservation, food security, economic viability, social equity, and quality of life. Fundamental questions in coupled human-natural systems consider feedback, human design and engineering of ecological processes and whole ecosystems, emergent behavior, and the dynamics of interacting agricultural, natural and socioeconomic systems.

The Global Change and Climate has used the *enr* philosophy to increase public awareness of climate change science and solutions for policy and behavior change. Trans-disciplinary research projects have been funded that incorporate climate adaptive and mitigation strategies for environment and natural resource management. Innovative partnerships between federal, states, academic, extension service, non-governmental and local community organizations have been established to create a scientifically-based, socially consciousness and culturally acceptable endeavor to address climate change issues in the agricultural industry. The Global Change and Climate Program has successfully partnered with other CSREES NRI Program, such as Weedy and Invasive Species, Soils and Managed Ecosystems to co-fund projects with the Department of Energy, NSF, NASA, NOAA and the Environmental Protection Agency. Strategic Planning is conducted with all 14 agencies associated with the US Climate Change Science Program.

Through the principal efforts of James Dobrowolski (USDA-CSREES-NRE), Evert Byington (USDA-ARS) and Ralph Crawford (USDA-FS-Research) communication and coordination across government occurs each month around the subjects of rangeland, grasslands, and pastures. Called the Interagency Working Group for Grazinglands (IWGG), national program leaders from at least four cabinet-level departments (Agriculture, Defense, EPA, Interior) meet to improve cooperation and efficiency, identify potential resource leveraging opportunities, identify resources for multidisciplinary teams, provide suggestions for long-term efforts at landscape scales, and continue to promote standardization of monitoring and assessment practices.

Section IV: Portfolio External Panel Recommendations

Relevance

Scope: Describe what the portfolio can provide in terms of coverage of work with the available funds

2005 Panel Recommendation: Reallocate resources from terminated programs to emerging programs.

Portfolio Response in 2009:
NRE Portfolio Programs are in the process of implementing the new 2008 Farm Bill that includes adapting to and understanding the new Agriculture and Food Research Initiative (AFRI) as well as new mandatory funding such as the Beginning Farmer and Rancher Development Program (BFRDP, Dobrowolski) and the Biomass Research and Development Initiative Competitive Grants Program (BRDI, Cassidy).

The CEAP program in partnership with USDA NRCS was redirected to focus on grazing lands, representing issues on over 50% of the U.S. land base. The program funded projects that evaluated the effects of grazing land conservation practices, especially with respect to understanding how the suite of conservation practices, the timing of these activities, and the spatial distribution of these practices throughout a watershed influence their effectiveness for achieving locally defined watershed health goals.

The Rangeland Research Program (RRP), managed as part of the NRE Portfolio, has goals that involve contributing to the improvement of U.S. rangeland resources and the ecosystem services they provide by supporting the development of new and emerging rangeland science methodologies which specifically address the interrelationships between multiple disciplines. The primary purpose of RRP is to provide U.S. agricultural producers, rural landowners, and land managers with integrated science strategies to make informed land management decisions with an emphasis on enhancing the restoration and sustainable integrity of rangelands.

Portfolio Response in 2008:
NRE Portfolio Programs have promoted the transformation of ways that working lands are managed by raising the environmental literacy of people that work the land, decision and policy makers, and that engage the general public. As part of the Environmental and Natural Resources Enterprise, existing portfolio programs emphasize systems levels approaches to natural resource management, and will be establishing a competitive extramural program call “Long-term Agroecosystem Program-LTAP” focusing on the economic, cultural and ecological aspects of soil carbon management. This program emphasizes team approaches to solving problems using interdisciplinary rather than disciplinary methodology and recognizes he knowledge related to biophysical dimensions of agroecosystems is useful only if people choose to use this knowledge to guide their actions.

Portfolio funds were allocated for research to estimate the seasonal and temporal distribution of emissions released from cropland burning in the contiguous U.S., using satellite and ground based observations Crop residue burning is an important land use practice in the U.S. On average 12% of all fires detected by the MODIS satellite in the contiguous U.S. are agricultural fires. These fires are a source of trace gas and particulate emissions and affect local and regional air quality. These estimates will support the improvement of the Environmental Protection Agency's National Emissions Inventory. The research will provide significant contributions to understanding the Nation's air quality by providing spatially and temporally explicit emission data from cropland burning. In addition, this research could be used as a prototype for an operational system to monitor agricultural burning, fire management practices, and associated air quality.

Portfolio programs have been working with NRCS to develop a grant program to address effects of conservation practices on watershed health in grazing lands. The grant program will be modeled after the successful Conservation Effects Assessment Program (CEAP) for watersheds – combining biophysical research with socio-economic research and an outreach/extension program to ranchers. The focus will be on determining the effects of NRCS conservation practices on watershed health including hydrology, soil quality, plant community dynamics, and other ecosystem services.

Portfolio Response in 2007:

The ECOP Forestry Task Force published an RREA strategic plan for FY 2005-2009 in April 2005. The plan was a direct outcome of a strategic planning effort that involved nearly 100 people from more than 45 land grant universities. The plan is unique in that it provides focused, strategic direction for a formula-funded program that heretofore was conducted across a very large range of issues with little focus.

New NRI research projects under the CSREES Global Change and Climate Program are developed in collaboration with NASA and other US federal agencies on the terrestrial carbon cycle. This program was initiated in 2004 and since then twelve projects have been funded directly by CSREES and twenty agriculture related projects were funded by collaborating federal agencies. Projects focus on emerging programs that identify the size, variability, and potential future changes to reservoirs and fluxes of carbon within the agricultural and forest ecosystems and provide the scientific underpinning for evaluating options to manage carbon sources and sinks. These projects contribute to the US Climate Change Science Program and the US Global Change Research Program. New collaborations for funded projects were made in 2007 with the US Environmental Protection Agency and NASA. The Global Change and Climate Program anticipates funding four projects from each collaboration and an equivalent number from the collaborating agency.

Portfolio Response in 2006:
The Renewal Resources Extension Act (RREA) program, through the National Focus Funds has awarded grants to address the issue of forest fragmentation, parcelization and conversion. This

represents an expansion beyond typical programs, issues and audiences that heretofore comprised the RREA program conducted by 72 institutions. This is an emerging issue for the nation's private forest lands and is one that requires attention by locally elected and appointed officials who make land use decisions. This is a reallocation of funds from a program with a traditional focus to an issue of contemporary importance.

Several National Programs Leaders with natural resources and environmental portfolios are engaged in the strategic planning and resource allocation under various CSREES competitive programs such as the National Research Initiative (NRI).

Focus: Demonstrate portfolio ability to remain focused on issues, topics and critical needs of the nation.

2005 Panel Recommendation: Balance national needs and regional priorities.

Portfolio Response in 2009:
Over the past six years, NRE Portfolio Programs funded research in Texas and Kansas to measure air emissions from cattle stock yards and to evaluate practices to mitigate these emissions. Texas and Kansas account for 42 percent of the cattle fed in the U.S.

NRE Portfolio Programs funded an extension grant that integrates forest cover and forest fragmentation issues into educational programs for local land use decision-makers in the U.S. Twenty five educators representing NEMO programs in eleven states participated in the Forest Resource Education for Municipal Employees (FREMO). Several of these program are working to adapt these materials to their states.

Portfolio Response in 2008:
Portfolio research programs have focused on regional priorities related to food production. Organically produced foods and food products are perceived among consumers as better for them and the environment than are those produced with conventional inorganic inputs. However, there is a potential for inadvertently contaminating food produced in amended soil with foodborne pathogens. Organic soil amendments include biosolids, animal and plant wastes. These amendments can enhance soil quality – including water holding capacity, bulk density and carbon sequestration. In Hawaii, (Special Research Grant) investigators view organic production of sweet corn as a means of reducing the high cost of importing farming materials and supplies so they are utilizing locally made compost materials and arbuscular mycorrhizae. The investigators hope to determine the most beneficial rate and type of amendment and microbial interactions for crop production. On the other hand, scientists in Delaware (NRI funded) are using molecular techniques to determine the fate and transport of the foodborne pathogens in amended soil. This is critical because understanding the survival behavior of foodborne pathogens will help determine the factors controlling the fate and transport of viruses in agricultural systems. These are two examples of several portfolio research projects that demonstrate the interconnected of soil and water quality and therefore the importance of

appraising soil resources (KA101), watershed protection (KA112) and management and waste disposal, recycling and reuse (KA403).

The portfolio covers the management of a number of projects monitoring agricultural emissions, such as NRSP-3 (National Research Support Project) which contributes to and manages the federal monitoring budget for the National Atmospheric Deposition Program (NADP). The National Trends Network (NTN) of NADP monitors the chemistry of precipitation at over 250 locations across the U.S. This program has been actively monitoring wet deposition for more than 25 years and has been integral to the U.S. acid rain program. NTN was created by the Agricultural Experiment Stations with Hatch multi-state research money. The multi-state research committee then became NRSP-3. Now eight other federal agencies and numerous state and private entities contribute more than $3 million/yr to support this important monitoring activity while USDA's contribution through the experiment stations is approximately 25 percent of that amount. NTN has played a significant role in documenting the impact of the CAA on sulfur emissions. Results indicate that sulfate emissions have significantly decreased over the past twenty years in the Northeast primarily from regulating sulfur emissions from coal-fired power plants. This project has also had an extensive outreach objective. The project collects wet deposition data and disseminates data and derived data products to the research community and to the general public.

Recent satellite images show that hurricanes Katrina and Rita killed or severely damaged 320 million trees in Mississippi and Louisiana, a previously unrecognized ecological disaster made even worse by several fast-growing invasive species that opportunistically are moving into the disturbed forests. One species with the most potential to do damage is cogon grass, a relative newcomer and possibly the greatest emerging threat to southeastern forests. Since 2005 over $500 million federal dollars have been appropriated to help Gulf Coast landowners replant damaged forests and fight the invasive species. The efforts to fight invasive species have been relatively ineffective, partially because of the large area impacted and the large amount of effort and resources required for control and rehabilitation. With support from the Biology of Weedy and Invasive Species in Agroecosystems Program a team of scientists at Mississippi State University are developing decision support tools that can be used in prioritization of efforts to minimize cogon grass impacts across large expanses of land altered by the storms. The specific aim is to develop a model for predicting occurrence and rates of cogon grass spread as a decision support tool that incorporates remote sensing data and ecological modeling, along with economic valuations, to predict locations most vulnerable to infestation. These locations can then be targeted for prevention, management, or rehabilitation thereby making the most effective use of the limited funds available for recovery.

Portfolio Response in 2007:
The *enr* Enterprise is establishing a business strategy to address long-term priorities that cut across programs and disciplines. The concept of working lands has been developed as part of the vision to address issues of the portfolio of national and regional levels.

The 1890 Capacity Building Program currently covers several Strategic Goal 6 Knowledge Areas, especially in the areas of soil, air and water. National Program Leaders of this portfolio were involved in the review process of applications for funding in 2007. In this cycle twelve research projects were funded totaling $6 million and thirty teaching projects were funded totaling the same amount. The projects are aimed at strengthening the institutional capacity of the 1890 institutions to improve their research and teaching capabilities.

The Extension Committee on Organization and Policy (ECOP) Forestry Task Force along with portfolio NPLs provided strategic guidance for the Renewable Resources Extension Act (RREA) program by reviewing current issues that necessitate an education approach, how the funds are allocated, and making recommendations for investments in projects of nationwide importance via the National Focus Funds.

The National Integrated Water Quality Program (NIWQP) continued to address national and regional needs to complement the locally-defined needs addressed by research funded through the Hatch Act Program. In 2007, CSREES through the NIWQP, in cooperation with the Natural Resources Conservation Service, held a grant competition to fund a project that would provide a synthesis of lessons learned from the Conservation Effects Assessment Project (CEAP) Competitive Grants Program. This synthesis will explore similarities and differences among watershed scale projects attempting to determine the link between implementation of conservation practices and water quality.

Portfolio Response in 2006:
All portfolio programs, such as the National Integrated Water Quality Program, have established a set of priorities for integrated research, education, and extension projects. These priorities change approximately every three years to reflect current priorities within the water resources program and the water research, education, and extension, community. Twelve projects were funded through this program covering areas such as the development of fact sheets to educate real estate professionals to developing new techniques to disinfect drinking water.

All National Research Initiative programs handled by NRE NPLs have 5 to 10 year goals that are mentioned in the annual Request for Applications. The goals are developed and reviewed through a program development team that is focused on environment and natural resources issues. Logic models are used extensively in the strategic planning process and incorporate stakeholder information from various forums. National Program Leaders play an active role in acquiring stakeholders input through review panels, society meetings, federal agency counterparts and scientific steering groups.

Emerging Issues: Identify contemporary and/or emerging issues that are consistent and relevant to the portfolio and its mission

2005 Panel Recommendation: Identify emerging issues by identifying “emerging stakeholders”.

Portfolio Response in 2009:
The portfolio has made significant efforts to increase the participation of emerging stakeholders such as those engaged in the social sciences, politics and economics of agriculture. Portfolio NPLs partnered with several land-grant universities and the Farm Foundation to co-sponsor a pre-conference workshop entitled, “Fundamentals of Spatial Economics” in July at the 2007 American Agricultural Economics Association (AAEA), the West Agricultural Economics Association (WAEA), and the Canadian Agricultural Economics Association (CAEA) Joint Annual Meeting in Portland, Oregon. AAEA and CAEA are the national flagship organizations of the agricultural and resource economics professionals in the U.S. and Canada, respectively; while WAEA is one of the four regional organizations in U.S. This workshop provided an introduction to foundational work in spatial economics. Five internationally renowned scholars from the U.S., New Zealand, and Canada were invited to present their long-term research results on spatial dynamic issues, such as migration-induced landscape change, amenity-driven urban/suburban development, and firm location behavior. Over 90 people, including 20 graduate students, attended this workshop.

Portfolio NPLs solicit stakeholder input through various mechanisms including request through individual program RFAs, and through participation of NPLs in numerous external activities including representation on multi-state committees, attending national and international scientific society meetings, and participating in work groups that include federal, state, and private sector personnel. It is through stakeholder involvement that the Protection and Management of Air Resources (KA 141) in general and specifically Air Quality based on agricultural emissions of ammonia was identified as an emerging issue. The agency’s Air Quality program, which requires that all funded projects integrate research, education and extension activities, is funded through the NRI. The same process resulted in the establishment of the Conservation of Biological Diversity knowledge area (KA 136).

The portfolio has successfully expanded the eXtension system through the eXtension Web site. One of the goals of eXtension is to develop a coordinated, Internet-based information system where customers will have round-the-clock access to trustworthy, balanced views of specialized information and education on a wide range of topics. For customers, the value will be personalized, validated information addressing their specific questions, issues, and life events in an aggregated, non-duplicative approach. Information on the eXtension Web site is organized into Communities of Practice (COP). COPs from emerging stakeholders are currently being sought and developed, e.g. for Climate change and Sustainability. Each COP includes articles, news, events, and frequently asked questions. The information comes from Land-Grant University System faculty and staff experts. It is based on unbiased research and undergoes peer review prior to publication. Current COPs are organized around a many topics, including but not limited to diversity, entrepreneurship, agrosecurity, cotton, dairy, and more.

Portfolio Response in 2007:
Several new collaborations with SERD have been established. Two of the eight FY 2006 Targeted Expertise Shortage Areas (TESA) were Natural Resources and Environment areas, particularly in forest ecosystem health and restoration; and Agricultural Systems and Natural Resources Engineering, especially in wood and fiber engineering. This collaboration addresses emerging stakeholders in these areas who are involved with education and capacity building in addition to the traditional science stakeholders.

Supported by RREA funding, the Sustainable Management of Rangeland Resources team has developed and filmed spots on over 120 topics. RREA helps to fund the development and delivery of rangeland monitoring workshops in Wyoming including four Range College 101 and 301 workshops with curricula which includes, general range education, assessment and monitoring, rangeland grazing management, rangeland manipulation, water quality and hydrology, and irrigated pasture topics. The objective of these efforts is to expand cooperative monitoring programs between public land management agencies and livestock grazing on federal lands with over 644 producers and agency personnel participating annually.

Portfolio Response in 2006:
A majority Air Quality stakeholder is the USDA Agricultural Air Quality Task Force that provides national needs. The total CSREES air quality portfolio (formula, special grants and competitive) has given presentations to the taskforce. The NRI Air Quality Program emphasis areas that are closely aligned to the task force recommendations. Eleven projects with a total cost of $5 million were funded during this time covering areas such as physical, chemical and biological characterization of particulate matter from livestock buildings to gaseous productions from swine waste storage.

Integration: Demonstrate functional integration of CSREES research, extension and education efforts in the portfolio.

2005 Panel Recommendation: Better integrate research, education and extension into projects and programs.

Portfolio Response in 2009:
Under the new AFRI, the NRE Portfolio Programs Air Quality, Biology of Weedy and Invasive Species in Agroecosystems, Managed Ecosystems, and the SAS-LTAP are integrated programs across research, education or extension.

Portfolio Response in 2008:
Through the efforts of portfolio NPLs and the RREA program, a project on Forest Resource Education for Municipal Official was established. The University of Connecticut is working with the Nonpoint Education for Municipal Officials (NEMO) to develop FREMO or Forest Resource Education for Municipal Officials. This is an on-going effort to integrate issues related to forest conversion, fragmentation, and parcelization into the decision-making process regarding

community land-use choices. FREMO is seeking to assist municipal officials understand the importance of balance between the need for urban development and a sustainable forest system.

The RREA program has also supported the National Extension Program Development and Planning for Forest-based Bioenergy Extension Program. Extension personnel at Michigan State University is recruiting a panel of natural resource experts to identify, analyze, and prioritize the gaps in extension programming for cellulosic biomass use, development, and management from forests. Their outcome will be a strategy for extension programming that will be based on evaluation of current bioenergy programs, adaptable for the needs of regions, scalable, and testable.

The Conservation Effects Assessment Project (CEAP) has been an on-going and successful collaboration between the portfolio and USDA's Natural Resources Conservation Service (NRCS). Through the portfolio, CSREES is mobilizing land grant universities, focusing research and extension efforts on determining the effects of conservation practices on water quality. The 13 watershed projects jointly funded by CSREES and NRCS serve as examples of collaborative work between land grant universities and NRCS. These watershed projects are unique in that they combine evaluation of the biophysical effects of conservation practices and the socio-economic context of the watershed location. The watershed projects also combine research and extension/outreach activities – involving agricultural producers in project outcomes. The CEAP Project has developed substantial capacity within the land grant university system to increase the understanding of effects of conservation practices and the effectiveness of conservation programs.

