National Research Initiative

Competitive Grants Program

Annual Report
Fiscal Year 2007

NRi

Knowledge for Tomorrow's Solutions

CSREES EDUCATION RESEARCH EXTENSION USDA

USDA

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A Message from the CSREES Science Advisor

The portfolio of competitive projects funded through the National Research Initiative (NRI) continues to expand our understanding of the many complex issues confronting agriculture and to increase the capacity of communities throughout the nation to respond to these rapidly changing issues. The quality and diversity of this year's projects reflects the growing complexity and intensity of problems facing our nation's agricultural and related resources. Some of the nation's most prolific agricultural, biological, environmental, and social scientists and educators are partnered with us through this remarkable array of competitive projects. These individuals, bolstered by the commitment of their institutions and engagement of communities, provide the nation with fundamental knowledge through research, human capital through education, and an informed citizenry through extension. Through integration of these activities innovative products, tools, and solutions are developed to ensure the integrity of our agricultural, social, and environmental systems well into the future. This report will provide a brief and informative overview of projects funded in Fiscal Year 2007. These projects reflect intense planning and development on the behalf of project directors and collaborators. This report also provides valuable data that will establish a platform for overall program evaluation and assessment for charting the future development of the NRI.

A short but important new addition to this annual report is the data on student support through NRI funding. Although these data have been tracked internally for some time, it is particularly important that this information be assessed collectively because so many agricultural scientists, engineers, and educators are but "a few good ideas" away from retirement. In fact, the 2006 Survey of Earned Doctorates revealed only 2.5 percent of the doctorates awarded went to agricultural scientists. Whereas the research described below will likely have far reaching impacts on agriculture and communities, it is critical that we understand the impact of the NRI on helping to sustain the nation's agricultural research workforce through the participation of students in these high quality projects and the transformation of curricula through integrated projects.

This year's portfolio includes excellent examples of integration across education, research, and extension. However, there is also integration across disciplines, stakeholders, as well as temporal and geospatial scales. For example, the project by Henry Bryant at Texas A&M University, "Effects of Biofuels Technology Development and Fossil Energy Extraction Conditions on World Agricultural Markets and Trade" alerts us to the need to pay attention to the global economic issues associated with biofuel production. The project by Francis Pierce, et al, "Soil Ecosystem Changes in Carbon and Nitrogen Budgets Induced by Shifts to Biofuels Production" will help us to understand sustainability of soils as crops are grown for biofuel production. The Global Phytophthora Network (GPN) of Seogchan Kang and colleagues at the Pennsylvania State University provides another example of the global nature of threats to U.S. agriculture and will provide an innovative mechanism to help manage these threats across broad geographical areas. The work of Jocelyn E. Malamy at the University of Chicago, "Identifying Molecular and Physiological Pathways that Regulate Root System Architecture in Arabidopsis and Crop Plants" will result

in our ability to breed plants more tolerant of the impacts from climate change and less dependent on fertilizers, leading to tremendous ecological benefits. Jizhong Zhou, et al, "A Genomics-enabled FACE Microbial Observatory: Changes in Microbial Diversity and Functions in Responding to Elevated CO_2, Nitrogen Deposition and Plant Diversity," will generate much needed information on the impacts of a principal greenhouse gases on perhaps the smallest members of our ecological community. Speaking of communities, William Wong's project, **"**Healthy Kids Houston: An Integrated Community Program for the Prevention of Obesity among Minority Children" demonstrates that the NRI directs attention to some of the most vulnerable members of our human communities as well. These are but a few examples that attest to the quality and diversity of projects summarized in this year's annual report.

NRI projects were selected through the competitive review process, which begins with the submission of innovative proposals by some of the nation's best scientists. Although over 1877 proposals were submitted in 2007, CSREES staff are redoubling their efforts to engage the 1890 and minority serving institution community to ensure that no element of the nation's intellectual potential goes untapped. We also are indebted to the 439 panelists who contributed their time and expertise to uncover the most relevant and creative projects for funding. The nation is fortunate to have these resources to call upon. All of us at CSREES are indeed grateful.

Stakeholder comments are always of tremendous importance to the continuing success of program development. It is equally important to acknowledge the efforts of CSREES leadership and staff who manage this diverse portfolio of NRI programs and who are committed to ensuring that future efforts of the NRI are characterized by even greater successes. It is amazing for some to realize that the NRI continues to perform at its present level of accomplishment while receiving only 38 percent of its Congressionally authorized funding. One can only imagine the impact of this program if a significantly greater portion of this nation's intellectual capital was unleashed or trained to address issues facing agriculture. Perhaps the concerns about sustaining the discipline would be of little or no prominence. However, to a large extent CSREES leadership and staff make this funding shortfall less apparent by effective management and innovation. Just as scientists and educators push for innovation, CSREES staff are constantly searching for ways to identify new areas and new challenges related to the agency's mission. For example, the focus of the 2007 NRI Annual Retreat was risk taking. Attendees discussed recent projects designated as "high-risk" that exceeded or did not quite meet expectations. Together, we analyzed and critiqued these NRI funded efforts and left the retreat with a general consensus that it is only through our individual and collective efforts to identify truly innovative projects – taking risks – that we will exceed our prior successes in this program.

I would like to extend my congratulations to all of the CSREES staff and NRI grant recipients throughout the nation who took risks to ensure another successful year for this remarkable program!

Dr. Larry Robinson
CSREES Science Advisor

National Research Initiative: An Overview

The Cooperative State Research, Education, and Extension Service (CSREES) has the unique mission to advance knowledge for agriculture, the environment, human health and well-being, and communities. The mission is achieved by funding projects that support mission-relevant topics benefiting society while advancing agricultural achievements. These projects promote effective communication between scientific disciplines and bring together stakeholders with similar interests. The National Research Initiative (NRI), the largest competitive program offered through CSREES, was established to further the mission by increasing the competitiveness of U.S. agriculture; improving human health and well-being through an abundant, safe, and high-quality food supply; and sustaining the quality and productivity of the natural resources upon which agriculture depends.

Beginning in Fiscal Year 2003, the NRI expanded its interests beyond those set during the program's inception to fund projects that integrate research, education, and extension. The inclusion of integrated projects into the traditional research platform allowed the NRI to better address the needs of the end-user.

Congress sets the basic budgetary framework for the NRI and requires that grants be consistent with the development of systems of sustainable agriculture. Members of Congress make recommendations for the scientific and programmatic administration of the NRI through appropriation language and through their questions and comments during Congressional budgetary hearings.

The administration signals program opportunities and directions through budget requests and documentation submitted for CSREES. In Fiscal Year 2007, the NRI administered a budget of $175,142,784 from a total appropriation of $190, 229,000 million[1]. The funds were distributed to support programs within four cluster areas: Agricultural Genomics and Biosecurity; Agricultural Production and Value-Added Processing; Nutrition, Food Safety and Quality; and Agroecosystems and Rural Prosperity.

Identification of Program Priorities

The Competitive Program staff assimilates the input of diverse stakeholder groups to develop programs that will solicit the highest-quality proposals to meet the needs of agriculture, food, forestry, environment, and rural communities in the United States. Setting program priorities is an important means of facilitating the scientific and technological advances needed to meet the challenges facing U.S. agriculture. The program priorities encompass one and often several of the six USDA strategic goals for Fiscal Year 2007:

1. Enhance international competitiveness of American agriculture
2. Enhance the competitiveness and sustainability of rural farm economies
3. Support increased economic opportunities and quality of life for rural America
4. Enhance protection and safety of the nation's agriculture and food supply
5. Improve the nation's nutrition and health
6. Protect and enhance the nation's natural resource base and environment

1 This amount is after set asides for administrative costs, the Small Business Innovation Research (SBIR) program, and the Biotech Risk Assessment program.

Input from coalitions and stakeholders provide broad perspectives on current research, extension, and education needs and priorities. Staff also meets with coalition groups and not-for-profit societies to determine current trends in each field. In addition, the NRI receives input on its programs from across academia, including administrators, staff members, and scientists, as well as research, extension, and academic administrators of the land-grant institutions.

NRI scientific staff attends scientific and professional meetings to ensure scientific trends are reflected in the Request for Applications (RFA). They also coordinate program priorities with other federal agencies. NRI staff participates in meetings with representatives of key commodity groups and other user groups to discuss stakeholders' current research, education, and extension priorities, to solicit comments and suggestions on NRI program priorities, and to determine how the NRI can best meet stakeholders' needs.

Grants Provided

The NRI provides grants that support research, education, and extension to address mission relevant goals. ***Fundamental Awards*** are granted to projects that provide basic knowledge, which advances applied research and conceptual breakthroughs in fields relevant to agriculture. ***Enhancement Awards*** are provided to strengthen the research capacity of individuals and institutions, such as postdoctoral fellowships, new investigator grants, and Strengthening Awards. ***Mission-linked Awards*** fund projects that address specific problems, needs, or opportunities in modern society as well as projects that convey information and technology on specific agricultural issues to end-users. ***Multi-disciplinary Awards*** encourage collaborations among institutions, agencies, and fields of study to solve complex problems and seek to initiate research in new areas of science and engineering that are relevant to agriculture, food, forestry, the environment, and rural communities. ***Integrated Awards*** fund projects that bring together at least two of the three components of the agricultural knowledge system (e.g., research, education, and extension). Integrated projects hold the greatest potential to produce, transfer, and apply knowledge directly to the end users, while providing educational opportunities to assure the development of agricultural expertise in future generations. All funding types are represented in the last type of award called the ***Coordinated Agricultural Project*** (CAP). In 2004, the CAP was created to support large-scale, multi-million dollar projects to promote collaboration, open communication, and the exchange of information; reduce duplication of effort; and coordinate activities among individuals, institutions, States, and regions. CAP awards are only solicited in defined programs and may be research or integrated based on the priorities of the program. Project participants serve as a team that conducts targeted project priorities in response to emerging or priority area(s) of national need. CAP awards are typically made as continuation grants.

Of the NRI awards funded each fiscal year, Congress designates that funds be allocated in a specific manner. Multi-disciplinary funding should be greater than or equal to 30 percent of funds awarded. Mission-linked funding should be greater than or equal to 40 percent of funds awarded. No less than 10 percent is to be awarded to strengthen research capacity of individuals and institutions. In Fiscal Year 2007, Congress designated that integrated projects may account for up to 22 percent of funds across the grant spectrum.

Program Implementation

Proposals are solicited through the NRI RFA. The RFA is distributed widely within the scientific community and among other interested groups. The Fiscal Year 2007 RFA, published on the CSREES Web site and Grants.gov, identified 26 program areas addressing the six strategic goals.

