2011 Delaware State University and University of Delaware Combined Research and Extension Annual Report of Accomplishments and Results

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I. Report Overview

1. Executive Summary

Delaware agriculture increasingly operates in a global economy and we face ongoing challenges in our efforts to contribute to ensuring food security for a growing world population, develop innovative means to improve profitability and productivity, protect environmental quality and heal damaged ecosystems. Emerging issues must also be addressed, including climate change, farmland losses to development, food safety, and social issues for families and youth such as reversing the growing epidemic of childhood obesity. Our plan of work includes the following 7 programs intended to provide research-based solutions to the complex, global challenges facing Delaware today. It is important to note that divisions between these programmatic efforts are artificial. Our research and extension efforts are most commonly conducted by multi-disciplinary teams working across programs, in collaboration with colleagues in other disciplines. We also regularly plan and work with stakeholders in other University departments, other governmental agencies, foundations, community groups, universities, and political or policy-making positions.

In 2010, the University of Delaware completed a study of the economic impact of agriculture to the state. Historically, $1.1 billion has been the most commonly cited number for the impact of agriculture in Delaware, but this number is only the total market value of agricultural products sold at the farm level. Results showed that in 2008, the total economic contribution of all categories of agriculture in Delaware was/is $7.95 billion in industry output. A portion of this amount goes to Delaware workers and agricultural producers in the form of wages, salaries, and profits. In addition to agricultural business expenditures, income by operators and workers in the sector are also spent in purchasing product and services from other Delaware businesses. Delaware's agricultural industry contributes $2.5 billion in value added activity, and $1.6 billion in labor income. The total value is the sum of direct, indirect, and induced effects. The estimated total number of jobs supported by the agricultural industry was about 30,000 jobs in 2008. The agricultural industry as a whole generates a job multiplier of 1.8 and an output multiplier of 1.4. These results echo the fact that agriculture is indeed a large and vital part of Delaware's economy and understanding its impact must be as accurate as possible.

(1) Global Food Security and Hunger: Delaware agriculture is fully integrated into the global economy and driven by the need to produce a safe and secure food supply for a growing world population. Longstanding components of agriculture in Delaware are animal production,, grain crops and vegetables, aquaculture, soil management and watershed protection, and agricultural and natural resource economics. Animal-based agriculture is one of the largest and most profitable enterprises in Delaware with poultry production and processing activities accounting for over $3.2 billion dollars in industry output, 13,437 jobs, and $911.6 million in value added, according to the 2010 report. Livestock industries ($28M farm income from dairy, beef cattle, swine) are important with dairy production leading the way, producing $73.3 million in industry output and providing 260 jobs, according to the UD study. Aquaculture has emerged as a new sector, in freshwaters and coastal areas with shellfish. For poultry, diagnosis and control of infectious avian diseases is a high research priority, while for all of animal agriculture, research and extension programs focus on key issues such nutrient management and water quality, air quality, food safety, labor, animal welfare, and community relations. Grain crops, vegetable crops for processing and fresh markets, and a growing horticultural industry dominate Delaware agriculture. Most cropland is used for corn, soybean, and small grains, mainly for animal feed, but interest grows in producing energy crops

(barley, soybeans). Crop management depends more than ever on fundamental research on plant genomes and using genomic information to solve production problems. We address advances in field-scale crop management and farm marketing skills to ensure that farmers and the "green industry" remain profitable. Basic studies on plant adaptation to the environment and biotic and abiotic stress are priorities, as are studies on soil microbe-plant relationships and plant/soil interfacial reactions key to plant nutrient use and plant adaptation to contaminated soils. Environmentally sound management of soil resources requires that we address a range of issues impacting air, soil, surface and ground water quality such as efficient use of nutrients in animal and crop production; fate, mobility, speciation, and bioavailability of metals and organic chemicals in soil and water environments; efficient use of ground water for irrigation; safe use of pesticides and herbicides;, and emission of gases and particulates from soils and wastes that can affect air quality, climate change, and human and ecosystem health. We conduct basic research to increase our fundamental understanding of soil processes and applied research and extension programs to develop and implement management strategies that sustain agriculture and other land uses while protecting the quality of our air, soil, and water. Integrating economics with basic and applied research is a key aspect of this planned program. Our economics research foci are international trade and policy, with an emphasis on energy economics and economic development, and natural resource economics, particularly as this relates to land use change, such as conversion of farmland and forests to developed land uses and formulation of sound policies to preserve agricultural land for future generations;

(2) Biotechnology and Biotechnology-Based Agribusinesses: The University of Delaware, in conjunction with the state and private industry, has devoted nearly 25 years to developing research capacity and expertise in basic and applied biotechnology. Areas of existing strength are avian virology, physiology, and genomics and plant molecular biology and plant breeding. In our avian programs, biotechnology is used at the basic level to improve poultry health and immune competence and to understand fundamental mechanisms of avian diseases. At the applied level, biotechnology efforts focus on improving diagnostic testing methods, developing vaccines and other disease control methodologies, surveying for emerging avian disease causing agents, and developing disease resistant breeds of chickens. For plants, basic biotechnology efforts include understanding gene regulation in plants, particularly those associated with RNA turnover or small RNA-mediated gene regulation. Other efforts include understanding disease resistance and signal transduction pathways in plants, understanding nitrogen fixation via the application of molecular and proteomics approaches, and understanding, at the molecular and atomic levels, plant-soil interfacial relations important to nutrient and heavy metal uptake. Key elements of this program include: expanding fundamental, cross-disciplinary research in the avian and plant/soil research areas; applying basic biotechnology research to the development of diagnostic methodologies for plants and animals; investigating new opportunities to apply biotechnology knowledge, such as alternate, bio-based energy sources that make economic sense for Delaware; producing pharmaceuticals, vaccines, nutriceuticals and other products from plants; and a new, high priority - developing biotechnology-based agribusinesses by financial planning, risk management analysis, and evaluation of the marketability and consumer acceptance of biotechnology based products;

(3) Natural Systems, Biodiversity, and Wildlife Ecology: Maintaining and restoring renewable natural resources and the vital services provided by healthy ecosystems in Delaware after 400 years of urban and agricultural land use is our focus in this planned program. The impact of past and current land use changes, such as agricultural/forestry practices and encroachment of urban/suburban populations on native landscapes, is not fully understood but is thought to be contributing to the loss of many plant and animal species. Perturbation of ecosystems, such as by fragmentation of wildlife habitats due to development and nutrient enrichment of aquatic resources caused by greater runoff as impervious surface increases, are key areas where the interface between terrestrial and aquatic ecosystems is in need of more research and extension programming. New technologies in agricultural production that include control of insects, weeds, filamentous algae, and plant pathogens are needed to ensure sustainability of agriculture in Delaware while restoring and maintaining biodiversity and natural ecosystems located on farms. Finding ways to replace and sustain biodiversity in suburban landscapes, which today comprise

54% of Delaware, is another priority and is vital to future efforts to sustain natural resources in the face of increasingly rapid land use change from agriculture to more developed land uses;

(4) Family and Youth Development: The rapid economic and social changes occurring in Delaware today place high demands on families and communities. These problems are not only confined to rural areas where development and urbanization of farmland are changing the nature of communities and the opportunities for youth, but also are found in our towns and cities. Strong families are the basic building unit for our future citizens, yet those charged with this important responsibility often do not have the time, money, or skills to carry out their family roles in a positive, productive manner. Preparing citizens to take prominent roles in shaping their future and the future of their communities is the fundamental goal of this planned program. Cooperative Extension activities are the major component of this program and focus on: helping Delaware youth develop the leadership and life skills needed to become productive, independent, contributors to our society; increasing educational opportunities in science, engineering, and technology for youth; providing guidance and training in areas important to financial security of families and to family well-being across the generations; safe community programs on drug and alcohol prevention and safety training for vehicles, bicycles, pedestrians, farm families, and businesses;

(5) Food Safety: The American food system provides consumers with an abundant supply of convenient, economical, high-quality, nutritious, and safe food products. However, foodborne illnesses still occur in the U.S. Outbreaks of foodborne illness due to microbial contamination continue to be a major but preventable public health problem. While advances in understanding and controlling foodborne pathogens have been significant, new pathogens, new food products, increases in imported foods, and increasing anti-microbial resistance present new challenges to the nation's food safety programs. Our research programs focus on understanding foodborne pathogens and reducing the occurrence of these microbes during pre- and post-harvest by intervention strategies (e.g., high pressure, ultraviolet light, antimicrobial packaging). Extension activities center on food safety education of food handlers and youth; emerging food safety and nutrition issues; and public education about how to respond to outbreaks of foodborne diseases;

(6) Childhood Obesity: This program revolves around development of healthy eating and physical activity patterns. These programs will be delivered by family and consumer science educators, youth agents, paraprofessionals, and trained volunteers. Special emphasis will be placed on minority, low-income and educationally disadvantaged individuals since nationwide data indicate these individuals have a disproportionate share of diet-related diseases, including being overweight. Although many diseases occur more frequently with advancing age, dietary practices in young people significantly affect the occurrence and onset of these diseases. Extension activities center on selecting foods from My Pyramid, meal planning, and food preparation to lose or maintain weight and increasing physical activity;

(7) Climate Change: Climate change will create major challenges for Delaware's agriculture and natural resource areas, due to a transition to a warmer climate, characterized by hotter summers and warmer winters, greater annual rainfall, and more extreme weather events. Predicted problems include prolonged droughts, disruptions of key farming operations such as planting and harvesting due to heavy spring and fall rains, higher incidences and more diversity in the types of animal and plant pests (insects, diseases), greater potential for water quality degradation as nutrients move more rapidly and more often to waters via leaching and runoff, and losses of biodiversity in forests, wetlands, and other areas as plants now native to Delaware become stressed and more susceptible to invasions by alien plants and gradually replaced by those more suited to a warmer climate. Sea level rise will lead to problems with salt water intrusion into ground waters used for irrigation, inundation of wetlands and other low-lying natural areas, and intensified flooding, particularly problematic for cropland near the coast that is only productive because of an extensive network of drainage ditches. Our research and extension focus in this planned program will be: (i) improving fundamental understanding of why and how a changing climate affects animal and plant physiological processes related to health and productivity, the transformations of carbon, nutrients, organic chemicals, and toxins in soils, and biodiversity of plants and wildlife in natural ecosystems; (ii) developing

cost-effective management strategies to help animal and crop producers and natural resource managers respond to weather extremes, greater pressures from insects and diseases, and sea level rise; and (iii) contributing to the development of climate change policies (e.g., carbon trading) that provide farmers and others with resources needed to adopt practices to mitigate climate change problems.

Total Actual Amount of professional FTEs/SYs for this State

Year: 2011	Extension		Research	
	1862	1890	1862	1890
Plan	59.1	8.4	120.6	18.3
Actual	53.1	16.1	110.5	12.5

II. Merit Review Process

1. The Merit Review Process that was Employed for this year

- Internal University Panel
- Combined External and Internal University Panel
- Combined External and Internal University External Non-University Panel
- Expert Peer Review
- Other (Northeast Cooperative Extension Directors)

2. Brief Explanation

Scientific Peer Review of Research Programs
We adopt by reference the National Standards for Peer Review.

Merit Review of Extension Programs
Merit review for Delaware Cooperative Extension consists of five levels of peer and stakeholder review. Extension professionals submit county plans that have been reviewed by their peers within the county and by county stakeholder advisory groups. These stakeholder groups provide input on critical needs and issues within their communities, which is used to develop the county plans. After county plans are complete, stakeholders review them for inclusion of the previously identified needs and issues, as well as, program delivery and evaluation methodologies. Each of these plans includes specific objectives that are examined for relevance, usefulness, and potential impact of the programs. This feedback is used to refine county plans and develop future plans. The second level of review is by college-wide issue teams that are cross-functional and multi-disciplinary. From this review, county plans are combined into a college-wide plan. The third level of review is both within and outside the university community. Copies of the plan are submitted to university administrators and related agency personnel who function as both present and future partners. These individuals are invited to comment on the objectives identified, areas of collaboration, and potential impacts. University administrators are also asked to comment on ways in which we might work across colleges and schools to increase our outreach efforts. A fourth level is with statewide stakeholder groups, including advisory groups, commodity organizations, volunteers, research partners, and state and local funding agencies. These groups are asked to provide feedback regarding objectives, potential impacts, and how it meets their specific needs. The final level is the Northeast

Extension directors, who have agreed to share all state plans among each other. This peer review helps states advise each other on opportunities to strengthen individual state plans and ways that we can collaborate across state lines.

III. Stakeholder Input

1. Actions taken to seek stakeholder input that encouraged their participation

- Use of media to announce public meetings and listening sessions
- Targeted invitation to traditional stakeholder groups
- Targeted invitation to non-traditional stakeholder groups
- Targeted invitation to traditional stakeholder individuals
- Targeted invitation to non-traditional stakeholder individuals
- Targeted invitation to selected individuals from general public
- Survey of traditional stakeholder groups
- Survey specifically with non-traditional groups
- Survey of selected individuals from the general public
- Other (Permanent advisory committees for extension programs and researc)

Brief explanation.

In the State of Delaware, the University of Delaware and Delaware State University use a multi-faceted approach to secure stakeholder input. We believe in direct contact with people and actively solicit input from a wide variety of clientele, users and stakeholders. College administrators, faculty working on research funded by state and federal agencies or industry, and Cooperative Extension staff regularly request input on the relevance of our research and extension priorities to state and regional problems. Numerous formal opportunities for input also exist and include, but are not limited to, the following: extension overall advisory committees, extension issue-based advisory committees, strengthening families statewide advisory committee, 4-H volunteers, 4-H Foundation, LINKS, agriculture commodity groups, environmental interests, the green industry, agribusinesses, agriculture associations (i.e., Farm Bureau, Grange, Pork Producers Association, Delmarva Poultry Industry, Soybean Board, Sheep Producers Association, etc.), Master Gardeners, Master Food Educators, and Master Financial Planners. We meet with these groups on a regular basis and request their input on our programs and encourage their involvement in all of our planning efforts.

2(A). A brief statement of the process that was used by the recipient institution to identify individuals and groups stakeholders and to collect input from them

1. Method to identify individuals and groups

- Use Advisory Committees
- Use External Focus Groups
- Open Listening Sessions
- Needs Assessments

Brief explanation.

Stakeholders are identified by a combined effort of college administrators, research and teaching faculty, and cooperative extension staff. We are very familiar with our traditional agricultural stakeholders and have established a number of advisory committees, at the county and state levels, to provide input on our research and extension programs. Similarly, we have long-

standing contacts and good relations with many individuals, organizations, and agencies involved in the natural resource and environmental matters important to our research and extension programs. We work hard to ensure that these committees represent the range of agricultural production systems present in the state, the interests of those concerned about natural resources and the environment, and the social and economic issues related to communities, families, and youth development. We also take proactive steps to ensure that our advisory committees encompass the increasing diversity (age, gender, background, ethnic group) of our stakeholders. When new issues come forth, or a need for re-organization and re-direction of an existing program arises, we often establish focus groups composed of a mix of individuals internal and external to our universities to help guide our planning and to ensure that all interested parties are contacted for input. As appropriate, we also will use surveys and open listening sessions to solicit input from the public.

2(B). A brief statement of the process that was used by the recipient institution to identify individuals and groups who are stakeholders and to collect input from them

1. Methods for collecting Stakeholder Input

- Meeting with traditional Stakeholder groups
- Meeting with traditional Stakeholder individuals
- Meeting with the general public (open meeting advertised to all)
- Meeting specifically with non-traditional groups
- Meeting with invited selected individuals from the general public
- Other (Meetings with permanent advisory committees)

Brief explanation.

We hold a variety of regular meetings across the state, which include a diverse mix of clientele, users, and stakeholders. These meetings include such things as: Agriculture Visiting Committee, State Chamber of Commerce, Kids County Advisory Council, Delaware Public Policy Institute Task Force, Friends of Agriculture Breakfast series, Council of Farm Organizations, USDA Food and Agricultural Council, State Agriculture Technical Committee, and user groups like 4-H regular and day camp parents. Students enrolled in our colleges, faculty, professionals and salaried staff, are all encouraged to provide input on program priorities. We have conducted random surveys of users and non-users of the programs and activities on a variety of issues including land use and economic development. Other tools that we use to get input include visioning processes and focus groups. For the Plan of Work, specific stakeholder input was obtained via a committee assembled by the Delaware Secretary of Agriculture to participate in the develop of a statewide plan for agricultural research. This committee consisted of leaders in agriculture as well as faculty and administrators from the University of Delaware and Delaware State University. All of these efforts have been focused on both building commitment and getting input from stakeholders such as government agencies, industry partners, and regulatory agencies. Our programs have expanded and input continues to increase. We are recognized as a source of not only useful but also reliable information. We will continue to seek input in a variety of ways. These methods will change as the issues themselves change.

3. A statement of how the input will be considered

- To Identify Emerging Issues
- Redirect Extension Programs
- Redirect Research Programs
- To Set Priorities

Brief explanation.

We value all input from our stakeholders and use it to guide a number of our applied research and extension programs. It is particularly valuable in our efforts to make sure that any new and emerging agricultural, environmental, and social issues are identified early and that programs are developed to address them effectively. We carefully consider stakeholder input in our periodic reviews of extension programs to ensure that our goals are up-to-date and that we have the appropriately trained staff in place to meet these goals. We also use stakeholder input to identify areas where research is perceived to be needed. In some cases, where an adequate research base is already available, we respond through an increased extension effort to communicate research findings to end-users. However, if stakeholders identify areas where new or expanded research is needed, we use their input to strengthen our requests for research support from funding agencies and to identify partners that can collaborate in research projects.

