2015 University of Delaware and Delaware State University Combined Research and Extension Plan of Work

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I. Plan Overview

1. Brief Summary about Plan Of Work

Delaware agriculture increasingly operates in a global economy and we face ongoing challenges in our efforts to help ensure food security for a growing population, develop innovative means to improve profitability and productivity, and protect the environment. Emerging issues must also be addressed, including climate change, farmland loss to development, food safety, and social issues for families and youth such as reversing the growing epidemic of childhood obesity. Agriculture in Delaware remains strong today, despite these challenges, and has weathered the recent economic downturn. The state has 490,000 acres of cropland (25% irrigated) that provide the grain crops needed for a thriving poultry industry, an innovative and profitable vegetable production industry, and a "green industry" that supports horticultural and natural resource interests of its citizens. A 2010 report led by the University of Delaware College of Agriculture & Natural Resources ("The Impact of Agriculture on Delaware's Economy") found that the total economic contribution of all categories of agriculture in Delaware was $7.95 billion in industry output and that the agricultural industry contributed $2.5 billion in value added activity, and $1.6 billion in labor income, supporting 30,000 jobs.

Our plan of work has been designed to help Delaware agriculture remain competitive, to meet s its environmental challenges, sustain the state's natural resources and support our rural and urban families and communities. We focus on the following four 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.

1. Sustainable Production Systems for Agricultural and Urban Landscapes

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, 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. Other livestock industries ($32M farm sales from dairy, beef cattle, swine) compose a smaller but locally important part of the agricultural economy. 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. 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 genetic solutions, thus research on plant genomes and related information is a unique strength in Delaware. 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.
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.

2. A Safe and Secure Food Supply for Human Nutrition and Health

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 . ;
Extension programming aimed at addre s sing childhood obesity involves the 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 Plate, meal planning, and food preparation to lose or maintain weight and increasing physical activity.

3. Family and Youth Development

The rapid economic and social changes occurring in Delaware today place high demands on families and communities. These problems occur in both rural and urban areas. 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.

4. Environmental Stewardship in a changing climate

This program focuses on maintaining and restoring renewable natural resources and the vital services provided by healthy ecosystems in Delaware after 400 years of urbanization and agriculture. 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 habitat, and nutrient enrichment of aquatic resources are key areas 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.

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 and more extreme weather events. 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. Research and extension foci 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.

Estimated Number of Professional FTEs/SYs total in the State.

Year	Extension		Research	
	1862	1890	1862	1890
2015	42.9	16.5	80.5	8.3
2016	42.9	16.5	80.5	8.3
2017	42.9	16.5	80.5	8.3
2018	42.9	16.5	80.5	8.3
2019	42.9	16.5	80.5	8.3

II. Merit Review Process

1. The Merit Review Process that will be Employed during the 5-Year POW Cycle

- 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. Evaluation of Multis & Joint Activities

1. How will the planned programs address the critical issues of strategic importance, including those identified by the stakeholders?

Delaware State University and the University of Delaware have always participated in multi-state, multi-institutional, and multi-disciplinary projects and regularly engage in joint research and extension programs. All 4 program areas in the Plan of Work involve some multi-state and joint activities and all reflect multi-disciplinary research and extension efforts. The planned programs target issues of strategic importance to Delaware and the Mid-Atlantic and Northeastern regions that were identified through a thorough stakeholder input process. Program evaluations and surveys are used annually to ensure that the planned programs are on track and relevant to state and regional needs. These programs have been effective in the past and continue to accomplish their goals. We regularly meet with colleagues from other states to discuss the relevance of our research and extension programs to multi-state issues and to develop plans to jointly address contemporary problems. For example, we share faculty in plant pathology with the University of Maryland; combined the dairy herds of Rutgers University and the University of Delaware to increase operational efficiency; cooperate actively with Mid-Atlantic and Northeastern states to develop fertilizer, lime, and manure recommendations for nutrient management plans for all crops; collaborate with Maryland, Virginia, and New Jersey on pesticide recommendations for field and horticultural crops; work actively with Maryland and Virginia to develop strategies to prevent and manage avian infectious diseases and potential outbreaks of major plant diseases such as Asian soybean rust; and participate in region-wide crisis management programs for beekeepers and stone fruit growers. We host the Northeast Center for Risk Management that coordinates extension efforts across all New England states, New Jersey, Pennsylvania, West Virginia, and Delaware designed to educate producers about the range of risk management strategies required to ensure profitability in their operations. The University of Delaware is also active in multi-state research. We have about 27 multi-state research projects in place and anticipate that this number will increase in the future. These projects address a wide range of contemporary topics such as food safety, genetic bases for resistance to avian diseases, breeding and genetics of forage crops, chemical and physical properties of particulates affecting air, water, and soil quality, bioavailability of pharmaceuticals and pesticides in terrestrial and aquatic ecosystems, management of wildlife in suburban and rural landscapes, integrated pest management for insect pests of corn, and rural communities, labor markets, and public policy.

2. How will the planned programs address the needs of under-served and under-represented populations of the State(s)?

Addressing the research and extension needs of underserved and underrepresented populations is a continuing challenge that we take very seriously. Representatives of these populations participate in our stakeholder input process and provided input into the goals and programs in our Plan of Work. Further, during a recent civil rights audit of the Extension programs in Delaware, suggestions were made on how to attract more underrepresented groups to our programs. We are now working to implement new strategies to better involve underrepresented groups in our extension and research programs. Additionally, Delaware State University, because of its charter as an 1890 Land Grant University, will primarily target the needs of the underserved and underrepresented members of our state in this planned program.

