

#### **E.4. Renewable Energy, Natural Resources, and Environment**

The Renewable Energy, Natural Resources, and Environment area primarily addresses CSREES' strategic goals to protect and enhance the Nation's natural resource base and environment and to support increased economic opportunities and improved quality of life in rural America. It also supports CSREES' strategic goal of enhancing protection and safety of the Nation's agriculture and food supply and energy self-sufficiency.

The fundamental concept behind this area of programs is the application of ecological, economic, and sociological principles to agricultural production systems. The concept of agroecosystems or agricultural working lands can be applied within agriculture, rangeland, forested, or community systems at a range of spatial scales including the field, family, the farm level enterprise, the landscape, watershed, institution, or community. Agriculture as managed systems involves human interactions and use of inputs. These production systems are influenced by and, in turn, influence the natural systems surrounding them.

Human well-being is inextricably linked to the sustainable use and management of agroecosystems. The fundamental purpose of agriculture is to manage ecological structures, functions, and processes to favor human needs. The concept of sustainable agroecosystem management allows for achieving the traditional agricultural goal of production while balancing the goals of conservation and protection of natural resources, mitigation of environmental impacts, maintenance of ecosystem services, and rural community viability. One benefit of the agroecological approach is that it accommodates a broad range of performance criteria in addition to increased production, such as ecological goods and services, sustainability, food security, energy resources, environmental quality, economic viability, and resource conservation. These criteria provide focus for the various programs.

The overall goal of the Renewable Energy, Natural Resources, and Environment area is to support research and integrated projects that will address the design or function of productive agriculture and rural communities that sustains yields and rural prosperity while minimizing the negative environmental impacts of agricultural practices and technologies on surrounding natural ecosystems. Addressing the degree to which agriculture and rural communities are sustainable is a critically important goal relevant to all USDA mission areas.

In FY 2009, AFRI invites applications in the following area of programs related to Renewable Energy, Natural Resources, and Environment:

- a. Air Quality**
- b. Biology of Weedy and Invasive Species in Agroecosystems**
- c. Managed Ecosystems**
- d. Soil Processes**
- e. Water and Watersheds**
- f. Global and Climate Change**
- g. Sustainable Agroecosystems Science and Long-Term Agroecosystem Program**
- h. Enhancing Ecosystem Services from Agricultural Lands: Management, Quantification, and Developing Decision Support Tools**

The following cross-cutting AFRI programs also contribute to the goals of the Renewable Energy, Natural Resources, and Environment area:

- Microbial Genomics
- Plant Biology: Environmental Stress
- Agribusiness Markets and Trade
- Biobased Products and Bioenergy Production Research

## **a. Air Quality**

Program Code - 94140

National Program Leader – Dr. Ray Knighton (202-401-6417 or [rknighton@csrees.usda.gov](mailto:rknighton@csrees.usda.gov))

Total Program Funds – approximately \$5 million, with approximately \$3.8 million for integrated projects

Proposed Budget Requests –

- Proposed integrated project budget requests must not exceed \$600,000 for project period of 2-4 years (including indirect costs).
- Proposed research project budget requests must not exceed \$400,000 for project period of 2-4 years (including indirect costs).
- Requests exceeding the budgetary guidelines above will be returned without review.

Letter of Intent Deadline – March 5, 2009 (5:00 P.M., ET) for **integrated projects only**; see Part II, F for format and submission instructions.

Anticipated Application Deadline – June 5, 2009 (5:00 P.M. ET); the firm deadline will be made available in the AFRI RFA.

### **Background**

Agriculture, forest, and range production practices have increasingly become subject to state and federal regulations aimed at protecting air resources. In many instances, data do not exist or are not representative of agricultural industries for the purpose of estimating emissions to the atmosphere of regulated pollutants and greenhouse gases, other than carbon dioxide, from agriculture, as well as public nuisances, such as odors and fugitive dust. In addition, there is a need to develop practices and technologies to assist producers in preventing or mitigating air emissions.

The long-term (10 year) goals of this program are: 1) to develop emission data for agriculture, forest, and range production practices leading to science-based emission reduction targets to improve air quality and protect human and environmental health; 2) to develop effective mitigation strategies and increase adoption of best management practices to reduce agricultural emissions; and 3) to improve understanding of the measurement, production, flux, and fate and transport of odor, gases, and particulate matter (PM) leading to knowledge of the environmental fate of agricultural atmospheric emissions.