Brief Explanation of what you learned from your Stakeholders

While our stakeholders have many and diverse interests and concerns, the following continue to be areas of high immediate importance to them and for the state of Delaware and USDA-NIFA:

1. Energy- as it dramatically affects both the costs of producing poultry and livestock, agricultural crops and the future of nature and management of cropping systems, the impact of energy, and the economic volatility associated with energy supply, on agriculture remains a high priority area today. How will the poultry industry, poultry growers, vegetable and crop farmers adapt to the competing demands from food and energy markets for their products in a manner that sustains profitability and protects the environment? Can biofuel crops become an economically viable option for Delaware farmers in the future, given our smaller and more fragmented landscape?
2. Land use change and farmland preservation- as the economic pressure to convert farmland to suburban and urban uses grows ever-greater, how will we sustain our agricultural land base to produce food, energy, fiber, and other products? How will the ecological and environmental benefits associated with agriculture be provided if crop land is converted to development? For the past 5 years, the pace of development has slowed markedly making this less of an issue. At the same time, funds for farmland preservation have been reduced in the state budget due to economic challenges facing the state of Delaware. However, more recently, there have been signs of economic growth in the housing industry, bringing this issue to the forefront again.
3. Water and air quality- despite intensive efforts to develop agricultural management practices that protect water quality, nonpoint pollution of ground and surface waters remains a serious problem. Recent changes at the federal level, particularly the proposed TMDL for the Chesapeake Bay and the newly required (for each Bay state) Watershed Implementation Plans are creating even greater pressures for farmers and others to efficiently manage fertilizer and manure nutrients. Development is competing with agriculture for ground and surface water raising concerns about water supply in the future, a serious concern given the importance of irrigation to crop production on the sandy, drought-prone soils of Delaware. Air quality concerns are growing, particularly for animal agriculture. Our stakeholders see a pressing need for an integrated approach to the water and air quality problems facing agriculture today, one that will provide reliable, consistent funding support for multi-year, multi-disciplinary research and extension programs and guide policies that enhance agriculture in the future.
4. Integrated Pest Management: Insects, weeds, and plant diseases continue to create serious problems for Delaware farmers and consumers increasingly concerned about the need for alternative control strategies other than pesticides. Delaware extension is responding to stakeholders - and learning more about their needs - through state and regional strategies and

programs focused on IPM. Examples include: (a) Mid-Atlantic Crop Management School which educated several hundred famers, crop consultants, state/federal agency participants on new IPM practices to be used on ~800,000 acres in the region resulting in an increase in $25 per acre in net income for their clientele. (b) National Plant Diagnostic Network which has greatly enhanced U.S. agricultural security through diagnostic programs. Delaware partners with the NPDN through the UD Plant Diagnostic Clinic and has become better prepared for detecting new pests and pathogens, and providing a rapid response. Specific Delaware objectives through NPDN include i) national communications, ii) upgrading lab infrastructure, iii) training in standard protocols for diagnosticians, iv) training First Detectors, and v) database analysis to detect unusual outbreaks. UD Plant Diagnostic Clinic accomplishments and impacts during 2010-2011 were many. For example, more than 750 samples were processed, all data were uploaded to the National Repository, maintained at CERIS at Purdue; over 130 First Detectors were trained for the state of Delaware, with 53 newly trained in 2011 as a part of Master Gardener Training. Cooperation between Delaware Department of Agriculture, USDA/APHIS PPQ and University of Delaware plant pathologists has increased; and expanded communication efforts which included web site updates, pest alerts, training presentations, posters, and public education efforts such as news articles, along with an updated brochure.

5. Farm labor- demands and opportunities in other sectors increasingly make it difficult for farmers and other sectors of the agricultural community to hire and retain qualified labor. Many farmers are also concerned about the future of agriculture due to the major economic hurdles faced by young men and women who wish to pursue agriculture as a career. As noted above, these challenges are directly linked to the need for policies that can preserve farmland, resolve complex immigration issues, and more rapidly advance the mechanization of agriculture. How will national policies affect our ability to sustain a viable population of farmers, maintain a stable farm labor base, and increase investments in the innovative technologies needed to increase agricultural productivity in the face of all these challenges?

6. Irrigation- major droughts continue to plague Delaware farmers, emphasizing the need for a statewide, long-term strategy to increase the amount of irrigated acreage and be more efficient in our irrigation practices. The state has responded by launching the DRIP program ("Delaware Rural Irrigation Program") to help farmers invest in new irrigation systems. Delaware extension continues to view this as an area of increased need for an integrated research/extension program that will focus on farmers to improve the efficiency of irrigation which can both increase agricultural profitability and help protect water quality by increasing nutrient utilization efficiency by irrigated crops, particularly with respect to corn and nitrogen management. Extension education programs on the latest advances in irrigation technology and research on nutrient management for irrigated grain and vegetable crops remain priority areas for the next decade.

7. Food safety - Seemingly constant outbreaks of food-borne illnesses and the growing demand for "local" foods due to their presumed greater safety and nutritional value are areas of increasing importance for Delaware's poultry and vegetable industries in particular. Research on the causes of foodborne illness is growing rapidly, from the molecular to applied scales. At the same time, growing pressures for new food processing technologies have led to increased research in areas such as non-thermal food processing. One area of growing concern for Delaware is fruit and vegetable production which accounts for ~ $179 million dollars of industry output, 750+ jobs, and $67.5 million in value added activities. Extension is now focusing a major effort on food safety of produce to help growers meet buyer demands for food safety by providing **Good Agriculture Practices/Good Handling Practices (GAP/GhP) training**. Programs emphasize the rationale behind food safety strategies, tactics for implementing GAPs and GHPs, what an audit would look like, how to implement GAP/GHP, information about on-farm worker training, and developing a food safety plan for the operation.

8. Family and Youth Development - Delaware Extension, particularly through its outstanding 4-H program, continues to address the many economic and social challenges facing families and youth today, particularly in underserved communities. Examples of these programs include: a) **Health**

Rocks tobacco and substance abuse prevention programs help youth learn skills in dealing with peer pressure and stress, and in making informed decisions that help them avoid problems; (b) **Operation Military Kids Program** continues to meet the complex challenges faced by youth and their families from all branches of the military both active and reserve; (c) **Expanded Food and Nutrition Education Program (EFNEP) and Supplemental Nutrition Assistance Program Education (SNAP-Ed)** provide interactive, hands-on education focused on developing skills to make healthy food choices based on family budgets, handling food safely, and to participate in physical activity each day. These programs empower individuals and linking diet, physical activity, and health together; (d) **Afterschool programs** conducted now at seven Delaware State Housing Authority complexes (two more than last year) reach hundreds of youth each day with programming designed to improve grades and reading skills particularly in STEM (Science, Technology, Engineering and Mathematics) areas.

IV. Expenditure Summary

1. Total Actual Formula dollars Allocated (prepopulated from C-REEMS)			
Extension		Research	
Smith-Lever 3b & 3c	1890 Extension	Hatch	Evans-Allen
1283108	1161667	1607767	1226238

2. Totaled Actual dollars from Planned Programs Inputs				
	Extension		Research	
	Smith-Lever 3b & 3c	1890 Extension	Hatch	Evans-Allen
Actual Formula	1280425	0	1494281	0
Actual Matching	1585090	0	1826679	0
Actual All Other	4415466	0	9583535	0
Total Actual Expended	7280981	0	12904495	0

3. Amount of Above Actual Formula Dollars Expended which comes from Carryover funds from previous				
Carryover	0	0	0	0

V. Planned Program Table of Content

V(A). Planned Program (Summary)

Program # 1

1. Name of the Planned Program

Global Food Security and Hunger

V(B). Program Knowledge Area(s)

1. Program Knowledge Areas and Percentage

KA Code	Knowledge Area	%1862 Extension	%1890 Extension	%1862 Research	%1890 Research
102	Soil, Plant, Water, Nutrient Relationships	20%	20%	10%	10%
112	Watershed Protection and Management	10%	10%	5%	5%
201	Plant Genome, Genetics, and Genetic Mechanisms	0%	0%	15%	15%
203	Plant Biological Efficiency and Abiotic Stresses Affecting Plants	0%	0%	5%	5%
205	Plant Management Systems	15%	15%	10%	10%
304	Animal Genome	0%	0%	10%	10%
305	Animal Physiological Processes	0%	0%	5%	5%
307	Animal Management Systems	15%	15%	5%	5%
311	Animal Diseases	10%	10%	15%	15%
601	Economics of Agricultural Production and Farm Management	5%	5%	5%	5%
605	Natural Resource and Environmental Economics	5%	5%	10%	10%
903	Communication, Education, and Information Delivery	20%	20%	5%	5%
	Total	100%	100%	100%	100%

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2011	Extension		Research	
	1862	1890	1862	1890
Plan	17.3	1.7	66.0	4.1
Actual Paid Professional	16.0	4.0	63.3	1.8
Actual Volunteer	0.0	0.0	0.0	0.0

2. Actual dollars expended in this Program (includes Carryover Funds from previous years)

Extension		Research	
Smith-Lever 3b & 3c	**1890 Extension**	**Hatch**	**Evans-Allen**
509443	0	604134	0
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
216652	0	446201	0
1862 All Other	**1890 All Other**	**1862 All Other**	**1890 All Other**
1790317	0	1955048	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

For animal agriculture, research and extension programs will target: (1) *Poultry Health and Disease Prevention and Control* - mechanisms of disease induction, host genetic resistance and immune responses in poultry with a focus on diagnostic surveillance methodology, vaccination and biocontainment; (2) *Poultry Growth and Development* - basic molecular and cellular mechanisms regulating poultry growth, development and meat yield; (3) *Avian Genomics* - development and application of avian microarrays for: disease diagnosis, resistance, and control; growth and development; and optimization of desired production traits; (4) *Alternative Production Systems* - alternative production systems to reduce disease, mortality, and waste production, minimize antibiotic use, integrate alternative energy into production systems and foster compatibility between animal production, environmental quality, and urban populations; (5) *Nutrient Utilization in Poultry and Ruminants* - increased nutrient utilization and reduced nutrient excretion via improved understanding of animal biology. For crop production, key activities are: (1) *Agronomic, Vegetable and Horticultural Crop Production* - improving varietal selection, disease and pest resistance, seed technology, cultural and marketing practices; (2) *New Crops* - financial and environmental impacts of new crops or new varieties of existing crops, (3) *Integrated Pest Management* - control of insect pests, weeds, and plant pathogens via biological and chemical methods; (4) *Engineering Technologies* - improvements in harvesting and guidance systems and expanded research and extension programs on irrigation management; implementing recent advances in remote sensing, tillage, and pesticide application; (5) *Plant Breeding, Crop Genomics, Proteomics, and Bioinformatics* - basic research on how plants adapt to their environments and manage stress and the nature of soil microorganism-plant symbiotic relationships and plant/soil interfacial reactions affecting crop growth and quality; (9) *Pasture and Forage Management* - research on pasture-based animal production systems and forage research on improving biological control systems for alfalfa. Soil science programs focus on: (1) *Fate, Transport, and Reaction Mechanisms* - fate, transport and reaction mechanisms of plant nutrients, wastes, and organic chemicals in soils, and their effects on soil, air and water pollution (2) *Cost-Effective, In-Situ Remediation* - cost-effective, *in-situ* methods for the remediation and speciation of contaminated soils; (3) *Nutrient Management for Water and Quality* - fertilizer and waste management programs to ensure economic and environmental sustainability while considering crop needs, nutrient reactions in soils, alternative fertilizer sources, and government policies. Resource and international economics activity areas include: (1) *Protection and Preservation of Agricultural Land* - current strategies to protect and preserve agricultural land will be evaluated and promising new approaches will be investigated; (2) *International Economics and Trade*: improved understanding of factors controlling export-import markets, particularly poultry.

2. Brief description of the target audience

For animal agriculture, primarily poultry integrators, growers, breeders, trade groups and allied industries; dairy and beef producers; livestock commodity groups; forage producers, equine owners,

producers and interest groups; state and federal agencies; federal research laboratories; peer scientists in the U.S. and international colleagues, K-12 teachers, and environmental and community groups.. For our resource economic programs the audience includes farmers, landowners, state agencies (Delaware Development Office; Land Use Planning and Preservation; Department of Agriculture; Department of Health and Human Services; Department of Natural Resources & Environmental Control; Department of Transportation; Economic Development Office), federal agencies (USDA, NRCS, USEPA), land use organizations (Conservation Districts, AFT), environmental organizations, business and community leaders, families, students, and the general public.

3. How was eXtension used?

eXtension was not used in this program

V(E). Planned Program (Outputs)

1. Standard output measures

2011	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	47890	191821	11262	2050

2. Number of Patent Applications Submitted (Standard Research Output)

Patent Applications Submitted

Year: 2011

Actual: 1

Patents listed

Exploiting Plant Microbe Partnership to Enhance Biomass, Yield Potential, and Drought Tolerance in Plants

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2011	Extension	Research	Total
Actual	4	37	41

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Number of Competitive Grants Submitted

Year	Actual
2011	78

Output #2

Output Measure

- Number of Competitive Grants Awarded

Year	Actual
2011	37

Output #3

Output Measure

- Number of Research Projects Completed

Year	Actual
2011	99

Output #4

Output Measure

- Number of Undergraduate Researchers

Year	Actual
2011	95

Output #5

Output Measure

- Number of M.S. Graduate Students

Year	Actual
2011	34

Output #6

Output Measure

- Number of Ph.D. Graduate Students

Year	Actual
2011	23

Output #7

Output Measure

- Number of Post-Doctoral Research Associates

Year	Actual
2011	6

Output #8

Output Measure

- Number of Refereed Journal Articles

Year	Actual
2011	41

Output #9

Output Measure

- Number of Books and Book Chapters

Year	Actual
2011	19

Output #10

Output Measure

- Number of Technical Reports

Year	Actual
2011	28

Output #11

Output Measure

- Number of Extension Bulletins and Factsheets

Year	Actual
2011	105

Output #12

Output Measure

- Number of Invited Presentations

Year	Actual
2011	120

Output #13

Output Measure

- Number of Volunteered Presentations

Year	Actual
2011	180

Output #14

Output Measure

- Number of Websites Established

Year	Actual
2011	18

Output #15

Output Measure

- Number of Workshops Conducted

Year	Actual
2011	186

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	Increased number of poultry producers participating in surveillance, diagnostic testing, and vaccination programs for infectious avian diseases. Implementation of statewide plans to address major outbreaks of avian diseases and an increase in the number of diagnostic laboratories using advances in avian genomics to rapidly diagnose infectious diseases.
2	Sustainable production practices for the dairy and beef industries that link forage and pasture production practices with animal health, performance, and meat and milk quality.
3	Increased number of poultry and dairy farmers using feed management practices that increase nutrient utilization and feeding diets with lower concentrations of nitrogen and phosphorus.
4	Increased use of air quality best management practices that prevent odor, ammonia, and particulate emissions from poultry farms.
5	Cost-effective solar power technology to heat and cool poultry houses will allow farmers to reduce their reliance on natural gas, oil, and purchased electricity, increasing the energy efficiency of poultry production.
6	Increased number of farmers adopting new crop varieties and high value, niche market crops, (culinary herbs, spices and essential oils). Integrating innovations in cultural practices, biological and chemical pest management, harvesting equipment, and irrigation management into these systems, including feasibility studies of greenhouses to produce high value plants, such as those intended for pharmaceutical or nutriceutical uses.
7	Increase in the number of farmers and others (e.g., the "Green Industry" - greenhouses, nurseries, landscapers) implementing comprehensive nutrient management and conservation plans that are profitable and protective of ground and surface water quality, build soil quality, prevent soil erosion, and protect natural resource areas.
8	Increased use of soil management programs and best management practices for agricultural, natural, suburban/urban, and disturbed or contaminated settings that incorporate latest advances in research and greater adoption of watershed scale modeling to predict changes in the functions and environmental impacts of soils in mixed-used watersheds (agriculture, suburban, urban, forests) as land use changes from agricultural to suburban and urban uses.
9	Improved economic competitiveness of Delaware agriculture relative to other regions in the U.S. and global competitors with an emphasis on greater adoption of new innovations in marketing and risk management for farmers who must increasingly compete globally.
10	Increased interactions and long-range strategic planning efforts between research and extension staff and the diverse stakeholders (state and federal agencies, community groups, not-for-profit organizations, developers, farmers, etc.) involved in farmland preservation and land use conversion from agriculture to suburban and urban uses.
11	Disease Prevention and Control: basic and applied research on mechanisms of poultry disease will translate into useable tools and strategies for improved disease surveillance, diagnosis, prevention, and control in broiler chicken production. Knowledge will be extended to commercial poultry and allied industries.
12	Animal Genomics: increased understanding of gene function and expression and targeting of candidate genes affecting economically important traits in broiler chicken growth and production, disease resistance and immunity. Improvements in classical poultry breeding programs by use of marker assisted selection (MAS) and technology transfer.
13	Animal Nutrition: research will lead to improved understanding of nutritional requirements for poultry and ruminants and adoption of recommended dietary strategies by practicing

	nutritionists and producers. Specifically, results of poultry directed research aim to minimize nutrient contamination of the environment from manure. Results from ruminant based research will lead to improved management of forages to maximize nutritional value, safe use, and minimize spoilage during storage. Nutritional effects on dairy cattle health and immune function including factors impacting white blood cell gene expression will be studied. Research will also lead to improved understanding of the molecular and cellular mechanisms associated with bovine lameness and early detection of the disease
14	Environmental Compatibility of Animal Agriculture: In addition to addressing nutrient related problems, research and extension programs will develop long-term strategies and management practices for other environmental issues related to animal agriculture such as the fate and transport of trace elements; concerns about air quality with ammonia, hydrogen sulfide, volatile organic compounds, and fine particulates originating from poultry houses; environmental and human health impacts of endocrine disruptors (estrogen, testosterone) found in manures; fate and transport of viruses and other pathogens during disease outbreaks and subsequent disposal of poultry mortality, and potential environmental and human health effects of antibiotics.
15	Plant Biology and Crop Production: basic research will lead to improved understanding of plant molecular biology and allow genetic manipulation of physiological processes important to increasing crop yields and quality and crop resistance to biotic and abiotic stresses. Applied research and extension programs on cultural practices, crop varieties, fertilizer and manure use, precision agriculture, and integrated pest management will increase crop yields, minimize costs, and protect environmental quality. Extension programs will guide management practices for horticultural plants for the "Green Industry" and for homeowners, important because of the rapid conversion of farmland to urban and suburban uses.
16	New Markets: advances in plant molecular biology and genomics will provide new markets for farmers and commercial-scale horticulture, such as plants for bioenergy, pharmaceutical and nutriceutical uses. New and creative marketing programs will stimulate diversification and growth in the production of value-added and niche market crops, such as culinary herbs, spices, essential oil plants, and specialty vegetables for urban and suburban markets.
17	Land Use Change: research will identify strategies needed to manage land use change in a state where preserving farmland is a major goal, but economic and social forces are resulting in steady conversion of agricultural lands to suburban and urban uses. The economic, social, and cultural impacts of land fragmentation, suburban sprawl, and the "critical mass" of land and businesses needed to sustain agriculture in the long-term will be determined. Research knowledge and extension programs will guide long-term land use planning in cooperation with state and local agencies and governments, community groups, and other stakeholders
18	International Economics and Trade: research will provide strategies to foster international trade and economic growth in developed and developing countries, with an emphasis on policy issues related to agricultural and energy markets and climate change, particularly those related to poultry production and bioenergy crops. Extension programs will educate agricultural producers on international marketing strategies for traditional agricultural products (e.g., poultry, grain crops) as well as new cropping systems, such as organic agriculture and genetically modified crops.
19	Educational programs for K-12 teachers and youth on: (i) advances in animal and plant molecular biology and applications of the basic animal and plant sciences to the production of animals and of plants used for food, fiber, landscaping, timber, bioenergy, and pharmaceutical and nutriceutical purposes; (ii) value of soils as a critical natural resource vital to civilization, including the many functions of soils in agricultural and natural ecosystems, the importance of soil management to environmental quality, and the role of soils in sustaining aesthetically pleasing managed landscapes in suburban and urban settings; and (iii) the relationship between land use and major societal issues, such as economic development, community and family adaptation to changing social and political conditions, and the value of

	sustaining ecosystems and protecting environmental quality.
20	Soils and Environment: basic research will increase understanding of physical, chemical, and biological factors influencing the fate and transport of nutrients, metals, organics, and pathogens in soils. Applied research will lead to development of nutrient management strategies and recommendations that minimize nonpoint nutrient pollution from all land uses. Remediation practices for soils contaminated by metals, organics, and nutrients will use innovative, research-based measures to prioritize risk to the environment and human health based on the speciation, mobility, and bioavailability of contaminants in soils. Mitigation approaches for polluted soils will combine soil chemistry, physics, and soil/plant molecular biology to enhance removal or in-situ degradation or stabilization of pollutants in soils.
21	Diagnosis of Plant Diseases

Outcome #1

1. **Outcome Measures**

Increased number of poultry producers participating in surveillance, diagnostic testing, and vaccination programs for infectious avian diseases. Implementation of statewide plans to address major outbreaks of avian diseases and an increase in the number of diagnostic laboratories using advances in avian genomics to rapidly diagnose infectious diseases.