The portfolio manages the funds for the National Center for Manure and Animal Waste Management. This is a unique multi-disciplinary program that addressed a wide variety of environmental, economic and social concerns. It consists of 16 universities across the U.S. and a Policy Advisory Committee. The Center is supported under the Fund for Rural America Program. Using a systems approach that integrated technologies across species and regions, Center efforts supported sustainable animal production practices that reduce environmental risks and meet public needs and concerns. Center efforts have emphasized the development and dissemination of knowledge and technology that support sustainable, profitable and internationally competitive animal production and also protect community interests and environmental quality. Working with producers, agribusiness and policy makers, the Center fused interdisciplinary research, extension and education activities to produce a holistic understanding of animal waste and manure production and management.

Portfolio Response in 2007:
The Water Quality Program had been successful in program integration through its partnerships. For example, through the Rutgers Cooperative Extension-Water Resources Program (WRP), the portfolio oversees 11 watershed research projects in New Jersey; the majority of which are sponsored by a State or Federal grant. As part of the Regional Water Coordination Program's Watershed Management Priority Area, the RCE-WRP has enhanced these efforts by directing extension programming and educational (graduate and undergraduate) efforts into these same

watersheds. The same is true in New York, where watershed research projects have been enhanced by providing training to targeted stakeholder groups. In the Virgin Islands, new curriculum and student research activities have been designed around an existing watershed study. This synergistic effort of integrating research, education and extension projects within a watershed has the best potential for truly making a difference in the quality of life of the residents in that watershed.

The NIWQP continued to fund watershed projects that integrate research, education, and extension activities within a single project. Each watershed project is required to have interrelated research, education, and extension objectives. These integrated watershed projects include stakeholder participation in design and implementation of research and extension components of the project. Students are actively engaged in the project through training and new curriculum development. Since 2005, 20 integrated watershed projects have been funded through the NIWQP and 13 integrated research and extension projects have been funded through the CEAP grants program.

Portfolio Response in 2006:
The NRI air quality program is fully integrated. All proposals submitted to this program integrated research with education or extension. An integrated extension and education proposals was funded for a national workshop on agricultural air quality. Eleven projects with a total cost of $5 million were funded during this time covering areas such as physical, chemical and biological characterization of particulate matter from livestock buildings to gaseous productions from swine waste storage.

The Biology of Weedy and Invasive Species in Agroecosystems committed at least a third of its annual budget to integrated research, education and extension projects. Out of 17 projects with a total budget of $4.6 million, 4 projects were integrated.

Multidisciplinary: Demonstrate multidisciplinary balance of the portfolio in solving scientific problems.

2005 Panel Recommendation: Increase integration of social and policy science into projects.

Portfolio Response in 2009:
The portfolio NPLs have been working with NRCS to develop a grant program to address effects of conservation practices on watershed health in grazing lands. The grant program will be modeled after the successful CEAP watersheds program – combining biophysical research with socio-economic research and an outreach/extension program to ranchers. The focus will be on determining the effects of NRCS conservation practices on watershed health including hydrology, soil quality, plant community dynamics, and other ecosystem services.

Scientists leveraged CSREES formula grants with a grant from the National Commission on Energy Policy and collaborated with a group of researchers to study how climatic changes would likely alter stream-flow patterns, ensuing hydrographs, and thus the potential impacts on

economic productivities in the Rio Grande valley in New Mexico. Using a hydro-economic model, i.e., RioGEM, that depicts the physical, economic, and institutional characteristics of the Upper Rio Grande watershed across both time and space, scientists assessed the potential consequences affecting the region's water uses under three climate change scenarios, such as wet, middle, and dry conditions.

Portfolio Response in 2008:
Through the leadership of the National Program Leaders of the portfolio, the CSREES Social Science Academy was established specifically to increase integration of so0ical and policy science into projects. Portfolio related issues include; Developing carbon markets, watershed market trading and other ecosystem services scenarios taking into consideration the legal pillars upon which those new ideas rest; Ensuring consumer protection while developing new "trading" schemes; Analyzing how new policies designed to enhance ecosystem services affect individual's contract and property rights as well as their liabilities associated with land ownership; and determining the economic value on ecosystem services.

CSREES has been leading the effort to translate science into practice for the conservation process under the Conservation Effects Assessment Program. This work will entail linking biophysical, economic, social, and behavioral sciences to achieve environmental goals. The projects are using pilot watershed studies to strategically locate conservation practices in critical areas that will yield the greatest impact. The projects are focused on communicating results to decision-makers at the watershed, state, and national scale to improve the effectiveness of conservation programs.

Portfolio funded scientists are evaluating the "Economic Linkages between Coastal Wetlands and Water Quality: A Review of Value Estimates Reported in the Published Literature." They have set out to: 1) document the current status of knowledge concerning the economic value of the water quality services generated by coastal and other wetlands; 2) provide a brief overview of the theoretical economic linkages between wetland ecosystems and water quality as a basic framework for understanding why specific variables and measurement methods are of interest; and 3) outline common methods used to value the water quality services of wetlands, along with their major advantages and disadvantages. An output of the project is a systematic and concise compendium of theoretical and technical information on estimating the economic value of wetlands' environmental services for water quality. The importance of geographic location, and the specific use demand, on water quality service value suggests that coastal wetland benefits should be carefully examined within a spatially disaggregated context. This comprehensive information will help enrich policymakers about the relative benefits and costs of different strategies in natural resource management such as to restore or preserve wetlands for improving water quality.

Portfolio Response in 2007:
The Global Change and Climate program has conducted joint solicitations with other federal agencies emphasizing societal impacts of land-use and land-cover change and management

strategies for carbon mitigation. A total of three projects from each of the above topic areas were funded and were highly multidisciplinary in nature.

Using the concept of working lands, the *enr* Enterprise will integrate agricultural, natural and human components. Working lands explicitly includes humans as an integral part of the system, not something apart from it. The ability to study, design, manage, evaluate and understand such hybrid systems requires an integrated, long-term, and interdisciplinary examination of biogeochemistry, energy transformations, biological processes and socio-economic relationships. Viewing agriculture as part of an ecological system as well as a human dominated socio-economic system produces a broad range of performance criteria including ecological goods and services, sustainability, food security, economic viability, resource conservation, social equity, as well as increased production. The *enr* vision will be used in the planning of future competitive research focus areas for all portfolio programs.

Portfolio Response in 2006:
The Integrated Water Quality Program included social and economic sciences in two program areas – Conservation Effects Assessment Project and the Integrated Water Quality Program. These priority areas for research, education, and extension were aimed at improving understanding of social and economic factors affecting behavior change among water users.

The portfolio has subscribed to the use of "agroecology" as an overarching theme in the NRI to integrate agricultural, natural and human components. Viewing agriculture as part of an ecological system as well as a human dominated sociological and economic system produces a broad range of performance criteria, including ecological goods and services, sustainability, food security, economic viability, resources conservation, social equity as well as increased production.

Quality

Significance: Demonstrate generation of significant findings in the portfolio.

2005 Panel Recommendation: Establish metrics to evaluate productivity and impacts from formula, competitive and appropriated funding.

Portfolio Response in 2009:
Metrics for formula funding were developed as part of the Plan of Work reporting system.

Portfolio National Program Leaders established project director annual meetings in Rangeland and Grassland Ecosystems (RGEP) funding lines for the Rangeland Research Program and CEAP at the Society for Range Management Meetings. RGEP PDs present their findings and undergo public review of their research, education and extension efforts.

Portfolio Response in 2008:
The McIntire-Stennis Cooperative Forestry Research Program created its strategic plan which establishes the guiding principles for forestry research, education and extension. The strategic plan identified seven new areas of knowledge and specific action and performance measures that cover science integration, ecosystem services, human interactions, decision making technology, forest products and urban ecosystems. This is unique for a formula funded program that was established over 45 years ago.

Under the Renewable Resources Extension Act Program, each institution that receives RREA formula funding is required to submit an annual progress report. This report must include Quantitative Indicator Data. This information captures the quantitative impact that an institution's RREA program produces; number of educational events, acres impacted, etc. This report is then combined with reports from all institutions to demonstrate the national impact of RREA. Due to the demanding nature of data-collection, each institution is encouraged to allocate 8-10 percent of their RREA program funds to program evaluation.
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Through the principal efforts of portfolio NPLS and colleagues at the Agricultural Research Service and Forest Service, increased communication and coordination across government has occurred each month around the subjects of rangeland, grasslands, and pastures. Called the Interagency Working Group for Grazinglands, national program leaders from at least four cabinet-level departments (Agriculture, Defense, EPA, Interior) meet to improve cooperation and efficiency, identify potential resource leveraging opportunities, identify resources for multidisciplinary teams, provide suggestions for long-term efforts at landscape scales, and continue to promote standardization of monitoring and assessment practices.

Training on Logic Model, Program Evaluation and Multi-state Programming was conducted in January 2008 as a joint effort between NRE and the CSREES Office of Planning and Accountability. Eighteen Faculty members from land grant and non-land grant representing urban forestry and outdoor recreation were trained. This training resulted in the formation of 2 multi-state projects in urban forestry and outdoor recreation with funding from McIntire-Stennis. The participants eventually formed their own network which facilitated their collaborative work in their respective multi-state project and also in grants application. A second similar training was conducted in April, 2008. Nineteen participants from 1890 and 1862 land grants, Forest Service and Agricultural Research Service were trained. A multi-state project in agroforestry is being developed led by the University of Missouri and co-led by Auburn University and University of Virginia. The University of the District of Columbia and 4 1890 institutions (Alcorn State University, Southern University, Tennessee State University and Alabama A&M) are participating using Evan-Allen funds. The University of the District of Columbia has started initiating agroforestry projects in forest farming and alley cropping on its University farm.

Portfolio Response in 2007:
The air quality program has been holding annual all investigator meetings to document progress on project objectives and held an international workshop to set science baselines for agricultural

emissions and known practices that reduce or mitigate emissions. The latest workshop published a 1300 page proceeding of the scientific presentations.

Metrics for portfolio knowledge areas continue to be defined to better address outputs and outcomes. These metrics are part of the *enr* vision and strategic plan to develop trans-disciplinary research programs that integrate with education and extension components. Monthly seminars are held presenting various *enr* subject areas to better define metrics for impacts. In addition, National Research Council studies have also been used to define the *enr* metrics. These metric are expected to be implemented in 2009.

Portfolio Response in 2006:
A considerable set of program impacts was developed through the Integrated Water Quality Program Impacts Report. This report includes research, education, and extension impacts and outcomes. The CSREES-NRCS CEAP Competitive Grants Program has funded 13 watershed-scale integrated (research and outreach) projects that evaluate the effects of conservation practices on water resources. This program focuses on understanding how the suite of conservation practices, the timing of these activities, and the spatial distribution of these practices throughout a watershed influence their effectiveness for achieving locally defined water quality goals.

Stakeholder Input: Demonstrate stakeholder/constituent input to the portfolio.

2005 Panel Recommendation: Expand stakeholder community to include under-served and urban populations.

Portfolio Response in 2009:
The Water Reuse in Agriculture: Ensuring Food Safety conference linked urban water users, producers and distributers to rural agriculture through irrigation system issues. This conference explored areas of challenge that require additional research and investigation.

Using McIntyre-Stennis funding, Auburn University's Forestry and Wildlife Sciences Department estimated the impacts of the impacts of urban trees and landscaping on tourism. They identified research methodologies and effective approaches to address this issue. The attributes of trees and landscape contributing the esthetics of cities have been investigated and analyzed. Personal perceptions and attitudes to city beatification also were evaluated. Some theoretical and philosophical aspects on the relationship between aesthetics, landscape ecology and culture have been explored. Surveys gathered important information concerning the perception and attitudes towards aesthetics of landscaping and the natural environment throughout Alabama. Results reflected the contribution of aesthetics on tourism and community sustainable development.

Auburn University's School of Forestry and Wildlife Sciences studied southern forest ecosystem growth and function as affected by stresses induced from changes in both the physical and chemical climate of the Earth, especially in urban areas. Determining the extent and magnitude

of damage caused by atmospheric pollutants is thus extremely important. The study quantified the structure, function, and economic value of the urban forest in a small, rapidly expanding municipality (Auburn, Alabama) in the southern United States. Results provided a fundamental understanding of the structure and functioning of several ecosystem types in the southern U.S. and also responses to various environmental stresses such as air pollution and climate change. In addition, certain ecosystem services were to be quantified. These results also provided information to decision makers so adequate protective standards could be developed.

Portfolio Response in 2008:
Through the RREA program, 298 educational events by 12 universities targeted their outreach efforts towards underserved populations and minority landowners and managers. There were 1,463 minority participants in these events representing 49,412 acres. Over a third, 491 participants, implemented at least one new practice on the lands. These 12 universities also identified 73 minority members as participating on their extension advisory committees.

The portfolio National Program Leaders have been actively engaged in their role as CSREES liaisons to land-grant institutions. All site visits include discussions on how the land-grant institutions fulfill the role in addressing the needs of under-served and urban populations. The needs of each state under this issue are also reviewed the NPLs through the state reports and plans of work submitted by each land-grant institution they handle.

National Program Leaders (NPLs) collaborated to develop and support a new program to increase HSI participation in the National Research Initiative (NRI) Grant program. The project will connect top agricultural researchers with students and faculty from HSIs. The project will also work to prepare students from typically unrepresented and underserved groups for careers in agricultural sciences, nutrition, engineering, and technology.

The portfolio is engaged as a member of the Interagency Arctic Research Policy Committee which was formed by Congress to establish the research policies and agenda for the Arctic Region. Current focus is on indigenous peoples and languages in the Arctic, specifically the State of Alaska.

Portfolio Response in 2007:
Two new multi-state projects were established in the Northeast US to address Urban Forestry and Wood utilization. Another new multi-state project was established in the North Central US to address agroforestry issues in that region. Another new multi-state project in the North Carolina Region will focus on the ecological footprint of animal production systems.

The Global Change and Climate Program adopted the US Climate Change Science Strategic Plan which undertakes periodic consultation with a broad community of stakeholders in formulating its activities and in the development of synthesis and assessment products for a growing agricultural community, including those in rural areas as well as managed forests.

Portfolio Response in 2006:
The Water Quality Program has focused its efforts to address the needs of urban populations through its Agriculture Water Security Initiative. A workshop was held where participants representing six key areas of water resource management identified how USDA can improve and charted a potential course for research, education, and economics within the six areas to increase water availability for agriculture, human consumption, and economic growth.

Underserved or underrepresented audiences also were a special focus of the Integrated Water Quality Program. Through this focused effort, grants were awarded to a Tribal Community College (Salish Kootenai) and a historically black university (Tennessee State) to facilitate increased capacity among scientists and educators at these institutions. The ultimate goal of these awards was to improve efforts to reach under-served audiences among minority and Native American agricultural producers.

Alignment: Demonstrate portfolio alignment with current state of science-based knowledge and previous work.

2005 Panel Recommendation: Establish strategic planning that addresses emerging issues and align with other USDA efforts and other federal agencies.

Portfolio Response in 2009:
Natural Resource and Environment National Program Leaders (NPLs) used program funds to garner stakeholder inputs through a systematic planning process by (1) convening a National Steering Committee comprised of 30 multi-disciplinary cross-section leaders in land-grant universities and federal agencies, and (2) conducting roundtable discussions at various national professional conferences, including Northeast Recreation Research Symposium, International Symposium on Society and Resource Management, and Society of American Foresters. The workshop increased the awareness of the dynamic and complexity of natural amenity-based recreation issues; fostered the interaction among multi-disciplinary researchers, educators, and practitioners; and enhanced cooperation with various federal agencies, including USDA-Economic Research Service, USDA-Forest Service, National Oceanic and Atmospheric Administration's Sea-grant Programs, National Park Service, National Institute of Health, U.S. Fish and Wildlife Service, Bureau of Land Management, and U.S. Army Corps of Engineers. A five-year strategic plan brochure, *Outdoor Recreation Research and Education for the 21st Century* (http://www.csrees.usda.gov/nea/nre/pdfs/orre_strategic_plan.pdf), was developed based on the stakeholder input. One direct outcome of this process is the formulation of a multi-state coordination committee, NECC 1011 (http://www.nimss.umd.edu/homepages/home.cfm?trackID=10676), which will help develop multi-disciplinary research/education/extension activities.

Portfolio National Program Leaders used program funds to elicit stakeholder input to identify new and emerging issues in both Rangeland and Grassland Ecosystems and Water Availability by holding an Extension Family Meeting at the Society for Range Management annual meetings

and by convening breakout sessions at the Water Reuse in Agriculture: Ensuring Food Safety conference, respectively.

Portfolio Response in 2008:
Portfolio National Program Leaders were involved in the creation of the USDA strategic plan for bioenergy and are working on a strategic plan for global change and climate. Portfolio National Program Leaders were also involved in the preparation of USDA lead US Climate Change Science Program Synthesis and Assessment Product on the Effects of Climate Change on Agriculture, Land, Water and Biodiversity.

Portfolio National Program Leaders were involved in the preparation of the US Climate Change Science Program's Scientific Assessment of the Effects of Global Change on the United States and the Revised Research Plan for the U.S. Climate Change Science Program. The assessment summarizes and integrates recent findings from several Synthesis and Assessment Products of the U.S. Climate Change Science Program as well as from assessments of the Intergovernmental Panel on Climate Change. Analyzing current and future trends in climate for the United States, the report assesses the present understanding of the impacts of climate change on key sectors of the Nation, such as water resources, transportation, agriculture, ecosystems, and human health.

The portfolio is mobilizing land grant universities, focusing research and extension efforts on determining the effects of conservation practices on water quality. The 13 watershed projects jointly funded by CSREES and NRCS serve as examples of collaborative work between land grant universities and NRCS. These watershed projects are unique in that they combine evaluation of the biophysical effects of conservation practices and the socio-economic context of the watershed location. The watershed projects also combine research and extension/outreach activities – involving agricultural producers in project outcomes.

NRE NPL James Dobrowolski, National Program Leader co-authored "Which Direction Is Forward: Perspectives on Rangeland Science Curricula" (*Rangelands 29:40-51*), addressing national curricular issues and future scientist training—both part of the critical issue portfolios of CSREES's Rangeland and Grassland Ecosystems Program and the Society for Range Management. Dobrowolski and NRE NPL Michael O'Neill co-authored as part of a multi-agency writing team "A Strategy for Federal Science and Technology to Support Water Availability and Quality in the United States" (*NSTC CENR OSTP*). Dobrowolski also authored "Putting Science into Action: From Washington State Community-based Outreach to National Programming in Washington DC" (*National Research Council, National Academy of Science Agricultural Water Management Report*). This widely circulated Federal Strategy will guide water research priorities and formulates a federal science strategy for the next decade. The Agricultural Water Management Report was distributed world-wide.