3. How will the planned programs describe the expected outcomes and impacts?

Each of the 4 planned programs contained in our Plan of Work provides several short-term, medium-term, and long-term outcome measures. These outcome statements directly

reflect the situation in our state and multi-state programs and the priorities we have established for the next five years for our research and extension programs. The outcome measures clearly describe the impacts we anticipate occurring as a direct result of the resources we will expend to conduct the activities outlined in each planned program.

4. How will the planned programs result in improved program effectiveness and/or

The 4 planned programs in our Plan of Work are the result of long-standing collaborations between research and extension staff at the University of Delaware and Delaware State University. Because our programs are issue-based and multi-disciplinary, they foster cooperation across departments and universities which increases their overall effectiveness and maximizes the efficiency of our human resources and infrastructure. Cooperative Extension staff regularly identifies pressing needs in the state and region and communicate these to researchers who then develop teams to address applied problems. Knowledge gained from basic research is communicated by scientists to Extension staff and our stakeholders via workshops, training sessions, and public meetings. Sharing results of fundamental research with potential end-users stimulates ideas on how to apply this knowledge in the most efficient and cost-effective manner.

IV. Stakeholder Input

1. Actions taken to seek stakeholder input that encourages 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 will be 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 will be 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.

V. Planned Program Table of Content

V(A). Planned Program (Summary)

Program # 1

1. Name of the Planned Program

SUSTAINABLE PRODUCTION SYSTEMS FOR AGRICULTURAL AND URBAN LANDSCAPES

2. Brief summary about Planned Program

Sustaining our food system requires an interdisciplinary approach, one that meets the following key goals: (1) profitable for the producer, (2) affordable, safe and nutritious for the consumer, and (3) respectful of the environment. Without any one of the three, the system fails. Our program focuses on food systems that span from large, intensive crop and animal-based agricultural systems to the growing number of smaller local systems that increasingly provide fresh food for urban and suburban populations. The ultimate goals are best management practices to maintain or enhance the competitiveness of Delaware's agriculture and food systems and development and adoption of appropriate technologies for food production and marketing in urban areas.

3. Program existence : Mature (More then five years)

4. Program duration : Long-Term (More than five years)

5. Expending formula funds or state-matching funds : Yes

6. Expending other than formula funds or state-matching funds : Yes

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	10%	10%	10%	10%
112	Watershed Protection and Management	5%	5%	5%	5%
201	Plant Genome, Genetics, and Genetic Mechanisms	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%
212	Pathogens and Nematodes Affecting Plants	5%	5%	5%	5%
304	Animal Genome	10%	10%	10%	10%
305	Animal Physiological Processes	5%	5%	5%	5%
307	Animal Management Systems	5%	5%	5%	5%
311	Animal Diseases	15%	15%	15%	15%
405	Drainage and Irrigation Systems and Facilities	10%	10%	10%	10%
604	Marketing and Distribution Practices	5%	5%	5%	5%
903	Communication, Education, and Information Delivery	5%	5%	5%	5%
	Total	100%	100%	100%	100%

V(C). Planned Program (Situation and Scope)

1. Situation and priorities

Today, Delaware's large-scale, production 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 ($750 million annually) accounting for 76% of the total economic value of agriculture in the state. Livestock industries ($28M income from dairy, beef cattle, swine) are important and 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 that provides fresh, local foods and plants for sustainable landscapes represent the diversity and breadth of 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) and in smaller, local operations that provide fresh produce and other products to urban populations. Crop management depends more than ever on fundamental research on plant genomes and using genomic

information to solve production problems. In this program, we address advances in field-scale crop management and farm marketing skills to ensure that farmers - large and small - and the "green industry" remain profitable. Basic studies on plant genetics and genomics, emphasizing 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 soil stresses. We conduct basic research to increase our fundamental understanding of plant and 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.

Animal agriculture, and in particular poultry production, will remain the mainstay of Delaware's agricultural economy and have an increasingly international focus via export markets. Research and extension priorities for animal agriculture are: prevention and control of infectious diseases affecting animals and humans; protecting air, water, soil, and human health from environmental pollution from animal agriculture; resolving socio-political conflicts between animal industries and growing urban and suburban communities; identifying suitable aquaculture species and low input methods to raise them profitably ; and providing management practices and technologies needed for success in an increasingly competitive global economy. Economic changes and population growth associated with urbanization, occurring worldwide, will exert increasing pressures to convert farmland and natural resource areas to developed land uses, threatening our ability to produce food and prevent losses of biodiversity. At the same time, the poultry industry will continue to need a large and reliable source of grain crops as a feed; vegetable and specialty crop production is growing as urban markets for these crops expands; and the need for locally grown foods, and horticultural plants for sustainable landscapes will increase. To sustain crop production as a vital part of Delaware's economy, research and extension priorities in the plant and soil sciences are: advances in plant genetics/breeding and engineering technologies (e.g., irrigation) and molecular biology (genomics, proteomics, and bioinformatics), increasing agronomic and vegetable crop yields from a decreasing land base; expanding the variety and marketability of vegetable and specialty crops and growing local food production systems focused on urban/suburban markets; improving environmental efficiency of all cropping systems; pasture management for grazing animals; integrating more biological control practices into hay production; enhancing marketing skills needed by farmers to adapt to changes in crops and consumer preferences; addressing invasive species and pest management, risk management practices, and developing environmentally sound horticulture programs emphasizing the use of native plant species.