### **FY 2009 Priorities for Integrated Projects** – Applicants must address at least one of the following priorities.

1. Measurement and Monitoring Integrated projects are solicited to improve inventories and emission rates of particulate matter and gases for within field/facility and edge-of-field/facility boundaries. Emission data for particulates, odors, and gases is of primary concern and is needed for all aspects of production practices and naturally occurring events such as wind and wet/dry deposition to update existing inventories. Educational product (curriculum, publications, demonstrations, and programs) development, delivery, and evaluation targeting priority emissions is needed. Extension/educational application of predictive tools for quantifying rural community impact or risk for exposure to priority emission sources are needed at the farm and community level. Projects are especially encouraged that focus on crop production practices with special emphasis given to emissions from the conversion of Conservation Reserve Program (CRP) land to crop production. High priority emission sources and corresponding constituents are:
  - a. tillage, nutrient management, and pest management, practices that emit PM, ammonia, nitrous oxide, and highly reactive volatile organic compounds (VOCs).
  - b. crop harvest and post-harvest practices that emit PM and gases.
  - c. controlled burning practices as sources of PM, gases, and smoke.
  - d. animal feeding operations as sources of ammonia, PM, VOCs, hydrogen sulfide, methane, odor and odorants.

For projects addressing emissions from animal feeding operations, measurement and monitoring projects that complement and do not duplicate the National Air Emissions Monitoring Study (NAEMS) are encouraged. Projects that include the same animal species, production practices, geographic regions, and analytes currently in the NAEMS study will not be considered for funding.

2. Mitigation Integrated projects should examine the efficacy of new and existing methods for mitigating emissions of reactive nitrogen and other agricultural air pollutants to the atmosphere and the development of best management practices. Projects are especially encouraged that evaluate the efficacy of conservation practices and other control technologies to reduce particulate and gaseous emissions. To ensure the relevance and adoption of practices, these projects should also analyze economic, behavioral, cultural, or policy barriers to implementing practices that reduce emissions. Evidence of commensurate investigator expertise to address and evaluate the human dimensions of the above mentioned barriers is required. Educational products that introduce and define value of mitigation technologies and that contribute to the development of farm management plans are solicited.

#### Other Key Information for Integrated Projects

- A letter of intent is **required** for **integrated projects** in this program. The letter of intent deadline is **March 5, 2009, by 5:00 P.M., Eastern Time**. See Part II, F for format and submission instructions.
- **This is an integrated program. Please refer to Part III, A for eligibility criteria.**
- Project proposals must include at least two of the three components of the agricultural knowledge system (i.e., research, education, and extension). Each component should be represented by one or more objectives within the proposal. Projects must budget sufficient resources to carry out the proposed set of research, extension and/or education activities, with **no more than two-thirds** of a project's budget being allocated to a single knowledge area. Please see Part II.C.2 for a full listing of integrated project requirements, which should be followed closely to ensure success in the peer review process.
- Please see Part IV, A. for the criteria that will be used to evaluate integrated proposals. Applicants are also encouraged to see <http://www.csrees.usda.gov/funding/integrated/integrated> for an example of an integrated proposal and other grant-writing resources.
- Applications must include the elements of a logic model detailing the activities, outputs, and outcomes of the proposed project. This information may be provided as a narrative or formatted into a logic model chart. The logic model planning process is a tool that should be used to develop your project **before** writing your proposal. Two additional pages are allowed for this information. More information and resources related to the logic model planning process are provided at [http://www.csrees.usda.gov/funding/integrated/integrated\\_logic\\_model.html](http://www.csrees.usda.gov/funding/integrated/integrated_logic_model.html).
- The AFRI encourages integrated projects that develop content suitable for delivery through eXtension. This content is for “end users” as opposed to staff development and must align with the eXtension Guiding Principles, Implementation Plan and other requirements as presented at <http://about.extension.org/university-researcher/>. Funds may be used to contribute to an existing Community of Practice or to form a new Community of Practice as appropriate.
- The AFRI encourages integrated projects that lead to measurable, documented changes in learning, actions or conditions in Family and Consumer Sciences disciplines and/or projects suitable for 4-H audiences and stakeholder groups while meeting identified program priorities. 4-H projects should align with 4-H Mission mandates of Science, Engineering, Technology, Healthy Living or Citizenship. See guiding principles at <http://www.national4-hheadquarters.gov/> <<http://www.national4-hheadquarters.gov/>> or contact your university Cooperative Extension headquarters or Family and Consumer Sciences State Leaders.
- Applications that do not address at least one of the stated integrated or research program priorities will be returned without review.
- If a project is funded, beginning in the first year of funding, the project director will be required to attend annual investigator meetings. Reasonable travel expenses should be included as part of the project budget.