In Fiscal Year 2007, the NRI provided integrated opportunities in 15 of the 26 programs: (1) Plant Biosecurity; (2) Managed Ecosystems; (3) Air Quality; (4) Bioactive Food Components for Optimal Health; (5) Human Nutrition and Obesity; (6) Epidemiological Approaches for Food Safety; (7) Animal Reproduction; (8) Animal Growth and Nutrient Utilization; (9) Animal Genome (A); (10) Animal Protection and Biosecurity (B and C); (11) Biology of Weedy and Invasive Species in Agroecosystems; (12) Plant Genome (D); (13) Plant Biology (A and B); (14) Agricultural Prosperity for Small and Medium-Sized Farms; and (15) Improving Food Quality and Value.

A total of 1,877 proposals were considered for funding in Fiscal Year 2007 and reviewed through a competitive review process. Each year, panels of scientific peers meet to evaluate and recommend proposals based on scientific merit, investigator qualifications, and relevance of the proposed work to U.S. agriculture. In Fiscal Year 2007, 30 peer panels reviewed and ranked the proposals. Criteria for the selection of panel members included active scientists with current knowledge of the relevant scientific discipline, educational background, experience, and professional stature within the scientific community. The membership of each panel was balanced carefully to reflect diversity in geographical region, type of institution, type of position, as well as gender and minority status. A breakdown of panel member statistics is shown in Table 1. Additional expertise was brought to proposal evaluation by a number of scientists and other experts through ad hoc reviews, which covered a wide variety of fields. These reviews provided the additional expertise that made it possible to select the highest quality and most meritorious proposals for funding. In total, more than 439 scientists contributed their time and expertise to the NRI proposal evaluation process in Fiscal Year 2007.

At the conclusion of the review process, a summary of the peer panel's evaluation and the written reviews were forwarded to the submitting investigators, providing them with critical assessments of their proposed project by recognized leaders in the appropriate fields. The reviewers' comments and suggestions also provided another avenue for the applicants to refine proposals for future resubmission.

Since 1993, non-technical summaries of each funded project have been published as Abstracts of Funded Projects and posted on the CSREES Web site on NRI Funding Opportunities page (http://www.csrees.usda.gov/funding/nri/nri.html).

Program Outreach

NRI program staff conducted Grantsmanship Workshops in Washington, D.C. and Denver, Colorado to increase applicant community and administrator understanding of the philosophy, directives, and procedures of the NRI competitive review process. These workshops focused on CSREES funding opportunities in competitive research and integrated programs, as well as capacity building in

the Science and Education Resource Development (SERD) programs, including higher education, international programs, and multi-cultural alliances. Information provided during breakout sessions expanded on guidelines to assist applicants with preparing proposals, individual program descriptions, and recent funding statistics. In addition, a Grantsmanship Workshop for Integrated Programs was held in New Orleans, Louisiana as part of the joint meeting of the American Society of Agronomy (ASA), the Crop Science Society of America (CSSA), and the Soil Science Society of America (SSSA). A second Grantsmanship Workshop was held in Scottsdale, Arizona as part of the American Society of Horticultural Science annual meeting. Both meetings focused on how to develop, write, and implement competitive proposals for CSREES integrated programs. In addition to Grantsmanship Workshops, the NRI staff made presentations on opportunities within the NRI program at national meetings of scientific and/or professional societies, for regional research groups, and other audiences from EPSCoR (Experimental Program for Stimulating Competitive Research) institutions and 1890 Land Grant Institutions.

In an effort to provide better guidance to our applicants, additional funding information was provided on the CSREES Web site. From the front page of the Agency's Web site, the National Research Initiative link located on the right-hand side of the screen directs the user to the NRI Funding Opportunities page where more information can be obtained. The Funding Opportunities page presents a series of links that provide valuable information to the user, including a link to the NRI program synopsis page, the current RFA, and abstracts of funded projects. In addition, the topics area and proposal due date link directs the user to a quick reference chart listing codes for the 26 NRI programs and submission deadline dates to assist applicants with the grant process.

Funded Projects in Fiscal Year 2007

A total of 1,877 proposals were submitted to the NRI, requesting a total of $772,095,728. Table 2 details the list of awards made to the 451 highest-ranked proposals totaling $164,372,877. The success rate is calculated in terms of number of proposals funded, excluding conferences, supplements, and continuing increments of the same grant, divided by the number of proposals submitted for review. The NRI funded approximately 22 percent of proposals submitted. Funding for 318 standard research projects averaged approximately $391,244 for 2.8 years, excluding Research Career Enhancement Awards, Equipment Grants, Seed Grants, Conference Grants, continuing increments, and supplements. Fifty-one standard integrated research, education, and extension projects were funded averaging $681,026 for 3.5 years, excluding Bridge Grants, Conference Grants, continuing increments, and supplements.

The NRI provided funds totaling $285,180 in partial support of 27 Conference Grants. These conferences brought scientists together to identify research, education, and extension priorities, provide an update on research information, and/or advance an area of science important to U.S. agriculture, food, forestry, the environment, and rural communities. The NRI provided a total of $16,735,732 in funds to the Agricultural Research Enhancement Awards (AREA). These awards support Postdoctoral Fellowships, New Investigator Awards, and Strengthening Awards. More details on AREA awards are provided in Table 3.

Crosscutting Areas

A number of topics of major importance to USDA span several program areas. NRI support for these crosscutting program areas in Fiscal Year 2007 is shown in Table 4. The data provided identify the total amount of funding from all program areas for a specified topic. For example, the water quality area includes projects from the Water and Watersheds Program as well as some projects from other programs relevant to water quality, such as Soils Processes.

Research Dimensions

As noted, research projects can be examined by type of investigation (fundamental or mission-linked) and by organization of research approach (single discipline or multi-disciplinary). These collaborations, where appropriate, may combine the biological, physical, chemical, and social sciences. NRI funding in Fiscal Year 2007 for these categories is shown in Table 5.

Education

The NRI contributed to the preparation of the next generation workforce for agriculture by funding 1806 years of student assistantships in fiscal year 2007. To continue to advance agriculture and remain competitive in the international market, it is imperative that every effort be made today to train tomorrow's workforce including researchers, practitioners, teachers, and policy makers. This can be achieved and sustained with funding for comprehensive training and education of students. Table 6 provides an overview of student support provided by programs within the NRI. Students funding ranged from undergraduate to post-doctoral level.

Participation

The range of institutions participating in the NRI is very broad. A breakdown of submitted applications, funded applications, and fiscal year 2007 dollars awarded is provided by institution in Table 7. The institution types include 1862, 1890, and 1994 land grant universities, as well as public non-land grant universities, private universities, private research organizations, and federal labs.

Interagency Research

NRI National Program Leaders work closely with their research-funding counterparts in other federal agencies to maximize interagency cooperation and avoid research duplication. Each interagency research program issues a single request for proposals, and representatives of the agencies work together to assemble a panel of scientific peers to identify the most meritorious proposals. From this group, representatives of each agency select proposals that are the most germane to the mission of that

agency. Thus, the NRI is able to attract researchers from an even wider applicant pool in order to address areas of importance to agriculture, food, forestry, and the environment. An example of cooperation is seen in the research that NRI funds jointly with other federal agencies, including:

The Microbial Genome Sequencing Program has been supported jointly by the USDA/CSREES NRI and the National Science Foundation (NSF) since Fiscal Year 2001. Over 100 microbial genomes have been sequenced to date. The USDA/CSREES and NSF Microbial Genome Sequencing Program will lead to improved breeding strategies, increased disease resistance, and enhanced yield and nutritive value.

The Fiscal Year 2007 Global Climate Change Program is supported with funds from USDA/CSREES NRI and the Environmental Protection Agency (EPA). Knowledge gained from this program addresses the impact of global climate change on land-based systems and the global carbon cycle. In addition, this program identifies agricultural and forestry activities that can help reduce greenhouse gas concentrations by using technologies and practices that reduce carbon in the atmosphere and enacting risk management practices that mitigate natural and human impacts on agricultural ecosystem dynamics.

The Maize Genome Project partners USDA/CSREES NRI with the National Science Foundation (NSF) and the Department of Energy (DOE) in supporting a large-scale sequencing of the corn genome. Previous funding from the USDA/CSREES NRI, NSF, and DOE has supported development of maize genome sequence resources, including physical and genetic maps, expressed sequence tags, sequences derived from gene-enriched genomic libraries, and a community genome database. The genetic sequence of maize will open new avenues of research for scientists to increase yields, reduce inputs, and develop more disease-resistant and drought tolerant varieties. This knowledge will also advance our understanding of the biology of important, but poorly understood processes, such as development of biofuels, hybrid vigor, drought tolerance, and asexual plant production.

CSREES NRI Awards and Honors

Every year the Competitive Programs unit of CSREES has two opportunities to honor highly successful, motivated, and innovative scientists funded through the National Research Initiative. **The President's Early Career Award for Scientists and Engineers** (PECASE) award is the highest honor bestowed by the U.S. government on outstanding scientists and engineers beginning their independent careers. CSREES selects its awardee from among the most meritorious investigators funded through the NRI Competitive Grants Program New Investigator Awards. The **Discovery Award** was established by the NRI to recognize outstanding researchers in agriculture who advance knowledge and address issues critical to agriculture, the environment, human health and well-being, and communities. The Discovery award highlights exceptional scientific and economic impacts of NRI-funded projects and recognizes outstanding scientists in agriculture who have supported the CSREES mission.

In October 2007, **Dr. Sarah D. Brooks** of Texas A&M University was the recipient of the Fiscal Year 2006 PECASE award. Dr. Brooks was nominated for her investigation into the chemical and physical properties of dust emissions from cattle feed lots and other agricultural operations. She received funding for her proposal entitled *Physical and Chemical Properties of Particulate Matter Emissions from Large Animal Feed Lots* from the NRI Air Quality Program. The EPA recently increased the stringency of National Ambient Air Quality Standards for particulates. Changes in ambient atmospheric conditions, such as temperature and humidity, alter the chemical characteristics of the particulate matter. Changes in particulates affect the chemical emissions. Both novel chemical methods to speciate the particulate matter along with scanning electron microscopy were employed in a controlled environment to evaluate how the physical characteristics of the particulates change when subjected to ambient atmospheric conditions under potential best management practices. Knowing the dynamic properties of the particulate matter will help to formulate better management practices to control emissions. This research will improve our understanding of how concentrated animal feeding operations (CAFOs) affect air quality and could lead to new management strategies to limit or lower emissions. The results from this study address a critical need for a better understanding of the air quality at CAFOs and future application to a range of other agricultural operations that influence air quality.