There is an increasing need to raise agricultural awareness in urban areas of Delaware; to address food access and security issues, and make nutritious and affordable foods available to all Delawareans; to teach urban communities to grow, prepare, and eat and demand fresh, locally grown food; and, to improve sense of community, as well as aesthetics, of urban areas. **This effort requires an integrated programmatic approach of agricultural, community development and nutrition and health efforts.**

2. Scope of the Program

- In-State Extension
- In-State Research
- Multistate Research
- Multistate Extension
- Integrated Research and Extension
- Multistate Integrated Research and Extension

V(D). Planned Program (Assumptions and Goals)

1. Assumptions made for the Program

Integrated, multi-disciplinary research and extension projects, often including cooperators from other states and countries, will be the model for future efforts. Competitive funding will increase, cooperative interactions with agricultural and energy industries, state and federal agencies, scientists and extension educators from other countries, and public advocacy groups will grow, and comprehensive research and extension programs will be developed for established and emerging sectors of Delaware agriculture. Developing approaches to preserve agricultural farmland and sustain the land base needed to produce crops for poultry and livestock will be a priority. Agricultural success will continue to be threatened by global pressures exerted on farmers by rising production costs, international competition, reduced commodity prices and barriers to an increase in the number of new farmers due to high land costs. Farmers will seek new land uses, new production technologies, and new, value-added cropping systems to increase profitability from smaller land bases. Climate change will create more extremes in weather and require advances in irrigation science and technology as well as advances in current approaches to the control of plant pests. Diversification of agricultural products will reduce risk and increase overall farm income. Crop production for bioenergy will become more important, particularly the production of biodiesel fuels from soybeans and cellulosic ethanol crops. The horticulture industry will expand into a major economic force in the state; locally grown food by small farmers will become more important; and greenhouse production of a bioengineered plants for non-agricultural uses will emerge as new opportunities. For all animal and plant production systems, protecting and improving water, air, and soil quality will remain a high priority for research and extension programs. Resource economists will develop land use policies that sustain agriculture and natural ecosystems and outreach programs to public policy and risk management for farmers, rural citizens, and urban/suburban populations. As with other successful programs we have developed in the past, we anticipate that external funding from competitive sources, often conducted with colleagues from other universities in the region, will provide the resources needed to conduct basic and applied research and develop extension teams to conduct educational programs and provide advice on new management strategies.

2. Ultimate goal(s) of this Program

The ultimate goal of Program 1 is sustainable production systems for agricultural and urban landscapes. This goal contributes to a safe and secure food supply across all scales, from large, intensive agriculture to the small producers of local food. Integrated into this goal is the commitment to develop research-based economic policies that sustain our agricultural land base and maintain the profitability of crop and animal agriculture.

V(E). Planned Program (Inputs)

1. Estimated Number of professional FTE/SYs to be budgeted for this Program

Year	Extension		Research	
	1862	1890	1862	1890
2015	16.8	5.1	34.1	2.0
2016	16.8	5.1	34.1	2.0
2017	16.8	5.1	34.1	2.0

Year	Extension		Research	
	1862	1890	1862	1890
2018	16.8	5.1	34.1	2.0
2019	16.8	5.1	34.1	2.0

V(F). Planned Program (Activity)

1. Activity for the Program

Research and extension programs fall into the following target areas:

I. **Best Management Practices to maintain or enhance the competitiveness of Delaware's agriculture and food systems**

A. Animal Agriculture: 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; (6) Comparative Pathology Laboratory. This laboratory supports the efforts of poultry diagnostic laboratories in Delaware and Maryland and features collaborative research on histopathologic analysis for researchers engaged in studies related to animal disease and animal models of human disease, and consultation regarding tissue dissection, collection, trimming, fixation, image capture, and techniques in immune-histochemistry.

B. Plant Biology and Crop Production: Key activities are: (1) Agronomic, Vegetable and Horticultural Crops - 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, emphasizing the growth of local food productions systems and sustainable landscape design practices for urban settings; (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 soil/climate stress and the nature of soil microorganism-plant symbiotic relationships and plant/soil interfacial reactions affecting crop growth and quality; (6) Pasture and Forage Management - research on pasture-based animal production systems and forage research on improving biological control systems for alfalfa. (7) 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.

II. Develop and adopt appropriate technologies for food production and marketing in urban areas.

Key activities are: (1) expand food production with micro entrepreneurship opportunities in urban/suburban areas; (2) leadership development for community leaders involved in urban food production projects; (3) increased educational programming to successfully plan and grow a garden/farm for individuals, communities, and community leaders (acquiring land to determine soil concerns and plant selection) increased educational programming to harvest and prepare healthy, local food for individuals, communities, and community leaders; and (4) develop appropriate technologies for food production in urban areas.

This will require us to maintain and develop new partnerships with other colleges/department/centers such as Urban Affairs and Public Policy, Institute of Public Administration, and Blueprint Communities, and others such as the Delaware Department of Agriculture, Department of Natural Resources and Environmental Control, the Delaware Center for Horticulture, City of Wilmington, Newark, and other cities in Delaware.