Not Reporting on this Outcome Measure

Outcome #2

1. **Outcome Measures**

Sustainable production practices for the dairy and beef industries that link forage and pasture production practices with animal health, performance, and meat and milk quality.

Not Reporting on this Outcome Measure

Outcome #3

1. **Outcome Measures**

Increased number of poultry and dairy farmers using feed management practices that increase nutrient utilization and feeding diets with lower concentrations of nitrogen and phosphorus.

Not Reporting on this Outcome Measure

Outcome #4

1. Outcome Measures

Increased use of air quality best management practices that prevent odor, ammonia, and particulate emissions from poultry farms.

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2011	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Poultry producers and intergrators, regulatory and advisory agencies concerned about air quality and the public

What has been done
Research has been conducted on ammonia control technologies (ACT) that use innovative methods to mitigate NH3 loss from poultry houses, thus increasing the N value of PL and reducing air and water quality concerns. Conserving NH3 in poultry houses has other benefits as well including resource conservation (the original source of the NH3 in PL was the fertilizer N used to grow the feed, which was produced using natural gas, a finite resource) and producing PL with higher N:P ratios which will more closely match crop uptake and thus be less likely to lead to P accumulations in soils;

Results
The ACT technology includes the use of permanently installed, in-house spinner spreaders that continuously apply litter amendments which control NH3 emissions. Recent studies showed that this new technology decreased ammonia loss by ~20% and led to higher nitrogen concentrations in poultry litter, thus increasing its fertilizer value.

4. Associated Knowledge Areas

KA Code	Knowledge Area
112	Watershed Protection and Management
307	Animal Management Systems
605	Natural Resource and Environmental Economics

903 Communication, Education, and Information Delivery

Outcome #5

1. Outcome Measures

Cost-effective solar power technology to heat and cool poultry houses will allow farmers to reduce their reliance on natural gas, oil, and purchased electricity, increasing the energy efficiency of poultry production.

Not Reporting on this Outcome Measure

Outcome #6

1. Outcome Measures

Increased number of farmers adopting new crop varieties and high value, niche market crops, (culinary herbs, spices and essential oils). Integrating innovations in cultural practices, biological and chemical pest management, harvesting equipment, and irrigation management into these systems, including feasibility studies of greenhouses to produce high value plants, such as those intended for pharmaceutical or nutriceutical uses.

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2011	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Vegetable and fruit producers, consumers, state commodity groups.

What has been done
Research and extension programs have addressed problems associated with watermelon production in Delaware and the Mid-Atlantic USA.

Results
In the 1990s, less than 1 percent of watermelons were seedless. Today, about 75 percent of the watermelons sold in the U.S. are seedless varieties. A seedless watermelon plant contains three sets of chromosomes and is sterile so it must be pollinated by a second plant to set fruit. As a

result, growers must pay strict attention to the pollination needs of their seedless watermelon crops. Most growers rent or own honeybee hives but some have started to use bumblebees. UD bee researcher Debbie Delaney and Cooperative Extension fruit and vegetable specialist Gordon Johnson are working with watermelon growers this summer to see if bumblebees improve crop productivity. Kate Everts also is conducting watermelon research but her projects focus on combating Fusarium wilt. This pestilent pathogen causes one of the most economically significant watermelon diseases worldwide. It causes wilt and plant death early in the season and again when the plant is in fruit. Once a field exhibits severe Fusarium wilt, it?s off limits for watermelon growing for 15 or more years.

4. Associated Knowledge Areas

KA Code	Knowledge Area
205	Plant Management Systems
601	Economics of Agricultural Production and Farm Management
903	Communication, Education, and Information Delivery

Outcome #7

1. Outcome Measures

Increase in the number of farmers and others (e.g., the "Green Industry" - greenhouses, nurseries, landscapers) implementing comprehensive nutrient management and conservation plans that are profitable and protective of ground and surface water quality, build soil quality, prevent soil erosion, and protect natural resource areas.

2. Associated Institution Types

- 1862 Extension
- 1890 Extension
- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2011	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Farmers, "Green Industry" businesses, advisory and regulatory agencies concerned about nutrient management and water quality, the public.

What has been done

Two major meetings on nutrient management were held in 2011, including an international symposium at the University of Delaware and a regional training workshop for the Mid-Atlantic states.

Results

The University of Delaware College of Agriculture &Y Natural Resources hosted the fourth international symposium focusing on "Global Issues in Nutrient Management: Science, Technology and Policy," from Aug. 21-24. The international symposium addressed global issues and trends in nutrient management and focused on how agricultural management practices, technological advances and global or regional policies affect both nutrient use efficiency in the food chain and the quality of the environment in different parts of the world. More than 100 participants from six different countries attended the symposium.

Of those responding, 97 percent of participants said that the information presented at the 2010 Mid-Atlantic Crop Management School will help them provide better crop management advice to their clientele (slightly higher than in the previous years). The respondents said that they consult or advise on about 700,000 acres about a 100,000 acres less than last year but still more than that reported in years prior to 2009. Of the reported 700,000 acres, those consulting on 400,000 acres reported on the dollar impact of the information presented in 2010. Economic impact of the school was calculated based on the responses to a question on the questionnaire regarding the value of the information the consultants or growers obtained from the school. Based on the average given by respondents, the impact of the school was approximately $26.75 per acre, which is very similar to that reported in previous years (ranging from a low of $19.10 in 2006 to a high of $29.17 per acre in 2007. In 2010 based on the total number of acres reported, the economic impact of the school to the farming community is $28,751,500.

4. Associated Knowledge Areas

KA Code	Knowledge Area
102	Soil, Plant, Water, Nutrient Relationships
112	Watershed Protection and Management
205	Plant Management Systems
307	Animal Management Systems
601	Economics of Agricultural Production and Farm Management
605	Natural Resource and Environmental Economics
903	Communication, Education, and Information Delivery

Outcome #8

1. Outcome Measures

Increased use of soil management programs and best management practices for agricultural, natural, suburban/urban, and disturbed or contaminated settings that incorporate latest advances in research and greater adoption of watershed scale modeling to predict changes in the functions and environmental impacts of soils in mixed-used watersheds (agriculture, suburban, urban, forests) as land use changes from agricultural to suburban and urban uses.

2. Associated Institution Types

- 1862 Extension
- 1890 Extension
- 1862 Research
- 1890 Research

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Actual
2011	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
University scientists, educators, and students, industries, agencies, municipalities and others in need of trained water scientists and managers.

What has been done
A new interdisciplinary graduate program in water science and policy at the University of Delaware was established and begins in the Fall of 2012.

Results
Developing solutions to the problem of meeting the growing need for clean water that are socially acceptable, economically viable and environmentally sustainable is a major global need. The new graduate program will offer a masters of science degree and doctoral degrees with either a water science or a water policy concentration. The curriculum draws on courses from four colleges at UD: the College of Agriculture and Natural Resources, the College of Earth, Ocean, and Environment, the College of Engineering, and the College of Arts and Sciences.

4. Associated Knowledge Areas

KA Code	Knowledge Area
102	Soil, Plant, Water, Nutrient Relationships
112	Watershed Protection and Management
605	Natural Resource and Environmental Economics
903	Communication, Education, and Information Delivery

Outcome #9

1. Outcome Measures

Improved economic competitiveness of Delaware agriculture relative to other regions in the U.S. and global competitors with an emphasis on greater adoption of new innovations in marketing and risk management for farmers who must increasingly compete globally.

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2011	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Farmers, agribusiness, state and regional financial institutions, state government, the public.

What has been done
A new economic analysis was conducted by the University of Delaware on the economic impact of Delaware agriculture.

Results
Agriculture is an $8 billion industry in Delaware, according to a recent study published by the Department of Food and Resource Economics in the University of Delaware's College of Agriculture and Natural Resources. The study -- conducted by UD faculty members Titus Awokuse and Tom Ilvento, with help from graduate student Zachary Johnston -- used input-output analysis, taking into account the market value of products sold from on-farm production, revenue from processing and manufacturing of agricultural products, and inter-industry linkages to determine the value added to the economy.

4. Associated Knowledge Areas

KA Code	Knowledge Area
601	Economics of Agricultural Production and Farm Management
605	Natural Resource and Environmental Economics
903	Communication, Education, and Information Delivery

Outcome #10

1. **Outcome Measures**

Increased interactions and long-range strategic planning efforts between research and extension staff and the diverse stakeholders (state and federal agencies, community groups, not-for-profit organizations, developers, farmers, etc.) involved in farmland preservation and land use conversion from agriculture to suburban and urban uses.

Not Reporting on this Outcome Measure

Outcome #11

1. **Outcome Measures**

Disease Prevention and Control: basic and applied research on mechanisms of poultry disease will translate into useable tools and strategies for improved disease surveillance, diagnosis, prevention, and control in broiler chicken production. Knowledge will be extended to commercial poultry and allied industries.

Not Reporting on this Outcome Measure

Outcome #12

1. **Outcome Measures**

Animal Genomics: increased understanding of gene function and expression and targeting of candidate genes affecting economically important traits in broiler chicken growth and production, disease resistance and immunity. Improvements in classical poultry breeding programs by use of marker assisted selection (MAS) and technology transfer.

Not Reporting on this Outcome Measure

Outcome #13

1. **Outcome Measures**

Animal Nutrition: research will lead to improved understanding of nutritional requirements for poultry and ruminants and adoption of recommended dietary strategies by practicing nutritionists and producers. Specifically, results of poultry directed research aim to minimize nutrient contamination of the environment from manure. Results from ruminant based research will lead to improved management of forages to maximize nutritional value, safe use, and minimize spoilage during storage. Nutritional effects on dairy cattle health and immune function including factors impacting white blood cell gene expression will be studied. Research will also lead to improved understanding of the molecular and cellular mechanisms associated with bovine lameness and early detection of the disease

Not Reporting on this Outcome Measure

Outcome #14

1. Outcome Measures

Environmental Compatibility of Animal Agriculture: In addition to addressing nutrient related problems, research and extension programs will develop long-term strategies and management practices for other environmental issues related to animal agriculture such as the fate and transport of trace elements; concerns about air quality with ammonia, hydrogen sulfide, volatile organic compounds, and fine particulates originating from poultry houses; environmental and human health impacts of endocrine disruptors (estrogen, testosterone) found in manures; fate and transport of viruses and other pathogens during disease outbreaks and subsequent disposal of poultry mortality, and potential environmental and human health effects of antibiotics.

Not Reporting on this Outcome Measure

Outcome #15

1. Outcome Measures

Plant Biology and Crop Production: basic research will lead to improved understanding of plant molecular biology and allow genetic manipulation of physiological processes important to increasing crop yields and quality and crop resistance to biotic and abiotic stresses. Applied research and extension programs on cultural practices, crop varieties, fertilizer and manure use, precision agriculture, and integrated pest management will increase crop yields, minimize costs, and protect environmental quality. Extension programs will guide management practices for horticultural plants for the "Green Industry" and for homeowners, important because of the rapid conversion of farmland to urban and suburban uses.

2. Associated Institution Types

- 1862 Extension
- 1890 Extension
- 1862 Research
- 1890 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2011	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

International researchers, global agribusiness, government agencies and not-for-profits interested in food security in Africa.

What has been done

Researchers from the University of Delaware College of Agriculture and Natural Resources (CANR) visited Ghana to meet with plant breeders and discuss the development of a software package they are calling ?The Breeders? Toolbox.

Results

Since 2009, a team of researchers has been fleshing out ideas, assessing demand, and identifying partners for the production of an integrated suite of software tools tailored to the meet the needs of plant breeders in developing countries. Randy Wisser, assistant professor in the Department of Plant and Soil Sciences, who serves as the group?s principal investigator, and Blake Meyers, Edward and Elizabeth Goodman Rosenberg Professor and chair of the Department of Plant and Soil Sciences, traveled to Ghana.

4. Associated Knowledge Areas

KA Code	Knowledge Area
102	Soil, Plant, Water, Nutrient Relationships
201	Plant Genome, Genetics, and Genetic Mechanisms
203	Plant Biological Efficiency and Abiotic Stresses Affecting Plants
205	Plant Management Systems
601	Economics of Agricultural Production and Farm Management
903	Communication, Education, and Information Delivery

Outcome #16

1. Outcome Measures

New Markets: advances in plant molecular biology and genomics will provide new markets for farmers and commercial-scale horticulture, such as plants for bioenergy, pharmaceutical and nutriceutical uses. New and creative marketing programs will stimulate diversification and growth in the production of value-added and niche market crops, such as culinary herbs, spices, essential oil plants, and specialty vegetables for urban and suburban markets.

Not Reporting on this Outcome Measure

Outcome #17

1. Outcome Measures

Land Use Change: research will identify strategies needed to manage land use change in a state where preserving farmland is a major goal, but economic and social forces are resulting in steady conversion of agricultural lands to suburban and urban uses. The economic, social, and cultural impacts of land fragmentation, suburban sprawl, and the "critical mass" of land and businesses needed to sustain agriculture in the long-term will be determined. Research knowledge and extension programs will guide long-term land use planning in cooperation with state and local agencies and governments, community groups, and other stakeholders

Not Reporting on this Outcome Measure

Outcome #18

1. **Outcome Measures**

International Economics and Trade: research will provide strategies to foster international trade and economic growth in developed and developing countries, with an emphasis on policy issues related to agricultural and energy markets and climate change, particularly those related to poultry production and bioenergy crops. Extension programs will educate agricultural producers on international marketing strategies for traditional agricultural products (e.g., poultry, grain crops) as well as new cropping systems, such as organic agriculture and genetically modified crops.

Not Reporting on this Outcome Measure

Outcome #19

1. **Outcome Measures**

Educational programs for K-12 teachers and youth on: (i) advances in animal and plant molecular biology and applications of the basic animal and plant sciences to the production of animals and of plants used for food, fiber, landscaping, timber, bioenergy, and pharmaceutical and nutriceutical purposes; (ii) value of soils as a critical natural resource vital to civilization, including the many functions of soils in agricultural and natural ecosystems, the importance of soil management to environmental quality, and the role of soils in sustaining aesthetically pleasing managed landscapes in suburban and urban settings; and (iii) the relationship between land use and major societal issues, such as economic development, community and family adaptation to changing social and political conditions, and the value of sustaining ecosystems and protecting environmental quality.

Not Reporting on this Outcome Measure

Outcome #20

1. **Outcome Measures**

Soils and Environment: basic research will increase understanding of physical, chemical, and biological factors influencing the fate and transport of nutrients, metals, organics, and pathogens in soils. Applied research will lead to development of nutrient management strategies and recommendations that minimize nonpoint nutrient pollution from all land uses. Remediation practices for soils contaminated by metals, organics, and nutrients will use innovative, research-based measures to prioritize risk to the environment and human health based on the speciation, mobility, and bioavailability of contaminants in soils. Mitigation approaches for polluted soils will combine soil chemistry, physics, and soil/plant molecular biology to enhance removal or in-situ degradation or stabilization of pollutants in soils.

Not Reporting on this Outcome Measure

Outcome #21

1. Outcome Measures

Diagnosis of Plant Diseases

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2011	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Farmers, agribusiness, commodity groups, national and international agricultural agencies concerned about preventing plant disease, consumers.

What has been done
The University of Delaware is an active participant in the National Plant Diagnostic Network and has expanded the activities of its statewide plant diagnostic clinic.

Results
The establishment of the National Plant Diagnostic Network (NPDN) has greatly enhanced U.S. agricultural security through diagnostic programs. Delaware partners with the NPDN through the UD Plant Diagnostic Clinic. Delaware has become better prepared for detecting new pests and pathogens, and providing a rapid response. In 2002, the National Plant Diagnostic Network was established within USDA CSREES (now NIFA). Worldwide damage from invasive pests and pathogens exceeds $100 billion annually. The mission of the NPDN is to enhance national agricultural security by quickly and accurately detecting high priority pests and pathogens. Specific objectives include i) national communications, ii) upgrading lab infrastructure, iii) training in standard protocols for diagnosticians, iv) training First Detectors, and v) database analysis to detect unusual outbreaks. The Network is composed of diagnostic facilities at Land Grant Universities in 50 states, some territories and state labs.

UD Plant Diagnostic Clinic accomplishments and impacts during 2010-2011 were many. Over 750 samples were processed. All data was uploaded to the National Repository, maintained at CERIS at Purdue. Training sessions were attended at the Penn State University Diagnostician Workshop, as well as a Botryosphaeria Workshop and a Nematology Workshop, and several webinars. Information sharing was achieved through meetings and conference calls. Nancy

Gregory, of the Plant Diagnostic Clinic, attended the 3rd National Meeting of the NPDN, representing Delaware. She serves as Chairman of the National Database Program Area Committee, which received an award for Team Service at the National Meeting. Over 130 First Detectors have been trained for the state of Delaware, with 53 newly trained in 2011 as a part of Master Gardener Training. Cooperation between Delaware Department of Agriculture, USDA/APHIS PPQ and University of Delaware plant pathologists has increased. Delaware wheat tested free of karnal bunt, important for unrestricted trade. A new leafspot of soybean was identified as soybean vein necrosis. A pest alert was issued and information placed in the NPDN National Newsletter. Other states then were able to follow Delaware?s lead to confirm soybean vein necrosis virus. Communication efforts for the Plant Diagnostic Clinic included web site updates, pest alerts, training presentations, posters, and public education efforts such as news articles, along with an updated brochure.

4. Associated Knowledge Areas

KA Code	Knowledge Area
203	Plant Biological Efficiency and Abiotic Stresses Affecting Plants
205	Plant Management Systems
601	Economics of Agricultural Production and Farm Management
903	Communication, Education, and Information Delivery

V(H). Planned Program (External Factors)

External factors which affected outcomes

- Natural Disasters (drought, weather extremes, etc.)
- Economy
- Appropriations changes
- Public Policy changes
- Government Regulations
- Competing Public priorities
- Competing Programmatic Challenges
- Populations changes (immigration, new cultural groupings, etc.)

Brief Explanation

V(I). Planned Program (Evaluation Studies)

Evaluation Results

Evaluation of the Global Food Security and Hunger planned program for FY 11 (65 research FTEs, 20 Extension FTEs) shows an extensive range of basic and applied research and extension activity in this area, one that has long been a primary area of emphasis in the state. Delaware's agricultural systems, particularly poultry, grain, and vegetable crop production, are linked closely with exports to other countries and serve as models for the application of new knowledge to challenges in emerging and developed countries worldwide. Research grants (37 awarded) supported the efforts of 158 graduate students,

post-docs, and undergraduate researchers who published 60 refereed journal articles and book chapters, made 300 invited and volunteered presentations, and conducted 186 workshops on improved efforts to contribute to the global need for a safe and secure food supply, increase agricultural profitability, become more competitive in global markets, and ensure the environmental compatibility of all forms of agriculture. Our evaluations have included annual internal administrative reviews, periodic University level Academic Program Reviews, and - for extension - surveys and other evaluations conducted with stakeholders participating in workshops and other extension programs. In general, we have received very positive feedback from the agricultural and natural resource communities about the programs we conduct related to Global Food Security and Hunger.