In Fiscal Year 2007, **Dr. Jorge Dubcovsky**, of the University of California - Davis, was awarded the NRI Discovery Award for his work to enhance the nutritional value of wheat. Twenty percent of all calories consumed globally come from wheat-derived foods, such as bread and pasta. Dr. Dubcovsky and colleagues received funding from the NRI Plant Genome program to clone a gene that controls levels of protein, iron, and zinc in wheat. They designated the cloned gene, GPC-B1, for its effect on grain protein content. GPC-B1 accelerates grain maturity and increases grain protein and micronutrient content by 10 to 15 percent in the wheat varieties studied to date. The researchers also found that all commercial pasta and bread wheat varieties have a nonfunctional copy of the GPC gene. This suggests that this gene was lost during the domestication of wheat. Reintroducing the functional gene into commercial wheat varieties could increase the nutritional value of this important crop. Dr. Dubcovsky's project offers a potential solution to nutritional deficiencies affecting hundreds of millions of children around the world. Dr. Dubcovsky's project was titled, *Wheat Applied Genomics - Coordinated Agricultural Project*.

Table 1 Characteristics of NRI Peer Review Panels, Fiscal Year 2007

Characteristic	Number of Peer Review Panelists	Percent
Geographic Region		
Northeast	79	18
North Central	124	28
Southern	143	33
Western	93	21
Type of Institution*		
Land Grant University		
1862 Land Grant University	266	60
1890 Land Grant University	23	5
1994 Land Grant University	1	0
Hispanic Serving	17	4
Public non-Land Grant	43	9
Private College/University	16	4
Private Research	8	2
Federal	49	11
Industry/Other	23	5
Type of Position		
Professor	125	28
Associate Professor	125	28
Assistant Professor	98	23
Federal	51	12
Industry	21	5
Other (Senior Lecturer)	19	4
Expertise Representation		
Researcher	271	61
Educator	90	21
Extension Educator	47	11
Other	31	7
Gender/Minority Representation		
Non-minority Male	196	45
Non-minority Female	128	29
Minority Male	87	20
Minority Female	28	6

*Seventy-four panelists represented USDA EPSCoR states and 53 panelists represented Small and Mid-sized Institutions.

Table 2 NRI Funding Allocations[2], Fiscal Year 2007

Program Name	Number of Grants Awarded	Total Dollars Awarded ($)
Agricultural Genomics and Biosecurity Program Cluster		
Plant Biosecurity	3	2,679,842
Animal Genome (A): Applied Animal Genomics	14	4,109,993
Animal Genome (B): Tools and Resources	4	2,892,913
Animal Genome (C): Bioinformatics	3	2,999,961
Animal Genome (D): Functional Genomics	2	977,599
Animal Protection & Biosecurity (A): Animal Disease	30	7,994,636
Animal Protection & Biosecurity (B): Animal Well-Being	7	2,498,479
Animal Protection & Biosecurity (C): Animal Biosecurity Coordinated Agricultural Projects (CAP)	2	1,684,667
Microbial Genomics (A): Genome Sequencing	5	5,000,000
Microbial Genomics (B): Functional Genomics of Microorganisms	4	3,000,000
Arthropod and Nematode Biology and Management (A): Organismal and Population Biology	22	5,800,000
Arthropod and Nematode Biology and Management (B): Suborganismal Biology	11	3,531,358
Arthropod and Nematode Biology and Management (C): Tools, Resources and Genomics	8	3,491,000
Microbial Biology (A): Microbial Observatories	2	2,211,000
Microbial Biology (B): Biology of Plant-Microbe Associations	19	5,400,000
Plant Genome (A): Tools, Resources, and Bioinformatics	7	2,301,000
Plant Genome (B): Functional Genomics	6	2,495,000
Plant Genome (C): Genome Structure and Organization*	0	0
Plant Genome (D): Applied Plant Genomics Coordinated Agricultural Project (CAP)	6	5,733,500
Total	**155**	**64,800,948**
Agricultural Production and Value-added Processing Program Cluster		
Agricultural Markets and Trade	18	5,100,000
Animal Growth and Nutrient Utilization	18	4,546,000
Animal Reproduction	19	4,441,929
Biobased Products and Bioenergy Production Research	23	7,454,562
Nanoscale Science and Engineering for Agriculture and Food Systems*	0	0
Plant Biology (A): Gene Expression and Genetic Diversity	13	4,200,000
Plant Biology (B): Environmental Stress	13	4,000,000
Plant Biology (C): Biochemistry	14	4,455,000
Plant Biology (D): Growth and Development	12	4,200,000
Total	**130**	**38,397,491**

Program Name	Number of Grants Awarded	Total Dollars Awarded ($)
Agroecosystems and Rural Prosperity Program Cluster		
Agricultural Prosperity for Small & Medium-Sized Farms	11	4,867,883
Air Quality	11	4,800,000
Biology of Weedy and Invasive Species in Agroecosystems	17	4,600,000
Global Climate Change	4	1,609,160
Managed Ecosystems	14	4,097,122
Rural Development*	0	0
Soil Processes	19	4,405,513
Water and Watersheds	15	5,215,756
Total	**91**	**29,595,434**
Nutrition, Food Safety and Quality Program Cluster		
Bioactive Food Components for Optimal Health	13	4,097,000
Epidemiological Approaches for Food Safety	7	4,270,000
Food Safety	18	5,527,000
Human Nutrition and Obesity	14	11,000,000
Improving Food Quality and Value	23	6,685,004
Total	**75**	**31,579,004**
Grand Total	**451**	**164,372,877**

*The program is offered every other year. It was not offered in Fiscal Year 2007.
[2]The content of this table varies from tables provided in documents supporting the President's budget to Congress each year in that these data represent all awards made with Fiscal Year 2007 appropriated funds as of January 29, 2008, regardless of the year awards were made.

Table 3 Agricultural Research Enhancement Awards[3], Fiscal Year 2007

Type of Award	Number of Grants Awarded	Total Dollars Awarded ($)
Post Doctoral Fellowships	20	2,486,438
New Investigator Awards	19	6,240,527
Strengthening Awards		
Research Career Enhancement Awards	6	348,502
Equipment Grants	11	367,803
Seed Grants	15	1,492,722
Standard Strengthening Research Project Awards*	21	5,799,740
Total	**92**	**16,735,732**

*Thirty-three additional grants totaling $13,246,061 were awarded to institutions eligible for Standard Strengthening Research Projects Awards.

[3]The content of this table varies from tables provided in documents supporting the President's budget to Congress each year in that these data represent all awards made with Fiscal Year 2007 appropriated funds as of January 29, 2008, regardless of the year awards were made.

Table 4 Crosscutting Program Areas[4], Fiscal Year 2007

Area	Number of Grants Awarded	Total Dollars Awarded ($)
Animal Genome	23	10,739,661
Animal Health	57	18,504,734
Food Safety	33	12,390,010
Forest Biology	30	12,419,532
Global Change	24	6,344,059
Integrated Pest Management	54	22,135,421
Plant Genome	30	18,939,702
Sustainable Agriculture	43	15,033,275
Water Quality	28	8,906,071

[4]The content of this table varies from tables provided in documents supporting the President's budget to Congress each year in that these data represent all awards made with Fiscal Year 2007 appropriated funds as of January 29, 2008, regardless of the year awards were made.

Table 5 Dimensions of NRI Research[5], Fiscal Year 2007

Dimension	Total Dollars of Support ($)	Percent
Fundamental	99,446,403	60
Mission-linked	64,926,474	40
Multi-disciplinary	112,490,819	68
Single Discipline	51,882,058	32
Integrated Research, Education, and Extension Projects	34,932,331	21
Research Projects	129,440,546	79

[5]The content of this table varies from tables provided in documents supporting the President's budget to Congress each year in that these data represent all awards made with Fiscal Year 2007 appropriated funds as of January 29, 2008, regardless of the year awards were made.

Table 6 Student Training Support, Fiscal Year 2007

Program Cluster	Number of Students	Months of Support	Years of Support
Agricultural Genomics and Biosecurity			
Undergraduate Students	114	1,320	110
Graduate Students	137	3,628	302
Postdoctoral Students	194	5,061	422
Subtotal	445	10,009	834
Agricultural Production and Value Added Processing			
Undergraduate Students	52	1,103	92
Graduate Students	94	2,029	169
Postdoctoral Students	51	1,487	124
Subtotal	197	4,619	385
Agroecosystems and Rural Prosperity			
Undergraduate Students	90	727	61
Graduate Students	108	2,071	173
Postdoctoral Students	28	526	44
Subtotal	226	3,324	277
Nutrition, Food Safety and Quality			
Undergraduate Students	43	497	41
Graduate Students	69	1,546	129
Postdoctoral Students	50	1,061	88
Subtotal	162	3,104	259
All Programs			
Undergraduate Students	299	3,647	304
Graduate Students	408	9,274	773
Postdoctoral Students	323	8,135	678
Total	**1030**	**21,056**	**1,755**

Table 7 Distribution of NRI Awards by Institution[6] Type, Fiscal Year 2007

Type of Institution	Percent of Submitted Applications	Percent of Grants Awarded	Percent of Total Dollars Awarded
Land Grant University			
1862 Land Grant University	73.3	76.3	76.7
1890 Land Grant University	1.3	1.3	0.8
1994 Land Grant University	0.0	0.0	0.0
Public non-Land Grant	10.5	8.3	6.3
Private College/University	4.5	5.3	5.6
Private Research	3.9	3.3	4.1
Federal	5.9	5.1	5.3
Industry/Other	0.6	0.4	1.2

[6]This breakdown represents awards made directly to the lead institution. Because many applications are submitted by multi-institution teams, the percentage provides a minimum value for the involvement of an institution type.

The National Research Initiative: Supporting the CSREES Mission

In Fiscal Year 2007, the NRI funded 451 grants. This section provides examples of both research and integrated projects in support of the mission priorities of USDA and CSREES. Integrated projects are denoted with a small Earth icon after the project title.

Strategic Goal 1

Enhance International Competitiveness of American Agriculture

Expanding global markets for agricultural products is critical for the long-term economic health and prosperity of our food and agricultural sector. U.S. farmers have a wealth of natural resources, cutting-edge technologies, and a supporting infrastructure that result in production capacity beyond domestic needs. Expanding global markets will increase demand for agricultural products and contribute directly to economic stability and prosperity for America's farmers.