2. Type(s) of methods to be used to reach direct and indirect contacts

Extension

Direct Methods	Indirect Methods
● Education Class ● Workshop ● Group Discussion ● One-on-One Intervention ● Demonstrations	● Newsletters ● TV Media Programs ● eXtension web sites ● Web sites other than eXtension ● Other 1 (Social Media, Newspapers) ● Other 2 (Blogs, Online Courses)

3. Description of targeted audience

For animal agriculture, the target audience is 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; scientists in the U.S. and international colleagues, K-12 teachers, and environmental and community groups. For crop and soils related research and extension programs, the audience includes existing and prospective grain crop producers, vegetable and horticultural crop producers, mixed (animal and crop production, e.g., dairy, horse) farms, crop commodity and trade, the "green industry" ,certified crop advisors, private agricultural consultants, state and federal agencies, agrichemical and agricultural equipment companies, processors, marketers of plants of flavor, fragrance, and medicine, peer scientists in the U.S. and other countries, K-12 educators, and policy-makers. For urban agriculture the audience

includes farmers, landowners, state agencies and federal agencies, land use organizations , environmental groups, business and community leaders, families, students, and the general public.

V(G). Planned Program (Outputs)

NIFA no longer requires you to report target numbers for standard output measures in the Plan of Work. However, all institutions will report actual numbers for standard output measures in the Annual Report of Accomplishments and Results. The standard outputs for which you must continue to collect data are:

- Number of contacts
  - Direct Adult Contacts
  - Indirect Adult Contacts
  - Direct Youth Contacts
  - Indirect Youth Contact
- Number of patents submitted
- Number of peer reviewed publications

☐ Clicking this box affirms you will continue to collect data on these items and report the data in the Annual Report of Accomplishments and Results.

V(H). State Defined Outputs

1. Output Measure

- Competitive Grants Awarded
- Undergraduate Researchers
- M.S.and Ph.D. Students
- Post-doctoral Research Associates
- Refereed Journal Articles
- Books and Book Chapters
- Extension Bulletins and Factsheets
- Webpage views/downloads
- Workshops at State, National or International Level

☐ Clicking this box affirms you will continue to collect data on these items and report the data in the Annual Report of Accomplishments and Results.

V(I). State Defined Outcome

O. No	Outcome Name
1	Best Management Practices to maintain or enhance the competitiveness of Delaware?s agriculture and food systems: Number of acres or animal units adopting practices to increase yield, increase profitability or more efficiently use inputs;
2	Development and adoption of appropriate technologies for food production and marketing in urban areas: Number of participants adopting appropriate technology for food production in urban areas.

Outcome # 1

1. Outcome Target

Best Management Practices to maintain or enhance the competitiveness of Delaware?s agriculture and food systems: Number of acres or animal units adopting practices to increase yield, increase profitability or more efficiently use inputs;

2. Outcome Type : Change in Action Outcome Measure

3. Associated Knowledge Area(s)

- 102 - Soil, Plant, Water, Nutrient Relationships
- 112 - Watershed Protection and Management
- 205 - Plant Management Systems
- 307 - Animal Management Systems
- 311 - Animal Diseases
- 405 - Drainage and Irrigation Systems and Facilities
- 604 - Marketing and Distribution Practices

4. Associated Institute Type(s)

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

Outcome # 2

1. Outcome Target

Development and adoption of appropriate technologies for food production and marketing in urban areas: Number of participants adopting appropriate technology for food production in urban areas.

2. Outcome Type : Change in Action Outcome Measure

3. Associated Knowledge Area(s)

- 102 - Soil, Plant, Water, Nutrient Relationships
- 205 - Plant Management Systems
- 307 - Animal Management Systems
- 604 - Marketing and Distribution Practices
- 903 - Communication, Education, and Information Delivery

4. Associated Institute Type(s)

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

V(J). Planned Program (External Factors)

1. External Factors which may affect 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.)

Description

V(K). Planned Program - Planned Evaluation Studies

Description of Planned Evaluation Studies

We will use both formative and summative evaluation studies for all programs developed for the Plan of Work. Extension will conduct statewide collection of outcome data in the New England Consortium Planning and Reporting Web tool to provide both output and outcome data and narrative information systematically across the state. During this 5-year period we will conduct both periodic needs assessments of clientele and regular evaluations at workshops, training sessions, and education programs and also periodically survey our stakeholders for input on the appropriateness of our research and extension programs relative to their needs. We will also conduct a retrospective evaluation at the end of this 5-year period to assess the performance of our research and extension programs relative to the Outputs and Outcomes provided in the Plan of Work.

V(A). Planned Program (Summary)

Program # 2

1. Name of the Planned Program

SAFE AND SECURE FOOD SUPPLY FOR HUMAN NUTRITION AND HEALTH

2. Brief summary about Planned Program

The American food system provides consumers with an abundant supply of convenient, economical, high-quality, nutritious and safe food products. This plan will focus on three aspects of the food supply: nutrition and health promotion, food safety, and healthy living from producer to consumer.

Improving the health of the nation requires a multidisciplinary effort. For example, efforts to promote healthy eating are not likely to be successful without considering the process by which food is produced, distributed, and marketed. Likewise, both agricultural systems and health systems are influenced by the built and natural environments in which they exist.