Key Items of Evaluation

There are no major items requiring NIFA attention at this time, other than the continued need for more federal funding for research and extension programs that seek to further expand our efforts to address the global challenges related to producing a safe and secure food supply.

V(A). Planned Program (Summary)

Program # 2

1. Name of the Planned Program

Biotechnology and Biotechnology-based Agribusiness

V(B). Program Knowledge Area(s)

1. Program Knowledge Areas and Percentage

KA Code	Knowledge Area	%1862 Extension	%1890 Extension	%1862 Research	%1890 Research
201	Plant Genome, Genetics, and Genetic Mechanisms	25%	25%	25%	25%
304	Animal Genome	25%	25%	25%	25%
601	Economics of Agricultural Production and Farm Management	10%	10%	10%	10%
602	Business Management, Finance, and Taxation	10%	10%	10%	10%
603	Market Economics	10%	10%	10%	10%
604	Marketing and Distribution Practices	10%	10%	10%	10%
903	Communication, Education, and Information Delivery	10%	10%	10%	10%
	Total	100%	100%	100%	100%

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2011	Extension		Research	
	1862	1890	1862	1890
Plan	0.0	0.0	27.1	3.5
Actual Paid Professional	0.0	0.0	19.1	4.5
Actual Volunteer	0.0	0.0	0.0	0.0

2. Actual dollars expended in this Program (includes Carryover Funds from previous years)

Extension		Research	
Smith-Lever 3b & 3c	**1890 Extension**	**Hatch**	**Evans-Allen**
0	0	237385	0
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
994	0	933882	0
1862 All Other	**1890 All Other**	**1862 All Other**	**1890 All Other**
5921	0	3142879	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

Research and Extension programs will target avian and plant biotechnology. In the avian arena, these projects will be aimed at understanding basic mechanisms of disease etiology and control and emergence of new disease causing agents. Research will continue and expand on sequencing of the chicken genome, as well as the genome of many poultry pathogens, to help provide the tools needed to advance our understanding of poultry growth, health and disease. We plan to apply these tools to diagnosis and treatment of disease and screening for desirable production traits. We also seek to develop genome based diagnostic methods, and study the molecular basis of disease resistance and susceptibility. Some specific avian biotechnology research areas planned include: identification of genomic factors influencing pathogenesis of avian herpesviruses and mycoplasmas; evolution of virulence of Marek's Disease virus; interaction of MDV proteins with host cells; regulation of the immune response to avian pathogens; and gene expression profiles in growth-selected chickens. With regard to plant biotechnology, projects will focus on understanding basic mechanisms of gene control in plants, disease resistance, nitrogen fixation, and plant/environment interactions. Areas of particular interest for basic plant biotechnology research include: RNA turnover or small RNA-mediated gene regulation; understanding disease resistance and signal transduction pathways in plants; understanding and enhancing symbiotic nitrogen fixation via the application of molecular and proteomics approaches; developing biotechnology-based diagnostic methods for major plant diseases; and understanding processes controlling plant/soil interfacial relations at the molecular and atomic levels to enhance crop utilization of nutrients and the effectiveness of plants at remediation of soils contaminated with metals and organics. For both avian and plant biotechnology, findings will be applied as much as possible to existing issues in agriculture with the goal of integrating biotechnology research into new agribusinesses such as those producing plants better adapted to environmental and biological stress, plants used for the production of pharmaceuticals and nutriceuticals, and plant with bioenergy uses.

2. Brief description of the target audience

Farmers, landowners, state agencies (Delaware Development Office, Departments of Agriculture, Health and Human Services, Natural Resources and Environmental Control, Transportation), federal agencies (USDA, USEPA), land use organizations, environmental organizations, business and community leaders, families, students, and the general public.

3. How was eXtension used?

eXtension was not used in this program

V(E). Planned Program (Outputs)

1. Standard output measures

2011	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	150	250	200	500

2. Number of Patent Applications Submitted (Standard Research Output)

Patent Applications Submitted

Year: 2011

Actual: 2

Patents listed

1) Rhizobacteria to Reduce Arsenic Uptake in Rice Plants;

2) Informatics Tools for Processing, Displaying and Analyzing Next-Gen Transcriptional and Chromatin-Based Genomic Data

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2011	Extension	Research	Total
Actual	0	30	30

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Number of Competitive Grants Submitted

Year	Actual
2011	25

Output #2

Output Measure

- Number of Competitive Grants Awarded

Year	Actual
2011	8

Output #3

Output Measure

- Number of Research Projects Completed

Year	Actual
2011	12

Output #4

Output Measure

- Number of Undergraduate Researchers

Year	Actual
2011	24

Output #5

Output Measure

- Number of M.S. Graduate Students

Year	Actual
2011	23

Output #6

Output Measure

- Number of Ph.D. Graduate Students

Year	Actual
2011	13

Output #7

Output Measure

- Number of Post-doctoral Research Associates

Year	Actual
2011	10

Output #8

Output Measure

- Number of Refereed Journal Articles

Year	Actual
2011	27

Output #9

Output Measure

- Number of Books and Book Chapters

Year	Actual
2011	7

Output #10

Output Measure

- Number of Technical Reports

Year	Actual
2011	0

Output #11

Output Measure

- Number of Extension Bulletins and Factsheets

Year	Actual
2011	0

Output #12

Output Measure

- Number of Invited Presentations

Year	Actual
2011	28

Output #13

Output Measure

- Number of Volunteered Presentations

Year	Actual
2011	8

Output #14

Output Measure

- Number of Websites Established

Year	Actual
2011	6

Output #15

Output Measure

- Number of Workshops Conducted

Year	Actual
2011	3

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	Increased awareness by all components of the poultry industry of the opportunities to use biotechnology to prevent, diagnose, and control avian infectious diseases.
2	Increased number of farmers and members of the horticultural industry aware of the opportunities to use advances in plant biotechnology to develop new businesses.
3	Educational programs for K-12 youth and teachers on basic principles and applications of biotechnology to the plant, animal, and environmental sciences.
4	Commercial evaluation in agronomic and horticultural settings of genetically modified plants developed using biotechnology research.
5	Integration of plant and animal biotechnology educational materials developed cooperatively by research and extension staff into K-12 curricula in Delaware schools.
6	Stronger, more formal links between scientists conducting biotechnology research, extension specialists familiar with biotechnology applications, and state and regional economic development agencies and private industry.
7	Avian Biotechnology: basic research will provide an improved understanding of the fundamental causes and modes of action of avian diseases and the factors that influence their potential to spread to other animal species and humans; applied research will provide innovations in surveillance and diagnostic tools that help prevent or contain disease outbreaks and vaccines that prevent or control infectious diseases.
8	Plant Biotechnology: basic research will lead to an improved understanding of the processes by which plants grow, resist or adapt to diseases and other stresses; can be used to produce bio-based products useful for human health and nutrition, and regulate the uptake of plant nutrients in agricultural soils and contaminants (e.g., heavy metals) in polluted soils; applied research will lead to plants that can produce increased yields with lower inputs, resist pest and climatic stresses, and remediate or stabilize polluted soils.
9	Biotechnology-Based Agribusinesses: research and extension programs will link results of biotechnology research to industries interested and capable of marketing advances in animal and plant biotechnology; biotechnology, financial planning, marketing, and risk management will be combined to establish agribusinesses specializing in the diagnosis and control of avian infectious diseases, production of crop varieties that have lower fertilizer requirements and that are more tolerant of climatic stress; utilization of hyper-accumulating plants that can remediate contaminated soils, and the production of high-value plant products useful for human health and nutrition.

Outcome #1

1. **Outcome Measures**

Increased awareness by all components of the poultry industry of the opportunities to use biotechnology to prevent, diagnose, and control avian infectious diseases.

Not Reporting on this Outcome Measure

Outcome #2

1. **Outcome Measures**

Increased number of farmers and members of the horticultural industry aware of the opportunities to use advances in plant biotechnology to develop new businesses.

Not Reporting on this Outcome Measure

Outcome #3

1. **Outcome Measures**

Educational programs for K-12 youth and teachers on basic principles and applications of biotechnology to the plant, animal, and environmental sciences.

Not Reporting on this Outcome Measure

Outcome #4

1. **Outcome Measures**

Commercial evaluation in agronomic and horticultural settings of genetically modified plants developed using biotechnology research.

Not Reporting on this Outcome Measure

Outcome #5

1. **Outcome Measures**

Integration of plant and animal biotechnology educational materials developed cooperatively by research and extension staff into K-12 curricula in Delaware schools.

Not Reporting on this Outcome Measure

Outcome #6

1. Outcome Measures

Stronger, more formal links between scientists conducting biotechnology research, extension specialists familiar with biotechnology applications, and state and regional economic development agencies and private industry.

Not Reporting on this Outcome Measure

Outcome #7

1. Outcome Measures

Avian Biotechnology: basic research will provide an improved understanding of the fundamental causes and modes of action of avian diseases and the factors that influence their potential to spread to other animal species and humans; applied research will provide innovations in surveillance and diagnostic tools that help prevent or contain disease outbreaks and vaccines that prevent or control infectious diseases.

Not Reporting on this Outcome Measure

Outcome #8

1. Outcome Measures

Plant Biotechnology: basic research will lead to an improved understanding of the processes by which plants grow, resist or adapt to diseases and other stresses; can be used to produce bio-based products useful for human health and nutrition, and regulate the uptake of plant nutrients in agricultural soils and contaminants (e.g., heavy metals) in polluted soils; applied research will lead to plants that can produce increased yields with lower inputs, resist pest and climatic stresses, and remediate or stabilize polluted soils.

2. Associated Institution Types

- 1862 Research
- 1890 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2011	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Vegetable and agronomic crop farmers and processors, bioenergy companies, agribusiness, consumers.

What has been done

1) Downy mildew is a potentially devastating disease that strikes lima beans (Phaseolus lunatus), one of Delaware?s most important vegetable crops. A diverse group of plant scientists in the University of Delaware?s College of Agriculture and Natural Resources has joined together to battle this important plant disease.
2) Plant genetic studies focused on controlling multiple plant diseases has been completed;
3) Research on microbial survival and effectiveness in converting renewable sources of energy into biofuels.

Results

1) Plant pathologists are testing fungicides, trying to understand the pathogen?s virulence mechanisms and how it evolves to attack certain aspects of the plants. Plant geneticists work on aspects of qualitative genetics and plant breeding and genomics of lima bean-downy mildew interactions. Plant biologists are studying the pathogen, monitoring the evolution of new races of the pathogen, and the epidemiology of the disease. Extension associates are diagnosing the disease from samples sent in by growers, maintaining the pathogen in culture for experiments and determining their races. Other extension associates are breeding lima beans for desirable traits.
2) Research published in the Proceedings of the National Academy of Sciences, by Randall Wisser, assistant professor in the Department of Plant and Soil Sciences, and colleagues showed that some genes in the maize (corn) genome can help protect the plant from multiple invaders. Their study focused on three fungal diseases, Southern leaf blight, Gray leaf spot, and Northern leaf blight, that threaten maize production worldwide and for which major epidemics have occurred in the U.S. and abroad.
3) Biofuels must be produced quickly and at high concentrations in order to make them economically feasible. Unfortunately, the process can be toxic to cells necessary in their manufacture. Blake Meyers, Edward and Elizabeth Goodman Rosenberg Professor and chair of the Department of Plant and Soil Sciences, is part of a team at UD that is working to create hardy organisms for producing biofuels and chemicals from renewable sources ? microorganisms that are more resistant to toxic chemicals and engineered to withstand the stress response that can inhibit cell growth and cause cell death.

4. Associated Knowledge Areas

KA Code	Knowledge Area
201	Plant Genome, Genetics, and Genetic Mechanisms
601	Economics of Agricultural Production and Farm Management
603	Market Economics
604	Marketing and Distribution Practices

Outcome #9

1. Outcome Measures

Biotechnology-Based Agribusinesses: research and extension programs will link results of biotechnology research to industries interested and capable of marketing advances in animal and plant biotechnology; biotechnology, financial planning, marketing, and risk management will be combined to establish agribusinesses specializing in the diagnosis and control of avian infectious diseases, production of crop varieties that have lower fertilizer requirements and that are more tolerant of climatic stress; utilization of hyper-accumulating plants that can remediate contaminated soils, and the production of high-value plant products useful for human health and nutrition.

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2011	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Farmers, breweries, restaraunts, state agencies, the public.

What has been done
Delaware is the first state to have its own yeast. Gov. Jack Markell signed a proclamation giving a yeast named Kloeckera (apiculata) (strain KA 1) this designation, which is an honorary title because the state legislature is not currently in session to vote on the matter.

Results
Tom Evans and Nancy Gregory isolated the yeast, identified it, and gave it its first home, in laboratories in the University of Delaware?s College of Agriculture and Natural Resources. The yeast is the key ingredient in Delaware Native Ale, or DNA, a new, limited-time ale created by Dogfish Head Brewery that features grown-in-Delaware hops, peach and pear juices and other native ingredients. The light ale was introduced recently at a mid-day gathering at the brewery?s pub in Rehoboth Beach.

4. Associated Knowledge Areas

KA Code	Knowledge Area
201	Plant Genome, Genetics, and Genetic Mechanisms

304	Animal Genome
602	Business Management, Finance, and Taxation
603	Market Economics
903	Communication, Education, and Information Delivery

V(H). Planned Program (External Factors)

External factors which affected outcomes

- Economy
- Appropriations changes
- Public Policy changes
- Government Regulations
- Competing Public priorities
- Competing Programmatic Challenges

Brief Explanation

V(I). Planned Program (Evaluation Studies)

Evaluation Results

Evaluation of the Biotechnology and Biotechnology-Based Agribusiness planned program for FY11 (24 Research FTEs) shows continued excellence in basic research and an increasing emphasis on application of results from fundamental studies, particularly in the plant sciences. Plant molecular biology faculty are now conducting field studies with soybeans and have filed patents on the uses of their discoveries by industries involved in corn and soybean breeding and production. Evaluations of research productivity showed that 8 major research grants were awarded and that faculty in this program supported the efforts of 70 graduate students, post-docs, and undergraduate researchers, that they published 34 refereed journal articles and book chapters, and made 36 invited and volunteered presentations at national and international meetings. Our evaluations focused on research and included annual internal administrative reviews, periodic University level Academic Program Reviews, and analyses of interactions of faculty with industry and state agencies interested in seeing biotechnology advances adopted by businesses. Feedback from all sources has been positive and we anticipate expanded efforts in the translation of basic research in this planned program to both applied field studies and industrial applications in the future.

Key Items of Evaluation

There are no major items requiring NIFA attention at this time, other than the continued need for more federal funding for research and extension programs that seek to further expand our efforts to conduct fundamental studies on plant and animal biology and apply the results to global challenges related to producing a safe and secure food supply.

V(A). Planned Program (Summary)

Program # 3

1. Name of the Planned Program

Natural Systems, Biodiversity, and Wildlife Ecology

V(B). Program Knowledge Area(s)

1. Program Knowledge Areas and Percentage

KA Code	Knowledge Area	%1862 Extension	%1890 Extension	%1862 Research	%1890 Research
112	Watershed Protection and Management	10%	10%	10%	10%
123	Management and Sustainability of Forest Resources	10%	10%	10%	10%
135	Aquatic and Terrestrial Wildlife	20%	20%	20%	20%
136	Conservation of Biological Diversity	15%	15%	15%	15%
215	Biological Control of Pests Affecting Plants	15%	15%	15%	15%
216	Integrated Pest Management Systems	20%	20%	20%	20%
306	Environmental Stress in Animals	5%	5%	5%	5%
903	Communication, Education, and Information Delivery	5%	5%	5%	5%
	Total	100%	100%	100%	100%

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2011	Extension		Research	
	1862	1890	1862	1890
Plan	1.5	2.9	3.8	1.2
Actual Paid Professional	1.4	1.8	3.3	2.5
Actual Volunteer	0.0	0.0	0.0	0.0

2. Actual dollars expended in this Program (includes Carryover Funds from previous years)

Extension		Research	
Smith-Lever 3b & 3c	**1890 Extension**	**Hatch**	**Evans-Allen**
10102	0	70651	0
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
200043	0	0	0
1862 All Other	**1890 All Other**	**1862 All Other**	**1890 All Other**
87878	0	813043	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

Research and extension programs will target: (1) Integrated Pest Management - developing and delivering integrated pest management (IPM) programs, a "systems" approach using chemical, cultural, mechanical, and biological control to increase profits to producers and protect the environment; (2) Sustainable Agriculture/Forestry - developing and promoting efficient and sustainable agricultural, forestry, and other resource conservation practices and policies that ensure sustained ecosystem function and provide food and habitat for biodiversity, including crop diversification, agroforestry, native windbreaks, cover crops, living mulches, field border systems, and conservation buffers; (3) Wildlife, Woodlands, and Aquatic Resources - understanding and mitigating the impact of agricultural practices and urbanization on biodiversity, woodlands, and aquatic resources. Focus will be on human impacts on the fundamental processes that create and maintain biodiversity, such as atmospheric nitrification of ecosystems, minimal habitat requirements, speciation, predator-prey interactions, community and ecosystem structure, and extinction processes. Approaches to develop and sustain biodiversity in agriculture, suburban landscapes, and natural habitats, will be studied. Nonpoint source nutrient pollution models will assess impacts of land use/cover change from agriculture to urban on water quality and quantity on local ponds and creeks; (4) Wetlands Ecosystems - improve understanding of wetlands restoration, protection, and preservation. Emphasis will be on seasonally saturated and non-seasonally saturated wetlands, the wildlife species that inhabit them, and the importance of sedges in wetland habitats; (5) Protection of Delaware's Native Species - research on non-indigenous invasive species, a leading cause of plant and animal extinction in Delaware, will focus on impacts of invasive species on ecosystem function and on methods of restoration after their removal; (6) Master Gardener Training - Extension programs will be developed and delivered on Wildlife Habitat Gardening, Waterwise Gardening, and use of native landscape plants in suburban gardens; (7) Human Activities and the Natural Environment - coupled environmental and socioeconomic modeling methodologies will highlight interactions between human activities (drivers), environmental impacts from those activities (stressors), potential changes to valued ecosystem components, and feedbacks experienced from the changes; (8) Wildlife Management - effects of human activity on migratory shore birds, box turtles in suburban habitat fragments, neotropical bird migrants in Delaware, Bobwhite quail in warm season grasslands, horseshoe crab ecology in the Delaware Bay, insect biomass production in suburban habitats, habitat restoration for bats and White-tailed deer populations and lead to recommendations for improved habitat management; (9) Fisheries - population status, spawning areas, and management of Atlantic sturgeon in the Delaware River.

2. Brief description of the target audience

Farm owners and operators, aquaculture producers, recreational fisheries, seafood consumers, water quality managers, agribusiness and private consultants, horticultural professionals, city land use planners and other policy-makers, home gardeners, childcare providers, environmental educators.