Plant Biology

Identifying Molecular and Physiological Pathways that Regulate Root System Architecture in Arabidopsis and Crop Plants

Jocelyn E. Malamy, University of Chicago

Identifying the genes that control root system architecture in two agriculturally important crop plants, soybean and tomato, will provide information needed to modify root systems. The results from this project will lay the groundwork to design crop plants that use soil, water, and nutrients more efficiently and reduce dependence on irrigation and fertilizers.

Modern agricultural practices involve intensive irrigation and application of fertilizers. These practices may strain freshwater resources and produce fertilizer runoff that contaminates waterways. Soil water and nutrient deficiencies in the absence of these inputs result in unacceptable crop losses. Plants that can tolerate drought and nutrient stress are particularly desirable because they require fewer agricultural inputs. Plant root system architecture (RSA) is a major factor in water and nutrient uptake. Identifying the key regulators of root system development and using these regulators to manipulate RSA in crop plants are an important agricultural and environmental goal. In this project, the researcher will translate knowledge gained from the model plant Arabidopsis, using tools developed to identify molecular regulators of RSA, to two agriculturally important crop plants. Tomato, a member of the Solanaceae family, and soybean are both economically important U.S. crops. This project will test whether these regulators are easily translated between Arabidopsis, soybean, and tomato. The findings will be used to predict root system regulatory genes in soybean and tomato and test the predictions by altering gene expressing directly in these crop plants. The resulting plants may be bred to accommodate growing conditions in altered climate conditions while limiting the impact on the surrounding environment.

Plant Biology

Role of a FLC-like MADS Box Gene in Poplar Vegetative Bud Development and Dormancy

Gary D. Coleman and Zhongchi Liu, University of Maryland

Late spring and early fall frost in fruit crops, such as tart cherry, juice grape, and plum, has significant impacts on the economic stability of the fruit industry. The results of this study will provide tools to control and alter the response of various fruit crops to their growth environment, including ways to manipulate dormancy initiation. The project also may result in an increase in the level of biomass in important energy crops, such as poplar.

Vegetative dormancy is an adaptive mechanism that ensures plant survival during unfavorable environmental conditions encountered during the winter. Deciphering the developmental genetics of bud dormancy has practical significance to forest and horticultural tree crop production. Forest tree productivity and wood quality is related to the length of the growing season that occurs between spring bud break and fall growth cessation and bud set. Temperate fruit tree productivity and economic losses associated with frost damage are directly linked to both the timing of bud flush and set. In addition, bud dormancy also impacts productivity of temperate fruit crops grown in tropical and subtropical climates. When insufficient chilling of temperate crops fails to overcome dormancy, bud break does not occur or is erratic resulting in abnormal shoot growth and asynchronous fruit production. As a consequence, artificial methods, including cultural and chemical treatments, are required for economic production. The researchers will examine the key regulatory gene, PtFLC2, which governs vegetative bud dormancy and chilling-mediated dormancy, in the model forest tree species Populus (poplars and cottonwoods). FLC (Flowering Locus C) is a gene involved in flower induction in plants, and ptFLC2 is an FLC-like gene specific to poplar. These genes belong to a class of genes known as MADS Box, which are often involved in the regulation of flowering time. During the study, transgenic poplars expressing altered levels of PtFLC will be compared to the anatomy, morphology, and physiology of wild-type poplars.

Agricultural Markets and Trade

Effects of Biofuels Technology Development and Fossil Energy Extraction Conditions on World Agricultural Markets and Trade

Henry Bryant, Texas A&M University

The potential of biofuel production to provide an alternative to foreign fuel has received a great deal of media attention in the past year. The resulting discussion often focuses on the type and benefit of different fuel alternatives. This study will compare the impact of biofuels on the domestic and international economy. The results from this project will support an efficient biofuel production sector, with minimum adverse impacts on the remaining sectors of the world economy.

Agricultural markets and trade are being profoundly affected by the dramatic, ongoing expansion of biofuel production. Alternative scenarios regarding biofuel technology development, fossil energy availability, and government policy will result in greatly different outcomes for the agricultural economy. The researcher will develop a recursive-dynamic computational general equilibrium model of world economic activity with detailed representation of agricultural and biofuels production sectors. The model will draw on the existing GTAP6 data base, the global data base representing the world economy for a given reference year. The researcher will add sectors for dedicated energy crops, algae production, and biofuel production. In addition, the model will include joint production of agricultural and forest residues. The revised model will be used to characterize the effects of differing fossil energy extraction conditions and the effects of differing renewable energy technological developments. This information will provide a more comprehensive view of biofuel and fossil fuel resources to promote socially and environmentally responsible policy decisions.

Strategic Goal 2

Enhance the Competitiveness and Sustainability of Rural Farm Economics

An economically prosperous agricultural production sector contributes to the nation's economic vitality and standard of living. Consumers benefit from efficiently produced and marketed agricultural products that minimize their food costs and maximize their consumption choices. The sector's success depends on the ability to expand into new markets, gain adequate capital, protect itself adequately against financial risk, and adjust to changing market conditions. Farm sector diversity is driven by fluctuations in resource availability, climate, individual preferences, and even lifestyles. The needs, concerns, and opportunities of larger, commercially oriented farms differ from those of smaller, intermediate farms, regardless of location.

Plant Biology

Biosynthesis of Volatile Homoterpene Defense Metabolites in Plants

Dorothea Tholl, Virginia Polytechnic Institute and State University

Plant volatiles provide plants a mechanism for communicating with the outside world. However, little is known about how plants synthesize these compounds. The results of this study will increase knowledge of volatile secondary metabolites synthesis, which may be used to develop new strategies and approaches for pest control, such as increased resistance to insect damage and biological pest control mechanisms. These traits would reduce the use of synthetic pesticides, decrease costs for plant production, and limit the release of harmful chemicals into the natural environment.

Plants use volatile secondary metabolites to communicate with the outside world. The metabolites allow plants to produce fragrance in order to signal to insect pollinators, to provide antimicrobial activity, and to produce flavor and aroma to communicate with animals. Some volatile secondary metabolites released from plants either ward-off herbivorous insects directly or attract natural enemies of the herbivores. While plant volatiles are clearly important for plant defense and fitness, knowledge of their biosynthesis and regulation is still limited. In this project, the researcher will characterize the biosynthesis and regulation of two homoterpene volatiles, called DMNT and TMTT that have been identified in maize, cabbage, tomato, cucumber, and Arabidopsis. This project makes use of the broad array of tools developed for Arabidopsis to examine the synthesis and regulation of DMNT and TMTT in leaves and roots. Enzymes and the genes that encode these volatiles will be identified and characterized using biochemical and molecular biological approaches. Experiments will also determine regulatory steps in the biosynthetic pathways and examine the compartmentation of these different volatiles in the roots and leaves of the plant. The research results will then be extended to other agriculturally important plants, like the mustard family (Brassica), to modify volatile production and provide the added beneficial traits.

Improving Food Quality and Value

Functional Foods Containing Novel Carbohydrates for Energy Balance and Improved Health

Bruce Hamaker, Terry Powley, Kimberly Kinzig, Robert Phillips, and Michael Kushnick
Purdue University, West Lafayette, Indiana

Introduction of novel, low, energy-dense, and low glycemic foods are needed to fight chronic degenerative diseases, such as Type II diabetes, cardiovascular diseases, and cancer. This project will improve the nation's understanding of the important role carbohydrates play in a healthy diet as well as produce carbohydrate-based functional foods that will provide optimum energy balance.

The nation is plagued by an increase in obesity, which plays a key role in degenerative diseases, such as Type II diabetes, cardiovascular diseases, and cancer. There is a link between obesity and foods that contains starch. Many carbohydrate-rich processed foods are easily digestible, which contributes to the high energy content as well as rapid elevation of blood glucose levels. The faculty of the Whistler Center for Carbohydrate Research at Purdue University, West Lafayette, IN is conducting cutting edge research on this topic, while maintaining a dialog with the food industry through meetings with their advisory board. The researchers will take a multidisciplinary integrated approach by involving stakeholders to develop a better understanding of the benefits associated with low glycemic food ingredients. The project directors from Purdue University and Ohio University, Athens will collaborate with the food industry in fulfilling these objectives. Once the targeted low glycemic food ingredients are developed, the investigators will assist the food industry in formulating functional foods to combat obesity and Type II diabetes through workshops and other forms of outreach. This information will also be shared with other stakeholders, including government regulators and dietitians.

Biobased Products and Bioenergy Production Research

Functional Genomic Analysis of the Interactions between Saccharomyces and Lactobacilli during Biomass Ethanol Fermentation

Trevor Phister, North Carolina State University

Efficient bioethanol fermentation is necessary to make ethanol a viable fuel alternative. It is imperative to gain a better understanding of the interactions between Saccharomyces and lactobacilli that routinely contaminate ethanol fermentations. The results of this study will have an immediate impact on biological ethanol production through the creation of a more robust biocatalysts that are more resistant to inhibitors and thereby capable of increasing product yield in the biological conversion of agricultural and forestry biomass.

Originally, researchers believed that lactic acid produced by bacteria inhibited the growth of the yeast Saccharomyces, effectively shutting down ethanol production. Recent research demonstrates that the amount of lactic acid produced by *Lactobacillus sp.* is not sufficient to account for the level of growth inhibition of Saccharomyces. Quorum sensing, the chemical signals that allow microbes to communicate, may play a role in interactions between yeast and bacteria. Saccharomyces produces aromatic alcohols as quorum sensing molecules. Lactobacilli can produce a number of aromatic alcohol byproducts that may play a role in bacteria-yeast interactions. The researcher will examine the effect of lactobacilli on Saccharomyces growth and ethanol production. The regulatory pathways needed for a Saccharomyces response to quorum sensing molecules will be identified, and Saccharomyces strains that are not impacted by the presence of the quorum sensing molecules will be developed. Using the data generated in this study, the researcher will eliminate or alter points in the Saccharomyces quorum sensing response pathway to find mutants unresponsive to the lactobacilli-produced compounds. The affects of these mutations on ethanol production will be examined to identify Saccharomyces strains that remain efficient ethanol producers. Finally, the study will reconstruct these mutations in industrially relevant Saccharomyces strains and characterize these strains for their ability to produce ethanol in the presence of lactobacilli contamination at a higher pH.