3. Program existence : Mature (More then five years)

4. Program duration : Long-Term (More than five years)

5. Expending formula funds or state-matching funds : Yes

6. Expending other than formula funds or state-matching funds : Yes

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	5%	5%	5%	5%
703	Nutrition Education and Behavior	25%	25%	25%	25%
704	Nutrition and Hunger in the Population	10%	10%	10%	10%
712	Protect Food from Contamination by Pathogenic Microorganisms, Parasites, and Naturally Occurring Toxins	20%	20%	20%	20%
723	Hazards to Human Health and Safety	5%	5%	5%	5%
724	Healthy Lifestyle	10%	10%	10%	10%
806	Youth Development	25%	25%	25%	25%
	Total	100%	100%	100%	100%

V(C). Planned Program (Situation and Scope)

1. Situation and priorities

The primary determinants of an individual's health status are lifestyle, environment, and genetics. Individuals and families who seek a healthier lifestyle face a myriad of social, economic, and environmental factors that reinforce their current behaviors. As a result, the United States continues to spend more on health care than any other nation but has the worst health outcomes of any developed nation. Evidence-based interventions, deployed in ways that are respectful of community, individual and family norms, beliefs and current practice, have been shown to keep people healthy, and delay or prevent the need for medical care.

A number of national trends help to define the situation and issues in the area of healthy living. Food security impacts health. Food insecurity hovers around 15% nationally, with those considered to have very low food security increasing. There is an increase in age-related health challenges. Nearly 33% of lifetime expenditures for healthcare occur during middle age and approximately 50% of total lifetime spending for healthcare is during the senior years. The leading health indicators have demonstrated little improvement in disparities over the past decade. Significant racial and ethnic health disparities continue to permeate the major dimension of population health. Economic inequalities also contribute to health disparities. The National assessment of Adult Literacy, found that 12% of the national population had proficient health literacy. Nine out of 10 adults have difficulty using everyday health information presented by health care facilities, retail outlets, media, local communities and other sources. Obesity is a major concern in the United States. Delawareans classified as obese rose from 19% in 1997 to 28% in 2008. The National Center for Advancing Translational Sciences suggests that community engagement is a significant factor in all phases of clinical and translational research, and is necessary to bring innovative treatments to individuals across the nation to improve health and well-being.

While the American food system can be characterized by high levels of food safety, foodborne illness still occurs. Each year, an estimated 48 million Americans contract foodborne illness and 3000 die as a result of food contaminated by microorganisms. Outbreaks of foodborne illness due to microbial contamination continue to be a major, but preventable public health problem. Advances in understanding and controlling foodborne pathogens have been significant, but new pathogens, new food products, increases in imported foods, and increasing anti-microbial resistance present new challenges to the nation's food safety.

2. Scope of the Program

- In-State Extension
- In-State Research
- Multistate Research
- Multistate Extension
- Integrated Research and Extension
- Multistate Integrated Research and Extension

V(D). Planned Program (Assumptions and Goals)

1. Assumptions made for the Program

There is a complex interplay between individual, community, and societal factors involved in human health. The individual's attitudes, beliefs, behaviors and choices play a significant role in health. The community and societal factors include both the settings in which people live and work, as well as the social and cultural norms, economics, education, social policies and inequalities. A social-ecological model that

includes not only these factors but the interplay between them underpins the work in this planned program. As with other successful programs we have developed in the past, we anticipate that external funding from competitive sources, often conducted with colleagues from other universities in the region, will provide the resources needed to conduct basic and applied research and develop extension teams to conduct educational programs and provide advice on new management strategies.

2. Ultimate goal(s) of this Program

The ultimate goal of Planned Program 2 is to increase the number of Delawareans who are healthy at every stage of life through nutrition, health and food safety efforts.

V(E). Planned Program (Inputs)

1. Estimated Number of professional FTE/SYs to be budgeted for this Program

Year	Extension		Research	
	1862	1890	1862	1890
2015	8.5	6.6	14.8	1.2
2016	8.5	6.6	14.8	1.2
2017	8.5	6.6	14.8	1.2
2018	8.5	6.6	14.8	1.2
2019	8.5	6.6	14.8	1.2

V(F). Planned Program (Activity)

1. Activity for the Program

I. Nutrition and Health Promotion
Extension programs will have a nutrition and health focus. The Expanded Food and Nutrition Education Program (EFNEP) and the Supplemental Nutrition Assistance Education Program focus on low income adults and children. Nutrition education programs for the broader population will include Dining with Diabetes and Eat Smart for a Healthy Heart. Delaware will fully invest in the youth mandate area of healthy living by preparing youth for healthy lifestyle choices in nutrition and physical activities. Additional health approaches will include drug and alcohol prevention, and bullying and suicide prevention. Curricula will include Health Rocks, Up for the Challenge, and Food Smart Families. Master Food Educator Volunteers and trained adult volunteers and teen mentors will participate in program delivery.

II. Food Safety
Research efforts involve high pressure processing to reduce bacteria, viruses, protozoan oocysts, and bacterial endospores; inactivation of pathogenic bacterial species with high pressure and mild heat; using various antimicrobial films to control bacteria, such as Listeria monocytogenes; physiological and genetic analysis of pressure-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.