3. How was eXtension used?

eXtension was used in the following ways in this planned program:

(1) Participated in a training webinar sponsored by eOrganic on using trap crops to manage stink bugs in cropping systems entitled "Stink Bug Management with Trap Crops". This information will be used to demonstrate trap cropping as a viable stink bug management strategy for stink bugs on small farms.

(2) Used information developed by eOrganic to help NRCS colleagues develop their 595 Organic Pest Management Job Sheet. This information will be used by producers looking to get cost share under the NRCS's Organics Transition Program.

(3) "Keep it Green" home gardener workshop series and "Grow your own Food" programs, summaries posted for program networking.
http://blogs.extension.org/ma tergardener/2010/11/01/keep-it-green-a-series-of-environmental-workshops-for-the-home-gardener/a
http://blogs.extension.org/mastergardener/2011/12/12/2011-search-for-excellence-workshops-category-award-winner-3rd-place/

V(E). Planned Program (Outputs)

1. Standard output measures

2011	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	12084	51225	1625	50

2. Number of Patent Applications Submitted (Standard Research Output)

Patent Applications Submitted

Year: 2011
Actual: 0

Patents listed

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2011	Extension	Research	Total
Actual	3	15	18

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Number of Competitive Grants Submitted

Year	Actual
2011	41

Output #2

Output Measure

- Number of Competitive Grants Awarded

Year	Actual
2011	23

Output #3

Output Measure

- Number of Research Projects Completed

Year	Actual
2011	14

Output #4

Output Measure

- Number of Undergraduate Researchers

Year	Actual
2011	50

Output #5

Output Measure

- Number of M.S. Graduate Students

Year	Actual
2011	28

Output #6

Output Measure

- Number of Ph.D. Graduate Students

Year	Actual
2011	8

Output #7

Output Measure

- Number of Post-doctoral Research Associates

Year	Actual
2011	0

Output #8

Output Measure

- Number of Refereed Journal Articles

Year	Actual
2011	18

Output #9

Output Measure

- Number of Books and Book Chapters

Year	Actual
2011	3

Output #10

Output Measure

- Number of Technical Reports

Year	Actual
2011	9

Output #11

Output Measure

- Number of Extension Bulletins and Factsheets

Year	Actual
2011	8

Output #12

Output Measure

- Number of Invited Presentations

Year	Actual
2011	231

Output #13

Output Measure

- Number of Volunteered Presentations

Year	Actual
2011	92

Output #14

Output Measure

- Number of Websites Established

Year	Actual
2011	7

Output #15

Output Measure

- Number of Workshops Conducted

Year	Actual
2011	96

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	Increased number of farmers and other producers aware of the principles of integrated pest management and familiar with the practices and technologies needed for a systems-based approach to prevent and control problems with insects, weeds, and plant pathogens.
2	Educational programs for K-12 youth and teachers on ecosystems and natural resources that emphasize the importance of sustaining biodiversity for natural and managed land uses.
3	Through the Center for Managed Ecosystems, conduct research and outreach programs on restoring and enhancing biodiversity and wildlife habitat in suburbanized landscapes.
4	Increased number of farmers and other land managers adopting integrated approaches to pest management for insects, weeds, alien invasive plants, and plant pathogens in agricultural and natural ecosystems.
5	Increased participation by all stakeholders in educational programs on responsible environmental management of natural resources, nutrients, and pesticides.
6	Increases in the amount of agricultural and suburban land where wildlife habitat has been restored or enhanced.
7	Integrated Pest Management: basic and applied research will increase the effectiveness of a systems-based approach to prevent or control pests (insects, weeds, plant pathogens) that threaten agricultural productivity and damage natural, urban, and suburban landscapes. Extension programs will promote adoption of IPM by farmers and other land managers.
8	Ecosystem restoration: fundamental research on ecosystem processes will provide evidence of the full range of ecological, water quality, and economic benefits associated with sustaining and enhancing natural ecosystems such as wetlands, forests, riparian corridors, and tidal marshes, and lead to greater restoration and expansion of areas important for wildlife habitat and biodiversity.
9	Wildlife habitat and management: research will assess the impacts of human activity on wildlife habitats and develop management practices that can protect threatened or endangered species and lead to policies that protect and enhance wildlife populations.
10	Protection of native species: research and extension programs will quantify the ecological and economic benefits of protecting indigenous plant species and restricting the spread of invasive plants and animals.

Outcome #1

1. Outcome Measures

Increased number of farmers and other producers aware of the principles of integrated pest management and familiar with the practices and technologies needed for a systems-based approach to prevent and control problems with insects, weeds, and plant pathogens.

2. Associated Institution Types

- 1862 Extension
- 1890 Extension
- 1862 Research
- 1890 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2011	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Farmers, environmental groups concerned about pesticide use, consumers

What has been done
The University of Delaware Integrated Pest Management program conducted educational programming, on-farm studies, and surveys to guide improved pest management.

Results
A coordinated insect-trapping network resulted in continued funding from the Delaware Department of Agriculture to maintain the state program and expand trapping efforts for 2 potential new pests (Spotted Wing Drosophila and Western Bean Cutworm). The Mid-Atlantic Crop Management School educated 210 participants on new IPM practices to be used on over 797,000 acres in the region resulting in an increase in $25 per acre in net income for their clientele. Surveys of field corn producers involved in the slug management program indicated that use of scouting to time bait applications and minimum tillage will be used to improve slug management on 2000 acres in 2011. Crop rotation, sampling to identify when to early harvest, row spacing, weed management and variety selection will again be used to manage Dectes stem borer on over 5000 acres of soybeans in 2011. In specialty crops (vegetables), ten percent of participants in the Small Farm workshops indicate they plan to incorporate reduced risk weed management option as a resulted of participation in summer field days. Soil health programs for vegetable producers and consultants resulted 45 individuals attending field days and in-field

training sessions and an additional 380 individuals attending educational sessions from January-April 2011.

4. Associated Knowledge Areas

KA Code	Knowledge Area
112	Watershed Protection and Management
215	Biological Control of Pests Affecting Plants
216	Integrated Pest Management Systems
903	Communication, Education, and Information Delivery

Outcome #2

1. Outcome Measures

Educational programs for K-12 youth and teachers on ecosystems and natural resources that emphasize the importance of sustaining biodiversity for natural and managed land uses.

2. Associated Institution Types

- 1862 Extension
- 1890 Extension

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2011	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Educators in K-12 programs, homeowners, land managers and others interested in wildlife conservation and management.

What has been done
Environmental education for wildlife enhancement and wise-use of our natural resources was presented during 10 events and/or workshops reaching over 776 individuals to help guide public policy and expand economic opportunities. Workshops were conducted on urban forest stewardship.

Results
This guidance provided invaluable knowledge for the survival of ?urban interface? communities, throughout the state, as rapidly increasing land-use changes convert rural ?open? lands to urban development infrastructures. During the year the RREA program increased educational outreach involvement through the Delaware ?Children in Nature-Greener Schools? initiative, Delaware

Envirothon State Challenge and Delaware Association for Environmental Education (as a founding Board member and educator).

Statewide rural and urban forest stewardship outreach was obtained through 13 educational events engaging 891 land managers (including additional on-site visits and office support to 164 individuals). Assistance was provided on tree health (including insect & disease diagnosis), tree/shrub identification, proper pruning & planting and marketing opportunities for wood products.

4. Associated Knowledge Areas

KA Code	Knowledge Area
112	Watershed Protection and Management
136	Conservation of Biological Diversity
903	Communication, Education, and Information Delivery

Outcome #3

1. Outcome Measures

Through the Center for Managed Ecosystems, conduct research and outreach programs on restoring and enhancing biodiversity and wildlife habitat in suburbanized landscapes.

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2011	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Homeowners, citizen groups interested in conservation and ecosystems, those concerned about how landscape management affects biodiversity and water quality.

What has been done
Taking a fresh look at water quality management, a University of Delaware College of Agriculture and Natural Resources (CANR) research team is studying how the replacement of urban lawns with more diverse vegetation can help protect water quality and make our landscapes more sustainable

Results

The researchers will be working at the Winterthur Gardens and in a local suburban community on their project. One of the main goals of the three-year study is to try to curb water pollution at its source ? preventing pollution in the first place rather than waiting to treat contaminated water before it enters waterways.

4. Associated Knowledge Areas

KA Code	Knowledge Area
112	Watershed Protection and Management
123	Management and Sustainability of Forest Resources
135	Aquatic and Terrestrial Wildlife
136	Conservation of Biological Diversity
903	Communication, Education, and Information Delivery

Outcome #4

1. Outcome Measures

Increased number of farmers and other land managers adopting integrated approaches to pest management for insects, weeds, alien invasive plants, and plant pathogens in agricultural and natural ecosystems.

Not Reporting on this Outcome Measure

Outcome #5

1. Outcome Measures

Increased participation by all stakeholders in educational programs on responsible environmental management of natural resources, nutrients, and pesticides.

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2011	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Farmers, homeowners, citizen action groups concerned about the importance of bees to natural and managed ecosystems.

What has been done

UD?s apiology program hosted numerous workshops this year and completely redesigned the Mid-Atlantic Apiculture Research and Extension Consortium (MAAREC) website, which is a major educational resource for the beekeeping industry.

Results

A queen-rearing workshop was held in Kent County for over 30 beekeepers. A beginner beekeeping workshop was offered in conjunction with Delaware State University. Twenty-five hives were established at the Newark Farm teaching apiary, which produced the first lot of "Dare to Bee" honey sold at the UDairy Creamery store with proceeds directly benefiting the apiology program. It was a successful first year and the beginning of collaboration with growers in Delaware concerning the development of a Best Management Practices for commercial bumblebees in watermelon, strawberries and pickling cucumbers.

The MAAREC website was in serious need of a makeover. Google analytics for the site reported 6,501 visits between March 4 and April 3, 2011. There were 21, 879 page views during this time as well. Average time on the site was reported as 4 minutes and there was a 47% bounce rate. Most of viewers were from the U.S. but Canada as well as Australia and England were also represented. This site has a large impact on the beekeeping world and is a great way to keep up a dialog amongst honeybee researchers, apiary inspectors and local beekeeping associations in the Mid-Atlantic region.

4. Associated Knowledge Areas

KA Code	Knowledge Area
135	Aquatic and Terrestrial Wildlife
136	Conservation of Biological Diversity
216	Integrated Pest Management Systems
903	Communication, Education, and Information Delivery

Outcome #6

1. Outcome Measures

Increases in the amount of agricultural and suburban land where wildlife habitat has been restored or enhanced.

Not Reporting on this Outcome Measure

Outcome #7

1. Outcome Measures

Integrated Pest Management: basic and applied research will increase the effectiveness of a systems-based approach to prevent or control pests (insects, weeds, plant pathogens) that threaten agricultural productivity and damage natural, urban, and suburban landscapes. Extension programs will promote adoption of IPM by farmers and other land managers.

2. Associated Institution Types

- 1862 Extension
- 1890 Extension
- 1862 Research

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Actual
2011	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Farmers growing agronomic, vegetable and fruit crops, homeowners,consumers.

What has been done
While merely an annoyance to most homeowners, the brown marmorated stink bug (BMSB) poses an economic threat to Delaware agriculture. Fruit crops seem to be at greatest risk, especially peaches and apples. About 18 percent of the mid-Atlantic apple crop had stink bug damage last year, according to the U.S. Apple Association. Brian Kunkel, an entomologist with the University of Delaware?s Cooperative Extension, and several of his colleagues in Extension and UD?s College of Agriculture and Nature Resources are researching BSMBs in soybean, lima bean, sweet corn, field corn and sweet pepper fields.

Results
The Univesity of Delaware, in cooperation with the USDA Beneficial Insects Introduction Research Lab, housed on UD?s campus, is investigating biocontrol measures for the BSMB. Biocontrol introduces natural predators into an environment to control, if not eradicate, the pest problem. A rigorous, multi-year research program is underway including initiatin efforts to obtain government approvals needed for biocontrol measures.

4. Associated Knowledge Areas

KA Code	Knowledge Area
216	Integrated Pest Management Systems
903	Communication, Education, and Information Delivery

Outcome #8

1. Outcome Measures

Ecosystem restoration: fundamental research on ecosystem processes will provide evidence of the full range of ecological, water quality, and economic benefits associated with sustaining and enhancing natural ecosystems such as wetlands, forests, riparian corridors, and tidal marshes, and lead to greater restoration and expansion of areas important for wildlife habitat and biodiversity.

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Actual
2011	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Land managers in urban and suburban areas facing problems with stormwater runoff, citizen groups and state/federal agencies interested in ecological approaches to stormwater management.

What has been done
Much of the University of Delaware's campus, including the College of Agriculture and Natural Resources (CANR) farm, drains into Cool Run, a tributary of White Clay Creek. There is an urgency to quell the impact of stormwater runoff into the creek. Stormwater runoff, unfiltered water that reaches bodies of water by flowing across impervious surfaces, enters White Clay Creek through multiple sources throughout the city of Newark and the UD campus. Because of this, CANR has teamed with partners from across the University and the city to see what can be done to help reduce the University?s contribution to the problem.

Results
One key activity to date has been the formation of the University of Delaware Watershed Action Team for Ecological Restoration (UD WATER). In addition to many projects undertaken on the CANR farm to stop stormwater pollutants from reaching White Clay Creek, the UD WATER team decided another step to curb stormwater runoff was to create a biological filtration system on the CANR campus. Supported by state and university funding, the biofiltration system has been installed and now treats runoff from ~3 acres of streets,parking lots, roofs, and other impervious surfaces, as well as a small portion of the CANR dairy farm. Monitoring of water quality benefits and environmental education programs on this "BMP" are now underway.

4. Associated Knowledge Areas

KA Code	Knowledge Area
112	Watershed Protection and Management
123	Management and Sustainability of Forest Resources
136	Conservation of Biological Diversity
216	Integrated Pest Management Systems
903	Communication, Education, and Information Delivery

Outcome #9

1. Outcome Measures

Wildlife habitat and management: research will assess the impacts of human activity on wildlife habitats and develop management practices that can protect threatened or endangered species and lead to policies that protect and enhance wildlife populations.

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2011	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Wildlife ecologists, citizen groups interested in protecting waterfowl, hunters, and state and federal wildlife agencies

What has been done
Chris Williams and his University of Delaware research team may be the first wildlife biologist to use apparatus more commonly seen on the battlefield ? night-vision riflescopes for waterfowl research.

Results
Williams, associate professor of wildlife ecology in the College of Agriculture and Natural Resources, is studying the behavior of the American black duck to determine if there are adequate food resources on the Mid-Atlantic coast to support this dabbling duck, which has been identified as a ?species of concern? by the U.S. Fish and Wildlife Service. Although considerable data are available on the daytime behaviors of the black duck, until now little has been known about its nightime behavior and how this affects population ecology and survival of this important

species.

4. Associated Knowledge Areas

KA Code	Knowledge Area
112	Watershed Protection and Management
135	Aquatic and Terrestrial Wildlife
903	Communication, Education, and Information Delivery

Outcome #10

1. Outcome Measures

Protection of native species: research and extension programs will quantify the ecological and economic benefits of protecting indigenous plant species and restricting the spread of invasive plants and animals.

2. Associated Institution Types

- 1862 Extension
- 1890 Extension
- 1862 Research
- 1890 Research

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Actual
2011	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
{No Data Entered}

What has been done
{No Data Entered}

Results
{No Data Entered}

4. Associated Knowledge Areas

KA Code	Knowledge Area
136	Conservation of Biological Diversity
903	Communication, Education, and Information Delivery

V(H). Planned Program (External Factors)

External factors which affected outcomes

- Economy
- Appropriations changes
- Public Policy changes
- Government Regulations
- Competing Public priorities
- Competing Programmatic Challenges

Brief Explanation

V(I). Planned Program (Evaluation Studies)

Evaluation Results

Evaluation of the Natural Systems, Biodiversity, and Wildlife Ecology planned program for FY11 (5 Research FTEs, 4 Extension FTEs) shows ongoing high quality efforts by research and extension scientists and educators to address the ecological and natural resources problems facing Delaware and of relevance to many other states and countries. Significant advances have been made in our understanding of wildlife ecology and management, the role of migratory birds in the transmission of avian diseases, and the use of biocontrol strategies to manage invasive plants. Evaluations of research and extension productivity showed that 23 grants were awarded and that faculty in this program supported the efforts of 86 graduate students, post-docs, and undergraduate researchers, that they published 21 refereed journal articles and book chapters, made 320 invited and volunteered presentations at national and international meetings, and conducted 96 workshops. Our evaluations have included annual internal administrative reviews, periodic University level Academic Program Reviews, and - for extension - surveys and other evaluations conducted with stakeholders participating in workshops and other extension programs. All evaluations and feedback from stakeholders have been positive in terms of the direction of research and extension programs, their relevance to Delaware, and their contributions to basic and applied science.

Key Items of Evaluation

There are no major items requiring NIFA attention at this time, other than the continued need for more federal funding for research and extension programs that seek to further expand our efforts to conduct research and outreach programs that meet the growing need to restore degraded ecosystems, protect biodiversity, and address the growing global problem of invasive species control.

V(A). Planned Program (Summary)

Program # 4

1. Name of the Planned Program

Family and Youth Development

V(B). Program Knowledge Area(s)

1. Program Knowledge Areas and Percentage

KA Code	Knowledge Area	%1862 Extension	%1890 Extension	%1862 Research	%1890 Research
801	Individual and Family Resource Management	25%	25%	25%	25%
802	Human Development and Family Well-Being	25%	25%	25%	25%
806	Youth Development	40%	40%	40%	40%
903	Communication, Education, and Information Delivery	10%	10%	10%	10%
	Total	100%	100%	100%	100%

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2011	Extension		Research	
	1862	1890	1862	1890
Plan	12.2	1.2	0.0	3.9
Actual Paid Professional	10.2	4.2	0.0	0.6
Actual Volunteer	0.0	0.0	0.0	0.0

2. Actual dollars expended in this Program (includes Carryover Funds from previous years)

Extension		Research	
Smith-Lever 3b & 3c	**1890 Extension**	**Hatch**	**Evans-Allen**
87759	0	0	0
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
669131	0	0	0
1862 All Other	**1890 All Other**	**1862 All Other**	**1890 All Other**
1275343	0	28334	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

Research and extension programs will target: (1) *Volunteer Leadership Development* programs will be delivered on public policy education; volunteer leadership development (e.g., 4-H adult and teen volunteers and camp counselors, master gardeners, master food educators; T.R.Y. (Teens reaching youth), middle management volunteers (volunteers managing volunteers); and extension advisory committees; (2) *Family Well-Being Across the Lifespan Educational Programming,* including *Just in Time Parenting* (Great Beginnings and the Brown Bag program for parents of young children) and Families Matter! (for parents of school-age children), interactive web sites, newsletter series, workshops, worksite seminars and classes focusing on positive parenting and care giving, family stress management, child development, healthy relationships and marriage education, savvy decision-making, anger management and conflict resolution, healthy communication, intergenerational well-being, teamwork, leadership, and community involvement skills; 3) *Safe Communities* - programs will include drug and alcohol prevention education, bicycle safety education, pedestrian safety education, farm safety, and car seat safety; (4) *Family Economic Well-Being and Consumer Decision Making* educational programs will be developed and delivered focusing on strategies for effective consumer decision making, financial planning, financial management counselor training, basic budgeting, credit management, and retirement planning; (5) *4-H Youth Development* programs will focus on life skills development, positive life choices, leadership development, citizenship/community involvement, and career exploration with emphasis on science, engineering and technology knowledge. Appropriate settings including clubs, camps, school enrichment and after school will use the latest technology to deliver the sustained opportunities.