**FY 2009 Priorities for Research Projects** – Applicants must address the following priority.

1. Fate and transport research projects should examine the fate and transport of emitted particulates and gases with specific emphasis placed on ammonia, nitrous oxide, and methane. Improved models are needed to predict movement and dispersion of air pollutants from agricultural production practices and management operations at both the local and regional scale. Process-based mechanistic models using mass balance techniques for component processes of the whole enterprise are of specific interest. Projects to better understand the processes controlling wet and dry deposition of reactive nitrogen compounds from agricultural sources are solicited.

**Other Key Information for Research Projects**

- **This is an integrated program.** Please refer to Part III, A for eligibility criteria.
- Applications that do not address at least one of the stated research program priorities will be returned without review.
- If a project is funded, beginning in the first year of funding, the project director will be required to attend annual investigator meetings. Reasonable travel expenses should be included as part of the project budget.

**b. Biology of Weedy and Invasive Species in Agroecosystems**

Program Code - 94240

National Program Leader – Dr. Michael Bowers (202-401-4510 or [mbowers@csrees.usda.gov](mailto:mbowers@csrees.usda.gov))

Total Program Funds – approximately \$4.6 million

Proposed Budget Requests

- Proposed integrated project budget requests must not exceed \$500,000 for project period of 2-4 years (including indirect costs).
- Requests exceeding the budgetary guidelines above will not be reviewed

Letter of Intent Deadline - April 20, 2009 (5:00 P.M., ET); see Part II, F for format and submission instructions

Anticipated Application Deadline - June 19, 2009 (5:00 P.M., ET); the firm deadline will be made available in the AFRI RFA.

**Background**

It has been estimated that approximately 50,000 species of plants and animals have been introduced into the United States resulting in more than \$100 billion in losses and damage each year. Invasive species threaten biodiversity, habitat quality, and ecosystem function. It is estimated that invasive species have contributed to the decline of 42 percent of the endangered and threatened species in the United States. Non-indigenous weeds alone cost U.S. agriculture \$7-27 billion per year. Exotic, invasive species are a particularly prevalent feature of agroecosystems and a major threat to food and fiber production. Increased globalization and climate change will likely increase the introduction, spread, and impact of invasive species.

The long-term (10-year) goal of the program is to provide ecologically and economically rational strategies for management, control, or elimination of weedy or invasive species in agroecosystems. The priorities for FY2009 focus on measuring impact of exotic and invasive species on ecosystem function and services.

**FY 2009 Priorities for Integrated Projects** - Applicants must address one of the following priorities which include research, extension, and education activity options:

1. Projects that focus on the abundance of weedy and invasive species and the individual and/or collective impacts of these species on a broad suite of ecosystem services, both market and non-market, and that can be used to evaluate tradeoffs of different management strategies. Projects might investigate how different cultivation and *nutrient management* regimes/practices, past and current land use, or disturbance, including fire, pests, and grazing, affects the abundance of weedy and invasive species and how these species, in turn, impact the conditions and processes through which agroecosystems provide food, fuel, fiber, and fresh water or by regulating air quality, climate, *erosion control*, and human diseases. The education and/or

extension components should, through curriculum development, participatory workshops, demonstration projects, etc. provide farmers, the public and land managers with an understanding of the diverse and various impacts that weedy and invasive species have on ecosystem services under different management scenarios and programs.

2. Development, delivery, and implementation of ecologically-based, invasive species management programs (e.g. use of cover crops, grazing, tillage, and biocontrol agents) that include economic decision support tools to evaluate tradeoffs of different management strategies.