III. Healthy Living
This is a new interdisciplinary focus on health beyond nutrition education. Research will explore the "One Health" concept and the contribution of plant, animal and ecosystem health to human health. Extension efforts will dovetail with the Cooperative Extension National Framework for Health approved by ECOP in spring 2014. The Delaware Extension program will focus on the topics of health literacy, chronic disease prevention and management, positive youth development for health, and integrated nutrition, health, environment, agriculture systems. This programmatic effort will highlight some new partnerships including the College of Health Sciences and the DE Department of Health.

2. Type(s) of methods to be used to reach direct and indirect contacts

Extension

Direct Methods	Indirect Methods
● Education Class ● Workshop ● Group Discussion ● One-on-One Intervention ● Demonstrations	● Newsletters ● TV Media Programs ● eXtension web sites ● Web sites other than eXtension ● Other 1 (Social Media, Newspapers) ● Other 2 (Blogs, Online Courses)

3. Description of targeted audience

Adults, youth, particularly low income adults and youth, 4-H adult and teen volunteers, as well as Master Food Educators are the primary target audiences for the Extension programs. Community groups and health organizations will be another audience but also partners in outreach efforts.

V(G). Planned Program (Outputs)

NIFA no longer requires you to report target numbers for standard output measures in the Plan of Work. However, all institutions will report actual numbers for standard output measures in the Annual Report of Accomplishments and Results. The standard outputs for which you must continue to collect data are:

- Number of contacts
  - Direct Adult Contacts
  - Indirect Adult Contacts
  - Direct Youth Contacts
  - Indirect Youth Contact
- Number of patents submitted
- Number of peer reviewed publications

☑ Clicking this box affirms you will continue to collect data on these items and report the data in the Annual Report of Accomplishments and Results.

V(H). State Defined Outputs

1. Output Measure

- Competitive Grants Awarded
- Undergraduate Researchersw
- M.S. and Ph.D Students
- Post-doctoral Research Associates
- Refereed Journal Articles
- Books and Book Chapters
- Extension Bulletins and Fact Sheets
- Webpage views/downloads
- Workshops at State, National, and International Level

☑ Clicking this box affirms you will continue to collect data on these items and report the data in the Annual Report of Accomplishments and Results.

V(I). State Defined Outcome

O. No	Outcome Name
1	Nutrition and Health: Increases in the knowledge, skills and plans to adopt and/or adoption of healthful diet practices and/or physical activity
2	Food Safety: Increases in the knowledge, skills and plans to adopt better food safety/food handling practices. The number of people certified in safe food handling practices. Basic and applied research 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.
3	Healthy Living: Increases in the knowledge, skills and plans to adopt and/or adoption of health literacy and chronic disease management and prevention skills. Increases in the knowledge, skills and plans to adopt and/or adoption of practices to prevent accidents and injuries. Increases in the knowledge, skills and plans to adopt and/or adoption of practices to prevent bullying and suicides. Increases in the knowledge, skills and plans to adopt and/or adoption of positive behaviors regarding health and legal risks of using tobacco, drugs, and alcohol.

Outcome # 1

1. Outcome Target

Nutrition and Health:
Increases in the knowledge, skills and plans to adopt and/or adoption of healthful diet practices and/or physical activity

2. Outcome Type : Change in Knowledge Outcome Measure

3. Associated Knowledge Area(s)

- 703 - Nutrition Education and Behavior
- 704 - Nutrition and Hunger in the Population
- 724 - Healthy Lifestyle
- 806 - Youth Development

4. Associated Institute Type(s)

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

Outcome # 2

1. Outcome Target

Food Safety:
Increases in the knowledge, skills and plans to adopt better food safety/food handling practices.
The number of people certified in safe food handling practices.
Basic and applied research 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. Outcome Type : Change in Knowledge Outcome Measure

3. Associated Knowledge Area(s)

- 501 - New and Improved Food Processing Technologies
- 712 - Protect Food from Contamination by Pathogenic Microorganisms, Parasites, and Naturally Occurring Toxins
- 723 - Hazards to Human Health and Safety
- 724 - Healthy Lifestyle
- 806 - Youth Development

4. Associated Institute Type(s)

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

Outcome # 3

1. Outcome Target

Healthy Living:
Increases in the knowledge, skills and plans to adopt and/or adoption of health literacy and chronic disease management and prevention skills.
Increases in the knowledge, skills and plans to adopt and/or adoption of practices to prevent accidents and injuries.
Increases in the knowledge, skills and plans to adopt and/or adoption of practices to prevent bullying and suicides.
Increases in the knowledge, skills and plans to adopt and/or adoption of positive behaviors regarding health and legal risks of using tobacco, drugs, and alcohol.

2. Outcome Type : Change in Knowledge Outcome Measure

3. Associated Knowledge Area(s)

- 724 - Healthy Lifestyle
- 806 - Youth Development

4. Associated Institute Type(s)

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

V(J). Planned Program (External Factors)

1. External Factors which may affect 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.)

Description

V(K). Planned Program - Planned Evaluation Studies

Description of Planned Evaluation Studies

We will use both formative and summative evaluation studies for all programs developed for the Plan of Work. Extension will conduct statewide collection of outcome data in the New England Consortium Planning and Reporting Web tool to provide both output and outcome data and narrative information systematically across the state. During this 5-year period we will conduct both periodic needs assessments of clientele and regular evaluations at workshops, training sessions, and education programs and also periodically survey our stakeholders for input on the appropriateness of our research and extension programs relative to their needs. We will also conduct a retrospective evaluation at the end of this 5-year period to assess the performance of our research and extension programs relative to the Outputs and Outcomes provided in the Plan of Work.