Portfolio Response in 2007:
Agency education programs have aligned the disciplines targeted for funding with the strategic plans of the *enr* Enterprise. For example, the 1890 Capacity Building Grants and the National

Needs Fellows Programs focused on Soil, Air, Water, Forestry and related Natural Resources disciplines

The Global Change and Climate Program has aligned its objectives to match those of the US National Climate Change Implementation Plan and continues to support emerging issues relevant to agriculture in collaboration with other US federal agencies.

CSREES National Program Leaders for the Water Program were part of a team of federal agencies that developed "A STRATEGY FOR FEDERAL SCIENCE AND TECHNOLOGY TO SUPPORT WATER AVAILABILITY AND QUALITY IN THE UNITED STATES". This report outlines a strategy for federally funded research and education activities to address water resources issues in the United States. The CSREES Water Program currently focuses on critical water issues identified in the strategy including: detection of pathogens, human dimensions of water resource management, and expanding water availability through new technologies.

Investigators funded through the NRI Water and Watersheds program meet during the CSREES National Water Conference where national, regional, and watershed scale projects discuss research, education, and extension program outcomes and impacts on water resources. The conference provides a forum for improving alignment of research (NRI) with integrated (NIWQP) activities in the CSREES Water Program.

The National Water Program, through the Committee for Shared Leadership for Water Quality, is sponsoring a meeting in Reno, NV in 2008 where Regional Water Quality Coordination Projects will meet with water-focused Multi-State Committees funded through the Hatch Act. This meeting will begin the alignment of formula-funded research with projects funded through competitive grants of the NIWQP.

Portfolio Response in 2006:
The Conservation Effects Assessment Project competitive grants program was jointly managed by CSREES and NRCS. Discussion with NRCS is underway to explore reallocation of the resources committed to this effort.

The Global Change and Climate Program has consistently collaborated with other federal agencies in preparing joint solicitation under a competitive grant process, which addresses critical needs identified by the US Climate Change Science Program. These areas include land use and land cover change, the global carbon cycle and ecosystem dynamics.

Through the principal efforts of James Dobrowolski (USDA-CSREES-NRE), Evert Byington (USDA-ARS) and Ralph Crawford (USDA-FS-Research) communication and coordination across government occurs each month around the subjects of rangeland, grasslands, and pastures. Called the Interagency Working Group for Grazing Lands, national program leaders from at least four cabinet-level departments (Agriculture, Defense, EPA, Interior) meet to improve cooperation and efficiency, identify potential resource leveraging opportunities, identify

resources for multidisciplinary teams, provide suggestions for long-term efforts at landscape scales, and continue to promote standardization of monitoring and assessment practices.

Methodology: Demonstrate use of appropriate and/or cutting edge methods and techniques for funded projects.

2005 Panel Recommendation: Implementation of on-line formats and interactive teaching methods as appropriate for target audiences for delivery of educational and research projects.

Portfolio Response in 2009:
RREA National Focus funds provided support for two eXtension Communities of Practice, Rangeland Stewardship and Health and Forest-based Bioenergy.

The Livestock and Poultry Environmental Stewardship eXtension project was funded through the National Integrated Water Quality Program and the National Research Initiative Air Quality program to provide an online database of fact sheets, archived webinars, and newsletters regarding livestock and poultry pollution issues. The project conducts monthly webcasts on livestock and poultry pollution prevention issues for both air and water resources. A recent webcast had the most Google hits of any eXtension program to address new EPA regulations on livestock. Agricultural producers, consultants, other federal, state, local and even international agencies access the webpage. The project's live webcasts attract large audiences, and an additional ten times that number access the archived webinars. The Livestock and Poultry Environmental Stewardship website (www.lpes.org) had a quarter million page views in its first year.

Portfolio Response in 2008:
Through the efforts of portfolio NPLs and funding from the RREA program, the National Learning Center for Private Forest and Range Landowners was established. This is a "virtual natural resource education center" providing interactive online instruction for private forest and range landowners. With the growth of technology and the increasing use of the Internet for educational purposes, this gateway provides a perfect opportunity for natural resource education. The National Learning Center will allow information to be centrally coordinated, facilitated, and managed for consistency of content and design. This consistency will allow landowners in all regions of the United States to get the reliable information from one source. Currently there are 17 learning modules available. In 2006, nearly 26,000 visitors came to the site and downloaded an average of 316 web-pages per month. The project is housed at the University of Tennessee.

RREA funding to Clemson University was provided to explore the "virtual" delivery of traditional natural resource extension events. By utilizing mp3 technology to address the confusing issue of conservation easements, project leaders are reaching new participants who are either absentee landowners, secluded, time-strapped, or financially constrained in an effort to help them make informed decisions about protecting lands.

RREA funding made possible the Forest Conservation Outreach Program Using the Netflix Mode. This is a joint partnership between the University of Maryland and West Virginia University, the objectives of this project are to develop and circulate a series of forestry activities DVDs using the Netflix circulation model. This delivery mechanism will attract a multitude of landowners who are interested in forestry but often cannot attend formal educational events. The model should reduce participant's time and cost constraints.

Portfolio Response in 2007:
Supported by RREA funding, University of Wyoming Extension produced "Wyoming's Natural Resources", a series of seventy-second TV spots which air twice weekly on statewide commercial television reaching an estimated 30,000 homes. The Sustainable Management of Rangeland Resources team has developed and filmed spots on over 120 topics. The segments have been complied on a DVD, available through UW CES offices. Viewers gain a better understanding and awareness of natural resources issues and how they impact the total state eXtension continues to develop new communities of practice and communities of interest to facilitate the integration of research, education and extension activities throughout the agency. A total of twenty-one communities of practice have been established and are currently working to support their respective communities of interest.

Portfolio Response in 2006:
eXtension tools and mechanisms have been developed to address the national need for an electronic-based system of extension tools for delivery of educational and research products to the stakeholder community.

Performance

Portfolio Productivity: Demonstrate the ability of CSREES to create and provide services through funding, directing, managing and partnering with its stakeholders

2005 Panel Recommendation: Demonstrate how projects meet objectives for research, education and extension.

Portfolio Response in 2009:
CSREES and NRCS are combining to fund two projects to conduct a synthesis of the watershed scale projects. These two projects will build a knowledge base to evaluate impacts of conservation practices over broad regions, improve management of agricultural landscapes, and inform policy decisions at the local, state, and national scale. The two projects differ in their approach – the first uses a synoptic overview of the 13 watershed studies and the second uses a modeling framework to spatially distribute results from the 13 watershed to broader geographic regions.

The RREA program funded the National Extension Program Development and Planning for Forest-based Bioenergy Extension Programs. In partnership with Michigan State University, a panel of natural resource experts is being recruited to identify, analyze, and prioritize the gaps in

extension programming for cellulosic biomass use, development, and management from forests. Their outcome will be a strategy for extension programming that will be based on evaluation of current bioenergy programs, adaptable for the needs of regions, scalable, and testable.

The Renewable Resources Extension Act has required each institution to produce a Popular Report as part of its reporting requirements. This is a one-page fact sheet that provides convincing and compelling evidence that each institution offers high quality educational programs focused on one or more the RREA Strategic Issues. This report is used in a variety of ways: posted on the RREA web site; provided to USDA officials in advance of trips to individual states and institutions; distributed to other USDA agencies and other departments whose program goals include outreach and possible collaboration with the Cooperative Extension System; provided to stakeholders, including funders, as appropriate. The fact sheet should also have utility for the institution in demonstrating to university and extension administrators and program partners how extension reaches target audiences with impactful programs.

Portfolio Response in 2007:

Funded projects under the National Research Initiative undergo post-award reviews for to evaluate how projects met their objectives under the mission goals of the agency. An annual retreat for competitive programs is held to evaluate progress and discuss mechanisms for reporting and evaluation of on-going projects.

Under the Renewable Resources Extension Act, funded projects must follow guidelines for reporting on indicators developed for this purpose and to include a report on the composition of their audiences and stakeholders.

The CSREES Water Program is reviewing each Regional Water Quality Coordination Project on a recurring three year cycle. Three projects are reviewed each year by a panel of experts from the national program and regional water experts. The reviews focus on accomplishments and impacts of the Regional Water Quality Coordination Projects and make recommendations for future program development, evaluation, and funding.

Portfolio Response in 2006:
The portfolio NPLs worked closely with the Office of Planning and Accountability to ensure successful evaluations of program are developed and implemented. Several portfolio NPLs act as state liaisons and review State Plans of Work which provide a mechanism for evaluating how projects meet their objectives for research, education and extension.

Portfolio Comprehensiveness: Demonstrate comprehensiveness of portfolio in terms of areas of work, outputs and outcomes.

2005 Panel Recommendation: More leadership by NPLs in facilitating strategic planning and resource allocation.

Portfolio Response in 2008/2009:

The portfolio NPLs took leadership to help organize and implement the *enr* "Call to Action" workshop to build upon the one-page *enr* Enterprise vision statement by 1) identifying high priority critical issues for working lands, 2) outlining high priority needs for each critical issue, 3) develop a list of deliverables with associated time-tables for each issue within the context of a logic model, and 4) cementing a broader participation among NPLs across the Agency. Portfolio NPLs held an agency-wide *enr* brown bag focused on the breadth dn depth of the *enr* Enterprise across the Agency and our partners, e.g., the role extension might play in the mission and goals of the Enterprise.

Participation by NPLs in review panels for competitive programs, federal interagency working groups, and stakeholder listening sessions are important mechanisms for CSREES to identify emerging issues. NPLs also attend professional and scientific meetings to remain current on scientific trends that should be reflected in CSREES programs and in the coordination of priority setting with other federal agencies. The Administrator and National Program Leaders have established close working relationships and networks with various stakeholder partners including research, education and extension scientists and educators at the universities and colleges, other federal agencies, county agents and educators, advocacy organizations, professional societies, advisory groups, environmental groups and Congress. Through such meetings, NPLs learn of stakeholders' current priorities, and solicit comments and suggestions on ways that CSREES can assist in meeting their needs. Through these interactions, emerging issues are identified for the development of strategic plans and resource allocation.

CSREES is mobilizing land grant universities, focusing research and extension efforts on determining the effects of conservation practices on water quality. The 13 watershed projects jointly funded by CSREES and NRCS serve as examples of collaborative work between land grant universities and NRCS. These watershed projects are unique in that they combine evaluation of the biophysical effects of conservation practices and the socio-economic context of the watershed location. The watershed projects also combine research and extension/outreach activities – involving agricultural producers in project outcomes. The CEAP Project has developed substantial capacity within the land grant university system to increase the understanding of effects of conservation practices and the effectiveness of conservation programs.

The CEAP Project has developed substantial capacity within the land grant university system to increase the understanding of effects of conservation practices and the effectiveness of conservation programs. CSREES continues to fund watershed scale projects that explore how "targeting" practices (focusing on critically sensitive lands or key producers) can improve water quality impacts. We also are developing educational materials to assist agricultural producers in adopting and maintaining appropriate practices. CSREES also is continuing to focus on water availability for agriculture – we envision that "Agricultural Water Security" will continue to be a defining issue over the next decade.

Training on Logic Model, Program Evaluation and Multi-state Programming was conducted in January 2008 as a joint effort between NRE and the CSREES Office of Planning and Accountability. Eighteen Faculty members from land grant and non-land grant representing urban forestry and outdoor recreation were trained. This training resulted in the formation of 2 multi-state projects in urban forestry and outdoor recreation with funding from McIntire-Stennis. The participants eventually formed their own network which facilitated their collaborative work in their respective multi-state project and also in grants application. A second similar training was conducted in April, 2008. Nineteen participants from 1890 and 1862 land grants, Forest Service and Agricultural Research Service were trained. A multi-state project in agroforestry is being developed led by the University of Missouri and co-led by Auburn University and University of Virginia. The University of the District of Columbia and 4 1890 institutions (Alcorn State University, Southern University, Tennessee State University and Alabama A&M) are participating using Evan-Allen funds. The University of the District of Columbia has started initiating agroforestry projects in forest farming and alley cropping on its University farm.

Portfolio Response in 2007:

National Program Leaders evaluate formula funded projects as part of the overall program portfolio and has resulted in a change in attitude towards the used of these types of funds to achieve program objectives through strategic planning and resource allocation of the portfolio.

Natural Resources and Environment knowledge areas are now reported as a single portfolio which allows better strategic planning and resource allocation and gives opportunities for improved leadership in collaborative efforts.

Portfolio Response in 2006:
The ECOP Forestry Task Force along with portfolio NPLs provided strategic guidance for the RREA program by reviewing current issues that necessitate an education approach, how funds are allocated and making recommendations for investments in projects of nation wide importance via the National Focus funds.

Portfolio Timeliness: Demonstrate the extent to which funded activities were completed within the funding time frame

2005 Panel Recommendation: Increased frequency and quality of reporting at the national and state levels.

Portfolio Response in 2009:

NRE Portfolio Programs are adapting to the new revisions in the CRIS Reporting System, providing input into the Leadership Management Dashboard, and training in the evaluation of Plan of Work updates and Annual Reports from the university partnership.

Portfolio Response in 2008:
Each institution that receives RREA formula funding is required to submit an annual progress report. This report is comprised of three parts.

AD-421 Progress Report: This part is submitted to the USDA Current Research Information System or CRIS by the institution's principle investigator. This submission includes a narrative summarizing significant results, accomplishments, conclusions, and impacts. A list of significant publications during the reporting period is also required.

The Popular Report: This is a one-page fact sheet provides convincing and compelling evidence that each institution offers high quality educational programs focused on one or more the RREA Strategic Issues. This report is used in a variety of ways: posted on the RREA web site; provided to USDA officials in advance of trips to individual states and institutions; distributed to other USDA agencies and other departments whose program goals include outreach and possible collaboration with the Cooperative Extension System; provided to stakeholders, including funders, as appropriate. The fact sheet should also have utility for the institution in demonstrating to university and extension administrators and program partners how extension reaches target audiences with impactful programs.

Quantitative Indicator Data: This information captures the quantitative impact that an institution's RREA program produces; number of educational events, acres impacted, etc. This report is then combined with reports from all institutions to demonstrate the national impact of RREA. Due to the demanding nature of data-collection, each institution is encouraged to allocate 8-10 percent of their RREA program funds to program evaluation.
Portfolio NPL's are actively involved in the review of State Plan's of Work and State Annual Reports resulting from funds received through the Hatch Act. Reports from the McIntire-Stennis, Smith-Lever and Evans-Allen Programs are also reviewed under this portfolio.

Training on Logic Model, Program Evaluation and Multi-state Programming was conducted in January 2008 as a joint effort between NRE and the CSREES Office of Planning and Accountability. Eighteen Faculty members from land grant and non-land grant representing urban forestry and outdoor recreation were trained. This training resulted in the formation of 2 multi-state projects in urban forestry and outdoor recreation with funding from McIntire-Stennis. The participants eventually formed their own network which facilitated their collaborative work in their respective multi-state project and also in grants application. A second similar training was conducted in April, 2008. Nineteen participants from 1890 and 1862 land grants, Forest Service and Agricultural Research Service were trained. A multi-state project in agroforestry is being developed led by the University of Missouri and co-led by Auburn University and University of Virginia. The University of the District of Columbia and 4 1890 institutions (Alcorn State University, Southern University, Tennessee State University and Alabama A&M) are participating using Evan-Allen funds. The University of the District of Columbia has started initiating agroforestry projects in forest farming and alley cropping on its University farm.

Portfolio Response in 2007:
Air Quality and Water Quality Assessment reports are made to allow for stakeholder input from all sectors. The reports are submitted to the National Academies of Science for their review and input. Review by the Academies give further credibility to federal partners such as EPA.

Global change and climate related projects are reported through national data bases established through the various interagency working groups and are reviewed by federal program officers assisted by scientific steering committees.

Portfolio Response in 2006:

The Agricultural Air Quality Workshop brought together all the CSREES funded research, in addition to other federal, state and privately funded agricultural research to develop assessment reports on agricultural emissions and control technologies that reduce emissions.

Multi-state and competitively funded projects under the portfolio have mandatory meetings of principal investigators with the managing National Program Leader to provide a means for reporting of project outcomes and impacts.

Agency Guidance: Demonstrate strength of CSREES program leadership and management relating to the portfolio program management.

2005 Panel Recommendation: Address needs for staffing levels for better allocation of time to leadership for program development and less to program management and maintenance.

Portfolio Response in 2009:

Dr. Daniel Cassidy successfully competed for the position of national program leader in Forest-based Bioenergy.

Portfolio Response in 2008:

Dr. Louie Tupas and Dr. Michael Bowers successfully completed the 2007-2008 LEAD 21 Leadership training program.

Dr. Daniel Cassidy successfully completed the USDA Executive Leadership Training Program.

Dr. Gary San Julian joined the NRE unit as a shared faculty with Pennsylvania State University to handle fisheries and wildlife.

Dr. Maureen McDonough, a forest sociologist from Michigan State University, continues to work with the portfolio as part of the Social Science Academy.

Dr. Justin Derner, an ARS Scientist, completed his Executive Leadership Development Program at the NRE unit and produced a report that was published to the ARS website detailing avenues of coordination and cooperation among scientists with both CSREES and ARS.

Dr. Jeffrey Herrick, an ARS principal scientist, was hosted at the NRE unit for a three month detail that drafted language for Ecological Site Descriptions to be included in CSREES RFAs involving rangeland projects.

Portfolio Response in 2007:

Dr. Robert Williamson joined the NRE unit as a shared faculty with North Carolina A&T University to handle fisheries and wildlife.

Dr. Maureen McDonough joined the NRE units as an IPA from Michigan State University as a forest sociologist.

Mr. Bruce Mertz was hired as the program specialist for invasive species, watersheds and sustainability.

Mr. Dewell Paez was hired as the program specialist for global change, air quality and soils.

Portfolio Response in 2006:

Dr. James Dobrowolski joined the NRE unit as the National Program Leader for Rangeland and Grassland Ecosystems.

Dr. Joanne Throwe joined the NRE unit a shared faculty with the University of Maryland to handle water and ecosystems.

Dr. Daniel Cassidy was hired as the program specialist for forest resources and biology.

Portfolio Accountability: Demonstrate the extent to which funded projects of the portfolio have been completed with thoroughness, clarity, timeliness, adequacy and usefulness

2005 Panel Recommendation: Focus on performance indicators, outcomes and impacts.

Portfolio Response in 2009:

Strategic planning in the *enr* portfolio is beginning to address Secretary of Agriculture Vilsack's priorities for USDA:

1. Promotion of a safe, sufficient, and nutritious food supply for all Americans and for people around the world. We need a modern food safety system, and USDA will also play a key role in the public health debate. Our nutrition programs should strive to both

alleviate hunger and prevent health care problems such as childhood obesity. President Obama has challenged us to eliminate childhood hunger by 2015, and as we move forward with reauthorization of the Child Nutrition Programs, we have the opportunity to emphasize the importance of healthful and nutritious eating.