#### Other Key Information

- A letter of intent is required for this program. The letter of intent deadline is **April 20, 2009, by 5:00 P.M., Eastern Time**. See Part II, F for format and submission instructions.
- **This is an integrated program. Please refer to Part III, A for eligibility criteria.**
- The program will only consider projects that focus on the biology of weedy and invasive plant and animal species of economic importance to agriculture **and** that have direct and obvious relevance to the elimination, management, or control of invasive species in agroecosystems, which includes cropping systems, managed forests, conservation lands, or rangeland. Successful applications will establish links between fundamental biological or ecological relationships and invasive species management plans and strategies. Applications that do not meet the above criteria or do not address one of the priority areas will not be reviewed.
- **Appropriate mechanisms of information delivery** for the target audiences are required. Field-based programs, conferences, workshops, lay and peer-reviewed publications, websites with various software tools, and new or improved curriculum, are just a few of the strategies that may be helpful to elicit positive change.
- Project proposals must include at least two of the three components of the agricultural knowledge system (i.e., research, education, and extension). Each component should be represented by one or more objectives within the proposal. Projects must budget sufficient resources to carry out the proposed set of research, extension and/or education activities, with **no more than two-thirds** of a project's budget being allocated to a single knowledge area. Please see Part II.C.2 for a full listing of integrated project requirements, which should be followed closely to ensure success in the peer review process.
- Please see Part IV, A. for the criteria that will be used to evaluate integrated proposals. Applicants are also encouraged to see <http://www.csrees.usda.gov/funding/integrated/integrated> for an example of an integrated proposal and other grant-writing resources.
- Applications must include the elements of a logic model detailing the activities, outputs, and outcomes of the proposed project. This information may be provided as a narrative or formatted into a logic model chart. The logic model planning process is a tool that should be used to develop your project **before** writing your proposal. Two additional pages are allowed for this information. More information and resources related to the logic model planning process are provided at [http://www.csrees.usda.gov/funding/integrated/integrated\\_logic\\_model.html](http://www.csrees.usda.gov/funding/integrated/integrated_logic_model.html).
- The AFRI encourages integrated projects that develop content suitable for delivery through eXtension. This content is for “end users” as opposed to staff development and must align with the eXtension Guiding Principles, Implementation Plan and other requirements as presented at <http://about.extension.org/university-researcher/>. Funds may be used to contribute to an existing Community of Practice or to form a new Community of Practice as appropriate.

- The AFRI encourages integrated projects that lead to measurable, documented changes in learning, actions or conditions in Family and Consumer Sciences disciplines and/or projects suitable for 4-H audiences and stakeholder groups while meeting identified program priorities. 4-H projects should align with 4-H Mission mandates of Science, Engineering, Technology, Healthy Living or Citizenship. See guiding principles at <http://www.national4-hheadquarters.gov/> <<http://www.national4-hheadquarters.gov/>> or contact your university Cooperative Extension headquarters or Family and Consumer Sciences State Leaders.
- **New Project Opportunity: REE-NET** – The program will accept proposals that coordinate networking activities directed towards the research priority. These projects should move the field forward or create new research directions or opportunities through increased coordination, networking and synthesis. Moreover, these projects should: foster communication and promote collaboration among Research, Education, and Extension (REE) faculty with common interests across disciplinary, geographical, and organizational boundaries; establish networks and collaborations between faculty at Tier 1 and 2 institutions, and faculty at small, mid-size, and minority serving institutions (1890 land-grant institutions, Hispanic-serving Institutions, 1994 land-grant institutions); minimize isolation and maximize cooperation so as to eliminate unnecessary duplication of efforts; and coordinate the development of new tools and methods and generate community resources such as databases. Additional considerations include:
  - The size of a group/network will vary depending on the theme and needs of the proposed activity and may be regional, national, or international in scope.
  - Each network will include a diversity of members—from established researchers at tier 1 and 2 schools to new researchers, post-docs, graduate students, and faculty at small, mid-size, and minority serving institutions.
  - Each project will include a clearly defined management plan that includes a description of the specific roles and responsibilities of the PD/Coordinator and other members of the group/network. The management plan should include provisions for flexibility to allow the structure of the group to change over time as membership and the network's foci evolve.
  - Grants are expected to be no more than \$50,000/yr for three or four years. Although REE-Net activities are expected to involve investigators from multiple sites, a single organization must serve as the submitting organization for each proposal. When the proposed activity involves generation of community resources such as databases, a plan for their timely release and the mechanism of sharing must be in place. In addition, there must be a plan for the long-term maintenance of such resources. The application must state in the first sentence in the summary that the project is a REE-Net proposal.
- If a project is funded, beginning in the first year of funding, the project director will be required to attend annual investigator meetings. Reasonable travel expenses should be included as part of the project budget.