V(A). Planned Program (Summary)

Program # 3

1. Name of the Planned Program

FAMILY AND YOUTH DEVELOPMENT

2. Brief summary about Planned Program

Societal and economic pressures on families and youth are greater and more complex than ever before. The nature of the family itself is changing, which increases pressure on youth, placing youth and families at greater risk. Asset models are key to research and extension priorities to expand life skill development in STEM areas as well as in leadership development of youth and adults, and ability to manage farm, small business and family resources for financial well-being.

3. Program existence : Mature (More then five years)

4. Program duration : Long-Term (More than five years)

5. Expending formula funds or state-matching funds : Yes

6. Expending other than formula funds or state-matching funds : Yes

V(B). Program Knowledge Area(s)

1. Program Knowledge Areas and Percentage

KA Code	Knowledge Area	%1862 Extension	%1890 Extension	%1862 Research	%1890 Research
601	Economics of Agricultural Production and Farm Management	15%	15%	15%	15%
801	Individual and Family Resource Management	15%	15%	15%	15%
803	Sociological and Technological Change Affecting Individuals, Families, and Communities	25%	25%	25%	25%
806	Youth Development	35%	35%	35%	35%
901	Program and Project Design, and Statistics	10%	10%	10%	10%
	Total	100%	100%	100%	100%

V(C). Planned Program (Situation and Scope)

1. Situation and priorities

Our extension and research priorities focus on delivering educational programs that: build the capacity of families to nurture and support their members over the life span; give youth the leadership, career development and life skills needed for academic and personal success; and provide financial planning, and consumer decision makingskills to relieve economic stresses on family members.

For more than a century, 4-H has engaged youth in science, technology, engineering, and math (STEM). This has traditionally meant a solid focus on agricultural science, electricity, mechanics, entrepreneurship, and natural sciences. Today, 4-H has grown to include rocketry, robotics, bio-fuels, renewable energy, computer science, environmental sciences, and more. The 4-H Science, Engineering and Technology Program provides hands-on learning experiences to encourage learning about the world in partnership with adults in STEM fields.

In school, science classes need to cover a broad range of topics in a limited amount of time. 4-H STEM allows time to dig deeper into specific topics. Youth can spend as much time as desired and choose topics based on their interests, questions, and skills. They also get expert support by working with adults who have made science and engineering their life's work. 4-H STEM allows youth to work on their questions, design their own tests, create their own models, build their understanding, and share their work with others.

Developing skills in the fields of science, technology, engineering, and mathematics (STEM) is increasingly important for student success at all levels of education. These same skills are also crucial for workforce success, as a growing number of jobs will be in STEM fields or require at least some STEM skills. In the 21st century, our economy will be driven even more by contributions that come from discoveries and innovations in the STEM fields.

Volunteers are the lifeblood of the Extension organization not only for youth development but also adult programming. Cooperative Extension benefits from a robust volunteer infrastructure that sustains the activities of the organization. There are over 3000 volunteers currently in the Delaware Cooperative Extension program. They are committed to the organization mission and goals and are responsive to the needs of the community. A blended learning leadership program is critical to maintaining the corps of volunteer leaders. Leadership development programs focus on development of leadership skills, promotion of volunteerism and civic engagement, equip leaders with the skills and knowledge they need to succeed, and support leaders in their organizational service efforts.

Studies show that financial well-being is critical to the overall well-being of families. Currently, median household income in Delaware is $58,415 (2012). It has continued to decline over the last few years from its peak in 2008 at $61,840. In addition, two-thirds of Delawareans have an income less than 400% of the poverty level, 27% have incomes less than 138% of the poverty level, and 19% have incomes below the poverty level. The unemployment rate (seasonally adjusted) was 6.8% in 2013, decreasing slightly since 2012 (http://quickfacts.census.gov/qfd/states/10000.html).

In Delaware, 19% of individuals reported that over the past year, their household expenditures exceeding their income (not including the purchase of a new home, car or other big investment), while 30% of individuals reported having medical bills that are past due. Individuals who are not balancing monthly income and expenses are not saving, and thus may find themselves struggling to make ends meet. Overdue medical debt can further compound a household's ability to meet monthly financial obligations.

Many Americans are not planning ahead for their financial future. In Delaware, 57% of individuals lack a "rainy day fund" to cover expenses for three months, in case of emergencies such as sickness, job loss or economic downturn. Individuals without this emergency fund lack adequate protection against financial emergencies or other shocks which may threaten their financial stability.

Family risk management focuses on health insurance literacy. Two-thirds of Delaware's population is potentially eligible for tax subsidies through healthcare.gov. Research shows that selecting health insurance is not an easy task for many consumers. They are challenged with making health insurance decisions, choosing appropriate levels of coverage, evaluating needs or examining personal financial situations (Consumer Reports, 2012; Kim, Braun & Williams, 2013; Quincy, 2012) Moreover, some consumers do not understand important terms, features or how to shop and compare.