2. Sustainable agricultural policies that foster economic viability for small and mid-size farms and rural businesses, protect natural resources, and promote value-added agriculture.
3. National leadership in climate change mitigation and adaptation. This will involve conservation and greater efficiency in energy use as well as new technologies and expanded opportunities in biofuels and renewable energy.
4. We need to advance research and development and pursue opportunities to support the development of additional biofuels, wind power, and other renewable energy sources. I want to provide incentives for farmers and ranchers to use management practices that promote clean air, clean water, and wildlife habitat.
5. Building a modern workplace with a modern workforce. We will focus on information technology and process improvements, led by an empowered and diverse workforce that reflects America and will bring the best ideas to the table.
6. Support for 21st century rural communities. We will promote the expansion of modern infrastructure; broadband service; affordable, energy-efficient housing; expanded opportunities for small businesses; and improved quality of life through community facilities.

Portfolio Response in 2008:
State and federal partners collaborate with CSREES in implementing the strategic plan for the RREA program. The implementation of this plan assists landowners and managers, natural resource professionals, policy makers and communities make better decisions and increased adoption of sustainable forest and rangeland management practices. The strategic plan encourages institutions to focus their programming to address the most pressing contemporary issues while expanding their outreach to the needs of diverse and limited-resource audiences. The strategic plan also assisted the funding officials in improving program management and accountability.

Training on Logic Model, Program Evaluation and Multi-state Programming was conducted in January 2008 as a joint effort between NRE and the CSREES Office of Planning and Accountability. Eighteen Faculty members from land grant and non-land grant representing urban forestry and outdoor recreation were trained. This training resulted in the formation of 2 multi-state projects in urban forestry and outdoor recreation with funding from McIntire-Stennis. The participants eventually formed their own network which facilitated their collaborative work in their respective multi-state project and also in grants application. A second similar training was conducted in April, 2008. Nineteen participants from 1890 and 1862 land grants, Forest Service and Agricultural Research Service were trained. A multi-state project in agroforestry is being developed led by the University of Missouri and co-led by Auburn University and University of Virginia. The University of the District of Columbia and 4 1890 institutions (Alcorn State University, Southern University, Tennessee State University and Alabama A&M)

are participating using Evan-Allen funds. The University of the District of Columbia has started initiating agroforestry projects in forest farming and alley cropping on its University farm.

Portfolio Response in 2007:
The *enr* concept has adopted the new logic model format that focuses on knowledge, actions and condition as outcomes, rather than short, medium and long-term outcomes for planning purposes. Using the *enr* concept and vision, metrics are being defined to be applied consistently across the knowledge areas to better address outputs and outcomes. Additionally, considerable efforts are deployed to include documentation of the use of stakeholder input in the development of scientific areas of focus, inclusion of social and economic sciences to improve impacts, and educational partnerships that will benefit from research applications.

Under the Renewable Resources Extension Act, funded projects must follow guidelines for reporting on indicators developed for this purpose and to include a report on the composition of their audiences and stakeholders. These include the use of a reporting template that every RREA institution must use, impacts should be based on state reports, recognition of funding sources, and requiring multiple institutions to file a single report.

Portfolio Response in 2006:
A considerable set of program impacts was developed through the Integrated Water Quality Impacts Report. This report includes research, education and extension impacts and outcomes. For example, the Non-point Education for Municipal Official (NEMO) project is a national effort to use of geographic information system and remote sensing technology as educational tools in its promotion of land use planning rather than mechanical devices as the primary weapon against water pollution.

The RREA strategic plan includes specific short, intermediate and long term performance measures for each of the strategic issues. A workshop was conducted to develop specific indicators for each measure. Examples of indicators include identification of the specific needs and issues of a diverse audience (short-term), adoption of new rangeland and forest technologies (medium-term) and improved health and sustainability of forests and rangeland (long-term).

Section V: Self-Assessment

Portfolio Scoring

Criteria	2005 Score	2006 Score	2007 Score	2008 Score	2009 Score
	External	Internal	Internal	Internal	Internal
1. Relevance					
1.1 Scope: Describe what the portfolio can provide in terms of coverage of work with the available funds	3	3	3	2.5	2.5
1.2 Focus: Demonstrate portfolio ability to remain focused on issues, topics and critical needs of the nation	2.5	2.5	2.5	2.5	2.5
1.3 Emerging Issues: Identify contemporary and/or emerging issues that are consistent and relevant to the portfolio and its mission	2.5	2.5	2.5	2.5	2.5
1.4 Integration: Demonstrate functional integration of CSREES research, extension and education efforts in the portfolio.	2	2	2	1.5	1.5
1.5 Multi-disciplinary: Demonstrate multidisciplinary balance of the portfolio in solving scientific problems	2	2.5	2.5	2.5	2.5
2. Quality					
2.1 Significance: Demonstrate generation of significant findings in the portfolio	2	2.5	2.5	2	2
2.2 Stakeholder: Demonstrate stakeholder/constituent input to the portfolio	2	2	2	2	2
2.3 Alignment: Demonstrate portfolio alignment with current state of science-based knowledge and previous work	2	2.5	2.5	2.5	2.5
2.4 Methodology: Demonstrate use of appropriate and/or cutting edge methods and techniques for funded projects	2.5	2.5	2.5	2.5	2.5
3. Performance					
3.1 Productivity: Demonstrate the ability of CSREES to create and provide services through funding, directing, managing and partnering with its stakeholders	2.5	2.5	2.5	2.5	2.5
3.2 Comprehensiveness: Demonstrate comprehensiveness of portfolio in terms of areas of work, outputs and outcomes	2	2	2	2	2
3.3 Timeliness: Demonstrate the extent to which funded activities were completed within the funding time frame	2.5	2.5	2.5	2.5	2.5
3.4 Agency guidance: Demonstrate strength of CSREES program leadership and management relating to the portfolio program management.	2.5	3	3	2.5	2.5
3.5 Accountability: Demonstrate the extent to which funded projects of the portfolio have been completed with thoroughness, clarity, timeliness, adequacy and usefulness	2	2	2	2	2
Overall Score	79	83	83	78	78

Portfolio Score Change Discussion for 2009

Portfolio NPLs voted unanimously to forgo the 2009 annual assessment and maintain the score of the *enr* portfolio exactly the same as in 2008. This decision is based on the fact that the team conducted its last 2008 portfolio annual assessment just six months ago. Rather than scoring again, the team spent considerable amount of time discussing how to restructure the portfolio as a "work in progress". The team agreed that the portfolio remains disconnected from the *enr* Enterprise—its content persists as an *NRE* rather than an *enr* portfolio. NPLs strongly suggested a shift to structuring the portfolio by thematic or issue area. The team felt that working with the KA approach is restrictive and tends to be seen as a stovepipe.

The team used the global climate change as an example. For example, global climate change should include both climate and land use change. However the KA structure separates the two into individual reporting silos and does not facilitate smooth discussion and integration. The team felt that grouping work by issue or theme gives NPLs more useful mechanism of handling related areas of work. This concept certainly fits well with some of the portfolio evaluation criteria.

Program goals and the larger issues often faced by portfolio NPLs do not necessarily or easily line up with KAs. NPLs discussed wanting to be organized in outcome-focused groups. This approach makes it easier to link similar areas and fill the information gap created by the disconnection among KAs. This new configuration will make it easier in the development of the new strategic plan consistent with the requirement of the Agriculture and Food Research Initiative (AFRI).

Portfolio NPLs expressed concern about their inability to objectively address the points raised by the external panel with their current lack of appropriate data, e.g., what is the return on investment? Questions were raised concerning the source of the data and the extent to which outcomes could not be easily linked to those data. The following series of questions were raised:

- Did a particular competitively funded project meet its objectives?
- Have we had an impact on natural resources management? And if so, how do we know that?

Portfolio NPLs agreed to form a committee to develop a strategy to realign the portfolio into thematic or issue areas. This committee will meet as a group quarterly rather than once per year. This approach will also compile a series of outcomes and make them available in a more efficient manner to the NPLs for own personal use and for reporting to outside requests.

NPLs recounted situations where proposals improved in quality since the last external review and that the Agency maintains a greater portfolio of integrated programs. The downside is that the level and quality of outcomes may not have changed. NPLs questioned whether there was a way to integrate the portfolio criteria and logic models more closely to the Plan of Work, giving the partners better guidance towards reporting more appropriate information.

Quarterly portfolio meetings will be conducted to identify and address issues related to the portfolio. These meetings, which will begin May 2009, will open dialogue among Environment and Natural Resources NPLs and other agency staff members about the portfolio's goals and strategic plan. These quarterly meetings will also serve as a platform for discussions related to post award management, outcome reporting and outcome retrieval. The May 2009 meeting will serve as a spring board for upcoming meetings as well as for discussions regarding 2010 portfolio reporting preparation.

Timeline for quarterly meetings and outcomes

- Quarterly meeting 1: Monday, August 17, 2009, 2:00 – 4:00 in **Room 3220**
    - Purpose: Core committee meets to secure the participation of NPLs inside and outside of NRE
        - Finalize the themes/issues
        - Begin to develop a strategic plan for the portfolio

- Quarterly meeting 2: Tuesday, November 4, 2009, 2:00 – 4:00 in **Room 3220**
    - Purpose: ENR *in toto* identifies critical areas of national needs and develop collaborative teams to implement strategies for solutions
        - Develop logic model
        - Begin to Develop RFAs consistent with new strategic direction
        - To the extent possible, associate partners from outside
        - Develop performance measures and identify data sources

- Quarterly meeting 3: Tuesday, February 4, 2010, 2:00 – 4:00 in **Room 3220**
    - Purpose: Outline portfolio document
        - Assign chapters to core committee
        - Review lessons learned from the new strategic alignment
        - Identify resources needed for new directions

- Quarterly meeting 4: Tuesday, May 4, 2010, 2:00 – 4:00 in **Room 1341**
    - Purpose: Finalize document, evaluate outcomes, remedy short comings
        - Review structure of document
        - Refine those outcomes to make them available for use by NPLs and agency to meet internal and external reporting needs and requirements
        - Review performance measures and adjust as necessary
        - Shift resources as needed for new directions

Appendix A – External Panel Recommendations to the Agency:

In response to directives from the Office of Management and Budget (OMB) of the President, CSREES implemented the Portfolio Review Expert Panel (PREP) process to systematically review its progress in achieving its mission. Since this process began in 2003, expert review panels have been convened and each has published a report offering recommendations and guidance. These external reviews occur on a rolling five-year basis. In the four off years an internal panel is assembled to examine how well CSREES is addressing the expert panel's recommendations. These internal reports are crafted to specifically address the issues raised for a particular portfolio; however, despite the fact that the expert reports were all written independent of one another on portfolios comprised of very different subject matter, several themes common to the set of review reports have emerged. This set of issues has repeatedly been identified by expert panels and requires an agency-wide response. The agency has taken a series of steps to effectively respond to those overarching issues.

Issue 1: Getting Credit When Credit is Due
For the most part panelists were complimentary when examples showing partnerships and leveraging of funds were used. However, panelists saw a strong need for CSREES to better assert itself and its name into the reporting process. Panelists believed that principal investigators who conduct the research, education and extension activities funded by CSREES often do not highlight the contributions made by CSREES.

Multiple panel reports suggested CSREES better monitor reports of its funding and ensure that the agency is properly credited. Many panelists were unaware of the breadth of CSREES activities and believe their lack of knowledge is partly a result of CSREES not receiving credit in publications and other material made possible by CSREES funding.

Issue 1: Agency Response:
To address the issue of lack of credit being given to CSREES for funded projects, the Agency implemented several efforts likely to improve this situation.

First it developed a standard paragraph about CSREES' work and funding that project managers can easily insert into documents, papers and other material funded in part or entirely by CSREES.

Second, the Agency is in the process of implementing the "One Solution" concept. One Solution will allow for the better integration, reporting and publication of CSREES material on the web. In addition, the new AREERA Plan of Work (POW) and Annual Report (AR) are fully functional. The agency requires a POW and AR on the four major research and extension formula funds; Hatch, Evans-Allen, Smith-Lever 3b&c, and 1890 Extension Programs. The reporting format and means of submission were substantially revised, they were restructured using an outcome-based, logic model design. Plan of Work and Annual Report of Accomplishment reports are being collected electronically via the internet using a database

system. The purpose of this revision was not only to reduce the burden imposed on collecting the Plan of Work (POW) and Annual Report of Accomplishments (AR), but to make the information collected usable for CSREES program leadership and portfolio evaluation. In addition, the information collected can be easily analyzed and assembled into a national report on the POW and AR for these formula funded programs.

Issue 2: Partnership with Universities

Panelists felt that the concept of partnership was not being adequately presented. Panelists saw a need for more detail to be made available. Questions revolving around long-term planning between the entities were common as were ones that asked how the CSREES mission and goals were being supported through its partnership with universities and vice versa.

Issue 2: Agency Response:

CSREES has taken several steps to strengthen its relationship with university partners. First, to the extent possible, implementing partners will be attending the CSREES strategic development exercise which is intended to help partners and CSREES fully align what is done at the local level. Second, CSREES has realigned the state assignments for its National Program Leaders (NPLs). Each state is now assigned to one specific NPL. By reducing the number of states on which any individual NPL is asked to concentrate and assigning and training NPLs for this duty, better communication between state and NPLs should occur.

Finally, several trainings that focused on the POW were conducted by CSREES in geographic regions throughout the country. A major goal of this training was to better communicate CSREES goals to state leaders which will facilitate better planning between the universities and CSREES.

Issue 3: National Program Leaders

Without exception the portfolio review panels were complimentary of the work being done by NPLs. They believe NPLs have significant responsibility, are experts in the field and do a difficult job admirably. Understanding the specific job functions of NPLs was something that helped panelists in the review process. Panelists did however mention that often times there are gaps in the assignments given to NPLs. Those gaps leave holes in programmatic coverage.

Issue 3: Agency Response:

CSREES values the substantive expertise that NPLs bring to the Agency and therefore requires all NPLs to be experts in their respective fields. Given the budget constraints often times faced by the agency, the agency has not always been able to fund needed positions and had to prioritize its hiring for open positions. In addition, because of the level of expertise CSREES requires of its NPLs, quick hires are not always possible. Often, CSREES is unable to meet the salary demands of those it wishes to hire. It is essential that position gaps be filled with the most qualified candidate.

Operating under these constraints and given inevitable staff turnover, gaps will always remain. However, establishing and drawing together multidisciplinary teams required to complete the

portfolio reviews has allowed the Agency to identify gaps in program knowledge and ensure that these needs are addressed in a timely fashion. To the extent that specific gaps are mentioned by the expert panels, the urgency to fill them is heightened.

Issue 4: Integration

Lack of integration has been highlighted throughout the panel reviews. While review panelists certainly noted in their reports where they observed instances of integration, almost without fail panel reports sought more documentation in this regard.

Issue 4: Agency Response:

Complex problems require creative and integrated approaches that cut across disciplines and knowledge areas. CSREES has recognized the need for these approaches and has undertaken steps to remedy this situation. CSREES has recently mandated that up to twenty percent of all NRI funds be put aside specifically for integrated projects. These projects cut across functions as well as disciplines and ensure that future Agency work will be better integrated. Finally, integration is advanced through the portfolio process which requires cooperation across units and programmatic areas.

Issue 5: Extension

While most panels seemed satisfied at the level of discussion that focused on research, the same does not hold true for extension. There was a call for more detail and more outcome examples based upon extension activities. There was a consistent request for more detail regarding not just the activities undertaken by extension but documentation of specific results these activities achieved.

Issue 5: Agency Response:

Outcomes that come about as a result of extension are, by the very nature of the work, more difficult to document than the outcomes of a research project. CSREES has recently shuffled its strategy of assigning NPLs to serve as liaisons for states. In the past, one NPL might serve as a liaison to several states or a region comprised of states. Each state will be assigned a specific NPL and no NPL will serve as the lead representative to more than one state. This will ensure more attention is paid to extension activities.

In addition CSREES also has been in discussion with partners and they have pledged to do their best to address this issue. The new POW will make extension-based results and reporting a priority. Placing heavy emphasis on logic models by CSREES will have the effect of necessitating the inclusion of extension activities into the state's POWs. This, in turn, will require more reporting on extension activities and allow for improved documentation of extension impact.

Issue 6: Program Evaluation

Panelists were complimentary in that they saw the creation of the Office of Planning and Accountability and portfolio reviews as being the first steps towards more encompassing program evaluation work; however, they emphasized the need to see outcomes and often stated

that the scores they gave were partially the result of their own personal experiences rather than specific program outcomes documented in the portfolios. In other words, they know first hand that CSREES is having an impact but would like to see more systematic and comprehensive documentation of this impact in the reports.

Issue 6: Agency Response:
The effective management of programs is at the heart of the work conducted at CSREES and program evaluation is an essential component of effective management. In 2003 the PREP process and subsequent internal reviews were implemented. Over the past three years fourteen portfolios have been reviewed by expert panel members and each year this process improves. NPLs are now familiar with the process and the staff of the Planning and Accountability unit has implemented a systematic process for pulling together the material required for these reports.

Simply managing the process more effectively is not sufficient for raising the level of program evaluations being done on CSREES funded projects to the highest standard. Good program evaluation is a process that requires constant attention by all stakeholders and the agency has focused on building the skill sets of stakeholders in the area of program evaluation. The Office of Planning and Accountability has conducted training in the area of evaluation for both NPLs and for staff working at Land-Grant universities. This training is available electronically and the Office of Planning and Accountability will be working with NPLs to deliver training to those in the field.

The Office of Planning and Accountability is working more closely with individual programs to ensure successful evaluations are developed, implemented and the data analyzed. Senior leadership at CSREES has begun to embrace program evaluation and over the coming years CSREES expects to see state leaders and project directors more effectively report on the outcomes of their programs as they begin to implement more rigorous program evaluation. The new POW system ensures data needed for good program evaluation will be available in the future.

In addition to process developed within the Office of Planning and Accountability, NPLs have discussed methods for improved post award management and reporting. Many Agency Requests for Applications (RFAs) are now encouraging program evaluation and post award reporting of outcomes and impacts of funded activities. Steps are being taken to providing an electronic database that will make it easier to report outcomes and impacts of CSREES funded activities anytime after Agency funding for the project has ended.

Issue 7: Logic Models
Panelists were consistently impressed with the logic models and the range of their potential applications. They expressed the desire to see the logic model process used by all projects funded by CSREES and hoped not only would NPLs continue to use them in their work but, also, that those conducting the research and implementing extension activities would begin to incorporate them into their work plans.