### **c. Managed Ecosystems**

Program Code - 94340

National Program Leader – Dr. Diana Jerkins (202-401-6996 or [djerkins@csrees.usda.gov](mailto:djerkins@csrees.usda.gov))

Total Program Funds – approximately \$4.5 million for priorities from AFRI and \$800,000 for priority 2 from NRCS-CEAP

Proposed Budget Requests –

- Proposed integrated project budget requests must not exceed \$500,000 (including indirect costs).
- Requests exceeding the budgetary guidelines above will not be reviewed.

Letter of Intent Deadline – March 3, 2009 (5:00 P.M., ET); see Part II, F for format and submission instructions.

Anticipated Application Deadline – June 2, 2009 (5:00 P.M., Eastern Time); the firm deadline will be made available in the AFRI RFA.

## Background

The goals of the Managed Ecosystems program are to protect and enhance agricultural production and the natural resource base and environment through the appropriate use and management of agricultural production systems; enhance economic opportunities by increasing productivity and ecosystem services; and improve the quality of life in rural America through improved environmental quality. The primary problem to be addressed is how to improve multi-functional agricultural production systems to be more economically and environmentally sustainable.

To meet these identified needs of agriculture, the long-term (10-year) goals for this program are: to develop, quantify, and verify predictive, multifunctional agroecosystem management systems and conduct experimental studies that will concurrently optimize resource use efficiency while increasing product and environmental quality; and develop indicators for land resource use assessment and quantify agroecosystem changes. Over the long term, projects will involve the design and verification of managed ecosystems, dissemination of decision support tools, and education about innovative management strategies and multi-functional research training.

This program will take a systems approach. Systems research is multidisciplinary and focuses on the interrelationship between management practices and response to biological, physical, economic, and social processes. A systems approach will be able to demonstrate agricultural sustainability and identify points of sensitivity and synergy between system components. Managed ecosystems that will be designed and evaluated must be multi-functional, i.e. provide agricultural products and other ecosystem services and lead to increased sustainability (system balance) over time.

For FY 2009, the program will be supporting two integrated priorities.

### FY 2009 Priorities for Integrated Projects –

1. Understanding, delivery, and implementation of multifunctional agricultural production management systems. – **Research** should lead to a better understanding of the function and structure of key agroecosystems processes and mechanisms to produce agricultural products and ecosystem services in a non-polluting, resource enhancing agricultural production system. Example of activities could include: monitoring and quantification of ecosystem services provided under multi-functional agroecosystem management; identifying indicators appropriate to indicate agroecosystem sustainability; and management and economic trade-offs between functions. Research projects should be hypothesis-driven. Research should lead to management recommendations which are multifunctional (production and ecosystem services) and lead to improved ecosystem services and environmental quality. Valuation of potential economic return for production of agricultural and environmental services is strongly encouraged. **Extension** activities should develop management strategies, guidelines, decision support tools for producers. Extension efforts should lead to the development of programs to train producers about the use and value of new systems and how ecosystems function. These activities should lead to the adoption of new management strategies to improve the productivity and environmental quality of the agroecosystem. **Education** activities should develop educational methodologies for trans-disciplinary education for multi-functional agricultural management and production systems. Development of curricula on systems research procedures and/or ecological systems functions is encouraged. Systems production training and curricula that integrate economic analysis of ecosystem services, stakeholder decision making, and analysis of project outcomes is also encouraged. All activities **must** include multiple ecosystem services.
2. Biodiversity in working agroecosystems – What are the measurable biological responses to conservation activities in working range and pasture land agroecosystems at watershed or landscape scale? Projects should utilize interdisciplinary, mechanistic approaches to quantify the response of native or naturalized terrestrial and aquatic plant and animal species biodiversity to conservation practices applied in working range and pasture land agroecosystems. Priority will be given to projects that quantify biological responses involving multiple species at watershed or landscape scale. Findings on the biological effects of conservation practices in these agroecosystems must be translated into adaptive management recommendations and protocols for sustaining species studied.