Agricultural Prosperity for Small and Medium-Sized Farms

Promoting Value-added Enterprises among Small and Medium-Sized Farms in Alabama
James Bukenya, Alabama A&M University

As the farmer's share of the food dollar plummets, small and medium-sized farm families are looking to new opportunities to expand farm profits. The results of this study will improve the opportunities for small and medium-sized farms by providing data on the success of collaborative ventures that enhance economic growth in rural Alabama.

The farmer's share of the food dollar has plummeted from 37 cents in 1980 to 21 cents in 1998. To reverse this trend, small to medium-size farm families need more new research, outreach, and technical assistance on the production of value-enhanced commodities and other value-added specialty products. The research knowledge will be generated by evaluating the feasibility of collaborative ventures and value chains for enhancing small and medium-sized farm income and rural community development in Alabama. The outreach program will consist of dissemination of research results through various news media, informational meetings, conferences, and through their Web site on Small Farmers Outreach and Technical Assistance Program. The technical assistance program will include training of farm operators on record keeping, risk management, development of a profitable mix of farm and/or non-farm activities, and on sustainable production techniques. This operational outreach and technical assistance programs will enhance awareness of and increase participation in value added enterprises among small and medium-size farmers in the rural community.

Strategic Goal 3

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

Rural America, home to one-fifth of the nation's population, is a collage of people and economic activities. The well-being of America is promoted 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. Education and training of residents and community and business leaders helps 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.

Animal Reproduction

Early Resumption of Postpartum Ovarian Cyclicity in Dairy Cows
R.O. Gilbert and W. R. Butler, Cornell University

The decline in dairy cow fertility is a concern for the milk production industry. The results from this study will lead to the development of new approaches to predict fertility in dairy cows after calving. This project is also expected to yield practical solutions to improve fertility in dairy cows, thereby improving profitability of dairy producers.

Reproduction in dairy cows has been declining at a rate of approximately one percent per year for more than three decades and is now at a critically low level. Reproduction is important for economic viability of dairy farms because the birth of a calf leads to onset of lactation and milk production by the cow. Cows that do not become pregnant consume limited resources inefficiently. Preliminary studies indicate that cow ovulation soon after calving has significantly improved reproductive performance in lactation. The researchers plan to distinguish between cows that ovulate soon after calving and those that do not, specifically identifying hormonal and metabolic differences between the two groups. They will investigate methods, including a novel feeding strategy, to increase the number of cows ovulating early in the postpartum period, with the overall goal of improving dairy herd reproduction.

Animal Growth and Nutrient Utilization

Modulation by Gonadal Steroid Hormones of the Effects of Growth Hormone, Prolactin and Somatolactin on Somatic Growth and Reproduction
E.G.Grau and T. Hirano, University of Hawaii

As more Americans turn to healthier diets, the aquaculture industry is attempting to determine the factors that affect growth in order to produce healthier fish. The results from this research might lead to the more efficient production of tilapia, thereby improving the competitiveness of U.S. aquaculture in the global market.

Growth in finfish, as in higher vertebrates, is controlled primarily by growth hormone (GH) and insulin-like growth factor-I (IGF-I). IGF-I is produced by the liver under the influence of growth hormone. For tilapia, an important fish for world aquaculture, males grow faster and larger than females. The researchers hypothesize that steroid hormones, which are produced by the gonad and involved in reproduction, determine whether feed energy is directed principally toward reproduction, such as protein production for the fish egg yolk, or toward growth of muscle and other body tissue. It is proposed that androgens, produced by the testis of males, modulates the actions of GH and IGF-I to direct more feed energy to production of muscle and other body tissue, whereas the steroid hormones produced by the ovaries in females directs energy toward production of eggs. A better understanding of how growth is controlled in tilapia might lead to development of new approaches to produce this important species more efficiently.

Plant Genome

Conifer Translational Genomics Network (CTGN) Coordinated Agricultural Project
David Neale, Steve McKeand, Jeff Dean, Dudley Huber, Tom Byram, Glenn Howe, Nick Wheeler, David Harry, Jennifer Lee, Jill Wegrzyn, Brad St. Clair, and Dana Nelson
University of California

The conifer industry is an important component to the U.S. economy. However, little is known about the conifer genetic code. The Conifer Translational Genomics Network (CTGN) project will provide tree breeders across the United States with new tools to enhance and accelerate traditional tree improvement activities. In addition, this project will focus on training the next generation of plant scientists with molecular and traditional tree breeding techniques.

The conifer industry in the United States accounts for $13 billion annually. This project will produce a link between traits of interest, like wood density and disease resistance, and the tree's genetic code. By adding genetic markers to their tool box, breeders will be able to select superior trees more accurately, rapidly, and economically than using traditional approaches alone. These enhanced approaches will permit greater utilization of the abundant genetic variation inherent in tree populations while simultaneously avoiding controversy associated with other technologies, such as genetic engineering. The results of these studies will be delivered directly to tree breeders managing the major tree improvement cooperatives around the country. In addition, the project will undertake an assertive and comprehensive education and extension program that will train graduate students in molecular-based breeding techniques and widespread training for undergraduate and graduate students, tree breeders, managers, lay-people and other stakeholders through a series of workshops, internships, and classes. It is anticipated that within five years cooperatives producing virtually all of the conifer seedlings in the United States will benefit from this technology improvement.

Epidemiologic Approaches for Food Safety

Potential Public Health and Food Safety Impacts Associated with use of Antibiotic Growth Promoters
Richard Isaacson, Randy Singer, and Srivand Sreevatsan, University of Minnesota

Halting the use of antibiotic growth promoters, a widely used practice in the animal industry, could result in increased carriage or load of food-borne pathogens in animal meat. The results from this project could have major impact on the policy of antimicrobial use in animal production and on the significance of agriculture on public health.

Antibiotic growth promoters are widely used in the animal industry to mediate the effects of bacteria by altering the intestinal bacterial microflora in agricultural animals. However, the use of antibiotics results in selection for antibiotic resistance in bacteria. The concern for public health has resulted in mounting pressure to reduce or eliminate the use of antibiotics for the sole purpose of growth promotion in livestock. Reducing this practice could result in increased carriage of food-borne pathogens by livestock, an overall reduction in health of the animals, and the need for greater use of therapeutic dosages of antibiotics to treat sick animals. The researchers will examine the use of antibiotic growth promoters in pigs to determine how it affects animal health and the presence of food-borne pathogens. The results may have a profound impact on developing public policy to improve animal well-being and secure a safe food supply for the nation.

Soil Processes

Soil Ecosystem Changes in Carbon and Nitrogen Budgets Induced by Shifts to Biofuels Production
Francis Pierce, Daniel Long, Stephen Albrecht, Harold Collins, and Steven Fransen Washington State University

As agriculture transitions land-use from grain and oil production to crop biofuel production, little is known about the impact this change will have on soils. The results of this study will provide information necessary to assess the mid- and long-term soil sustainability during this important agricultural transition.

Biofuels produced from cellulosic materials obtained from crops may provide a long-term solution to energy demands. In addition, biofuels could reduce the nation's dependence on foreign oil and curb emissions of the greenhouse gases from agricultural ecosystems. The researchers will examine potential changes in soil sustainability and behavior following the shift from crop production to biofuel production. Little is known about the potential impacts on soils from shifting land use and cropping practices associated with biomass based energy production. The researchers address the impact of a rapid transition to biomass removal for energy production on carbon and nitrogen cycles in soils, with particular emphasis on microbial activity and carbon sequestration, over a broad range of production. Assessing regional soil sustainability will help develop management regimes that maintain soil health and productivity on agricultural lands.

Strategic Goal 4

Enhance Protection and Safety of the Nation's Agriculture and Food Supply

Providing consumers with a healthy food supply and a secure agricultural production system is critical. This is achieved by ensuring that the nation's meat, poultry, egg, and plant products are safe, wholesome, and labeled accurately. This also is achieved by protecting the nation's agricultural system from pests and disease outbreaks, minimizing production losses, maintaining market viability and promoting responsible environmental stewardship.

Microbial Genomics

***Phytophthora sojae*: A High Quality Reference Sequence for the Oomycetes**

Brett Tyler, Jeffrey Boore, Igor Grigoriev, and Richard Myers, Virginia Polytechnic Institute and State University

Phytophthora sojae is a major oomycetes plant pathogen of the U.S. crops, in particular soybean. This pathogen has been responsible for billions of dollars worth of crop damage worldwide annually. The results of this project will improve our knowledge of the genome structure of P. sojae so that it will be easily transferred to other oomycetes sequences and can be used to design new control strategies.

Oomycete plant pathogens cause destructive diseases on a tremendous variety of crop and non-crop plant species, including potato, tomato, soybean, cacao, citrus, walnut, avocado, pepper, and cucurbits. In addition, Phytophthora species also have been tremendously destructive to forests and native ecosystems. These pathogens cause billions of dollars worth of damage worldwide annually on numerous agriculturally important crops. However, no high quality reference sequence is currently available for this group and horticultural species. The researchers will produce a high-quality, finished sequence of the genome *Phytophthora sojae.* A draft genome sequence has already been developed for *P. sojae* and six other oomycete plant pathogens. The draft sequences for the six oomycetes display an extraordinary conservation of genome structure and gene order. The researchers will improve the *P. sojae* sequence and transfer the new information to the other oomycete sequences. The availability of a reference sequence will enhance the efforts to understand the mechanisms by which these pathogens cause disease and lead to a rational design for new control strategies to protect U.S. agriculture.

Animal Genome

Genomics to Increase Aflatoxin Resistance in Turkeys

Roger Coulombe, Kent Reed, and John Hall, Utah State University

Turkeys are susceptible to even legal levels of the aflatoxin mycotoxin aflatoxin B1. The results of this project will increase resistance in poultry to aflatoxicosis, which will help the industry through improvements in animal health, increased productivity, and safer products for consumers.

Aflatoxin is a toxic compound produced by the fungi Aspergillus flavus and A. parasiticus. Poisoning from this toxin, called aflatoxicosis, results from ingestion of contaminated foods. Modern commercial turkeys are the most susceptible animals to the toxic effects of a particular strain of aflatoxin, *mycotoxin aflatoxin B1*. Levels of feed-borne *mycotoxin aflatoxin B1* contamination that are within the legal limit can cause measurable adverse health effects in turkeys. Previous work by this research group led them to believe that *mycotoxin aflatoxin B1* hypersensitivity in turkeys is dictated by two genes. These genes were inadvertently selected against through years of intensive breeding for other traits, such as meat quality and quantity. In this study, the researchers will use a genomic approach to identify markers of these genes that relate to *mycotoxin aflatoxin B1* resistance in wild turkeys and modern commercial turkey descended from specific wild varieties. The results of this project will restore protective traits in commercial turkeys by selective breeding, which will improve the health of the animals, reduce economic losses to the industry, and provide a safe and sustainable food supply.