Issue 7: Agency Response:
Logic models have become a staple of the work being done at CSREES and the Agency has been proactive in promoting the use of logic models to its state partners. Recent agency-wide initiatives highlight this. First, in 2005, the POW reporting system into which states submit descriptions of their accomplishments was completely revamped. The new reporting system now closely matches the logic models being used in portfolio reports.
Beginning in fiscal year 2007, states will be required to enter all of the following components of a standard logic model. These components include describing the following:

- Program Situation
- Program Assumption
- Program Long Term Goals
- Program Inputs which include both monetary and staffing
- Program Output which include such things as patents
- Change in Knowledge
- Changes in Behavior
- Changes in Condition
- External Factors
- Target Audience

The system is now operational and states were required to begin using it by June of 2006. By requiring the inclusion of the data components listed above states are in essence, creating a logic model that CSREES believes will help improve both program management and outcome reporting.

OPA conducted a recent training seminar regarding logic model concerns. In October and November of 2005 four separate training sessions were held in Monterrey, California, Lincoln, Nebraska, Washington D.C. and Charleston, South Carolina. More than 200 people representing land-grant universities attended these sessions where they were given training in logic model creation, program planning, and evaluation. In addition, two training sessions were provided to NPLs in December 2005 and January 2006 to further familiarize them with the logic model process. Ultimately it is hoped these representatives will pass on to others in the Land-Grant system what they learned about logic models thus creating a network of individuals utilizing the same general approach to strategic planning. These materials also have been made available to the public on the CSREES website.

As a result of OPAs efforts to inform and educate agency staff about the logic model, NPLs have started implementing logic model use in RFAs, particularly in AFRI. These logic models are used as a planning tool for agency funded projects. RFA applicants, reviewers and awarders are able to grasp the progression of a proposed activity and define expected outputs, outcomes and impacts.

Appendix B - Detailed Funding Tables for Primary KAs – CSREES Funding:

CSREES Only Funding tables provide details of agency specific funding for a five fiscal year span for primary KA activities. The funding sources are agency ONLY funding sources. The grand total of these funding sources equals CSREES ADMIN funding that is included in the Overall Funding tables. Below are definitions for CSREES funding sources identified in the following funding tables.

- Hatch (HATCH) formula funds are allocated to the States, for the purpose of conducting agricultural research by the State Agricultural Experiment Stations. Hatch dollars are reported as expenditures in the following funding tables.

- McIntire-Stennis (MC-STN) are funds allocated to the States, for the purpose of conducting forestry research by schools of forestry, land-grant colleges, and State Agricultural Experiment Stations. McIntire-Stennis dollars are reported as expenditures in the following funding tables.

- Evans-Allen funds are allocated to the eligible institutions for support of agricultural research by the 1890 Colleges and Tuskegee University. These dollars are reported as expenditures to the Current Research Information System.

- Animal Health and Disease Program formula funds are allocated to eligible institutions for support of livestock and poultry disease research. These dollars are reported as expenditures to the Current Research Information System.

- Special Research Grants funds are awarded to eligible institutions for the purpose of conducting research to facilitate or expand food and agricultural research programs. These dollars are obligated funds reported in the Current Research Information System.

- National Research Initiative (NRI) Competitive Grants awarded to the eligible institutions for the purpose of conducting research emphasizing natural resources and the environment; nutrition, food quality, and health; plant systems; animal system; rural development, markets, and trade; and processing for value-added products. These dollars are obligated funds reported in the Current Research Information System. These dollars are obligated funds reported in the Current Research Information System.

- Small Business Innovation Research (SBIR) Program grants awarded to eligible institutions for the purpose of supporting high quality research proposals containing advanced concepts related to research on forests and related resources; plant production and protection; animal production and protection; air, water and soils; food science and nutrition; rural and community development; aquaculture; and industrial applications. These dollars are obligated funds reported in the Current Research Information System.

- OTHER CSREES funds are CSREES Administered funding programs not included in Hatch, McIntire-Stennis, Evans-Allen, Animal Health and Disease, Special Research Grants, National Research Initiative, or Small Business Innovation Research funding programs. These include cooperative agreements, and all other agency administered research grants awarded either competitively or non-competitively. These dollars are obligated funds reported in the Current Research Information System.

- Smith Lever 3(d) provides the opportunity for 1862 and 1890 Land-Grant Institutions, including Tuskegee University and West Virginia State University, and the University of the District of Columbia to compete for and receive extension funds. Smith Lever 3(d) funds became competitive in 2008, prior to that it was a non-competitive extension funding source for the previously mentioned institutions. These dollars are obligated funds reported in the Current Research Information System.

- Smith Lever 3(b) and (c) funds provide funding for agricultural extension programs at 1862 Land-grant universities. These dollars are reported as expenditures in the Plan of Work Annual Report.

- 1890 funds provide funding for agricultural extension programs at 1890 Land-grant universities. These dollars are reported as expenditures in the Plan of Work Annual Report.

*NOTE: FY 2007 funding data includes funding data reported from CRIS and POW annual report, FY 2003 – 2006 funding data are reported from CRIS **ONLY***

CSREES Research and Extension Dollars for KA 101: Appraisal of Soil Resources						
Combined Research and Extension Dollars						
Formula -Expenditures/Grant-Obligations in Thousands						
Funding Sources	**FY 2003**	**FY 2004**	**FY 2005**	**FY 2006**	**FY 2007**	**Grand Total**
Hatch	1,459	1,338	1,532	1,785	2,332	8,446
McIntire-Stennis	58	154	141	154	103	610
Evans Allen	436	303	311	0	8	1,058
Animal Health	0	0	0	0	0	0
Special Grants	498	568	794	935	0	2,795
NRI Grants	1,310	801	1,552	154	1,383	5,200
SBIR Grants	262	138	103	0	129	632
Other CSREES	523	141	36	368	73	1,141
Smith-Lever 3(d)	n/a	n/a	n/a	n/a	6	6
Total Reported in CRIS	4,546	3,443	4,469	3,396	4,034	19,888
Smith-Lever 3(b) and (c)	n/a	n/a	n/a	n/a	561	561
1890 Extension	n/a	n/a	n/a	n/a	42	42
Total Extension Reported in POW	n/a	n/a	n/a	n/a	603	603
Total (CSREES Admin)	4,546	3,443	4,469	3,396	4,637	20,491

n/a denotes that data wasn't either reported or recorded that fiscal year

CSREES Research and Extension Dollars for KA 102: Soil, Plant, Water, Nutrient Relationships						
Combined Research and Extension Dollars						
Formula -Expenditures/Grant-Obligations in Thousands						
Funding Sources	**FY 2003**	**FY 2004**	**FY 2005**	**FY 2006**	**FY 2007**	**Grand Total**
Hatch	5,815	5,753	6,311	5,690	6,813	30,382
McIntire-Stennis	1,043	945	928	811	1,093	4,820
Evans Allen	1,316	1,239	1,411	1,534	1,890	7,390
Animal Health	0	0	0	0	0	0
Special Grants	2,706	1,073	1,149	1,641	0	6,569
NRI Grants	4,293	1,822	5,812	5,396	4,923	22,246
SBIR Grants	0	219	0	450	402	1,071
Other CSREES	1,902	1,471	1,581	2,517	1,743	9,214
Smith-Lever 3(d)	n/a	n/a	n/a	n/a	101	101
Total Reported in CRIS	17,075	12,522	17,192	18,038	16,965	81,792
Smith-Lever 3(b) and (c)	n/a	n/a	n/a	n/a	5,784	5,784
1890 Extension	n/a	n/a	n/a	n/a	548	548
Total Extension Reported in POW	n/a	n/a	n/a	n/a	6,332	6,332
Total (CSREES Admin)	17,075	12,522	17,192	18,038	23,297	88,124

CSREES Research and Extension Dollars for KA 103: Management of Saline and Sodic Soils and Salinity						
Combined Research and Extension Dollars						
Formula -Expenditures/Grant-Obligations in Thousands						
Funding Sources	**FY 2003**	**FY 2004**	**FY 2005**	**FY 2006**	**FY 2007**	**Grand Total**
Hatch	207	139	79	91	294	810
McIntire-Stennis	7	13	10	6	7	43
Evans Allen	0	46	43	35	0	124
Animal Health	0	0	0	0	0	0
Special Grants	0	0	146	148	0	294
NRI Grants	119	0	0	0	38	157
SBIR Grants	0	0	0	0	0	0
Other CSREES	0	89	208	309	0	606
Smith-Lever 3(d)	n/a	n/a	n/a	n/a	0	0
Total Reported in CRIS	333	287	486	589	340	2,035
Smith-Lever 3(b) and (c)	n/a	n/a	n/a	n/a	72	72
1890 Extension	n/a	n/a	n/a	n/a	11	11
Total Extension Reported in POW	n/a	n/a	n/a	n/a	82	82
Total (CSREES Admin)	333	287	486	589	422	2,117

n/a denotes that data wasn't either reported or recorded that fiscal year

CSREES Research and Extension Dollars for KA 104: Protect Soil from Harmful Effects of Natural Elements						
Combined Research and Extension Dollars						
Formula-Expenditures/Grant-Obligations in Thousands						
Funding Sources	**FY 2003**	**FY 2004**	**FY 2005**	**FY 2006**	**FY 2007**	**Grand Total**
Hatch	446	375	510	557	638	2,526
McIntire-Stennis	111	121	97	76	74	479
Evans Allen	152	158	138	150	182	780
Animal Health	0	10	10	0	0	20
Special Grants	87	100	98	154	0	439
NRI Grants	124	137	698	0	263	1,222
SBIR Grants	0	59	87	180	0	326
Other CSREES	163	313	241	243	0	960
Smith-Lever 3(d)	n/a	n/a	n/a	n/a	0	0
Total Reported in CRIS	1,083	1,273	1,881	1,361	1,157	6,755
Smith-Lever 3(b) and (c)	n/a	n/a	n/a	n/a	553	553
1890 Extension	n/a	n/a	n/a	n/a	179	179
Total Extension Reported in POW	n/a	n/a	n/a	n/a	731	731
Total (CSREES Admin)	1,083	1,273	1,881	1,361	1,888	7,486

n/a denotes that data wasn't either reported or recorded that fiscal year

CSREES Research and Extension Dollars for KA 111: Conservation and Efficient Use of Water						
Combined Research and Extension Dollars						
Formula -Expenditures/Grant-Obligations in Thousands						
Funding Sources	**FY 2003**	**FY 2004**	**FY 2005**	**FY 2006**	**FY 2007**	**Grand Total**
Hatch	1,460	1,224	1,128	1,363	1,839	7,014
McIntire-Stennis	89	80	91	104	69	433
Evans Allen	0	16	71	82	205	374
Animal Health	0	0	0	0	0	0
Special Grants	2,011	1,628	1,635	1,638	0	6,912
NRI Grants	992	114	667	786	237	2,796
SBIR Grants	0	78	296	0	0	374
Other CSREES	4,194	4,703	3,942	3,481	862	17,182
Smith-Lever 3(d)	n/a	n/a	n/a	n/a	14	14
Total Reported in CRIS	8,746	7,843	7,830	7,453	3,226	35,098
Smith-Lever 3(b) and (c)	n/a	n/a	n/a	n/a	2,576	2,576
1890 Extension	n/a	n/a	n/a	n/a	406	406
Total Extension Reported in POW	n/a	n/a	n/a	n/a	2,983	2,983
Total (CSREES Admin)	8,746	7,843	7,830	7,453	6,209	38,081

n/a denotes that data wasn't either reported or recorded that fiscal year

CSREES Research and Extension Dollars for KA 112: Watershed Protection and Management						
Combined Research and Extension Dollars						
Formula -Expenditures/Grant-Obligations in Thousands						
Funding Sources	**FY 2003**	**FY 2004**	**FY 2005**	**FY 2006**	**FY 2007**	**Grand Total**
Hatch	2,191	2,406	2,440	2,630	3,288	12,955
McIntire-Stennis	863	1,037	913	911	1,443	5,167
Evans Allen	409	630	718	872	641	3,270
Animal Health	0	0	0	34	0	34
Special Grants	829	917	2,505	796	0	5,047
NRI Grants	2,483	2,378	3,498	3,177	2,028	13,564
SBIR Grants	0	80	0	0	0	80
Other CSREES	5,877	7,730	5,096	9,647	2,861	31,211
Smith-Lever 3(d)	n/a	n/a	n/a	n/a	0	0
Total Reported in CRIS	12,652	15,178	15,170	18,066	10,260	71,326
Smith-Lever 3(b) and (c)	n/a	n/a	n/a	n/a	4,540	4,540
1890 Extension	n/a	n/a	n/a	n/a	171	171
Total Extension Reported in POW	n/a	n/a	n/a	n/a	4,711	4,711
Total (CSREES Admin)	12,652	15,178	15,170	18,066	14,971	76,037

n/a denotes that data wasn't either reported or recorded that fiscal year

CSREES Research and Extension Dollars for Knowledge Area 121: Management of Range Resources						
Combined Research and Extension Dollars						
Formula -Expenditures/Grant-Obligations in Thousands						
Funding Sources	**FY 2003**	**FY 2004**	**FY 2005**	**FY 2006**	**FY 2007**	**Grand Total**
Hatch	563	641	675	762	914	3,555
McIntire-Stennis	335	493	574	451	552	2,405
Evans Allen	0	0	0	0	0	0
Animal Health	0	0	0	0	0	0
Special Grants	1,132	1,104	1,299	1,319	0	4,854
NRI Grants	677	185	623	1,098	469	3,052
SBIR Grants	289	80	0	54	0	423
Other CSREES	380	898	480	360	1,955	4,073
Smith-Lever 3(d)	n/a	n/a	n/a	n/a	54	54
Total Reported in CRIS	3,376	3,401	3,651	4,044	3,945	18,417
Smith-Lever 3(b) and (c)	n/a	n/a	n/a	n/a	1,331	1,331
1890 Extension	n/a	n/a	n/a	n/a	25	25
Total Extension Reported in POW	n/a	n/a	n/a	n/a	1,355	1,355
Total (CSREES Admin)	3,376	3,401	3,651	4,044	5,300	19,772

n/a denotes that data wasn't either reported or recorded that fiscal year

CSREES Research and Extension Dollars for Knowledge Area 122: Management and Control of Forest and Range Fires						
Combined Research and Extension Dollars						
Formula -Expenditures/Grant-Obligations in Thousands						
Funding Sources	**FY 2003**	**FY 2004**	**FY 2005**	**FY 2006**	**FY 2007**	**Grand Total**
Hatch	62	136	142	151	132	623
McIntire-Stennis	581	519	611	600	785	3,096
Evans Allen	0	0	0	0	0	0
Animal Health	0	0	0	0	0	0
Special Grants	0	0	0	0	0	0
NRI Grants	244	175	730	505	150	1,804
SBIR Grants	282	1,058	968	0	426	2,734
Other CSREES	281	262	323	313	0	1,179
Smith-Lever 3(d)	n/a	n/a	n/a	n/a	0	0
Total Reported in CRIS	1,450	2,150	2,774	1,569	1,493	9,436
Smith-Lever 3(b) and (c)	n/a	n/a	n/a	n/a	192	192
1890 Extension	n/a	n/a	n/a	n/a	0	0
Total Extension Reported in POW	n/a	n/a	n/a	n/a	192	192
Total (CSREES Admin)	1,450	2,150	2,774	1,569	1,685	9,628

n/a denotes that data wasn't either reported or recorded that fiscal year

CSREES Research and Extension Dollars for Knowledge Area 123: Management and Sustainability of Forest Resources						
Combined Research and Extension Dollars						
Formula -Expenditures/Grant-Obligations in Thousands						
Funding Sources	**FY 2003**	**FY 2004**	**FY 2005**	**FY 2006**	**FY 2008**	**Grand Total**
Hatch	1,199	926	840	836	1,175	4,976
McIntire-Stennis	8,206	7,966	8,311	8,368	10,609	43,460
Evans Allen	53	72	78	84	99	386
Animal Health	0	0	0	0	0	0
Special Grants	2,777	3,062	3,500	3,376	0	12,715
NRI Grants	3,218	208	2,864	2,499	2,139	10,928
SBIR Grants	303	296	481	616	466	2,162
Other CSREES	921	579	512	1,079	79	3,170
Smith-Lever 3(d)	n/a	n/a	n/a	n/a	0	0
Total Reported in CRIS	16,677	13,109	16,586	16,858	14,566	77,796
Smith-Lever 3(b) and (c)	n/a	n/a	n/a	n/a	2,390	2,390
1890 Extension	n/a	n/a	n/a	n/a	310	310
Total Extension Reported in POW	n/a	n/a	n/a	n/a	2,700	2,700
Total (CSREES Admin)	16,677	13,109	16,586	16,858	17,266	80,496

n/a denotes that data wasn't either reported or recorded that fiscal year

CSREES Research and Extension Dollars for Knowledge Area 124: Urban Forestry						
Combined Research and Extension Dollars						
Formula -Expenditures/Grant-Obligations in Thousands						
Funding Sources	**FY 2003**	**FY 2004**	**FY 2005**	**FY 2006**	**FY 2007**	**Grand Total**
Hatch	138	109	150	160	337	894
McIntire-Stennis	274	278	433	311	615	1,911
Evans Allen	217	182	34	85	22	540
Animal Health	0	0	0	0	0	0
Special Grants	35	0	0	0	0	35
NRI Grants	0	0	15	108	112	235
SBIR Grants	0	0	0	0	0	0
Other CSREES	224	368	421	433	0	1,446
Smith-Lever 3(d)	n/a	n/a	n/a	n/a	10	10
Total Reported in CRIS	888	937	1,053	1,097	1,096	5,071
Smith-Lever 3(b) and (c)	n/a	n/a	n/a	n/a	764	764
1890 Extension	n/a	n/a	n/a	n/a	96	96
Total Extension Reported in POW	n/a	n/a	n/a	n/a	859	859
Total (CSREES Admin)	888	937	1,053	1,097	1,956	5,931

n/a denotes that data wasn't either reported or recorded that fiscal year

CSREES Research and Extension Dollars for Knowledge Area 125: Agroforestry						
Combined Research and Extension Dollars						
Formula -Expenditures/Grant-Obligations in Thousands						
Funding Sources	**FY 2003**	**FY 2004**	**FY 2005**	**FY 2006**	**FY 2007**	**Grand Total**
Hatch	120	198	249	508	225	1,300
McIntire-Stennis	682	737	660	426	531	3,036
Evans Allen	0	0	0	0	51	51
Animal Health	0	0	0	0	0	0
Special Grants	497	464	301	367	0	1,629
NRI Grants	0	264	119	233	0	616
SBIR Grants	0	178	0	0	0	178
Other CSREES	497	0	1,186	285	22	1,990
Smith-Lever 3(d)	n/a	n/a	n/a	n/a	17	17
Total Reported in CRIS	1,796	1,841	2,515	1,819	846	8,817
Smith-Lever 3(b) and (c)	n/a	n/a	n/a	n/a	264	264
1890 Extension	n/a	n/a	n/a	n/a	290	290
Total Extension Reported in POW	n/a	n/a	n/a	n/a	554	554
Total (CSREES Admin)	1,796	1,841	2,515	1,819	1,400	9,371