### Other Key Information for Integrated Projects

- A letter of intent is required for this program. The letter of intent deadline is March 3, 2009 **by 5:00 P.M., Eastern Time**. Format and content for the letter of intent can be found in Part II F.
- **This is an integrated program. Please refer to Part III, A for eligibility criteria.**
- Project proposals must include at least two of the three components of the agricultural knowledge system (i.e., research, education, and extension). Each component should be represented by one or more objectives within the proposal. Projects must budget sufficient resources to carry out the proposed set of research, extension and/or education activities, with **no more than two-thirds** of a project's budget being allocated to a single knowledge area. Please see Part II.C.2 for a full listing of integrated project requirements, which should be followed closely to ensure success in the peer review process.
- Please see Part IV, A. for the criteria that will be used to evaluate integrated proposals. Applicants are also encouraged to see <http://www.csrees.usda.gov/funding/integrated/integrated> for an example of an integrated proposal and other grant-writing resources.
- Applications must include the elements of a logic model detailing the activities, outputs, and outcomes of the proposed project. This information may be provided as a narrative or formatted into a logic model chart. The logic model planning process is a tool that should be used to develop your project **before** writing your proposal. Two additional pages are allowed for this information. More information and resources related to the logic model planning process are provided at [http://www.csrees.usda.gov/funding/integrated/integrated\\_logic\\_model.html](http://www.csrees.usda.gov/funding/integrated/integrated_logic_model.html).
- The AFRI encourages integrated projects that develop content suitable for delivery through eXtension. This content is for “end users” as opposed to staff development and must align with the eXtension Guiding Principles, Implementation Plan and other requirements as presented at <http://about.extension.org/university-researcher/>. Funds may be used to contribute to an existing Community of Practice or to form a new Community of Practice as appropriate.
- The AFRI encourages integrated projects that lead to measurable, documented changes in learning, actions or conditions in Family and Consumer Sciences disciplines and/or projects suitable for 4-H audiences and stakeholder groups while meeting identified program priorities. 4-H projects should align with 4-H Mission mandates of Science, Engineering, Technology, Healthy Living or Citizenship. See guiding principles at <http://www.national4-hheadquarters.gov/> <<http://www.national4-hheadquarters.gov/>> or contact your university Cooperative Extension headquarters or Family and Consumer Sciences State Leaders.
- Applicants must specify type of production system and ecosystem services being investigated.
- Applications must address agricultural production systems. Development of management strategies should be limited to the following areas: **Focus area 1:** 1) crop, 2) range, 3) forest, 4) shrub and grassland, 5) mixed land use. These systems may be at the rural level or urban agricultural interface. Animal systems may be incorporated as part of the listed production systems. **Focus area 2:** 1) rangeland, 2) pasture land.
- In **Focus area 1**, to better understand the interrelationship between agroecosystem functions, management systems being investigated must include multiple ecosystem services which are considered stacked or bundled. In **Focus area 2**, the primary required ecosystem service for investigation is biodiversity, but may also include other ecosystem services.
- For examples of ecosystem services see the Millennium Ecosystem Assessment reports, [www.millenniumassessment.org](http://www.millenniumassessment.org)
- If the project involves model development, the model should conceptualize either new or improve existing models. The project must include field testing for verification of the model. If model development is part of

[Redacted]

[Redacted]

[Redacted]











program is to engage extension to establish a network of land managers and farmers and connect them with researchers in the collective and collaborative study of long-term processes and the coupled dynamics of ecological, production, and socio-economic systems. The research should be hypothesis driven, inter-disciplinary, and employ experimental, observational, theoretical, and/or modeling approaches.

The Long Term Agroecosystem Program is relevant to all agency mission areas (Food and Fiber, Natural Resources and Environment, etc.), and most of the CSREES strategic goals, especially Goal 4, “Enhance protection safety of the nation’s agriculture and food supply,” and Goal 6, “Protect and enhance the nation’s natural resource based and environment.”

### **SAS-LTAP focus**

The program is using an interdisciplinary, research, education and extension approach to understand the biophysical, ecological and cultural factors influencing soil ecology, especially those processes affecting soil carbon within and across farms, as well as the effect of soil carbon on agroecosystem functionality. An LTAP site will be comprised of a distributed system of farms that collectively capture at the watershed/regional scale the variation in existing conditions and management approaches practiced within a particular agriculture production system. Depending on funding, the budget for a SAS-LTAP team would be approximately \$1 million/yr with duration of 10 years. This year, however applicants are limited by the proof of concept restrictions on budget and project period described above.