Animal Protection and Biosecurity

Trout Humoral Immunity: Examining the Role of Antibody Secreting Cell Diversity Following Vaccination and Infection
Erin Bromage, University of Massachusetts-Dartmouth

Despite the growth in the aquaculture industry, little is known about fish immune function, especially in the cultured salmonid fishes. The results from this project will define strategies to develop long-term humoral immune responses in trout. The conclusions from this study will be applicable to other fish species and pathogens.

Current knowledge of immune functions in fish is extremely limited and defining the immune response to aquaculture pathogens is an important goal for the industry. Cultured salmonid fishes, including rainbow trout and Atlantic salmon, are very important economically. There are, however, very few licensed vaccines for their diseases. It would be useful to have a better understanding of both the antibody and cellular salmonid immune functions. A model bacterial pathogen will be used to trigger antibody secretion in rainbow trout, and the results will be assessed to determine which cells produced antibodies and how it effects survival. The results of this project will be used to establish guidelines for evaluating vaccines in salmonid fish that can be transferred to other fish types.

Arthropod and Nematode Biology and Management

Understanding the Interactions among the Nematode, Beneficial Microorganisms and Crop Species in a *Heterodera schachtii* Suppressive Soil
James Borneman and J. Ole Becker, University of California, Riverside

Suppressive soils hold considerable potential for managing soil-borne pathogens. The results from this research will develop an environmentally sound alternative for controlling the sugar beet nematode, which is a major economic pest world-wide. The approach used in this project will be applicable to the study of suppressive soils against other species of nematodes in agricultural systems.

Suppressive soils can be defined as 1) a soil in which the pathogen does not establish or persist; 2) a soil in which pathogens persist, but cause little or no damage; or 3) a soil in which pathogens persist and cause disease that diminishes over time. The biological origin for suppressive soils requires the identification of the causal organisms and an understanding of the agronomic and environmental factors that enable them to function. In prior work, the researchers identified key microorganisms that suppress the sugar beet cyst nematode, *Heterodera schachtii*, in a naturally suppressive soil. In this study, the researchers will clarify the interactions among the beneficial microorganisms, nematode populations, and crops that lead to the development and stability of *H. schachtii* suppressiveness in soil. The results will reduce application of expensive and environmentally harmful nematicides and provide a healthier and safer food supply.

Plant Biosecurity

Global Phytophthora Network (GPN): A Cyber Infrastructure Linking Data, e-Tools, and Human Capital to Support the Monitoring and Management of Phytophthora

Seogchan Kang, David M. Geiser, Scott Isard, and Michael D. Coffey, The Pennsylvania State University

The genus Phytophthora contains some of the most destructive plant pathogens and is global in scope. Early detection and accurate identification significantly increase the probability of preventing an outbreak of disease and subsequent spread. To address this need, the Global Phytophthora Network (GPN) is being established, which will be used at the national and international level to improve management of these pathogens. Conferences and workshops will expand the network of cooperators and help members of the global Phytophthora community manage these pathogens using the best available information and tools.

Mapping and documenting the diversity and distribution of Phytophthora worldwide is an essential step for improving management of these pathogens. The Global Phytophthora Network (GPN) will link data, e-tools, and global human capital to support research, education, and extension needs in managing new or reemerging Phytophthora species. The GPN will weave together a Phytophthora Database that supports detection, identification, and risk assessment of these pathogens. It will utilize Geographic Information Systems (GIS) tools to monitor and visualize the distribution and change of Phytophthora species. As a result, it will generate maps of the diseases across environmental, geospatial, and temporal fields. In addition, the project will cultivate the next generation of scientists by providing tools, training, and materials to support educational and extension activities. This grant was used to leverage additional funding to develop a research/internship programs for undergraduate students as well as for the development of a Phytophthora on-line laboratory and field protocols. In addition, it will fund workshops on the diagnosis and management of Phytophthora diseases for extension educators and other end users. The GPN will mitigate the impact of diseases caused by Phytophthora species throughout the world. The IT platforms developed for the GPN project should easily be adapted for other pathogens of agriculturally important crops.

Food Safety

Emergence and Fitness Mechanisms of Fluoroquinolone Resistant Campylobacter in Poultry

Qijing Zhang and Orhan Sajin, Iowa State University

The prevalence of antibiotic resistant Campylobacter jejuni, one of the leading causes of food-borne illness in the United States, in the poultry industry even after cessation of antibiotic application remains an enigma. The results from this project will define the parameters responsible for enhanced colonization of poultry by this bacterial pathogen. The strategies developed to reduce the prevalence of Campylobacter jejuni may have broader implications for other bacterial species.

The use of the antibiotic fluroquinolones during poultry production indicated that bacteria evolve rapid resistance to this class of antibiotics. The U.S. poultry industry abandoned use of this antibiotic five years ago, but resistance in *Campylobacter jejuni* remains higher than expected. *C. jejuni* is common among poultry and causes millions of incidents of food-borne illness annually in the United States. In previous studies, the researchers demonstrated that fluoroquinolone resistant *C. jejuni* are more aggressive colonizers of chickens even in the absence of the antibiotics. In this project, the researchers will determine the molecular basis for the enhanced fitness of these pathogenic isolates and how this is related to the mutation in DNA gyrase, the primary site of fluoroquinolone (FQ) action on bacteria. The results of this project will provide the poultry industry with valuable information to develop more effective management strategies to deal with this important bacterium, resulting in a healthier and safer food supply.

Strategic Goal 5

Improve the Nation's Health and Nutrition

America's health is promoted through nutrition education, and guidelines for the general public and targeted groups. These goals inform and motivate Americans to use this information to improve their diets and physical activity patterns. This is also accomplished by expanding research and scientific knowledge about the contribution of food and human nutrition to public health. Promoting better diets, reaching children early, and ensuring access to healthy food contributes to the nation's health.

Human Nutrition and Obesity Program

Healthy Kids Houston: An Integrated Community Program for the Prevention of Obesity among Minority Children

William Wong, Baylor College of Medicine

This community-based, multi-disciplinary obesity intervention program will create a unique partnership among health care providers, researchers, local parks and recreation department, and a local transit authority to improve nutrition knowledge, dietary behavior, physical activity levels, and weight status in pre-adolescent minority children. This project may serve as a model for interventions in other communities across the United States.

According to the Centers for Disease Control and Prevention, 17 percent of children and adolescents were classified as overweight in 2003-2004. Minority children have a disproportionally higher prevalence of being overweight than white children. This integrated project will combine research and extension to test the effectiveness of a multi-disciplinary, outcome-based community program, called Healthy Kids–Houston, on the prevention of overweight among minority children. The project includes a partnership among the USDA Children's Nutrition Research Center at Baylor College of Medicine, Houston Parks and Recreation Department (HPARD), Houston Metropolitan Transit Authority, and Texas Children's Hospital, including Texas Children's Pediatric Associates. The Healthy Kids program consists of three six-week sessions, once each in the fall, spring, and summer. Each session offers two hours of physical activity, nutrition education, and behavioral lessons, twice a week for six weeks. The proposed collaborative research is designed to evaluate an innovative, community-based program that offers a safe, accessible, and effective environment for the prevention of pediatric obesity in high-risk populations by increasing physical activity and healthy lifestyle choices. The integrated project also includes plans to disseminate the Healthy Kids curriculum to other federal, state, and private agencies across the country.

Developmental Iron Deficiency and Persistent Effects

John Beard, The Pennsylvania State University

Iron deficiency results in irreversible changes in brain development in young children that may lead to serious consequences that persist into adulthood. Supplementation of iron deficient infants at the appropriate time can prevent these changes from happening. The results from this study will guide health care professionals about the optimum time to provide iron supplementation to infants.

Iron deficiency is the leading nutrient deficiency disorder in the United States, affecting primarily young children and women of childbearing age. According to the Centers for Disease Control and Prevention, the highest prevalence of iron deficiency in the U.S. is found in infants and toddlers ages 9-18 months of age. Approximately seven percent of toddlers 1-2 years of age were found to be iron deficient in a large nationally representative survey in 1999-2000. Previous research in humans has shown that irreversible changes occur in the brain as a result of iron deficiency in early life, including changes in monoamine metabolism. These changes lead to problems such as decreased attention, poor learning and memory, and slowed nerve conduction velocity, which persist into adulthood. The researcher will use an animal model for iron deficiency to determine whether dietary intervention during a short time period early in life (during early to mid lactation) will prevent these irreversible changes in the brain. The investigators will identify the persistent genomic changes that occur with both iron deficiency in early life and aggressive iron therapy and explore the mechanisms responsible for the impact of iron deficiency on developing brain cells. This study may lead to improved guidelines to help health care professionals determine the optimum time to provide iron supplements to infants.

Efficacy of Vegetables to Reduce Oxidant Stress and Inflammation in At-Risk Overweight Women: A Dose-Response Study

Cynthia Thomson, Chieri Kubota, and Mikel Aickin, University of Arizona

Obesity in post-menopausal women is on the rise. Increasing access to information about the daily intake of vegetables will help this at-risk group reduce their risk for chronic disease. The information will be used to update nutrition guidance documents for consumers, such as the Dietary Guidelines for Americans and MyPyramid, and by nutrition educators who work with this audience.

Post-menopausal women are among the fastest growing segment of the U.S. population demonstrating the greatest incidence of obesity. Obesity has been associated with an increased risk for several chronic diseases, included heart disease and some forms of cancer. The increased risk is primarily related to elevations in oxidant stressand inflammatory response. The researchers will identify a biologically relevant "dose" of daily vegetable consumption necessary to reduce oxidant stress and/or inflammation in this population, thereby reducing their risk for chronic disease. The research team will feed vegetables rich in carotenoids and other nutrients in three dose levels in a randomized, cross-over study to overweight post-menopausal women. The changes in oxidant stress and inflammation in this "at-risk" population will be assessed and the daily "dose" of vegetables necessary to modulate biomarkers of oxidant stress and inflammation will be evaluated. Finally, the association between plasma nutrient and carotenoid levels in relation to changes in oxidant stress and inflammation in this population will be evaluated. The results of this research will provide a more thorough description of the oxidant stress and inflammatory status of overweight, postmenopausal women in the United States and be used to update consumer guidance brochures on healthy diet.