n/a denotes that data wasn't either reported or recorded that fiscal year

CSREES Research and Extension Dollars for KA 131: Alternative Use of Land						
Combined Research and Extension Dollars						
Formula -Expenditures/Grant-Obligations in Thousands						
Funding Sources	**FY 2003**	**FY 2004**	**FY 2005**	**FY 2006**	**FY 2007**	**Grand Total**
Hatch	533	555	632	620	929	3,269
McIntire-Stennis	205	240	249	286	286	1,266
Evans Allen	0	32	34	68	35	169
Animal Health	0	0	0	0	0	0
Special Grants	124	194	912	65	0	1,295
NRI Grants	564	1	1,126	952	322	2,965
SBIR Grants	0	0	0	16	60	76
Other CSREES	1,401	124	315	172	31	2,043
Smith-Lever 3(d)	n/a	n/a	n/a	n/a	9	9
Total Reported in CRIS	2,827	1,146	3,268	2,178	1,672	11,091
Smith-Lever 3(b) and (c)	n/a	n/a	n/a	n/a	1,573	1,573
1890 Extension	n/a	n/a	n/a	n/a	258	258
Total Extension Reported in POW	n/a	n/a	n/a	n/a	1,831	1,831
Total (CSREES Admin)	2,827	1,146	3,268	2,178	3,503	12,922

n/a denotes that data wasn't either reported or recorded that fiscal year

CSREES Research and Extension Dollars for KA 132: Weather and Climate						
Combined Research and Extension Dollars						
Formula -Expenditures/Grant-Obligations in Thousands						
Funding Sources	**FY 2003**	**FY 2004**	**FY 2005**	**FY 2006**	**FY 2007**	**Grand Total**
Hatch	844	1,048	825	976	1,142	4,835
McIntire-Stennis	147	113	149	167	206	782
Evans Allen	0	0	0	17	40	57
Animal Health	0	0	0	0	0	0
Special Grants	1,365	474	338	2,146	41	4,364
NRI Grants	227	263	165	518	604	1,777
SBIR Grants	0	259	0	0	0	259
Other CSREES	1,665	3,408	3,893	996	154	10,116
Smith-Lever 3(d)	n/a	n/a	n/a	n/a	0	0
Total Reported in CRIS	4,248	5,565	5,371	4,821	2,187	22,192
Smith-Lever 3(b) and (c)	n/a	n/a	n/a	n/a	583	583
1890 Extension	n/a	n/a	n/a	n/a	124	124
Total Extension Reported in POW	n/a	n/a	n/a	n/a	708	708
Total (CSREES Admin)	4,248	5,565	5,371	4,821	2,895	22,900

n/a denotes that data wasn't either reported or recorded that fiscal year

CSREES Research and Extension Dollars for KA 133: Pollution Prevention and Mitigation						
Combined Research and Extension Dollars						
Formula -Expenditures/Grant-Obligations in Thousands						
Funding Sources	**FY 2003**	**FY 2004**	**FY 2005**	**FY 2006**	**FY 2007**	**Grand Total**
Hatch	5,902	5,583	5,715	4,413	5,597	27,210
McIntire-Stennis	312	319	275	308	400	1,614
Evans Allen	747	851	1,148	1,144	1,358	5,248
Animal Health	0	0	21	6	0	27
Special Grants	1,455	1,639	1,912	2,165	0	7,171
NRI Grants	2,194	5,029	5,848	4,700	4,214	21,985
SBIR Grants	1,288	643	703	1,111	731	4,476
Other CSREES	3,149	2,416	3,948	2,387	1,841	13,741
Smith-Lever 3(d)	n/a	n/a	n/a	n/a	0	0
Total Reported in CRIS	15,047	16,480	19,571	16,234	14,140	81,472
Smith-Lever 3(b) and (c)	n/a	n/a	n/a	n/a	2,767	2,767
1890 Extension	n/a	n/a	n/a	n/a	190	190
Total Extension Reported in POW	n/a	n/a	n/a	n/a	2,957	2,957
Total (CSREES Admin)	15,047	16,480	19,571	16,234	17,097	84,429

n/a denotes that data wasn't either reported or recorded that fiscal year

CSREES Research and Extension Dollars for KA 134: Outdoor Recreation						
Combined Research and Extension Dollars						
Formula -Expenditures/Grant-Obligations in Thousands						
Funding Source	**FY 2003**	**FY 2004**	**FY 2005**	**FY 2006**	**FY 2007**	**Grand Total**
Hatch	253	194	244	342	365	1398
McIntire-Stennis	476	343	356	446	672	2293
Evans Allen	0	0	0	0	0	0
Animal Health	0	0	0	0	0	0
Special Grants	112	331	0	0	0	443
NRI Grants	10	0	93	38	0	141
SBIR Grants	0	80	496	444	0	1020
Other CSREES	218	212	163	160	204	957
Smith-Lever 3(d)	n/a	n/a	n/a	n/a	0	0
Total Reported in CRIS	1,069	1,160	1,351	1,430	1241	6251
Smith-Lever 3(b) and (c)	n/a	n/a	n/a	n/a	395	395
1890 Extension	n/a	n/a	n/a	n/a	128	128
Total Extension Reported in POW	n/a	n/a	n/a	n/a	523	523
Total (CSREES Admin)	1,069	1,160	1,351	1,430	1,764	6,774

n/a denotes that data wasn't either reported or recorded that fiscal year

CSREES Research and Extension Dollars for KA 135: Aquatic and Terrestrial Wildlife						
Combined Research and Extension Dollars						
Formula -Expenditures/Grant-Obligations in Thousands						
Funding Sources	**FY 2003**	**FY 2004**	**FY 2005**	**FY 2006**	**FY 2007**	**Grand Total**
Hatch	2,135	2,270	2,338	2,371	2,155	11,269
McIntire-Stennis	1,332	1,291	1,499	1,481	1,761	7,364
Evans Allen	190	147	251	222	192	1,002
Animal Health	11	10	11	9	9	50
Special Grants	171	219	69	0	0	459
NRI Grants	964	49	378	1,245	451	3,087
SBIR Grants	333	454	96	128	173	1,184
Other CSREES	882	584	959	724	179	3,328
Smith-Lever 3(d)	n/a	n/a	n/a	n/a	19	19
Total Reported in CRIS	6,018	5,024	5,601	6,180	4,940	27,763
Smith-Lever 3(b) and (c)	n/a	n/a	n/a	n/a	1,477	1,477
1890 Extension	n/a	n/a	n/a	n/a	78	78
Total Extension Reported in POW	n/a	n/a	n/a	n/a	1,555	1,555
Total (CSREES Admin)	6,018	5,024	5,601	6,180	6,495	29,318

n/a denotes that data wasn't either reported or recorded that fiscal year

CSREES Research and Extension Dollars for KA 136: Conservation of Biological Diversity						
Combined Research and Extension Dollars						
Formula -Expenditures/Grant-Obligations in Thousands						
Funding Sources	**FY 2003**	**FY 2004**	**FY 2005**	**FY 2006**	**FY 2007**	**Grand Total**
Hatch	n/a	n/a	15	106	432	553
McIntire-Stennis	n/a	n/a	0	7	243	250
Evans Allen	n/a	n/a	0	0	64	64
Animal Health	n/a	n/a	0	0	0	0
Special Grants	n/a	n/a	0	146	0	146
NRI Grants	n/a	n/a	0	1,805	950	2,755
SBIR Grants	n/a	n/a	0	0	0	0
Other CSREES	n/a	n/a	0	384	13	397
Smith-Lever 3(d)	n/a	n/a	n/a	n/a	0	0
Total Reported in CRIS	n/a	n/a	15	2,448	1,702	4,165
Smith-Lever 3(b) and (c)	n/a	n/a	n/a	n/a	510	510
1890 Extension	n/a	n/a	n/a	n/a	230	230
Total Extension Reported in POW	n/a	n/a	n/a	n/a	740	740
Total (CSREES Admin)	n/a	n/a	15	2,448	2,442	4,905

n/a denotes that data wasn't either reported or recorded that fiscal year

CSREES Research and Extension Dollars for KA 141: Air Resource Conservation and Management						
Combined Research and Extension Dollars						
Formula -Expenditures/Grant-Obligations in Thousands						
Funding Sources	**FY 2003**	**FY 2004**	**FY 2005**	**FY 2006**	**FY 2007**	**Grand Total**
Hatch	n/a	n/a	0	64	186	250
McIntire-Stennis	n/a	n/a	0	0	0	0
Evans Allen	n/a	n/a	0	79	113	192
Animal Health	n/a	n/a	0	0	0	0
Special Grants	n/a	n/a	0	371	0	371
NRI Grants	n/a	n/a	0	0	2,493	2,493
SBIR Grants	n/a	n/a	0	282	483	765
Other CSREES	n/a	n/a	0	0	743	743
Smith-Lever 3(d)	n/a	n/a	n/a	n/a	0	0
Total Reported in CRIS	n/a	n/a	0	796	4,018	4,814
Smith-Lever 3(b) and (c)	n/a	n/a	n/a	n/a	527	527
1890 Extension	n/a	n/a	n/a	n/a	144	144
Total Extension Reported in POW	n/a	n/a	n/a	n/a	671	671
Total (CSREES Admin)	n/a	n/a	0	796	4,689	5,485

n/a denotes that data wasn't either reported or recorded that fiscal year

CSREES Research and Extension Dollars for KA 403: Waste Disposal, Recycling and Reuse						
Combined Research and Extension Dollars						
Formula -Expenditures/Grant-Obligations in Thousands						
Funding Sources	**FY 2003**	**FY 2004**	**FY 2005**	**FY 2006**	**FY 2007**	**Grand Total**
Hatch	1,606	1,503	1,704	1,523	1,810	8,146
McIntire-Stennis	72	83	176	106	73	510
Evans Allen	266	313	619	343	360	1,901
Animal Health	0	0	0	0	0	0
Special Grants	1,378	1,484	1,775	2,243	0	6,880
NRI Grants	273	530	285	80	841	2,009
SBIR Grants	276	268	767	533	595	2,439
Other CSREES	629	2,015	2,013	1,393	0	6,050
Smith-Lever 3(d)	n/a	n/a	n/a	n/a	14	14
Total Reported in CRIS	4,500	6,196	7,339	6,221	3,692	27,948
Smith-Lever 3(b) and (c)	n/a	n/a	n/a	n/a	1,943	1,943
1890 Extension	n/a	n/a	n/a	n/a	86	86
Total Extension Reported in POW	n/a	n/a	n/a	n/a	2,029	2,029
Total (CSREES Admin)	4,500	6,196	7,339	6,221	5,721	29,977

n/a denotes that data wasn't either reported or recorded that fiscal year

CSREES Research and Extension Dollars for KA 405: Drainage and Irrigation Systems and Facilities						
Combined Research and Extension Dollars						
Formula -Expenditures/Grant-Obligations in Thousands						
Funding Sources	**FY 2003**	**FY 2004**	**FY 2005**	**FY 2006**	**FY 2007**	**Grand Total**
Hatch	298	194	161	135	289	1,077
McIntire-Stennis	0	0	0	0	0	0
Evans Allen	0	0	0	0	0	0
Animal Health	0	0	0	0	0	0
Special Grants	403	386	529	523	0	1,841
NRI Grants	155	0	0	0	139	294
SBIR Grants	75	334	0	0	79	488
Other CSREES	212	799	415	811	40	2,277
Smith-Lever 3(d)	n/a	n/a	n/a	n/a	20	20
Total Reported in CRIS	1,143	1,713	1,105	1,469	568	5,998
Smith-Lever 3(b) and (c)	n/a	n/a	n/a	n/a	361	361
1890 Extension	n/a	n/a	n/a	n/a	33	33
Total Extension Reported in POW	n/a	n/a	n/a	n/a	394	394
Total (CSREES Admin)	1,143	1,713	1,105	1,469	962	6,392

n/a denotes that data wasn't either reported or recorded that fiscal year

CSREES Research and Extension Dollars for KA 605: Natural Resources and Environmental Economics						
Combined Research and Extension Dollars						
Formula -Expenditures/Grant-Obligations in Thousands						
Funding Sources	**FY 2003**	**FY 2004**	**FY 2005**	**FY 2006**	**FY 2007**	**Grand Total**
Hatch	2,417	2,698	3,127	2,636	3,212	14,090
McIntire-Stennis	490	499	420	544	823	2,776
Evans Allen	235	0	0	0	0	235
Animal Health	0	0	0	0	0	0
Special Grants	741	81	129	326	0	1,277
NRI Grants	994	196	1,500	897	74	3,661
SBIR Grants	38	0	0	24	0	62
Other CSREES	828	1,036	1,429	2,254	672	6,219
Smith-Lever 3(d)	n/a	n/a	n/a	n/a	40	40
Total Reported in CRIS	5,743	4,510	6,605	6,681	4,820	28,359
Smith-Lever 3(b) and (c)	n/a	n/a	n/a	n/a	2,265	2,265
1890 Extension	n/a	n/a	n/a	n/a	138	138
Total Extension Reported in POW	n/a	n/a	n/a	n/a	2,403	2,403
Total (CSREES Admin)	5,743	4,510	6,605	6,681	7,223	30,762

n/a denotes that data wasn't either reported or recorded that fiscal year

Appendix C - Detailed Funding Tables for Primary KAs – All Known Funding:

Overall Funding tables provide financial information regarding outside funding sources and their contribution to agency activities, for a five fiscal year span. The grand total of these funding sources amounts to the total funding for agency activities, including internal and external funding.

- CSREES ADMIN funds are expenditures of formula grant and other grant funding administered by CSREES and distributed to the State Agricultural Experiment Stations (SAES) and Other Cooperating Institutions (OCI). The programs included are Hatch, McIntire Stennis, Evans Allen, Animal Health, Special Grants, Competitive Grants, Small Business Innovation Research Grants, Other CSREES grant, Smith-Lever 3(d), Smith-Lever 3(b) and (c), and 1890 Extension programs.

- Other USDA funds are expenditures of funds received by the SAES and other cooperating institutions from contracts, grants, or cooperative agreements, with one of the USDA research agencies other than CSREES.

- Other Federal (FED) funds are expenditures of funds by USDA agencies, the SAES and other cooperating institutions received from federal sources, outside of USDA, through contracts, grants, and cooperative agreements directly with other federal agencies.

- State Appropriations (APPR) funds are expenditures of funds by the SAES and other cooperating institutions received from sources outside of the federal government. Direct appropriations from individual state governments.

- OTHER NON-Federal (FED) funds are expenditures of funds by USDA agencies, the SAES and other cooperating institutions received from sources outside of the federal government. Sources include the sale of products (self generated), industry grants, and miscellaneous non federal sources

** NOTE: FY 2007 funding data includes funding data reported from CRIS and POW annual report, FY 2003 – 2006 funding data are reported from CRIS **ONLY***

Overall Research and Extension Dollars for KA 101: Appraisal of Soil Resources						
Combined Research and Extension Dollars						
($ in the thousands)						
Funding Sources	**FY 2003**	**FY 2004**	**FY 2005**	**FY 2006**	**FY 2007**	**Grand Total**
CSREES	4,546	3,443	4,469	3,396	4,637	20,491
Other USDA	1,189	564	1,034	818	637	4,242
Other Federal	3,921	4,611	6,443	4,789	5,158	24,922
State Appropriations	7,127	7,814	10,989	8,928	11,103	45,961
Other non-Federal	3,159	2,423	3,716	3,706	3,338	16,342
Total	19,942	18,855	26,651	21,637	24,873	111,958

Overall Research and Extension Dollars for KA 102: Soil, Plant, Water, Nutrient Relationships						
Combined Research and Extension Dollars						
$ in the thousands						
Funding Sources	**FY 2003**	**FY 2004**	**FY 2005**	**FY 2006**	**FY 2007**	**Grand Total**
CSREES	17,075	12,522	17,192	18,038	23,297	88,124
Other USDA	2,830	3,591	4,503	3,690	5,332	19,946
Other Federal	16,419	12,069	17,152	12,413	19,324	77,377
State Appropriations	37,647	37,432	45,758	39,878	51,386	212,101
Other non-Federal	14,865	16,645	21,841	16,933	23,591	93,875
Total	88,836	82,259	106,446	90,952	122,930	491,423

Overall Research and Extension Dollars for KA 103: Management of Saline and Sodic Soils and Salinity						
Combined Research and Extension Dollars						
$ in the thousands						
Funding Sources	**FY 2003**	**FY 2004**	**FY 2005**	**FY 2006**	**FY 2007**	**Grand Total**
CSREES	333	287	486	589	422	2,117
Other USDA	108	99	45	86	139	477
Other Federal	565	202	356	394	351	1,868
State Appropriations	2,172	1,588	1,613	1,672	1,765	8,810
Other non-Federal	307	352	430	549	495	2,133
Total	3,485	2,528	2,930	3,290	3,172	15,405

Overall Research and Extension Dollars for KA 104: Protect Soil from Harmful Effects of Natural Elements

Combined Research and Extension Dollars						
$ in the thousands						
Funding Sources	**FY 2003**	**FY 2004**	**FY 2005**	**FY 2006**	**FY 2007**	**Grand Total**
CSREES	1,083	1,273	1,881	1,361	1,888	7,486
Other USDA	361	436	601	224	181	1,803
Other Federal	1,460	1,585	2,512	775	1,392	7,724
State Appropriations	2,667	2,087	2,877	2,822	3,312	13,765
Other non-Federal	1,466	2,796	3,979	2,293	1,034	11,568
Total	7,037	8,177	11,850	7,475	7,807	42,346

Overall Research and Extension Dollars for KA 111: Conservation and Efficient Use of Water						
Combined Research and Extension Dollars						
$ in the thousands						
Funding Sources	**FY 2003**	**FY 2004**	**FY 2005**	**FY 2006**	**FY 2007**	**Grand Total**
CSREES	8,746	7,843	7,830	7,453	6,209	38,081
Other USDA	845	1,173	1,576	1,192	1,880	6,666
Other Federal	3,377	2,028	2,728	1,780	3,647	13,560
State Appropriations	12,038	11,824	13,703	11,523	13,864	62,952
Other non-Federal	3,500	3,651	5,634	3,704	4,512	21,001
Total	28,506	26,519	31,471	25,652	30,112	142,260

Overall Research and Extension Dollars for 112: Watershed Protection and Management						
Combined Research and Extension Dollars						
$ in the thousands						
Funding Sources	**FY 2003**	**FY 2004**	**FY 2005**	**FY 2006**	**FY 2007**	**Grand Total**
CSREES	12,652	15,178	15,170	18,066	14,971	76,037
Other USDA	2,128	2,548	3,324	2,772	3,973	14,745
Other Federal	6,211	10,443	12,481	9,513	13,193	51,841
State Appropriations	17,922	21,180	25,638	21,763	26,545	113,048
Other non-Federal	9,172	10,902	13,726	8,714	11,715	54,229
Total	48,085	60,251	70,339	60,828	70,397	309,900