2. Brief description of the target audience

Youth ages 5-19, 4-H members, 4-H volunteers, new 4-H volunteers, Master Gardeners, Community Leaders, at-risk youth and families, court appointed and incarcerated youth and adults, parents of children (from birth through school-age), families with members in the second ½ of the lifespan, youth agency professionals, key decision-makers, human service professionals, child care/after school providers, family day home providers, social clubs, church groups, private and public school youth and teachers, after school 4-H clubs and school age child care programs.

3. How was eXtension used?

eXtension was used in the following ways:

1) Referred clients to the bankruptcy/ debtor educator online course because they offer 'closed caption' and the client was in need of these special services.

2) Educators participate in parenting and financial management community of practice.

3) eXtension funded the development of Just in Time Parenting (JITP), a pioneer Community of Practice at www.extension.org/parentingled by UD faculty member Barbara Nelson. JITP is offering the best of Extension parenting and family resources - available to every interested family (and the professionals who work with families) nationwide

4) Community of Practice entitled Diversity, Equity & Inclusion utilized for expanding civil rights and diversity programmingefforts across the state.

V(E). Planned Program (Outputs)

1. Standard output measures

2011	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	7806	11205	24758	5240

2. Number of Patent Applications Submitted (Standard Research Output)

Patent Applications Submitted

Year: 2011

Actual: 0

Patents listed

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2011	Extension	Research	Total
Actual	0	0	0

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Number of Competitive Grants Submitted

Year	Actual
2011	14

Output #2

Output Measure

- Number of Competitive Grants Awarded

Year	Actual
2011	13

Output #3

Output Measure

- Number of Research Projects Completed

Year	Actual
2011	0

Output #4

Output Measure

- Number of Undergraduate Researchers

Year	Actual
2011	0

Output #5

Output Measure

- Number of Refereed Journal Articles

Year	Actual
2011	0

Output #6

Output Measure

- Number of Technical Reports

Year	Actual
2011	2

Output #7

Output Measure

- Number of Extension Bulletins and Factsheets

Year	Actual
2011	150

Output #8

Output Measure

- Number of Invited Presentations

Year	Actual
2011	45

Output #9

Output Measure

- Number of Volunteered Presentations

Year	Actual
2011	33

Output #10

Output Measure

- Number of Websites Established

Year	Actual
2011	4

Output #11

Output Measure

- Number of Workshops Conducted

Year	Actual
2011	753

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	Leadership development programs for volunteers interested in improving the quality of life for youth, families and communities.
2	Greater knowledge by Delaware youth of the importance of academic performance, social skills, and job preparedness to their future careers.
3	Educational programming for adults and youth emphasizing the development of positive life skills related to parenting, family financial planning, and safe communities.
4	Number of youth adopting behaviors that reduce their risk of using alcohol, tobacco and related substances, and that result in improved academic, social, and job preparedness skills.
5	Number of parents/families participating in extension programming who demonstrate positive parenting skills.
6	Number of youth and adults adopting increased leadership, communication, conflict management and decision-making skills
7	Number of program participants adopting skills for balancing work and family and stress management that promote healthy, well-functioning individuals and families
8	Number of families who adopt best practices in financial management, retirement planning and consumer decision-making.
9	Number of adults adopting best practices in child development, business development, educational program development in child care settings.
10	Number of youth who have increased science, engineering, and technology skills.
11	Number of youth with greater involvement in citizenship and community service programs.
12	An enhanced capacity for families and youth to improve their quality of life because of increased skills in parenting and family relationships, academic preparedness, career development, family financial planning, leadership and volunteerism, and citizenship and community involvement

Outcome #1

1. Outcome Measures

Leadership development programs for volunteers interested in improving the quality of life for youth, families and communities.

2. Associated Institution Types

- 1862 Extension
- 1890 Extension

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2011	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Families, youth, potential employers in industry, government, academia, and other areas.

What has been done
Ten Delaware youth were selected to participate in the National 4-H Youth Congress, which was held recently in Atlanta.

Results
This leadership development conference is considered the flagship event of the 4-H program, providing youth with an unparalleled opportunity to learn about community involvement, culture diversity and service to others. Participants benefitted from interaction with other adult and youth leaders from throughout the US.

4. Associated Knowledge Areas

KA Code	Knowledge Area
801	Individual and Family Resource Management
806	Youth Development
903	Communication, Education, and Information Delivery

Outcome #2

1. Outcome Measures

Greater knowledge by Delaware youth of the importance of academic performance, social skills, and job preparedness to their future careers.

Not Reporting on this Outcome Measure

Outcome #3

1. Outcome Measures

Educational programming for adults and youth emphasizing the development of positive life skills related to parenting, family financial planning, and safe communities.

2. Associated Institution Types

- 1862 Extension
- 1890 Extension

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2011	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Delaware families, youth, employers,educational insttituions and others concerned about positive parenting and youth development.

What has been done
Extension teams received the national awards related to early childhood care and family financial planning.

Results
Kathleen Splane received the National Early Childhood Child Care Training Award and an editing team consisting of Maria Pippidis, Margo McDonough and Sandy Peralta received an Eastern Region Newsletter Communication Award. Splane is Extension?s family and consumer science educator for Kent County. The child care training award recognizes Splane?s innovative online program, ?Healthy Habits, Healthy Start.? Splane received funding from the state Division of Public Health for the program, which is designed for providers throughout the state who serve preschoolers. Some curriculum content was provided by Nemours Health & Prevention Services. The Extension editing team, led by Maria Pippidis, was recognized for Two Cent Tips for

Delaware, an email newsletter that focuses on consumer money management skills. Recent issues have covered such topics as retirement planning, getting along and saving money in multigenerational households, reducing the cost of holiday travel, and helping teenagers and young adults become credit savvy. Pippidis is the director of the New Castle County Cooperative Extension office, Peralta is an administrative assistant in that office and McDonough is a UD communications specialist.

4. Associated Knowledge Areas

KA Code	Knowledge Area
801	Individual and Family Resource Management
802	Human Development and Family Well-Being
806	Youth Development
903	Communication, Education, and Information Delivery

Outcome #4

1. Outcome Measures

Number of youth adopting behaviors that reduce their risk of using alcohol, tobacco and related substances, and that result in improved academic, social, and job preparedness skills.

2. Associated Institution Types

- 1862 Extension
- 1890 Extension

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2011	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Familes, youth, employers, health care industries and agencies, state and federal government agencies, the public.

What has been done
In 2010 and 2011, 4-H educators reached over 5500 youth with the Health Rocks tobacco and substance abuse prevention curriculum.

Results
At the 2011 Extension Conference, The Health Rocks Team was awarded an Outstanding Program Award of Excellence. Here is a sampling of the positive evaluation data for 2010: Nine

out of ten youth participants had goals for their life and realized the importance of managing stress in a positive way, and it is not worth taking the risk to try cigarettes, alcohol, and other drugs; Nine out of ten youth participants were confident that they would be able to say ?no? if other people such as peer friends offer them drugs, they would be able to choose healthy behaviors to deal with stress instead of turning to drugs or alcohol, and they would never use drugs; Over 90% of youth participants demonstrated social competency, volunteerism, self-confidence and strong values; Health Rocks training help youth learn skills in dealing with peer pressure and stress, and in making informed decisions and youth participants reported the highest improvements in these specific skills.

4. Associated Knowledge Areas

KA Code	Knowledge Area
806	Youth Development
903	Communication, Education, and Information Delivery

Outcome #5

1. Outcome Measures

Number of parents/families participating in extension programming who demonstrate positive parenting skills.

Not Reporting on this Outcome Measure

Outcome #6

1. Outcome Measures

Number of youth and adults adopting increased leadership, communication, conflict management and decision-making skills

2. Associated Institution Types

- 1862 Extension
- 1890 Extension

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2011	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Families, youth, potential employers, state and federal agencies involved in addressing family problems related to the military.

What has been done
The 4-H Operation Military Kids Program resulted in 389 military 4-H youth entering items in the Delaware State Fair.

Results
A total of 1,100 fair entries were entered by the military youth with $3,500 in fair premiums earned by these youth.

4. Associated Knowledge Areas

KA Code	Knowledge Area
801	Individual and Family Resource Management
806	Youth Development
903	Communication, Education, and Information Delivery

Outcome #7

1. Outcome Measures

Number of program participants adopting skills for balancing work and family and stress management that promote healthy, well-functioning individuals and families

Not Reporting on this Outcome Measure

Outcome #8

1. Outcome Measures

Number of families who adopt best practices in financial management, retirement planning and consumer decision-making.

Not Reporting on this Outcome Measure

Outcome #9

1. Outcome Measures

Number of adults adopting best practices in child development, business development, educational program development in child care settings.

Not Reporting on this Outcome Measure

Outcome #10

1. Outcome Measures

Number of youth who have increased science, engineering, and technology skills.

Not Reporting on this Outcome Measure

Outcome #11

1. Outcome Measures

Number of youth with greater involvement in citizenship and community service programs.

2. Associated Institution Types

- 1862 Extension
- 1890 Extension

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2011	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Families, youth, agencies working to provide food to families in need.

What has been done
The 4-H Garden at Nemours was established to teach 4-H youth about the ins and outs of growing vegetables while supplying produce to the Food Bank of Delaware. In addition, some vegetables are set aside for a produce stand that 4-H has been operating at Nemours/Alfred I. duPont Hospital for several summers.

Results
UD Cooperative Extension provided the tools, seeds and plants, supplemented by donations from local growers needed for these projects. Youth from 4-H -- assisted by Master Gardeners -- supply the labor necessary to maintain the 60-foot by 35-foot vegetable garden. Several 4-Hers entered produce from the garden into the State Fair vegetable contests.

4. Associated Knowledge Areas

KA Code	Knowledge Area
801	Individual and Family Resource Management
806	Youth Development

Outcome #12

1. Outcome Measures

An enhanced capacity for families and youth to improve their quality of life because of increased skills in parenting and family relationships, academic preparedness, career development, family financial planning, leadership and volunteerism, and citizenship and community involvement

Not Reporting on this Outcome Measure

V(H). Planned Program (External Factors)

External factors which affected outcomes

- Natural Disasters (drought, weather extremes, etc.)
- Economy
- Appropriations changes
- Public Policy changes
- Government Regulations
- Competing Public priorities
- Competing Programmatic Challenges
- Populations changes (immigration, new cultural groupings, etc.)

Brief Explanation

V(I). Planned Program (Evaluation Studies)

Evaluation Results

Evaluation of the Family and Youth Development planned program for FY11 (1 Research FTE, 14 Extension FTEs) shows a continued dedication by Extension faculty and professionals to meet the many challenges faced by Delaware families today. Issues where evaluations indicate particular success are those related to family financial planning, youth development and mentoring - particularly on the importance of education, strengthening families and parenting skills, and youth learning to avoid risks related to drugs and alcohol. Evaluations of extension programming showed remarkable success in grants (13 of 14 submitted were awarded), the publication of 150 new fact sheets, 78 invited and volunteered presentations in local communities and at regional and national meetings, and the presentation of more than 750 workshops. Our evaluations have included annual internal administrative reviews and numerous surveys and other evaluation methods conducted with stakeholders participating in workshops and other extension programs. Specific examples of stakeholder evaluation of these programs are provided in the "Outcomes" section of the FY11 annual report. The response from our stakeholders and internal reviews has been universally positive and complimentary of the dedicated efforts of

Extension professionals to address the very complex challenges faced by Delaware families and youth today.

Key Items of Evaluation

There are no major items requiring NIFA attention at this time, other than the continued need for more federal funding for research and extension programs which seek to develop innovative educational programming that strengthens families, fosters positive youth development and education, and builds stronger communities in the difficult financial times we all face today.

V(A). Planned Program (Summary)

Program # 5

1. Name of the Planned Program

Food Safety

V(B). Program Knowledge Area(s)

1. Program Knowledge Areas and Percentage

KA Code	Knowledge Area	%1862 Extension	%1890 Extension	%1862 Research	%1890 Research
501	New and Improved Food Processing Technologies	15%	15%	15%	15%
502	New and Improved Food Products	10%	10%	10%	10%
712	Protect Food from Contamination by Pathogenic Microorganisms, Parasites, and Naturally Occurring Toxins	60%	60%	60%	60%
903	Communication, Education, and Information Delivery	15%	15%	15%	15%
	Total	100%	100%	100%	100%

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2011	Extension		Research	
	1862	1890	1862	1890
Plan	1.1	0.9	3.9	0.9
Actual Paid Professional	1.2	2.1	3.9	1.1
Actual Volunteer	0.0	0.0	0.0	0.0

2. Actual dollars expended in this Program (includes Carryover Funds from previous years)

Extension		Research	
Smith-Lever 3b & 3c	**1890 Extension**	**Hatch**	**Evans-Allen**
22381	0	12691	0
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
872	0	0	0
1862 All Other	**1890 All Other**	**1862 All Other**	**1890 All Other**
379577	0	575516	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

Research efforts involve using high pressure processing to reduce bacteria, viruses, protozoan oocysts, and bacterial endospores; inactivation of pathogenicbacterial specieswith high pressure and mild heat; using various antimicrobial films to control bacteria, such as *Listeria monocytogenes*;physiological and genetic analysis ofpressure-resistant *Listeria monocytogenes*; testing of activity of antimicrobial films against native and inoculated bacteria on foods and surfaces; effects and mechanisms of non-thermal processes (ozone, UV, oxidative chemicals, iron, and/or high pressure processing) on protozoa, human pathogenic viruses, and bacteriophage, and increase understanding of basic biochemistry of these microorganisms. Extension efforts include conducting Keep Food Safe, ServSafe®, Don't Give Kids a Tummy Ache, Food Safety for Entrepreneurs, Keep'em Down on the Farm, Chances and Choices, Operation Risk, Microbial Contamination, Don't Bug Me!,; training volunteers including Master Food Educators, 4-H leaders, agency personnel, and teacher about food safety so that they can educate families, community groups, and institutions (e.g., childcare centers, schools); developing and delivering programs on Kids Cooking (1890 EFNEP), Food Safety for Youth, and Eat Smart, Play Hard; developing web-based information and fact sheets; distributing information to media; developing a marketing campaign to expand program participation; developing a marketing strategy with state and local government partners, faith-based groups, parents, social workers, childcare providers, low income housing managers, and corporate wellness centers to collectively deal with low income and socially disadvantaged individuals.

2. Brief description of the target audience

Restaurant workers, volunteer food handlers, delicatessen workers, day care providers, institutional foodservice workers, school foodservice personnel, caterers/private chefs, food entrepreneurs, retail food owners/managers, food producers, youth ages 5 to 18, parents and caregivers of children from birth to 18, limited-resource individuals and families, 4-H leaders and clubs, Boys and Girls clubs, teachers and other school personnel, youth in low-income schools, policy makers, and media.

3. How was eXtension used?

eXtension was not used in this program

V(E). Planned Program (Outputs)

1. Standard output measures

2011	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	3113	198	2584	4250

2. Number of Patent Applications Submitted (Standard Research Output)

Patent Applications Submitted

Year: 2011

Actual: 0

Patents listed

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2011	Extension	Research	Total
Actual	1	25	26

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Number of Competitive Grants Submitted

Year	Actual
2011	38

Output #2

Output Measure

- Number of Competitive Grants Awarded

Year	Actual
2011	9

Output #3

Output Measure

- Number of Research Projects Completed

Year	Actual
2011	11

Output #4

Output Measure

- Number of Undergraduate Researchers

Year	Actual
2011	16

Output #5

Output Measure

- Number of M.S. Graduate Students

Year	Actual
2011	14

Output #6

Output Measure

- Number of Post-doctoral Research Associates

Year	Actual
2011	4

Output #7

Output Measure

- Number of Refereed Journal Articles

Year	Actual
2011	26

Output #8

Output Measure

- Number of Books and Book Chapters

Year	Actual
2011	5

Output #9

Output Measure

- Number of Technical Reports

Year	Actual
2011	11

Output #10

Output Measure

- Number of Extension Bulletins and Factsheets

Year	Actual
2011	4

Output #11

Output Measure

- Number of Invited Presentations

Year	Actual
2011	22

Output #12

Output Measure

- Number of Volunteered Presentations

Year	Actual
2011	24

Output #13

Output Measure

- Number of Websites Established

Year	Actual
2011	2

Output #14

Output Measure

- Number of Workshops Conducted

Year	Actual
2011	469

Output #15

Output Measure

- Number of Newsletters

Year	Actual
2011	460

Output #16

Output Measure

- Number of Ph.D. Graduate Students

Year	Actual
2011	9

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	Increased number of farmers, processors, food handlers, and families who are aware of food safety and nutrition issues that can lead to illness and long-term health problems and of the practices and technologies needed to ensure a safe and healthy food supply.
2	Educational programs for K-12 youth and teachers on food safety that will help reduce the likelihood of food-borne illness.
3	Increased number of farmers and food processors adopting research-based advances in food science technology that will prevent the incidence and spread of foodborne illnesses.
4	Safe, new food products that are preserved using innovative technologies designed to maintain food quality and nutrient content.
5	Increased number of program participants improving in one or more safe handling practices.
6	Increased number of participating youth increasing understanding of safe food handling procedures.
7	Food science and technology: basic and applied research will lead to optimization of intervention strategies incorporating high hydrostatic pressure processing, ultraviolet light, ozone treatment, active packaging and low-temperature storage to eliminate or significantly reduce the source of foodborne disease in food products. Applied food science research and extension programs in these areas will increase awareness to food producers and consumers of the most effective strategies for food product safety.
8	Food safety: research and extension programs will lead to enhanced safety and wholesomeness of foods as a result of improved understanding of the mechanisms whereby food pathogens exist, enter, survive, propagate and actuate disease syndromes in individuals who consume contaminated products. Gene-based methods to rapidly and accurately identify food-borne pathogens will increase the safety of food products.

Outcome #1

1. Outcome Measures

Increased number of farmers, processors, food handlers, and families who are aware of food safety and nutrition issues that can lead to illness and long-term health problems and of the practices and technologies needed to ensure a safe and healthy food supply.

2. Associated Institution Types

- 1862 Extension
- 1890 Extension

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2011	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Food service industry, food processors, consumers, farmers, health service agencies.

What has been done
University of Delaware Cooperative Extension has two programs that target quantity food handlers. The ServSafe® program is the premiere food safety certification offered by the National Restaurant Association Educational Foundation. This program is designed for managers of foodservice operations. Successful completion of the certification exam helps in meeting Delaware Food Code requirements. DineSafe is designed for quantity food preparers working in a variety of settings. They learn skills and strategies required to keep food safe regardless of their specific job.