Strategic Goal 6

Protect and Enhance the Nation's Natural Resource Base and Environment

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. High-quality soils and abundant supplies of clean air and water are the essential to production agriculture and forestry, rural economies, and all life. It is imperative to ensure that the nation's natural resources meet the long-term needs of a dynamic society with an increasing population.

Microbial Biology

A Genomics-enabled FACE Microbial Observatory: Changes in Microbial Diversity and Functions in Responding to Elevated CO_2, Nitrogen Deposition, and Plant Diversity

Jizhong Zhou, Zhili He, and Laurie Kellogg, **University of** Oklahoma

Little is known about how changes in carbon dioxide and nitrogen deposition affect our ecosystems or how ecosystems respond to these changes. This is particularly true for above ground plant diversity and soil microbial communities associated with plants. The results from this study will provide insights into grassland soil microbial community diversity and their interactive responses to elevated carbon dioxide and nitrogen deposition, as well as the diversity of plants associated with soil microbes.

Plants and associated microbes have received little characterization in our ecosystems. While there is some understanding of plant vegetation response to changes in carbon dioxide and nitrogen deposition, little is known about the responses of the below ground soil microbial communities to these changes. This is further complicated by the fact that only a small percentage of microbes in the environment can be cultivated. Genomics and associated genomic technologies provide a great opportunity to rapidly characterize microbial community structure and activities. The researchers will establish a genomics-enabled Microbial Observatory at the Biodiversity, Carbon dioxide, and Nitrogen Deposition (BioCON) and Free Air Carbon dioxide Enrichment (FACE) site at Cedar Creek Natural History Area in Minnesota to address the multiple research challenges simultaneously. They will advance the sequencing technology and microarray technology for large scale identification and sequencing of grassland soil metagenomes and examine phylogenetic and biogeochemically-important functional gene diversity. Pathways and isolates for plant polymer degradation will be identified using a functional gene expression-based approach and/or cultivation methods. In addition, functional gene arrays will be constructed for monitoring microbial communities in natural environments. The arrays will be used to analyze and identify the responses and temporal dynamics of microbial communities to the changes in carbon dioxide, nitrogen deposition, and plant diversity.

Air Quality

Develop a Fire and Smoke Management Program to Minimize Impact of Prescribed Rangeland Burning in the Central Plains

Douglas Goodin, William Hargrove, John Harrington, Walter Fick, Jay Ham, James Murphy and Scott Goodrick, Kansas State University

Management tools will be developed that will help land managers maintain productivity of the range while minimizing the downwind impact of burning on air quality. This project will develop the relationship between burning rangelands, climate, and air quality. Land managers and the public will be better educated through outreach efforts on the value of prairie preservation and the need for proper management of prairie resources. The project will improve communication among land managers, air quality regulators, and the general public leading to improved air quality and health in surrounding urban corridors.

Burning is used as a management tool in many rangelands for maintaining native prairie ecosystems. When these rangelands are burned, cities hundreds of miles downwind can experience impaired air quality. The higher concentration of gas and particulate matter can lead to increased concentrations of tropospheric ozone in urban areas exceeding ambient air quality standards. A fire and smoke management program will be developed that will minimize the impact of prescribed fire in the Central Plains of Kansas on several metropolitan air sheds. Remote sensing tools will be used to identify the total biomass burned, which will be used in a coupled fire emissions – climate model to estimate the direction and dispersion of gases and particulates in the smoke. The climatology of events that adversely impact urban areas will be quantified to determine when weather conditions are appropriate for burning. Outreach will be conducted simultaneously to train burn managers and ranchers on the appropriate use of fire to manage the prairie. Additional outreach mechanisms will be used to inform the public of the value of the prairie, including all aspects of prairie preservation, wildlife conservation, safety, cattle production, and air and water quality.

Stable Isotopes of Reactive Nitrogen and Particulate Matter: Improved Tools for Characterizing the Transport and Fate of Agricultural Emissions

Emily Elliott, University of Pittsburgh

Emissions from agricultural centers are a concern for air and water quality. The results of this project will provide a better understanding of the sources and transport of reactive nitrogen and the development of new methods to quantify regional emissions. In addition, the results will improve emission data for existing inventories and determine the relative importance of biogenic emissions. Regulatory and voluntary reduction programs may choose to reprioritize the emissions of concern to more effectively improve air and water quality.

Reactive nitrogen and particulate matter emissions into the atmosphere can play a significant role in the degradation of air and water quality as they are re-deposited in terrestrial systems from wet and dry deposition. Agricultural sources of reactive nitrogen and particulate matter are often difficult to quantify downwind of their source because of mixing with other agricultural and non-agricultural sources. The researcher will use stable isotopes of nitrogen and other chemical compounds to determine the source of reactive nitrogen based on distinct chemical source signatures in the isotopic fractionation in the emissions. She will develop isotopic sampling that form longitudinal transects near major agricultural emission sources to track the transport of nitrogen and particulate matter to plants, surface waters, and soils. In addition, the researcher will focus on ammonia from livestock operations to quantify the importance of livestock emissions at regional and national scales and to characterize the spatial and temporal variations of isotopic ammonia from these sources. The results of this study will illustrate the effectiveness of stable isotopes to assess the influence of agricultural emissions on the surrounding environment.

Water and Watersheds

Human Health Risks from Animal Agriculture: Comparative Analysis of the Transmission of Multiple Zoonotic Pathogens in Mixed-Use Agriculture
Thomas Harter, University of California, Davis

The movement of organisms, such as E. coli O157:H7, from manure waste and municipal wastewater to fruits and vegetables causes sickness in humans. The results from this project will be used to design best management practices that will minimize or eliminate pathogens from agricultural land, protect drinking water supplies, and reduce the risk of transmission that will lead to greater consumer confidence in the safety of U.S. grown fruits and vegetables.

Organisms, such as *Cryptosporidium parvum, Campylobacter spp., E. coli O157:H7, Salmonella spp.*, and *Enterococcus sp.*, are found in animal manure and municipal wastewater effluent that is often applied to agricultural fields. These organisms cause sickness in humans and animals. The researcher will analyze agricultural fields on a spatial and temporal basis where manure and municipal wastewater effluent are applied in order to understand pathogen movement from shallow groundwater and surface runoff to wells and irrigation ditches. The researcher will develop hydrologic models to explain the occurrence, transmission, and survival of pathogenic organisms from livestock, humans, and wildlife in rural and agricultural watersheds. They will also use the model to assess the occurrence and survival of all the pathogenic species on a spatial and temporal basis. This predictive tool can help to identify intervention methods that will minimize or control pathogenic organisms in well-water and irrigation water supplies to improve the water quality in rural communities and the safety of agricultural crops.

Biology of Weedy and Invasive Species in Agroecosystems

Responding to Emerald Ash Borer Impacts on Forest Structure and Invasive Plant Colonization
John Cardina, Daniel A. Herms, and Kathleen Knight, The Ohio State University

The emerald ash borer, which was accidentally introduced from Asia, has the potential to decimate ash populations throughout eastern North America. The resulting economic and ecological impacts will be substantial. The combination of research and educational outreach materials will provide areas impacted by this pest with the tools necessary to successfully manage forests and limit the impact of invasive species.

The emerald ash borer has killed more than 20 million ash trees in southeast Michigan and northwest Ohio since its accidental introduction. Besides drastically changing the composition of eastern forests, other invasive plants that were previously shaded out in the understory will thrive as the ash population declines triggering a cascade of changes in forest structure and dynamics. By understanding forest succession, the scientists, working with landowners, will be able to address specific questions regarding the trajectory of ash tree decline and death. The Stand Visualization System, which combines state of the art forest succession models with input about forest management from landowners, produces images of forest stands through time, including the consequences of ash mortality to forest dynamics and composition. These images are an excellent tool for teaching the landowner about the consequences of different management options. This 'virtual forest' approach is an excellent teaching tool that will be used in outreach programs or as a stand-alone display. A simplified version where users can choose initial conditions of ash density and invasive plant encroachment will be made available at state park visitor centers and through the project Web site. Research results, combined with model simulations, will be used to develop outreach programs on emerald ash borer and invasive plants. In addition to raising awareness of the issues and describing the biology of invasion, materials will be developed as handouts and fact sheets, with suggestions for how to manage woodlots, make good choices of ornamental plants for the home landscape, identify and control invasive plants, and restore these impacted landscapes.

Development of an Integrated Forage/Biofuels Management System for the Mid-South

Patrick Keyser, Gary Bates, Craig Harper, and John Waller, University of Tennessee

Grassland ecosystems in the mid-south provide the dominant agricultural system in the region and support the largest beef-cattle industry in the eastern United States. The results from this study will establish production parameters for forages, biofuels, and wildlife habitat in this region.

In the mid-south, grassland ecosystems cover over 51 million acres or 69 percent of non-forested agricultural lands and support the largest beef-cattle herd east of the Mississippi. Current use of warm season forages limits the economic vitality of both stocker yearling and cow-calf operations. Introduction of native warm-season perennial grasses (NWSG) into an integrated forage system could provide substantial economic benefit through increased stocker yearling rates, weight gains, and production of higher value grass-finished animals, which is an expanding niche market. Perennial grasses, such as switchgrass, can also be used as biofuels feedstock, providing the cattle producers a strategy for diversification and improved farm income. These grazing/forage systems can be designed to have flexible harvest schedules to substantially enhance wildlife habitat for at-risk bird species, which would support recreational and cultural activities in the region. Using a multifunctional management systems approach, the researchers will test the harvest timing and species mixtures of warm season and perennial forages treatments as well as two of the same species mixtures and grazing treatments. The integration of biofuel production and forages will enhance economic opportunities and create optimum wildlife habitat as an ecosystem service.

NRI Impacts

The NRI Annual Report provides an opportunity to highlight both research and integrated projects funded in Fiscal Year 2007 that address critical issues in agriculture, nutrition, rural communities, and the environment. The Annual Report also provides a way to illustrate the success and impact of projects funded in previous fiscal years. The project highlighted below received funding from the National Research Initiative within the past six years. Research and integrated funds produced monitoring programs to protect agriculturally important crops and animals from disease, unlocked the genome of agriculturally important crops, animals, and insects in order to maintain food security at home and abroad, and developed new methods to keep food safe from pathogens in the domestic market and exports for trade. In addition, research and integrated funds opened the line of broadband communication to rural communities and re-evaluated the true value of a farm by incorporating the aesthetic value of landscape into the calculation. Integrated funds for human nutrition, obesity, and environment addressed the American consumer on healthy eating habits and sustainability in agriculture. These projects provide a glimpse into the impact CSREES NRI funds have on the agriculture and the nation as a whole.