A detailed program of education can extend current knowledge to improve soil carbon storage. However, understanding the mechanisms and processes involved in soil ecosystems and the accumulation and loss of stored soil carbon provides an opportunity to refine and improve management strategies that increase carbon storage and decrease carbon loss, with potential long-term impacts on food security, economic viability and sustainability of farms and climate change. Soil is the largest reservoir of carbon in terrestrial ecosystems. Organic carbon in agricultural soils contributes positively to soil fertility and crop production. Changes in agricultural management to improve soil biotic and physical structure can increase or decrease soil organic carbon while, respectively, decreasing or increasing atmospheric carbon dioxide. Moreover, soil carbon plays central roles in the flow of energy through agroecosystems, and in defining the physical, chemical, and biological attributes of soils. Considering that the gross turnover of soil organic carbon can be more than 20 years in temperate regions, practices aimed at carbon management need to be evaluated on a decadal time scale or longer.

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.

Key unanswered questions about the biogeochemical aspects of soil systems management include:

- How do agronomic inputs and extractable yield associated with different kinds of management impact soil biology and carbon storage in the short and long-term?
- What is the maximum potential carbon storage of a soil? How long does it take to attain the storage potential? How long does it reside there?
- How do changes in the global environment, such as increased atmospheric carbon dioxide levels and weather patterns (especially drought), impact soil carbon cycling?
- What is the relationship between the carbon-to-nitrogen ratio of crop residue to greenhouse gas emissions;
- What is the relationship between soil carbon and ecosystem functionality, especially soil biodiversity.

Key unanswered questions about soil systems from the land manager's perspective include:

- How does soil carbon management affect the short and long-term economics of farming, especially relative to yield and the costs of water, energy, fertilizer, and the control of weeds and pests, etc.?
- How is soil carbon management related to risk mitigation practices and the need to control short and long-term agronomic outputs?
- What is the potential to develop models and standards allowing carbon credits from agricultural systems to be traded on a carbon marketplace?
- What is the relationship between environmental stewardship, values, and soil carbon management? How might this change under different land ownership and changing social networks and demographics?

The interdisciplinary nature of the questions and the focus on problem-solving creates unique opportunities for education and extension.

Critical questions from an extension perspective might include:

- How best to establish a dynamic knowledge network of farmers, researchers and extension personnel around the issue soil carbon management that could work to immediately implement and evaluate current best management practices, identifying knowledge gaps for research ?
- Identify incentives for farmers to try new management methods. Critical questions from an education perspective might include:
- How do we train students to conduct transdisciplinary analyses of both the natural and human components of farming systems?
- How do we design student theses and dissertation projects around long-term integrated agroecosystem studies?
- How do we implement changes in curricula, hiring and reward at colleges and universities required to achieve this transdisciplinary approach to training and research?

It is assumed that an improved scientific-based understanding of the social, economic, and environmental benefits of managing carbon will eventually lead to local understanding, acceptance and support of novel farming strategies. Knowledge related to the biophysical dimensions of agroecosystems is useful only if people "choose" to use this knowledge to guide their actions. Employing a participatory approach and a partnership involving farmers, land managers, and faculty engaged in research, teaching and extension, guarantees the LTAP will be stakeholder driven and, therefore, stakeholder relevant.

### **SAS-LTAP Proof of Concept Proposals**

In this RFA we are exploring the feasibility of SAS-LTAP projects through two-year, proof-of concept proposals that will develop the intellectual, analytical, and organizational structure that could form the foundation for a full SAS-LTAP site proposal. A SAS-LTAP Proof of Concept proposal should: i) develop the intellectual context for the development of a SAS- LTAP site including the major question(s) to be addressed around the topic of soil ecosystems and carbon management, ii) justify focusing on a particular production system (or systems) and a particular site comprised of a network of farms (combining local studies in a regional approach); and 3) plan for innovative and/or integrative approaches, and the anticipated roles of training, education, and extension.

More specifically, proof of concept proposals should describe approaches, activities and timelines that would:

- Establish an interdisciplinary team of researchers, a community of land managers, farmers, etc., and extension personnel and educators. Detail the methods and approaches that will be used to communicate