Overall Research and Extension Dollars for Knowledge Area 121: Management of Range Resources						
Combined Research and Extension Dollars						
($ in the thousands)						
Funding Sources	**FY 2003**	**FY 2004**	**FY 2005**	**FY 2006**	**FY 2007**	**Grand Total**
CSREES	3,376	3,401	3,651	4,044	5,300	19,772
Other USDA	1,086	1,103	2,165	3,467	2,698	10,519
Other Federal	3,102	3,594	5,790	5,936	6,399	24,821
State Appropriations	7,429	6,801	10,227	6,667	8,384	39,508
Other non-Federal	3,049	2,189	3,006	2,673	3,488	14,405
Total	18,042	17,088	24,839	22,787	26,269	109,025

Overall Research and Extension Dollars for Knowledge Area 122: Management and Control of Forest and Range Fires						
Combined Research and Extension Dollars						
($ in the thousands)						
Funding Sources	**FY 2003**	**FY 2004**	**FY 2005**	**FY 2006**	**FY 2007**	**Grand Total**
CSREES	1,450	2,151	2,774	1,569	1,685	9,629
Other USDA	349	355	2,265	1,123	2,683	6,775
Other Federal	1,074	1,068	3,019	2,171	2,770	10,102
State Appropriations	1,478	1,649	3,701	2,542	2,533	11,903
Other non-Federal	1,799	1,339	2,791	1,457	2,518	9,904
Total	6,150	6,562	14,550	8,862	12,189	48,313

Overall Research and Extension Dollars for Knowledge Area 123: Management and Sustainability of Forest Resources						
Combined Research and Extension Dollars						
($ in the thousands)						
Funding Sources	**FY 2003**	**FY 2004**	**FY 2005**	**FY 2006**	**FY 2008**	**Grand Total**
CSREES	16,677	13,109	16,586	16,858	17,266	80,496
Other USDA	6,125	7,236	12,245	7,070	9,902	42,578
Other Federal	12,027	11,521	15,773	10,110	16,103	65,534
State Appropriations	29,164	25,134	39,617	24,217	42,271	160,403
Other non-Federal	15,958	16,038	27,827	18,628	27,942	106,393
Total	79,951	73,038	112,048	76,883	113,484	455,404

Overall Research and Extension Dollars for Knowledge Area 124: Urban Forestry						
Combined Research and Extension Dollars						
($ in the thousands)						
Funding Sources	**FY 2003**	**FY 2004**	**FY 2005**	**FY 2006**	**FY 2007**	**Grand Total**
CSREES	889	937	1,053	1,097	1,956	5,932
Other USDA	199	214	315	327	459	1,514
Other Federal	107	130	454	347	743	1,781
State Appropriations	2,005	2,342	2,999	2,111	2,242	11,699
Other non-Federal	626	672	1,210	1,306	1,142	4,956
Total	3,826	4,295	6,031	5,188	6,542	25,882

Overall Research and Extension Dollars for Knowledge Area 125: Agroforestry						
Combined Research and Extension Dollars						
($ in the thousands)						
Funding Sources	**FY 2003**	**FY 2004**	**FY 2005**	**FY 2006**	**FY 2007**	**Grand Total**
CSREES	1,796	1,841	2,515	1,819	1,400	9,371
Other USDA	2,554	3,050	3,110	500	475	9,689
Other Federal	704	557	1,168	818	1,012	4,259
State Appropriations	2,296	2,573	2,485	1,942	4,264	13,560
Other non-Federal	1,065	985	1,497	927	1,572	6,046
Total	8,415	9,006	10,775	6,006	8,723	42,925

Overall Research and Extension Dollars for KA 131: Alternative Use of Land

Combined Research and Extension Dollars						
$ in the thousands						
Funding Sources	**FY 2003**	**FY 2004**	**FY 2005**	**FY 2006**	**FY 2007**	**Grand Total**
CSREES	2,827	1,146	3,268	2,178	3,503	12,922
Other USDA	601	998	1,447	768	989	4,803
Other Federal	2,233	2,753	4,353	2,424	3,387	15,150
State Appropriations	3,108	3,501	5,419	3,853	5,993	21,874
Other non-Federal	2,233	2,118	2,608	1,933	6,261	15,153
Total	11,002	10,516	17,095	11,156	20,133	69,902

Overall Research and Extension Dollars for KA 132: Weather and Climate						
Combined Research and Extension Dollars						
$ in the thousands						
Funding Sources	**FY 2003**	**FY 2004**	**FY 2005**	**FY 2006**	**FY 2007**	**Grand Total**
CSREES	4,248	5,565	5,371	4,821	2,895	22,900
Other USDA	890	817	792	453	304	3,256
Other Federal	4,858	5,745	6,202	4,164	5,493	26,462
State Appropriations	4,671	6,434	8,206	7,262	8,427	35,000
Other non-Federal	1,500	1,225	3,863	3,125	5,470	15,183
Total	16,167	19,786	24,434	19,825	22,589	102,801

Overall Research and Extension Dollars for KA 133: Pollution Prevention and Mitigation						
Combined Research and Extension Dollars						
$ in the thousands						
Funding Sources	**FY 2003**	**FY 2004**	**FY 2005**	**FY 2006**	**FY 2007**	**Grand Total**
CSREES	15,047	16,480	19,571	16,234	17,097	120,889
Other USDA	2,236	2,049	2,933	2,564	2,809	17,148
Other Federal	10,794	12,984	12,784	10,230	11,874	72,435
State Appropriations	24,743	25,801	29,340	30,964	30,448	195,041
Other non-Federal	10,888	11,122	14,481	11,744	16,757	64,992
Total	63,708	68,436	79,109	71,736	78,985	484,662

KA 134: Outdoor Recreation Overall Funding						
(as reported by the Current Research Information System)						
$ in the thousands						
Funding Source	**FY 2003**	**FY 2004**	**FY 2005**	**FY 2006**	**FY 2007**	**Total**
CSREES Admin	1,069	1,160	1,351	1,430	1,764	6,774
Other USDA	519	470	697	532	941	3,159
Other Federal	1,207	1,212	1,439	861	1502	6,221
State Appropriations	2,249	2,573	3,274	2,664	4,136	14,896
Other non-Federal	1,339	1,139	2,018	1,737	2,980	9,213
Total	6,383	6,554	8,779	7,224	11,323	33,880

Overall Research and Extension Dollars for KA 135: Aquatic and Terrestrial Wildlife
Combined Research and Extension Dollars
($ in the thousands)

Funding Sources	FY 2003	FY 2004	FY 2005	FY 2006	FY 2007	Grand Total
CSREES	6,018	5,024	5,601	6,180	6,495	29,318
Other USDA	2,476	2,709	4,196	2,833	4,407	16,621
Other Federal	15,128	16,057	28,681	17,999	26,379	104,244
State Appropriations	20,300	20,462	29,556	22,454	30,268	123,040
Other non-Federal	12,524	14,732	26,189	15,455	30,458	99,358
Total	56,446	58,984	94,223	64,921	98,007	372,581

Overall Research and Extension Dollars for KA 136: Conservation of Biological Diversity						
Combined Research and Extension Dollars						
($ in the thousands)						
Funding Sources	FY 2003	FY 2004	FY 2005	FY 2006	FY 2007	Grand Total
CSREES	n/a	n/a	15	2,448	2,442	4,905
Other USDA	n/a	n/a	187	1,250	482	1,919
Other Federal	n/a	n/a	90	616	1,713	2,419
State Appropriations	n/a	n/a	269	1,306	4,275	5,850
Other non-Federal	n/a	n/a	779	779	1,424	2,982
Total	n/a	n/a	1,340	6,399	10,336	18,075

Overall Research and Extension Dollars for KA 141: Air Resource Conservation and Management						
Combined Research and Extension Dollars						
$ in the thousands						
Funding Sources	FY 2003	FY 2004	FY 2005	FY 2006	FY 2007	Grand Total
CSREES	n/a	n/a	0	796	4,689	5,485
Other USDA	n/a	n/a	0	0	10	10
Other Federal	n/a	n/a	0	36	204	240
State Appropriations	n/a	n/a	41	239	1,180	1,460
Other non-Federal	n/a	n/a	0	114	394	508
Total	n/a	n/a	41	1,185	6,477	7,703

Overall Research and Extension Dollars for KA 403: Waste Disposal, Recycling and Reuse						
Combined Research and Extension Dollars						
$ in the thousands						
Funding Sources	FY 2003	FY 2004	FY 2005	FY 2006	FY 2007	Grand Total
CSREES	4,500	6,196	7,339	6,221	5,721	29,977
Other USDA	372	851	1,484	673	854	4,234
Other Federal	2,452	7,467	1,443	1,009	2,090	14,461
State Appropriations	8,174	7,514	8,419	7,194	8,821	40,122
Other non-Federal	3,027	3,241	4,076	4,005	3,994	18,343
Total	18,525	25,269	22,761	19,102	21,480	107,137

Overall Research and Extension Dollars for KA 405: Drainage and Irrigation Systems and Facilities

Combined Research and Extension Dollars						
$ in the thousands						
Funding Sources	**FY 2003**	**FY 2004**	**FY 2005**	**FY 2006**	**FY 2007**	**Grand Total**
CSREES	1,143	1,713	1,105	1,469	962	6,392
Other USDA	243	215	246	153	158	1,015
Other Federal	782	781	1,041	572	255	3,431
State Appropriations	3,342	2,353	2,566	1,503	1,777	11,541
Other non-Federal	728	669	1,510	499	627	4,033
Total	6,238	5,731	6,468	4,196	3,779	26,412

Overall Research and Extension Dollars for KA 605: Natural Resources and Environmental Economics						
Combined Research and Extension Dollars						
$ in the thousands						
Funding Sources	**FY 2003**	**FY 2004**	**FY 2005**	**FY 2006**	**FY 2007**	**Grand Total**
CSREES	5,743	4,510	6,605	6,681	7,223	30,762
Other USDA	1,306	1,498	1,730	1,443	3,153	9,130
Other Federal	2,336	2,928	4,426	3,584	4,231	17,505
State Appropriations	11,016	12,268	15,389	14,802	16,415	69,890
Other non-Federal	5,690	4,988	4,436	4,184	5,636	24,934
Total	26,091	26,192	32,586	30,694	36,658	152,221

Appendix D - List of Supporting Programs:

Programs Related to Environment and Natural Resources Portfolio	
Name of Related Program	**Description of Relationship**
Agricultural & Biological Engineering	Partnership with Water KAs for irrigation technology
Agricultural Markets and Trade	Partnership with *enr* Enterprise for social science integration
Agronomic & Forage Crops	Partnership with Climate KA for adaptive species development
Animal Breeding, Genetics & Genomics	Partnership with Climate KA for adaptive species development
Animal Nutrition & Growth	Partnership with Pollution Management KA for animal feed development
Aquaculture	Partnership with Land Use KA for land conversion studies
Biobased Pest Management	Partnership with Pollution Management KA for technology development
Biobased Products & Processing	Partnership with Forestry KAs for forest product development
Ecosystems	Partnership with Land Use and Climate KAs for land conversion studies
Horticulture	Partnership with Climate KA for adaptive species development
Housing & Indoor Environment	Partnership with Air KA for air quality analysis
Integrated Pest Management	Partnership with Pollution Management KA for technology development
Manure & Nutrient Management	Partnership with Pollution Management KA for technology development
Organic Agriculture	Partnership with Land Use and Climate KAs for land conversion studies
Pesticides	Partnership with Pollution Management KA for technology development
Plant Breeding, Genetics & Genomics	Partnership with Climate KA for adaptive species development
Precision Farming	Partnership with Climate KA for adaptive management development
Public Policy	Partnership with Climate KA for adaptive management development
Rural & Community Development	Partnership with *enr* Enterprise for social science integration
Sensor Technology	Partnership with Air KA for air quality analysis
Sustainable Agriculture	Partnership with *enr* Enterprise for social science integration
Sustainable Development	Partnership with *enr* Enterprise for social science integration

Appendix E - Partnering Agencies and Other Organizations:

Portfolio: Environment and Natural Resources Partnering Agencies and Organizations	
Name of Program	**Agency Type**
Natural Resources Conservation Service	USDA and non-USDA Federal Agency
U.S. Forest Service	USDA and non-USDA Federal Agency
Farm Service Agency	USDA and non-USDA Federal Agency
Economic Research Service	USDA and non-USDA Federal Agency
Agriculture Research Service	USDA and non-USDA Federal Agency
National Agriculture Statistics Service	USDA and non-USDA Federal Agency
Environmental Protection Agency	Non-USDA Federal Agency
Bureau of Land Management	Non-USDA Federal Agency
Bureau of Reclamation	Non-USDA Federal Agency
Federal Emergency Management Agency	Non-USDA Federal Agency
U.S. Geological Survey	Non-USDA Federal Agency
National Oceanic and Atmospheric Administration	Non-USDA Federal Agency
National Space Aeronautics Administration	Non-USDA Federal Agency
Fish and Wildlife Service	Non-USDA Federal Agency
Army Corps of Engineers	Non-USDA Federal Agency
National Park Service	Non-USDA Federal Agency
Soil Conservation Districts	Non Federal Organization
Resource Conservation and Development councils	Non Federal Organization
State agencies	Non Federal Organization
Tribal governments	Non Federal Organization
National Commodity Organizations	Non Federal Organization
Regional Air Quality Planning Organizations	Non Federal Organization

Highlights of Key Partnerships

The Natural Resources and Environment (NRE) team supports strong linkages with the USDA's ARS, Economic Research Service (ERS), the Natural Resource and Conservation Service (NRCS), and Forest Service (FS), the Environmental Protection Agency (EPA through NCER), and the National Council for Economic Education (NCEE). Strong collaboration, linkage and integration of programs in research, education, and extension amongst our agencies ensure the well-being of not only the American public, but also the larger global community. This partnership works because the ARS and ERS in-house research is complementary to CSREES' work; university partners (mainly faculty) are heavily involved in education and extension activities; FS provides forest-specific efforts, and NRCS provides technical assistance. EPA's role in regulation and research through STAR grants (Science To Achieve Results) helps to protect the natural resource base and environment at the local, regional, and national levels. These cooperators extend the knowledge beyond CSREES.

CSREES collaborates with the Agricultural Research Service researchers through ARS scientist participation on our peer review panels and CSREES NPLs participating in ARS stakeholder workshops and strategic planning. In addition, CSREES funds ARS research through the NRI/AFRI competitive program. As with university partners, these research projects can bring In collaborations with other agencies who may fund related research. For example, a research project involving a team of ARS scientists and post docs were funded by the NRI, , DOE, and the Madison County Cattleman's association to study different aspects of the issue of endophyte-infected tall fescue pastures that are toxic to cattle and wildlife, and the introduction of a novel endophyte association to compete with and replace this widespread toxic association. This research resulted in more economical and environmentally friendly pasture management strategies and recommendations for the use of this novel endophyte infected tall fescue seed for equivalent productivity form southeastern beef farms.

All major US federal agencies, including USDA, are actively involved in the US Climate Change Science Program. Portfolio NPLs sit on the various interagency working groups and participate actively in strategic planning and program implementation. Scientist and research program managers from all the agencies work together to develop knowledge of variability and change in climate and related environmental and human systems, and translate the knowledge into technologies for application.

The Global Change and Climate has used the *enr* philosophy in combination with the US Climate Change Science Program Strategic and Implementation plans to increase public awareness of climate change science and solutions for policy and behavior change. Trans-disciplinary research projects have been funded that incorporate climate adaptive and mitigation strategies for environment and natural resource management. Innovative partnerships between federal, states, academic, extension service, non-governmental and local community organizations have been established to create a scientifically-based, socially consciousness and culturally acceptable endeavor to address climate change issues in the agricultural industry. The Global Change and Climate Program has successfully partnered with other CSREES NRI Program, such as Weedy and Invasive Species, Soils and Managed Ecosystems to co-fund projects with the Department of Energy, NSF, NASA, NOAA and the Environmental Protection Agency. Strategic Planning is conducted with all 14 agencies associated with the US Climate Change Science Program.

CSREES and NRCS work together to implement the Conservation Effects Assessment Program. The partnership of CSREES and NRCS serve as examples of collaborative work between land grant universities and USDA agencies. The CEAP Project has developed substantial capacity within the land grant university system to increase the understanding of effects of conservation practices and the effectiveness of conservation programs. These watershed projects are unique in that they combine evaluation of the biophysical effects of conservation practices and the socio-economic context of the watershed location. The watershed projects also combine research and extension/outreach activities – involving agricultural producers in project outcomes. CSREES will be leading the effort to translate science into practice for the conservation process. This work will entail linking biophysical, economic, social, and behavioral sciences to achieve

environmental goals. CSREES will work with NRCS to develop a grant program to address effects of conservation practices on watershed health in grazing lands. The grant program will be modeled after the successful CEAP watersheds program – combining biophysical research with socio-economic research and an outreach/extension program to ranchers. The focus will be on determining the effects of NRCS conservation practices on watershed health including hydrology, soil quality, plant community dynamics, and other ecosystem services.

Through the principal efforts of James Dobrowolski (USDA-CSREES-NRE), Evert Byington (USDA-ARS) and Ralph Crawford (USDA-FS-Research) communication and coordination across government occurs each month around the subjects of rangeland, grasslands, and pastures. Called the Interagency Working Group for Grazinglands, national program leaders from at least four cabinet-level departments (Agriculture, Defense, EPA, Interior) meet to improve cooperation and efficiency, identify potential resource leveraging opportunities, identify resources for multidisciplinary teams, provide suggestions for long-term efforts at landscape scales, and continue to promote standardization of monitoring and assessment practices.

Appendix F - Program Evaluations:

Portfolio Environment and Natural Resource's Program Evaluations			
Date	**Brief Description**	**Evaluation Recommendations**	**What Was the Effect**
External Evaluation(s)			
February 1, 2005	There are a number of areas where the panel felt sincere and swift efforts need to be made in order to get NRE and perhaps, CSREES as a whole, to a new level of operational excellence. The CSREES Administrator and NPLs can take a leadership role through workshops, meetings, and conferences to demonstrate new and innovative ways of working collaboratively. These include changes in how members of the partnership operate when it comes to responding to Requests for Applications, the use of the logic model framework throughout the partnership (including formula funds), greater coordination with other stakeholders and partners, and the meaningful planning, collection, interpretation, and reporting of data about the successes of CSREES-funded projects.	The panel recommends enhancing multi-disciplinary contributions. CSREES still has barriers to equally valuing research, education, and extension, which real or perceived, need to be removed. NPLs need to be equally informed across all three components so they can provide a more comprehensive package when attending meetings and making site visits.	The portfolio has undertaken a major initiative, called the Environment and Natural Resources (*enr*) Enterprise, which is a new business strategy for all knowledge areas and programs under this portfolio. It cuts across boundaries and shares resources and capabilities to better address the complex issues facing the nation's natural resource base and the environment.