Results
During the last two years, University of Delaware Cooperative Extension has reached over 350 quantity foodservice workers in both the ServSafe® and DineSafe programs. As a result of the program, 86 percent passed the ServSafe® certification examination. Additionally, 89, 70, 80, 74, 68, 71, and 81 percent indicated that they would personally or have their staff wash hands more frequently, improve personal hygiene, calibrate thermometers on a regular basis, keep foods above 140ºF, cool foods more rapidly, use sanitizers correctly, and thoroughly wash and sanitize work surfaces, respectively. Likewise, DineSafe participants indicated that they would improve food safety practices with 87 percent reporting the intent to wash hands more frequently, 71 percent keeping foods hot and cooling food rapidly, and 76 percent thoroughly washing and sanitizing work surfaces before preparing food.

4. Associated Knowledge Areas

KA Code	Knowledge Area
501	New and Improved Food Processing Technologies
712	Protect Food from Contamination by Pathogenic Microorganisms, Parasites, and Naturally Occurring Toxins
903	Communication, Education, and Information Delivery

Outcome #2

1. Outcome Measures

Educational programs for K-12 youth and teachers on food safety that will help reduce the likelihood of food-borne illness.

2. Associated Institution Types

- 1862 Extension
- 1890 Extension

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2011	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Consumers, families, youth, educators involved in health, nutrition, and food safety.

What has been done
An intensive 30-hour course in nutrition and food safety was developed to provide volunteers with the tools to either assist Cooperative Extension Family and Consumer Science staff or deliver basic programs in New Castle County. Both technical background information and hands-on experiences were included in the training.

Results
Participants successfully completing the training are designated as Master Food Educators (MFEs). A total of 19 individuals have graduated since the program started in the fall of 2009. Since that time, Master Food Educators have volunteered over 900 hours with an approximate value of $21,000. Examples of activities include assisting with Extension programs such as Eat Smart for a Healthy Heart and Dining with Diabetes, judging 4-H foods at Delaware State Fair, giving presentations at libraries throughout the county, and staffing both food safety and nutrition displays for public events

4. Associated Knowledge Areas

KA Code	Knowledge Area
712	Protect Food from Contamination by Pathogenic Microorganisms, Parasites, and Naturally Occurring Toxins
903	Communication, Education, and Information Delivery

Outcome #3

1. Outcome Measures

Increased number of farmers and food processors adopting research-based advances in food science technology that will prevent the incidence and spread of foodborne illnesses.

2. Associated Institution Types

- 1862 Extension
- 1890 Extension

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2011	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Fruit and vegetable producers, food processors, food service business owners and employers, health service agencies, consumers

What has been done
The economic impact of a foodborne outbreak associated with Delaware grown produce would be overwhelming. Fruit and vegetable production and activities associated with getting the items to market account for about $179 million dollars of industry output, 754 jobs, and $67.5 million in value added activities. A team of agricultural and family and consumer science educators delivered an educational program targeting commercial fruit and vegetable growers in Delaware.

Results
The program was developed to address the increasing concerns over food safety of produce and to help growers meet buyer demands for food safety. Delaware growers attended a two part voluntary Good Agriculture Practices/Good Handling Practices (GAP/GHP) training. Classes consisted of the rationale behind food safety strategies, tactics for implementing GAPs and GHPs, what an audit would look like, how to implement GAP/GHP, information about on-farm worker training, and developing a food safety plan for the operation. Six-month post and final program surveys were sent to 156 participants who completed training. Of the 70 respondents

returning the six-month survey, 90 percent reported being better able to manage risks as they relate to farm food safety and 95 percent better understand their role in preventing foodborne illness. Operators trained over 430 farm workers, operators/ consultants conducted 23 mock audits, and 18 percent completed a farm safety plan. In 2011, an additional 58 producers - 20 larger wholesale and 38 smaller growers participated in 6 and 3-hour training sessions, respectively. Two farms had GAP/GHP audits and assistance was provided in writing three produce food safe plans in 2011.

4. Associated Knowledge Areas

KA Code	Knowledge Area
501	New and Improved Food Processing Technologies
712	Protect Food from Contamination by Pathogenic Microorganisms, Parasites, and Naturally Occurring Toxins
903	Communication, Education, and Information Delivery

Outcome #4

1. Outcome Measures

Safe, new food products that are preserved using innovative technologies designed to maintain food quality and nutrient content.

Not Reporting on this Outcome Measure

Outcome #5

1. Outcome Measures

Increased number of program participants improving in one or more safe handling practices.

Not Reporting on this Outcome Measure

Outcome #6

1. Outcome Measures

Increased number of participating youth increasing understanding of safe food handling procedures.

Not Reporting on this Outcome Measure

Outcome #7

1. Outcome Measures

Food science and technology: basic and applied research will lead to optimization of intervention strategies incorporating high hydrostatic pressure processing, ultraviolet light, ozone treatment, active packaging and low-temperature storage to eliminate or significantly reduce the source of foodborne disease in food products. Applied food science research and extension programs in these areas will increase awareness to food producers and consumers of the most effective strategies for food product safety.

2. Associated Institution Types

- 1862 Research
- 1890 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2011	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Food processing industry, health service agencies concerned about safe food supply, food service and packaging industry, consumers.

What has been done
Researchers continue the fight against foodborne illness through advanced and applied research addressing causes of this problem and new technologies to solve it.

Results
Haiqiang Chen, associate professor in the Department of Animal and Food Sciences, will serve as the project director for a team of researchers focusing on the ?Inactivation of Enteric Foodborne Viruses in High Risk Foods by Non-Thermal Processing Technologies.? Kali Kniel, associate professor of animal and food sciences, along with Manan Sharma of the USDA-Agricultural Research Service Environmental Microbiology and Food Safety Laboratory and Jeri Barak of the University of Wisconsin, Madison, will study ?Plant Responses to Foodborne Bacteria and Viruses.?

4. Associated Knowledge Areas

KA Code	Knowledge Area
501	New and Improved Food Processing Technologies

502	New and Improved Food Products
712	Protect Food from Contamination by Pathogenic Microorganisms, Parasites, and Naturally Occurring Toxins

Outcome #8

1. Outcome Measures

Food safety: research and extension programs will lead to enhanced safety and wholesomeness of foods as a result of improved understanding of the mechanisms whereby food pathogens exist, enter, survive, propagate and actuate disease syndromes in individuals who consume contaminated products. Gene-based methods to rapidly and accurately identify food-borne pathogens will increase the safety of food products.

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2011	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Consumers, health service agencies concerned about food safety, the food processing and service industry, farmers.

What has been done
New multi-disciplinary, multi-state research projects have been launched to develop strategies to reduce virus-caused diseases and increase the safety of produce.

Results
1) Kali Kniel, associate professor in the University of Delaware?s Department of Animal and Food Sciences, is part of a national team led by North Carolina State University to strengthen food safety by studying human noroviruses across the food supply chain in an effort to design effective control measures and reduce the number of virus-caused food-borne illnesses. Human noroviruses are the most common cause of food-borne disease, responsible for more than 5 million cases in the United States each year. Noroviruses spread from person to person, through contaminated food or water, and by touching contaminated surfaces.
Researchers at the University of Delaware are participating in a project that is focused on increasing produce safety and delivering more trustworthy salad fixings. The three-year study promises to be one of the most comprehensive studies of fresh produce safety ever conducted. Kali Kniel, associate professor in UD?s Department of Animal and Food Sciences, and Kathryne

Everts, professor and Cooperative Extension specialist in plant pathology at Maryland with a joint appointment at UD, are part of the University of Delaware team.
2)

4. Associated Knowledge Areas

KA Code	Knowledge Area
501	New and Improved Food Processing Technologies
502	New and Improved Food Products
712	Protect Food from Contamination by Pathogenic Microorganisms, Parasites, and Naturally Occurring Toxins
903	Communication, Education, and Information Delivery

V(H). Planned Program (External Factors)

External factors which affected outcomes

- Economy
- Appropriations changes
- Public Policy changes
- Government Regulations
- Competing Public priorities
- Competing Programmatic Challenges
- Populations changes (immigration, new cultural groupings, etc.)

Brief Explanation

V(I). Planned Program (Evaluation Studies)

Evaluation Results

Evaluation of the Food Safety planned program for FY11 (5 Research FTEs, 2 Extension FTEs) shows that an active research program focused on food safety and innovative food processing technologies is well-linked with our extension programs, particularly in food safety and human nutrition. Areas of strength are on the biology of food pathogens, management strategies to prevent contamination of fresh produce by viruses and bacteria, food processing technologies that can ensure food safety, and a wide range of extension programs for families, youth, food handlers, and the food service industry. Evaluations of research and extension productivity showed that 9 grants were awarded, that faculty in this program supported the efforts of 43 graduate students, post-docs, and undergraduate researchers, that they published 31 refereed journal articles and book chapters, made 51 invited and volunteered presentations at national and international meetings, and conducted 469 workshops. Our evaluations have included annual internal administrative reviews and numerous surveys and other evaluation methods conducted with stakeholders participating in workshops and other extension programs. Specific examples of stakeholder evaluation of these programs, particularly by our extension professionals, are provided in the "Outcomes" section of the FY11 annual report. Internal and external reviews of research quality and feedback from stakeholders have been positive and

complimentary of the dedicated efforts of our food safety research and extension team to provide science-based solutions to the many challenging problems related to providing a safe and secure food supply today.

Key Items of Evaluation

There are no major items requiring NIFA attention at this time, other than the continued need for more federal funding for research and extension programs which, while productive, are only addressing a fraction of the growing and very complex problems related to food safety today.

V(A). Planned Program (Summary)

Program # 6

1. Name of the Planned Program

Childhood Obesity

V(B). Program Knowledge Area(s)

1. Program Knowledge Areas and Percentage

KA Code	Knowledge Area	%1862 Extension	%1890 Extension	%1862 Research	%1890 Research
702	Requirements and Function of Nutrients and Other Food Components	10%	10%	10%	10%
703	Nutrition Education and Behavior	20%	20%	20%	20%
724	Healthy Lifestyle	60%	60%	60%	60%
903	Communication, Education, and Information Delivery	10%	10%	10%	10%
	Total	100%	100%	100%	100%

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2011	Extension		Research	
	1862	1890	1862	1890
Plan	16.8	0.6	0.0	3.3
Actual Paid Professional	16.0	2.6	0.0	0.3
Actual Volunteer	0.0	0.0	0.0	0.0

2. Actual dollars expended in this Program (includes Carryover Funds from previous years)

Extension		Research	
Smith-Lever 3b & 3c	1890 Extension	Hatch	Evans-Allen
418333	0	0	0
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
90237	0	0	0
1862 All Other	**1890 All Other**	**1862 All Other**	**1890 All Other**
354828	0	0	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

Extension and applied research efforts include, but are not limited to, conducting and studying Healthy Habits, Healthy Start - a 6 hour program on healthy eating and physical activity for child care workers, Family Meals Workshops - a series of three, three-hour programs for families with young children, FoodSkills, an eight part workshop for low-income adults without children; Expanded Food and Nutrition Education Program - a series of eight lessons for low-income adults with children; Expanded Food and Nutrition Education Program for low-income youth ; training volunteers including Master Food Educators, 4-H leaders, agency personnel, and teachers; providing Just In Time parenting newsletters; incorporating physical activity and healthy foods/snacks in all 4-H camps and after-school programs; providing special educational programs at the 4-H Military Program; and conducting favorite foods contests and CATCH programs for youth.

2. Brief description of the target audience

Day care workers, parents, low-income adults and youth, 4-H youth, Master Food Educators, 4-H leaders, teachers

3. How was eXtension used?

eXtension was used to participate in the Healthy Communities Community of Practice.

V(E). Planned Program (Outputs)

1. Standard output measures

2011	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	5373	5169	3626	3493

2. Number of Patent Applications Submitted (Standard Research Output)

Patent Applications Submitted

Year: 2011

Actual: 0

Patents listed

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2011	Extension	Research	Total
Actual	0	0	0

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Number of Competitive Grants Submitted

Year	Actual
2011	14

Output #2

Output Measure

- Number of Competitive Grants Awarded

Year	Actual
2011	10

Output #3

Output Measure

- Number of Extension Bulletins and Factsheets

Year	Actual
2011	21

Output #4

Output Measure

- Number of Invited Presentations

Year	Actual
2011	13

Output #5

Output Measure

- Number of Volunteered Presentations

Year	Actual
2011	24

Output #6

Output Measure

- Number of Websites Established

Year	Actual
2011	1

Output #7

Output Measure

- Number of Workshops Conducted

Year	Actual
2011	837

Output #8

Output Measure

- Number of Research Projects Completed

Year	Actual
2011	1

Output #9

Output Measure

- Number of Undergraduate Researchers

Year	Actual
2011	10

Output #10

Output Measure

- Number of M.S. Graduate Students

Year	Actual
2011	2

Output #11

Output Measure

- Number of Refereed Journal Articles

Year	Actual
2011	0

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	Statewide educational programs for K-12 youth and teachers focused on nutrition, healthy diets and obesity causing factors that will help reduce the likelihood of food-borne illness, develop good nutritional and dietary habits, avoid obesity, and prevent chronic illnesses related to poor nutrition.
2	Targeted educational programs on understanding the causes of obesity and the means to reduce obesity for low-income communities, youth through after-school programs and childcare workers.
3	Increased number of program participants improving one or more nutrition practices.
4	Increased number of program participants who improve the frequency and quality of family meals.
5	Increased number of program participants engaged in greater levels of physical activity
6	Reducing obesity in Delaware by extension programs that modify individual, family, and community behavior in a manner that promotes healthy lifestyles, physical activity on a regular basis, the consumption of healthy foods in appropriate quantities, and increasing family meals.
7	Greater understanding, particularly in low-income communities and by youth, of the health risks associated with obesity and the options available to prevent or correct obesity problems.

Outcome #1

1. Outcome Measures

Statewide educational programs for K-12 youth and teachers focused on nutrition, healthy diets and obesity causing factors that will help reduce the likelihood of food-borne illness, develop good nutritional and dietary habits, avoid obesity, and prevent chronic illnesses related to poor nutrition.

2. Associated Institution Types

- 1862 Extension
- 1890 Extension

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2011	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Families, youth, childcare center owners and staff, health service agencies, and consumers.

What has been done
There are 52,728 licensed childcare slots in Delaware. Providing safe, nutritious food during a child?s time outside the home is extremely important for the health and well being of the child. Additionally, habits learned early in life are more likely to be carried into adulthood. Therefore, day care workers need to understand the importance of good nutrition and to develop skills to plan, prepare, and serve nutritious, safe foods.

Results
University of Delaware Family and Consumer Science Educators provide many workshops that Delaware center and family day care providers can participate in to gain the skills necessary for providing safe, nutritious meals and snacks. Because of time constraints placed on these workers, an on-line training was developed to provide an additional method for child care workers to obtain the necessary credits. Development of the program, Healthy Habit Healthy Start was funded by a grant from the Delaware Department of Public Health. Fifty-one childcare providers completed the on-line course in addition to 160 individuals attending in person sessions. Based on evaluation of the on-line participants, 86 percent were very satisfied with the content of the professional development experience.

4. Associated Knowledge Areas

KA Code	Knowledge Area

703	Nutrition Education and Behavior
724	Healthy Lifestyle
903	Communication, Education, and Information Delivery

Outcome #2

1. Outcome Measures

Targeted educational programs on understanding the causes of obesity and the means to reduce obesity for low-income communities, youth through after-school programs and childcare workers.

2. Associated Institution Types

- 1862 Extension
- 1890 Extension

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2011	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Families, youth, health service agencies, state and federal agencies concerned about public health.

What has been done
Two federally-funded programs, the Expanded Food and Nutrition Education Program (EFNEP) and Supplemental Nutrition Assistance Program Education (SNAP-Ed) provide a minimum of 10 hours of interactive, hands-on education. The focus of both programs is on participants developing skills to make healthy food choices based on their budget, to use their resources wisely, to handle food safely, and to participate in physical activity each day. These programs empower individuals and families participating in the sessions to expand their horizons and to link diet, physical activity, and health together.

Results
During 2011, participation in SNAP-Ed increased to 511 individuals compared to 406 individuals in 2010. When asked to rate their eating habits on a 10-point scale, 94 percent of the participants indicated a higher rating at the end of the class compared to the beginning of the class. Additionally, 66 and 63 percent of participants improved one or more nutrition and food resource management practices, respectively. Although initially 64 percent demonstrated acceptable food practices related to thawing and storing food properly, safe food handling practices improved among SNAP-Ed graduates with 36 percent reporting improvement in one or more food safety practices. EFNEP reached 406 adults and 1,127 youth in 2011. Based on food recalls taken at

the beginning of the program and at the end, improvement in intake of grains, fruits, vegetables, milk, and meat were noted by 37, 52, 62, 64, and 37 percent of participants, respectively. Of the families graduating in 2011, 85 percent improved at least one nutrition practice, 77 percent improved at least resource management practice, and 60 percent improved at least one food safety practice

4. Associated Knowledge Areas

KA Code	Knowledge Area
702	Requirements and Function of Nutrients and Other Food Components
703	Nutrition Education and Behavior
724	Healthy Lifestyle
903	Communication, Education, and Information Delivery

Outcome #3

1. Outcome Measures

Increased number of program participants improving one or more nutrition practices.

Not Reporting on this Outcome Measure

Outcome #4

1. Outcome Measures

Increased number of program participants who improve the frequency and quality of family meals.

Not Reporting on this Outcome Measure

Outcome #5

1. Outcome Measures

Increased number of program participants engaged in greater levels of physical activity

Not Reporting on this Outcome Measure

Outcome #6

1. Outcome Measures

Reducing obesity in Delaware by extension programs that modify individual, family, and community behavior in a manner that promotes healthy lifestyles, physical activity on a regular basis, the consumption of healthy foods in appropriate quantities, and increasing family meals.

2. Associated Institution Types

- 1862 Extension
- 1890 Extension

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Actual
2011	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Families, youth, health and social service agencies concerned about health and nutrition in all communities

What has been done
A comprehensive extension education program is underway to assist Delaware families in understanding the importance of proper nutrition, excercise, and diets to healthy lifestyles.

Results
1) Extension programs are helping Delawareans combat impediments to nutritious eating with the Eat Smart for a Healthy Heart program. The three-part program includes education, cooking demonstrations and samplings of healthy foods. The first class focuses on desserts, the second on main dishes and the final class on side dishes. The program also includes basic information about heart disease, including risk factors, and other measures, such as exercise, that can impact cardiovascular health.

2) Boning Up On Health, a five lesson interactive curriculum was developed to emphasize the importance of getting adequate amounts of exercise and calcium daily. Specific topics include MyPlate, sources of dairy products, risk factors for developing osteoporosis, and ways to prevent its development when young. A total of 1,409 youth participated in the Boning Up On Health sessions throughout the state during the summer of 2011. Paired comparison of responses from each youth before and at the end of the classes revealed that thirty-eight percent could correctly identify a dairy food after the lessons compared to before the lessons. When asked to identify a weight-bearing exercise, 40% of the youth were correct after the lessons.