Strategic Goal 1

Cracking the Porcine Genetic Code

In 2006, the porcine industry contributed $14 billion to the U.S economy and marketed 29.2 billion pounds of pork products. New DNA-based tools will help this important industry identify and select genetically superior pigs that resist infectious diseases and produce high quality and consistent cuts of meat. Animal management may be expedited using the animal's genotype determined at birth. This research was made possible with funding through the NRI Porcine Genome Sequence program. The new DNA-based technologies will improve food safety and consumer confidence by assisting in the verification of parentage and indentifying individual animals and animal products as they pass through the food production chain. Finally, pigs often provide better models in biomedical research for human disease compared to the conventional rodent model. The porcine genome sequence is beginning to provide new insights into the mechanisms underlying complex human diseases, such as obesity, diabetes, and cardiovascular diseases.

Debugging Walnuts

The international trade of agricultural commodities has become an integral part of the global economy. Agricultural exports, however, are natural carriers of exotic insect pests. To reduce the risk of introducing pests, importing countries or regions impose quarantine and phytosanitary requirements, which could lead to food spoilage, or use methyl bromide fumigants, which are harmful to the environment. Radio Frequency (RF) treatments effectively control insect pests at life stages present in in-shell walnuts without negatively affecting walnut quality or storability. This research was made possible with funding through the NRI Improving Food Quality and Value program. The RF process is technically feasible for large-scale commercial applications. The RF treatments can potentially serve as a non-chemical alternative to chemical fumigants for post-harvest pest control in similar commodities, such as almonds, pecans, pistachios, lentils, peas, and soybeans, and increase the competitiveness of agricultural industries in the global economy.

Strategic Goal 2

Mapping Soybean Rust

The most aggressive species of soybean rust, *Phakopsora pachyrhizi*, was first identified in U.S. soybean production fields in November, 2004. U.S. soybean cultivars are thought to be highly susceptible to this fungus. Fungicides have been used to manage this disease, but are harmful to the environment. With funding from the NRI Plant Biosecurity program, this project developed and operates the Soybean Rust

Aerobiology Modeling System to forecast the aerial transport of *P. pachyrhizi*. The daily forecasts showing the risk of *P. pachyrhizi* to a region are delivered to growers and government agencies through a Web site with easy to read, color maps. In 2006, USDA Economic Research Service published a report stating that millions of U.S soybean fields that normally would have received a prophylactic application of fungicide were left untreated based on information provided by the Web site. The savings and the positive environmental implications from preventing the needless spraying of millions of acres with fungicides demonstrate the value of a coordinated national pest management framework. This project has stimulated the development of the 2006 Pest Information Platform for Extension and Education (PIPE), which has extended its survey to include soybean aphid and viruses of legumes.

Controlling Johne's Disease

Johne's disease is a contagious, chronic, and often fatal infection that attacks the small intestine of ruminant animals, including cattle, goats, sheep, bison, buffalo, deer, and antelope. The disease is worldwide in distribution. With funding from the NRI Animal Protection and Biosecurity program, the Johne's Disease Coordinated Agricultural Project (CAP) maintains successful and widely utilized online training modules for both veterinarians and farmers. Since its debut in March, 2004, the Online Johne's Disease Veterinary Certificate Program has been adopted by 38 states and over 900 people have registered for the course. The USDA-APHIS includes this certificate program in their annual training for Designated Johne's Coordinators. The online training provides a common foundation in Johne's Disease basics, such as the microbiology, pathology, and epidemiology of the disease, as well as the most up-to-date tests and test interpretation, control, rules and regulations, which allow instructors to reach deeper levels of training and problem-solving in the face-to-face sessions. These training programs allow the most up-to-date management information to control Johne's Disease to be widely disseminated across the United States to mitigate and manage this important agricultural disease.

Strategic Goal 3

What is the Value of a Farm?

North Carolina leads the nation in the rate of lost farmland. Since 2002, the state has lost more than 6,000 farms and 300,000 acres of farmland. The Farmland Values Project is looking at the full value of farmland in Buncombe, Haywood, Madison and Henderson counties by asking residents and visitors to the area about the various kinds of benefits they receive from farmland, such as scenic beauty, flood control, or wildlife habitat. This research was made possible with funding through the NRI Agricultural Prosperity for Small and Medium-Sized Farms program. This project is an important first step to assess the value of farm loss in rural North Carolina. Policymakers will have the opportunity to use this information to provide programs that can protect farmland in North Carolina. In particular, the results of the Farmland Values Project could lead to new programs that would allow farmers to directly benefit from the scenic beauty and ecological services provided by their farms.

Closing the Internet Gap

Rural areas often lag behind urban areas in broadband Internet availability. This produces communication islands that could potentially isolate rural community development. This project examines the factors that inhibit broadband Internet adoption and the corresponding impact on community development in rural areas. This research was made possible with funding through the NRI Rural Development program. This project assessed the consequences of rural investments in broadband technology and how this investment led to sound rural development policy in four counties located in Michigan, Texas, and Kentucky. Pre-post surveys and ethnographic interviews were completed in each of the counties four years apart. By implementing the findings from this project, the broadband gap between rural and urban areas can be closed. In order to benefit the community, the adoption of broadband technology must be carefully managed to feature educational, economic, and social benefits that can improve the lives of rural residents and help stabilize rural communities.

Strategic Goal 4

A Thin Barrier to E. coli

Epidemiological studies suggest *Escherichia coli O157: H7*, a particularly dangerous bacterium associated with food poisoning, sickens approximately 100,000 people each year and results in over 100 fatalities. News stories linking *E. coli* to fresh produce caused national concern. Scientists developed an edible antimicrobial film to coat fresh fruits and vegetables and create an additional layer of protection for the nation's food supply. This research was made possible with funding through the NRI Food Safety program. At a concentration of 0.1 percent, oregano essential oil in an apple-based film proved to be the most potent antimicrobial agent, killing over 50 percent of the *E. coli* sample in the first three minutes. The films also act as an oxygen barrier providing additional preservative benefits to fresh-cut produce. This study may lead to herbal oils and extracts from tea, grape, and plums, to produce antimicrobial protection for the nation's food supply.

Solving the Bee Mystery

Honeybee contributions to agricultural productivity are valued at $15 billion annually for their role in pollinating plants. This important pollinator has recently experienced a decline in populations, called Colony Collapse Disorder (CCD). The reason for the decline remains unclear. A gene chip of the honeybee genome was developed and distributed, which will enhance and accelerate research to protect honeybee health. This research was made possible with funding through the NRI Functional Genomics of Agriculturally Important Organisms program. The gene chip is now being used to examine how diseases, such as American Foul Brood, affect bee health and functioning. With this information, scientists can develop an appropriate immune response to further protect honey bee health. The honeybee gene chip is available for public use and is being used worldwide to help solve the CCD mystery that is devastating honeybee populations throughout the United States.

Strategic Goal 5

Fruits, Vegetables, and Health

Low fruit and vegetable intakes are widespread among lower income groups. The food habits that are developed at a young age are likely to have a profound effect on the dietary habits into adulthood. This project developed an effective nutrition intervention to improve food choice behaviors in economically-disadvantaged young adults. The intervention group received print materials containing messages based on information collected during an initial interview and received two educational telephone calls. The control group received a non-tailored pamphlet from the five-a-day campaign promoting five servings of fruits and vegetables every day. At the 12-month follow-up, participants in the intervention group had significantly higher intakes of fruits and vegetables. The researchers concluded that tailored educational messages and research-extension partnerships are advantageous for improving fruit and vegetable intakes of young adults. The findings will enable nutrition educators to more successfully reach this age group with nutrition education messages. The program is now being tailored to reach young adults attending college. The continuation of this program was made possible with funding through the NRI Human Nutrition and Obesity program.

Flood-Tolerant Rice Increases Food Security throughout the World

Rice is the primary food for more than three billion people around the world. Approximately one fourth of the global rice crop is grown in rain-fed, lowland plots that are prone to seasonal flooding. While rice is the only cereal crop that can withstand submergence in water, most rice varieties will die if submerged for too long. The researchers identified a gene that enables rice to survive complete submergence, allowing for the development of a new rice variety that can withstand flooding. The new gene may also be useful in suppressing weeds and reducing herbicide applications for conventional and organic rice farmers. This research was made possible with funding through the NRI Plant

Genome program. Cultivation of the new rice variety is expected to increase food security for 70 million of the world's poorest people in developing countries. Development of submergence-tolerant varieties for commercial production in Laos, Bangladesh and India is now well underway.

Strategic Goal 6

Healthy Grown: Healthy Food and Healthy Land

Eco-labeling is a type of certification program, similar to the organic label that recognizes the importance of management practices in adjacent non-crop habitats within the farm. These practices lead to increased biodiversity and pest management while reducing the input of dangerous chemicals. The Healthy Grown label is an eco-label placed on food items grown in this manner. Increased grower participation and consumer awareness promotes balanced agricultural management and supports broad ecosystem health. This project was made possible with funding through the NRI Managed Ecosystems program. The project seeks to sustain biological diversity, understand insect population density and diversity, and reduce pest pressure in the field and therefore application of chemicals on land. Healthy Grown farmers are encouraged to participate in demonstrations, presentations, and discussions at field day events to persuade others to adopt these management techniques. In addition, the project is educating consumers of the link between food grown with healthy land management practices and ecosystem services. The eco-label allows consumers to know that a product is grown following specific environmental standards and practices to ensure ecosystem health.

Ecological Genetics of Plant Invasion

Invasive species threaten natural biodiversity and can dramatically alter ecosystem processes. Non-native species may evolve more invasive traits through genetic recombination during repeated introduction episodes. Reed canarygrass, *Phalaris arundinacea*, is native to Eurasia occurring in wetland habitats from Finland to southern France. In the United States, reed canarygrass was intentionally and repeatedly introduced for a multitude of agronomic and restoration practices, such as forage, restoration of marginal lands, and ditch stabilization. Over time, the introduced grass emerged earlier and had greater biomass than the native counterparts suggesting that these individuals evolved to become more aggressive. Since initial introduction, reed canarygrass has spread into ecologically sensitive wetland habitats where it outcompetes native plant species, diminishing wildlife habitat and altering the hydrological regime. This research was made possible with funding through the NRI Biology of Weedy and Invasive Species in Agroecosystems program. The results from this study will assist scientists, ecologists, and farmers find new ways to mitigate species that are currently invasive and prevent newly introduced plants from becoming invasive.

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