Portfolio Environment and Natural Resource's Program Evaluations Cont…

Date	Brief Description	Evaluation Recommendations	What Was the Effect
External Evaluation(s)			
February 1, 2005 cont…		Better integration of research, education, and extension is a must. To every extent possible, the CSREES calls for proposals and programs should require and award points for applicants who effectively integrate all three components in their proposals. Some consideration should be given to how rapid response and innovation can be infused into CSREES funding. - Coordination with the partnership in all areas, including priority setting, must be accelerated. So much can be gained with NPLs getting out and sharing CSREES goals, logic models, aspirations, and so forth. The panel encourages CSREES to find ways to encourage multi-disciplinary and integrated efforts with formula funds. Since formula funds are a large part of the CSREES budget, influencing the direction and effective reporting of program activities supported by these funds can create large, beneficial shifts in thinking and behavior.	*enr* programs will invest in projects that enhance individual and collective capacity to discover, learn, create, and identify problems and formulate solutions with respect to the principles and needs of our partners and stakeholders. This strategy will develop a competitive agricultural workforce. In all of *enr*'s research programs, developing new knowledge will incorporate educating and mentoring students, and informing the public through outreach.

Portfolio Environment and Natural Resource's Program Evaluations Cont…

Date	Brief Description	Evaluation Recommendations	What Was the Effect
Internal Evaluation (s)			
September 1, 2006	The portfolio NPLs realized even before the portfolio review the need to better address its environmental and natural resources function of the agency. This function goes beyond that of the NRE Unit and involves all National Program Leaders (NPLs) who have a background in environmental and natural resources issues and have personal interest, skills knowledge and experience in the area. The challenge for the portfolio is to increase the knowledge necessary to mitigate or adapt to the potential magnitude of environmental changes and their feedbacks in agricultural, forestry and rangeland ecosystems to help society respond effectively. Research, educational and extension activities for this initiative would focus on the complexity of changes in ecosystem processes and their frequency and intensity, particularly those that have significant consequence for society.	The portfolio has identified a few areas where progress was achieved in 2006. There have been, however, significant changes in terms of strategic planning and implementation that will result in more significant outcomes and impacts in the years to come. The National Program Leaders have been in the process of planning its overall approach to the portfolio even before the review and these plans are now in the process of its final stage of development and will soon be implemented to achieve the goals of the portfolio.	*enr* programs will invest in activities that integrate research, education and extension, and that develop reward through effective integration at all levels. Programs will also ensure that the findings and methods of research are quickly and effectively communicated in a broader context and to a larger audience. This strategy is vital to the accomplishment of its strategic goals.

Portfolio Environment and Natural Resource's Program Evaluations Cont…

Date	Brief Description	Evaluation Recommendations	What Was the Effect
Internal Evaluation (s)			
September 1, 2006		The Environmental and Natural Resources (*enr*) Enterprise needs to employ integrative strategies that will guide its National Program Leaders in establishing priorities, identifying opportunities, and designing new programs and activities. This will cut across all related CSREES programs and activities, and each is critical to accomplishing CSREES's Strategic Goal to "Protect and Enhance the Nation's Natural Resource Base and Environment" (Strategic Goal 5).	*enr* programs will promote collaboration and partnerships between disciplines and institutions and among academe, industry and government to enable the movement of research, education and extension throughout the public and private sectors. *enr* partnerships will optimize the impact of research, education and extension on the economy and on society through its stakeholders.

Portfolio Environment and Natural Resource's Program Evaluations Cont…

Date	Brief Description	Evaluation Recommendations	What Was the Effect
Internal Evaluation (s)			
September 1, 2007	Strategic Goal 6 used to be Strategic Goal 5 which comprised two objectives: 5.1 Forests, and Rangeland and 5.2: Soil, Air, and Water. These two objectives served the basis upon which two external reviews were conducted in FY2005 and two internal reviews in 2006. Its evolution into Strategic Goal 6 in 2007 divided the portfolio into 4 objectives: Clean, Abundant Water and Clean Healthy Air; Soil Quality and Productive Working Lands; Forests and Rangelands; and Wildlife Habitat. A new strategic plan developed by the Natural Resources and Environment (NRE) unit concluded that Strategic Goal 6 would be better served if it were treated as one portfolio rather than subdividing it into 4 distinct portfolios. The portfolio reviewed the entire Environment and Natural Resources Portfolio in a single document in order to integrate all the activities that cut across the knowledge areas of the portfolio. The nature of this portfolio is such that issues are best addressed in an interdisciplinary manner bringing into focus the interactivity of the soil, air and water resources, to forest, rangeland and grassland and the crosscutting elements among them.	After evaluating all the updated information of the portfolio, the national program leaders have determined that no changes to the newly integrated score are warranted at this time. The averaged score from the integration serves a new benchmark for the portfolio. It is the intent of the national program leaders to use this new benchmark as the starting point for future evaluations.	Research, educational and extension activities for this initiative would focus on the complexity of changes in ecosystem processes and their frequency and intensity, particularly those that have significant consequence for society.

Portfolio Environment and Natural Resource's Program Evaluations Cont…

Date	Brief Description	Evaluation Recommendations	What Was the Effect
Internal Evaluation (s)			
September 1, 2007 cont…		Significant advances in many areas have been made but at this point their impacts have not yet been realized. Integrating the separate objectives into a single portfolio is a first step towards achieving a base for the new portfolio, taking into consideration all components of the portfolio together for the first time.	The national program leaders from the NRE unit and other natural resources and environment programs within CSREES are identifying and apriority research topics in support of an *enr* working plan and develop a common goal that is implementable across the various programs.
		As a starting point, this approach puts heavy emphasis on planning and implementing that provides a strong foundation for evaluation. This further emphasizes the need to assess the portfolio in its entirety.	The agroecosystem, as an organizing theme for the *enr* Enterprise, can be applied at a range of spatial scales including the field, family, the farm level enterprise, the landscape, watershed, institutional or community scale within agricultural, rangeland, forested, or community systems.

Portfolio Environment and Natural Resource's Program Evaluations Cont…

Date	Brief Description	Evaluation Recommendations	What Was the Effect
Internal Evaluation (s)			
September 1, 2007 cont…		The transition from Strategic Goal 5 into Strategic Goal 6 highlights a significant change and the way in which the *enr* Enterprise serves a solid foundation for more components and integrated approach to program development in the natural resources and the environment.	A logic model of an agroecosystem upon which all *enr* programs and linkages can be mapped and their linkages defined is presented below.

Portfolio Environment and Natural Resource's Program Evaluations Cont…

Date	Brief Description	Evaluation Recommendations	What Was the Effect
Internal Evaluation (s)			
September 1, 2008	The portfolio reviews the entire Environment and Natural Resources Portfolio in a single document in order to integrate all the activities that cut across the knowledge areas of the portfolio. The nature of this portfolio is such that issues are best addressed in an interdisciplinary manner bringing into focus the interactivity of the soil, air and water resources, to forest, rangeland and grassland and the crosscutting elements among them. The core Natural Resources and Environment portfolio is now composed of 20 related topical Knowledge Areas (KAs) that integrate research, education, and extension activities, depending on funding line and authority. The portfolio and its related KAs demonstrate the complementary nature of research, education, and extension that is integrated to solve national problems and to ensure that public investment is effective and efficient. KAs are now subject-linked and discussed as one topic area under specific objectives of the CSREES Strategic Plan.	In order to adequately implement and manage the mission and vision of the Environment and Natural Resources Portfolio under the CSREES Strategic Plan for 2007-2012 the NRE unit needs to involve all NPLs whose programs are related to many environmental and natural resources issues of the nation and link that to personal interest, skills, knowledge and experience in the area.	This is the most recent portfolio evaluation so the recommendations have not yet been implemented and their impacts have not yet been evaluated.

Portfolio Environment and Natural Resource's Program Evaluations Cont…

Date	Brief Description	Evaluation Recommendations	What Was the Effect
Internal Evaluation (s)			
September 1, 2008 cont…		A formal collaborative effort, cutting across boundaries has begun and is making progress in terms of breaking down the administrative boundaries of the agency in ways that enhance CSREES's effectiveness in dealing with its mission to serve the public and its partners. Successful research, education, and extension activities for the *enr* Enterprise requires collaboration from within CSRESS, USDA and across other federal agencies but more so from the partnerships with the Land Grant Universities. This is needed to address the scientifically important and socially relevant issues facing government and society.	

Appendix G – List of Stakeholder Groups Consulted:

Stakeholder Groups	Year Consulted
US Climate Change Science Program Interagency Working Groups for:	
Atmospheric Composition	2008
Climate Variability	2008
Global Water Cycle	2008
Global Carbon Cycle	2008
Ecosystems	2008
Decision Support	2008
Observations and Monitoring	2008
Communications	2008
International Research Cooperation	2008
North America Carbon Program	2008
USDA Global Change Task Force	2008
National Agriculture Research, Education, Extension and Economics Board	2008
National Council for Science and Environment	2008
University Federal Dialogue US Dry Pea and Lentil Council	2008
National Grape and Wine Initiative	2008
National Association of State Universities and Land Grant Colleges	2008
Association of Natural Resource Extension Professionals	2008
National Association of County Agricultural Agents	2008
Joint Council of Extension Professionals	2008

Appendix H - Documentation of Previous Score Changes: Compilation by year of previous score changes with the brief rationale for those changes since the panel. This can be simply cut and pasted from Section V each year.

Portfolio Score Change Discussion for 2008

The National Program Leaders for this portfolio analyzed the progress of all its knowledge areas and scored each criterion relative to the performance over the past 3 years and not just the previous year. This resulted in a thorough evaluation of the impacts of the whole portfolio and not simply selected success or failures in implementation and response to the 2005 external evaluation. The National Program Leaders took into account the appraisal of a single portfolio for Environment and Natural Resources, the 2007 score remaining unchanged from the 2006 score because of the merger of the former objectives under the 2006 strategic plan, and a meticulous self-analysis on program impacts and outcomes. The National Program Leaders also took into account a self-assessed overall score prior to the 2005 External Panel Evaluation that was below 70. Using that score as a more relevant benchmark for self-scoring, the National Program Leaders provided a more meaningful portfolio scoring that sets new standards for performance and planning.

The overall score for 2008 was 78. It is almost the same as the score the external panel gave in 2005. This does not negate the fact much significant progress in all aspects of portfolio management of resources and programs and meaningful outputs and outcomes has been produced over the past years. The portfolio has been very responsive to the recommendations provided by the external review panel and have created new initiatives to develop partnership and activities for research, education and extension. The lower score in 2008 relative to 2006/2007 reflects the assessment of the National Programs Leaders of the portfolios needs for considerable changes that are meaningful for the whole portfolio and not just individual pieces. Several knowledge areas have contributed greatly to the success of the portfolio but the portfolio itself as a whole has not made significant progress in addressing larger issues of natural resources and environment concerns.

Four of the fourteen criteria received a lowering of their score by a half-point each. All the remaining criteria retained their score relative to 2006/2007. So for the most part, the portfolio has maintained a steady progress towards its objectives and the three criteria that received a lower score reflect the four areas where the portfolio as a whole needs to focus its efforts to achieve significant improvement. The four criteria that received a lowering of score have a strong dependency on overall agency support in terms of financial resources and cross-program integration. Detailed explanations of these factors are described below.

Relevance Criteria 1.1: Scope (Describe what the portfolio can provide in terms of coverage of work with the available funds).
Previous score: 3; Current score: 2.5

This criterion received a half-point lowering of the score because the National Program Leaders believed that although the portfolio has done a superb job of extending its coverage, this is hampered by the availability of funds to be effective. The measure of the performance was not based on existing coverage of work which is already very significant, but on the availability of funds to provide that coverage. The portfolios individual programs have made significant gains in terms of research, education and extension activities but the portfolio as a while remains relatively under-funded when compared to other units in CSREES. The external panel was generous in providing a score of 3 which was maintained over the past 3 years, however, the appraisal of the National Program Leaders was that this score need s to be adjusted to 2.5 to reflect the need of the portfolio to obtain and focus resources to solve issues rather than run programs.

Relevance Criteria 1.4: Integration (Demonstrate functional integration of CSREES research, extension, and education efforts in the portfolio).
Previous score: 2; Current score: 1.5

Functional integration of CSREES research, extension, and education efforts is one of the difficult implementation issues not only for this portfolio but for all portfolios of CSREES. The external panel was aware of this situation but was also generous in providing a score of 2 which was maintained over the past 3 years. Functional integration involves strong partnerships and although that has been an area for improvement through the implementation of the Environment and Natural Resources Enterprise, the individual program responses have not yet been realized to a large extent. The National Program Leader believe that there is still a lot more that can be done to progress in this area and have lowered the score by a half-point to motivate the entire portfolio to achieve better integrations. As in most cases, individual programs have significant integrated projects but the portfolio as a whole needs to step-up to address this issue together with all parts of the agency.

Quality Criteria 2.1: Significance (Demonstrate generation of significant finding in the portfolio). Previous score: 2.5; Current score: 2

The portfolio has generated significant findings from individual knowledge areas, especially under the CEAP and RREA programs. The National Program Leaders analysis of the portfolio as a whole however showed that many areas of the portfolio still need improvement. The recommendation the 2005 review panel was to establish metrics to evaluate productivity and impacts for formula, competitive and appropriated funding. Although the portfolio has been successful in creating metrics, the implementation has not been comprehensive over all types of funding authority. The generation of significant findings is dependent on the responses of the program's funded scientists and compliance has not been consistent and the quality of the repots needs improvement. This requires a change in attitude for report generation and the National

Program Leaders have few resources to implement such changes. The 2005 panel gave this criterion a score of 2 which was increased to 2.5 over the 2006/2007 evaluation cycle. The National Program Leaders lowered the score back to a 2 to focus efforts of the portfolio to address the implementation of metrics over all portfolio areas.

Performance Criteria 3.4: Agency Guidance (Demonstrate strength of the CSREES program leadership and management relating to the portfolio program management). Previous score: 3; Current score: 2.5

The external review panel's recommendation for this criterion was to address the needs for staffing levels for better allocation of time to leadership for program development and less to program management and maintenance. The portfolio has made great progress in acquiring National Program Leaders and other staff to manage the various knowledge areas. Several National Programs Leaders and staff have received significant leadership training as well. The improvement in staffing levels however has not been able to address the fundamental need for more program leadership and development. The National Program Leaders were now more concerned about improving their leadership role rather than the coverage of leadership for the portfolio, which has been successful over the past years. The number of staff has also been supplemented by shared-faculty and other assigned details to the unit but has not really improved leadership for portfolio program development. The essential element for program development must be the functionality of the programs themselves and less to do with the number of program leaders to do them. Portfolio programs have to address common issues in order to allow for any development and progress to take place. The Environment and Natural Resources Enterprise has been developed for portfolio program leadership to take advantage of functional programs addressing critical needs and not simply the individual implementation of knowledge area objectives. The 2005 review panel gave this criterion a score of 2.5 which was increased to 3 over the 2006/2007 cycle. Although previous analysis provided valid justification for the increase, the National Program Leaders lowered the score back to 2.5 for this cycle to focus efforts on creating a balanced portfolio of programs with concurrent leadership expectations from all portfolio areas. Emphasis will be placed on the overall portfolio improvement using the knowledge areas as contributing pieces and not as individual components for future evaluation.

The remaining ten criteria scores remain unchanged. This is not a reflection of lack of progress. The absolute scores themselves are relatively high. Rather these criteria have maintained steady efforts towards addressing the needs of the portfolio and the recommendations of the external panel have been followed and in many cases exceeded. The overall score is a result of the weighting of the various criteria but as a whole, there is consistency in identifying the areas of the portfolio which need improvement. Goals for achieving progress in these areas have been developed and are described below. The National Program Leaders have their sights set on implementing portfolio wide improvements in performance. This requires strong support from CSREES for resources and policies that allow for leadership and program development. The new portfolio score of 78 has created more room for improvement and reflects a self-assessment that is goal oriented rather than a decrease in the efforts of the portfolio. All criteria have had significant increases that on an individual basis may have maintained or increased scores. The

portfolio as a whole though needs to achieve in a balance of performance in all its knowledge areas and that is the current goal of its leaders.

Portfolio Goals Discussion

There has been significant progress in terms of strategic planning and implementation of the Environmental and Natural Resources (*enr*) Enterprise that will result in more measurable and significant outcomes and impacts in the years to come. The National Program Leaders have been in the process of planning the overall integration of *enr* into the portfolio and it will soon be implemented across the agency to achieve its goals. The *enr*Enterprise will employ four integrative strategies that will guide its National Program Leaders in establishing priorities, identifying opportunities, and designing new programs and activities.

1. Develop Intellectual Capacity

The *enr* Enterprise will invest in projects that enhance individual and collective capacity to discover, learn, create, and identify problems and formulate solutions with respect to the principles and needs of our partners and stakeholders. This strategy will develop a competitive agricultural workforce. In all of *enr*'s research programs, developing new knowledge will incorporate educating and mentoring students, and informing the public through outreach.

2. Integrate Research, Education and Extension

The *enr* Enterprise will invest in activities that integrate research, education and extension, and, particularly those that develop reward through effective integration at all levels. Programs will also ensure that findings and methods of research are quickly and effectively communicated in a broader context and to a larger audience. This strategy is vital to accomplish the new direction of the new strategic goals.

3. Promote Partnership

The *enr* Enterprise will promote collaboration and partnerships between disciplines and institutions and among academe, industry and government to enable strong linkages and movement of research, education and extension among various key stakeholders both in the public and private sectors. Such strong interactions and relationships will strengthen *enr* partnerships and optimize the impact of research, education and extension on the economy and on society.

4. Incorporation of Community Developed Strategic Plans

The strategic plan developed by the Renewable Resources Extension Act (RREA) Strategic Plan has provided and excellent model of community-based thinking that addresses issues of environment and natural resources sustainability. In the case of RREA plan, the nation's forests and rangeland resources are focus areas where strategic imperatives are addressed to cover issues

such as a diverse audience, stewardship, land conversion and others. Similar plans have been developer or are in the process of development for air, soil and water resources. The global change and climate program is based on the US Climate Change Science Program strategic and implementation plans over broad sectors such as carbon cycling. The *enr* Enterprise will provide an overall philosophy and linkage to these community developed strategic plans and will be a significant contribution to the portfolio. The *enr* vision will also be the guiding philosophy for the development of future community-based efforts to address current and future portfolio issues.