3) Dining With Diabetes helps citizens with diabetes understand the importance of controlling their blood sugar levels and shows them how to eat the right amount of food in the right portion at the right time to help control their blood sugar levels. As a result of participating in Dining with Diabetes, attendees reported eating more vegetables (80 percent), eating more fruits (70 percent), reading Nutrition Facts labels (90 percent), reading ingredient labels (90 percent), being more physically active (45 percent), more likely to eat on a regular basis (60 percent), and more likely to eat breakfast (55 percent). Furthermore, planning healthier meals, using different artificial sweeteners, and using better portion control were noted as additional ways to manage their diabetes by 75, 70, and 85 percent of participants, respectively.

4. Associated Knowledge Areas

KA Code	Knowledge Area
702	Requirements and Function of Nutrients and Other Food Components
703	Nutrition Education and Behavior
724	Healthy Lifestyle
903	Communication, Education, and Information Delivery

Outcome #7

1. Outcome Measures

Greater understanding, particularly in low-income communities and by youth, of the health risks associated with obesity and the options available to prevent or correct obesity problems.

2. Associated Institution Types

- 1862 Extension
- 1890 Extension

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Actual
2011	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Families, youth, health service and social service agencies concerned about health and nutition in low-income communities

What has been done
A series of three classes were developed for low-income families emphasizing the importance of family meals. The goal of the Family Meals Workshops, called Dinner Parties, was to provide the family meal provider with the tools to prepare meals at home for their families thereby increasing the emotional and physical health of their children and increasing their knowledge of the cost effectiveness of preparing health foods at home. Funds were obtained to conduct the first series of workshops from The Fund for Women grant program

Results
Twenty-nine individuals participated in the workshops, which were conducted at three Delaware Housing Authority sites in Kent County. Feedback from the workshops was very positive with 90 percent strongly agreeing that they learned new information. When asked if the information was relevant to them, if they would use now, if they would use in the future, or if they would refer to the

handouts again, 83, 83, 72, and 90 percent, respectively, strongly agreed with the statement. Response to an open-ended question on what ideas or practices they planned to try as a result of attending the workshops yielded a myriad of responses. However, a few themes emerged, including label reading, planning meals, eating more fruits and vegetables, and mealtime conversation.

4. Associated Knowledge Areas

KA Code	Knowledge Area
702	Requirements and Function of Nutrients and Other Food Components
703	Nutrition Education and Behavior
724	Healthy Lifestyle
903	Communication, Education, and Information Delivery

V(H). Planned Program (External Factors)

External factors which affected outcomes

- Economy
- Appropriations changes
- Public Policy changes
- Government Regulations
- Competing Public priorities
- Competing Programmatic Challenges
- Populations changes (immigration, new cultural groupings, etc.)

Brief Explanation

V(I). Planned Program (Evaluation Studies)

Evaluation Results

Evaluation of the Childhood Obesity planned program for FY11 (0.3 Research FTE, 19 Extension FTEs) shows a diverse and comprehensive extension effort to address the statewide issues associated with health, nutrition, diets, and families. Some particularly strong areas of extension programming include: (i) an integrated team effort to modify individual, family, and community behavior in a manner that promotes healthy lifestyles, encourages physical activity on a regular basis, promotes the consumption of healthy foods in appropriate quantities, and increases the frequency of family meals and (ii) an extensive set of programs for after-school children and childcare providers on healthy lifestyles and diets. Evaluations of extension programming showed excellent success in grants (10 of 14 submitted were awarded), the publication of 21 new fact sheets, 37 invited and volunteered presentations in local communities and at regional and national meetings, and the presentation of more than 800 workshops. Our evaluations have included annual internal administrative reviews and numerous surveys and other evaluation methods conducted with stakeholders participating in workshops and other extension programs. Specific examples of stakeholder evaluation of these programs are provided in the "Outcomes" section of the

FY11 annual report. Stakeholder feedback and internal reviews are quite positive and appreciative of the very comprehensive programs our Extension professionals have developed and are implementing widely and successfully today.

Key Items of Evaluation

There are no major items requiring NIFA attention at this time, other than the continued need for more federal funding for research and extension programs that will help build on our current successes and allow us to reach more families and provide them with the skills needed to prevent or correct the serious problem of childhood obesity.

V(A). Planned Program (Summary)

Program # 7

1. Name of the Planned Program

Climate Change

V(B). Program Knowledge Area(s)

1. Program Knowledge Areas and Percentage

KA Code	Knowledge Area	%1862 Extension	%1890 Extension	%1862 Research	%1890 Research
102	Soil, Plant, Water, Nutrient Relationships	15%	15%	15%	15%
111	Conservation and Efficient Use of Water	10%	10%	10%	10%
132	Weather and Climate	10%	10%	10%	10%
136	Conservation of Biological Diversity	10%	10%	10%	10%
203	Plant Biological Efficiency and Abiotic Stresses Affecting Plants	5%	5%	5%	5%
205	Plant Management Systems	10%	10%	10%	10%
305	Animal Physiological Processes	5%	5%	5%	5%
307	Animal Management Systems	10%	10%	10%	10%
311	Animal Diseases	10%	10%	10%	10%
601	Economics of Agricultural Production and Farm Management	5%	5%	5%	5%
605	Natural Resource and Environmental Economics	5%	5%	5%	5%
903	Communication, Education, and Information Delivery	5%	5%	5%	5%
	Total	100%	100%	100%	100%

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2011	Extension		Research	
	1862	1890	1862	1890
Plan	10.2	1.2	19.8	1.5
Actual Paid Professional	6.8	0.9	19.4	1.2
Actual Volunteer	0.0	0.0	0.0	0.0

2. Actual dollars expended in this Program (includes Carryover Funds from previous years)

Extension		Research	
Smith-Lever 3b & 3c	**1890 Extension**	**Hatch**	**Evans-Allen**
232407	0	569420	0
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
407161	0	446596	0
1862 All Other	**1890 All Other**	**1862 All Other**	**1890 All Other**
521602	0	3068715	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

Research and extensions programs will focus on: (1) *Animal agriculture*: understanding impacts of climate change on animal physiological processes, health, and disease, particularly for poultry and dairy; developing management practices to rapidly diagnose, prevent, and mitigate (e.g., new vaccines) effects of avian diseases on poultry health and productivity, including current disease problems and new ones that may appear and proliferate under new climatic conditions; developing new systems and technologies to reduce effects of environmental stress on animal health and productivity; (2) *Agronomic crops*: basic research on how environmental stresses associated with climate change (e.g., heat, moisture stress) affect crop physiology and productivity; plant genetics and breeding studies to develop cultivars of major crops better adapted to a changing climate, in terms of water use efficiency and resistance to insects and disease; applied research and extension programs on irrigation management and water use efficiency for periods of prolonged drought and restricted water use and for groundwaters that may become more saline from salt water intrusion; integrated pest management to diagnose and control insects, weeds, and diseases (current and newly emerging) during longer growing seasons and under warmer and wetter growing conditions; nutrient cycling and management, particularly for manures and other byproducts where decomposition and nutrient release rates and timings are affected by warmer, wetter climates; basic and applied research on factors controlling C sequestration and new agronomic management practices that help mitigate greenhouse gas emissions by sequestering C in soils; (3) *Natural Ecosystems*: characterizing effects of climate change on biodiversity of plants and wildlife exposed to greater pressure from droughts, insects, disease, and invasive species; studying how climate change affects natural ecosystems and insects critical to crop production (e.g., pollination, honeybees); investigate value of marshes, wetlands, and forests to sequester C; increase C storage by encouraging tree planting and sustainable forestry management, (4) *Resource economics*: develop creative new economic policies to profitably link agriculture and forestry with those sectors generating significant quantities of greenhouse gases (e.g., energy, transportation) in cooperative efforts to mitigate greenhouse gas emissions; improve understanding of the relationship of climate change to agricultural and environmental policy development, including farmland preservation, conservation reserve programs; study impacts of climate change on groundwater aquifers, integrate climate change into the Chesapeake Bay water quality model; contribute to policies and educational programs on recycling, develop environmentally-friendly bio-based fuels from local feed stocks, and assist in analysis of Delaware's greenhouse gas inventories from energy use (mobile sources, utilities, residential, industrial, transportation, commercial, natural gas distribution, waste management, agriculture, land use, etc.).

2. Brief description of the target audience

For animal agriculture, primarily poultry integrators, growers, breeders, trade groups and allied industries; dairy and beef producers; livestock commodity groups; forage producers, equine owners,

producers and interest groups; for crop and soils related research and extension programs, the audience includes existing and prospective grain crop producers, mixed (animal and crop production, e.g., dairy, horse) farms, crop commodity groups and trade associations, the "green industry" (e.g., horticulture, nurseries, landscapers), and certified crop advisors; for natural resource and ecology programs, private and not-for-profit organizations managing forests, wetlands, marshes, and other natural resource areas; state and federal agencies responsible for wildlife, forestry management, and coastal ecosystems; for our resource economic programs the audience includes farmers, landowners, policy-makers and state and federal agencies directly related to climate change policy (Delaware Development Office; Land Use Planning and Preservation; Department of Agriculture; Department of Health and Human Services; Department of Natural Resources & Environmental Control; Department of Transportation; Economic Development Office, USDA, NRCS, USEPA). For all programs, Delaware State Government and local legislators, homeowner associations, educators, community leaders, utility managers, retail stores distributing Energy Star products, fleet managers, building industry, Delaware Clean State Program members, Delaware Farm Bureau leaders, federal-state-local agriculture businesses, state and federal agencies; federal research laboratories; peer scientists in the U.S. and international colleagues, K-12 teachers, and environmental and community groups.

3. How was eXtension used?

eXtension was not used in this program

V(E). Planned Program (Outputs)

1. Standard output measures

2011	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	15527	91894	2306	100

2. Number of Patent Applications Submitted (Standard Research Output)

Patent Applications Submitted

Year: 2011

Actual: 0

Patents listed

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2011	Extension	Research	Total
Actual	2	48	50

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Number of Competitive Grants Submitted

Year	Actual
2011	84

Output #2

Output Measure

- Number of Competitive Grants Awarded

Year	Actual
2011	41

Output #3

Output Measure

- Number of Research Projects Completed

Year	Actual
2011	72

Output #4

Output Measure

- Number of Undergraduate Researchers

Year	Actual
2011	57

Output #5

Output Measure

- Number of M.S. Graduate Students

Year	Actual
2011	32

Output #6

Output Measure

- Number of Ph.D. Graduate Students

Year	Actual
2011	28

Output #7

Output Measure

- Number of Post-doctoral Research Associates

Year	Actual
2011	9

Output #8

Output Measure

- Number of Refereed Journal Articles

Year	Actual
2011	50

Output #9

Output Measure

- Number of Books and Book Chapters

Year	Actual
2011	12

Output #10

Output Measure

- Number of Technical Reports

Year	Actual
2011	28

Output #11

Output Measure

- Number of Extension Bulletins and Factsheets

Year	Actual
2011	16

Output #12

Output Measure

- Number of Invited Presentations

Year	Actual
2011	135

Output #13

Output Measure

- Number of Volunteered Presentations

Year	Actual
2011	114

Output #14

Output Measure

- Number of Websites Established

Year	Actual
2011	19

Output #15

Output Measure

- Number of Workshops Conducted

Year	Actual
2011	133

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	Educational programs for the poultry, livestock and equine industries on likely effects of climate change on animal health, productivity, the incidence of disease, greater energy costs due to warmer temperatures, and their management options to prevent new problems.
2	Greater awareness by farmers, the "Green Industry", other producers, and land managers of the types and possible magnitude of climate change impacts on crop production, with an emphasis on drought and irrigation management, increased incidences and diversity of pest pressures from insects, disease, and weeds, and nutrient cycling and transport for different crop rotations and tillage systems.
3	Outreach programs and demonstration projects on underlying principles and soil management programs now available to enhance carbon sequestration by agriculture, forestry, and other natural ecosystems (e.g., marshes, wetlands).
4	Educational programs for K-12 teachers, policy-makers, and the public on climate change and its potential effects on agriculture, natural ecosystems, and current and proposed approaches and new policies that could mitigate problems associated with climate change.
5	Increased number of poultry and livestock producers adopting management practices specifically designed to mitigate disease and animal health problems associated with climate change, particularly those related to year-round warmer conditions and weather extremes.
6	Increased number of crop producers adopting management practices specifically designed to mitigate plant growth problems associated with climate change, particularly those related to drought, pest pressures, and nutrient use.
7	Development of systematic strategies and plans to address climate change impacts on natural resource areas, particularly those related to plant species change, loss of biodiversity, wildlife ecology, and invasive plants.
8	Increased number of farmers, natural resource managers, and others aware of and participating in programs related to mitigating greenhouse gas emissions through programs such as carbon credits and carbon trading.
9	Greater scientific understanding of the fundamental mechanisms by which climate change affects plant and animal physiological processes, soil biological and chemical processes, and ecosystem health, with particular emphasis on challenges due to plant and animal diseases, water use efficiency, and biodiversity
10	Successful adoption of research-based management practices and economic policies that sustain animal agriculture, ensure crop productivity, protect or restore natural resource areas negatively impacted by climate change, and reduce greenhouse gas emissions.

Outcome #1

1. Outcome Measures

Educational programs for the poultry, livestock and equine industries on likely effects of climate change on animal health, productivity, the incidence of disease, greater energy costs due to warmer temperatures, and their management options to prevent new problems.

Not Reporting on this Outcome Measure

Outcome #2

1. Outcome Measures

Greater awareness by farmers, the "Green Industry", other producers, and land managers of the types and possible magnitude of climate change impacts on crop production, with an emphasis on drought and irrigation management, increased incidences and diversity of pest pressures from insects, disease, and weeds, and nutrient cycling and transport for different crop rotations and tillage systems.

Not Reporting on this Outcome Measure

Outcome #3

1. Outcome Measures

Outreach programs and demonstration projects on underlying principles and soil management programs now available to enhance carbon sequestration by agriculture, forestry, and other natural ecosystems (e.g., marshes, wetlands).

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Actual
2011	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Land managers, state and federal agencies engaged in conservation practices focused on carbon sequestration, the public.

What has been done
University of Delaware students were engaged in demonstration projects to enhance carbon sequestration through tree plantings.

Results
Professor Kent Messer and his students have planted more than 55,000 trees over a 60-acre plot of land in the Milford Neck region of Delaware, which will result in the sequestration of an estimated 17,500 tons of carbon, providing direct benefits for biodiversity and water quality for the region.

4. Associated Knowledge Areas

KA Code	Knowledge Area
102	Soil, Plant, Water, Nutrient Relationships
132	Weather and Climate
205	Plant Management Systems
605	Natural Resource and Environmental Economics
903	Communication, Education, and Information Delivery

Outcome #4

1. Outcome Measures

Educational programs for K-12 teachers, policy-makers, and the public on climate change and its potential effects on agriculture, natural ecosystems, and current and proposed approaches and new policies that could mitigate problems associated with climate change.

Not Reporting on this Outcome Measure

Outcome #5

1. Outcome Measures

Increased number of poultry and livestock producers adopting management practices specifically designed to mitigate disease and animal health problems associated with climate change, particularly those related to year-round warmer conditions and weather extremes.

Not Reporting on this Outcome Measure

Outcome #6

1. Outcome Measures

Increased number of crop producers adopting management practices specifically designed to mitigate plant growth problems associated with climate change, particularly those related to drought, pest pressures, and nutrient use.

Not Reporting on this Outcome Measure

Outcome #7

1. **Outcome Measures**

Development of systematic strategies and plans to address climate change impacts on natural resource areas, particularly those related to plant species change, loss of biodiversity, wildlife ecology, and invasive plants.

Not Reporting on this Outcome Measure

Outcome #8

1. **Outcome Measures**

Increased number of farmers, natural resource managers, and others aware of and participating in programs related to mitigating greenhouse gas emissions through programs such as carbon credits and carbon trading.

Not Reporting on this Outcome Measure

Outcome #9

1. **Outcome Measures**

Greater scientific understanding of the fundamental mechanisms by which climate change affects plant and animal physiological processes, soil biological and chemical processes, and ecosystem health, with particular emphasis on challenges due to plant and animal diseases, water use efficiency, and biodiversity

2. **Associated Institution Types**

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2011	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Poultry producers, agribusinesses, state and federal agencies assessing impacts of climate change on animal agriculture, the public.

What has been done

Research on (1) how resistance of poultry to heat stress has been affected by genetic changes in poultry in the past 50 years and (2) relationship between genetic diversity in corn and susceptibility of this globally important crop to stress associated with climate change.

Results

1) Carl Schmidt, associate professor of animal and food sciences and biological sciences at the University of Delaware, is studying heat stress on chickens ? both those that would have been around in the grocery stores of the 1950s and those that are found in supermarkets today. The basic thought is that with climate change, there will be more intense and hotter heat waves, which impacts poultry production. By studying poultry from the 1950s, or ?heritage? chickens, Schmidt is trying to see if any specific alleles ? or individual gene variances ? have been bred out of modern chickens that might make them less resistant to heat stress.

2) The University of Delaware?s Randall Wisser and a group of six fellow researchers have received a five-year $4.2 million grant from the U.S. Department of Agriculture?s National Institute of Food and Agriculture (USDA-NIFA) to study the genetics of adaptation and crop improvement. They are hoping to utilize the genetic diversity found in corn grown in the tropics to apply the genetic diversity to corn grown in the U.S. Populations that lack genetic diversity can fall prey to climate change or other stressors by not having an array of genes on which to draw from. Breeding-based solutions to addressing abiotic and biotic challenges require access to genetic diversity.

4. Associated Knowledge Areas

KA Code	Knowledge Area
102	Soil, Plant, Water, Nutrient Relationships
111	Conservation and Efficient Use of Water
132	Weather and Climate
136	Conservation of Biological Diversity
203	Plant Biological Efficiency and Abiotic Stresses Affecting Plants
205	Plant Management Systems
305	Animal Physiological Processes
307	Animal Management Systems
311	Animal Diseases

Outcome #10

1. Outcome Measures

Successful adoption of research-based management practices and economic policies that sustain animal agriculture, ensure crop productivity, protect or restore natural resource areas negatively impacted by climate change, and reduce greenhouse gas emissions.

Not Reporting on this Outcome Measure

V(H). Planned Program (External Factors)

External factors which affected outcomes

- Natural Disasters (drought, weather extremes, etc.)
- Economy
- Appropriations changes
- Public Policy changes
- Government Regulations
- Competing Public priorities
- Competing Programmatic Challenges
- Populations changes (immigration, new cultural groupings, etc.)

Brief Explanation

V(I). Planned Program (Evaluation Studies)

Evaluation Results

Evaluation of the Climate Change planned program shows growing activity in research and extension in this area as faculty and extension professionals have begun to incorporate a range of aspects on climate change into existing projects and launch new studies where climate change impacts are a central component. More than 40 grants supported the efforts of 70 graduate students, post-docs, and undergraduate researchers who conducted studies in areas that would be affected by expected changes in future climates. Similarly, 50 refereed journal articles, 250 invited and volunteered presentations, and 135 workshops were completed in areas where climate change impacts must be considered more carefully in the future. Our evaluations suggest that farmers, land managers, state and federal agencies, environmental groups, and the public value efforts to determine how current priority areas for research in Delaware may be affected by the anticipated changes in future climate

Key Items of Evaluation

There are no major items requiring NIFA attention at this time, other than the continued need for more federal funding for research and extension programs that seek to incorporate potential climate change impacts into current and planned projects on areas of high priority to Delaware.