Family risk management for farm owners is also critical to Delaware. The market value of agricultural products (both livestock and crop) in Delaware averaged about $519,794 per farm. Of the 2451 farms in Delaware, 917 of them reported receiving government payments of approximately $10,553 per farm. The total number farms reporting net gains in 2012 were 1,563 (approximately $232,823 per farm). Conversely, 978 farms reported a net loss in 2012 (approximately $48,610 per farm).

Operating expenses continue to increase. Fertilizer, fuels, hired farm labor, interest expense and chemicals account for a large portion of the input expenses. Crop insurance is an additional expense, but also a source of revenue for 246 farms that reported receiving payments, averaging $27,199 per farm. Delaware reports several other sources of farm-related sources, including agritourism, sales of forest products and custom work. (USDA 2012 Census of Agriculture).

Given the number of farms, the diversity, the average age of the principal operator and the unique loan programs for farmers, Delaware Extension will carry-on traditional farm management education programs (financial recordkeeping, marketing, and estate planning) as well as new programs to meet the risk management needs of all generations involved in agriculture in the state. With the passing of the 2014 Farm Bill, the farm risk management program will provide Farm Bill education as well.

2. Scope of the Program

- In-State Extension
- Multistate Extension

V(D). Planned Program (Assumptions and Goals)

1. Assumptions made for the Program

Social and economic stresses faced by Delaware families will increase and become more complex. Youth will be constantly faced with a need for support external to the family to provide programs on social and leadership skills, academic success, financial planning, and preparation for an increasingly sophisticated, technologically oriented workplace. Adults will face serious challenges as their parents and other relatives age. Financial management related to health insurance continues in importance as the percentage of expenditure in this area rises. Farm financial management and knowledge of new programs and procedures in the 2014 Farm Bill will be critical to farm families. Public pressure to provide assistance and educational programs to families will grow, providing opportunities for Extension to lead family and youth development programs that can contribute significantly to this societal need. As with other successful programs we have developed in the past, we anticipate that external funding from competitive sources, often conducted with colleagues from other universities in the region, will provide the resources needed to conduct basic and applied research and develop extension teams to conduct educational programs and provide advice on new management strategies.

2. Ultimate goal(s) of this Program

The ultimate goals of Planned Program 3 are an increased capacity of families, individual adults and youth, and communities to improve their quality of life and financial status through comprehensive, research-based, outreach and educational programming. 4-H Youth Development will work to ensure opportunities for all youth to participate in long-term, sustainable relationships under the direction of caring adults in community-based settings.

V(E). Planned Program (Inputs)

1. Estimated Number of professional FTE/SYs to be budgeted for this Program

Year	Extension		Research	
	1862	1890	1862	1890
2015	9.8	2.9	0.9	0.3
2016	9.8	2.9	0.9	0.3
2017	9.8	2.9	0.9	0.3
2018	9.8	2.9	0.9	0.3
2019	9.8	2.9	0.9	0.3

V(F). Planned Program (Activity)

1. Activity for the Program

Extension programs will target: (1) Science, Technology, Engineering, and Math (STEM) for youth development, (2) Volunteer and Leadership Development, and (3) Farm, Small Business and Family Resource Management.

Science, Technology, Engineering, and Math (STEM) will be a key component of 4-H Youth Development programs. Incorporating a youth assets approach, 4-H 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. All programming will encompass the latest research on positive youth development and will incorporate the components of positive and sustained adult-youth relationships; life skills-building activities for youth; and opportunities for youth participation in and leadership of valued community activities.

Volunteer Leadership Development programs will be delivered across all program areas. With a core of 3000 volunteers in Cooperative Extension, this program will include core volunteer competencies for volunteer leadership development that will be implemented with 4-H adult and teen volunteers and camp counselors, master gardeners, master food educators; middle management volunteers (volunteers managing volunteers); and extension advisory committees. Core competencies as well as subject matter training and update training to maintain certifications will be provided. Delivery of educational program through volunteers will also occur across all program areas.

Farm, Small Business, and Family Resource managementeducational programs will be developed and delivered focusing on strategies for effective consumer decision making, financial planning and financial management practices, basic budgeting and credit management, and risk management including health insurance literacy. Additionally, business management strategies focused on business and marketing plans, new business development, business diversification, and improving employability and building human capital skills.

2. Type(s) of methods to be used to reach direct and indirect contacts

Extension

Direct Methods	Indirect Methods
● Education Class ● Workshop ● Group Discussion ● One-on-One Intervention ● Demonstrations	● Newsletters ● TV Media Programs ● eXtension web sites ● Web sites other than eXtension ● Other 1 (Social Media, Newspapers) ● Other 2 (Blogs, Online Courses)

3. Description of targeted audience

The target audience includes:Youth ages 5-19, 4-H members, 4-H volunteers, new 4-H volunteers, Master Gardeners, Master Food Educators, Community Leaders, at-risk youth and families, court appointed and incarcerated youth and adults, parents of children (from birth through school-age), 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, farm owners and farm families

V(G). Planned Program (Outputs)

NIFA no longer requires you to report target numbers for standard output measures in the Plan of Work. However, all institutions will report actual numbers for standard output measures in the Annual Report of Accomplishments and Results. The standard outputs for which you must continue to collect data are:

- Number of contacts
  - Direct Adult Contacts
  - Indirect Adult Contacts
  - Direct Youth Contacts
  - Indirect Youth Contact
- Number of patents submitted
- Number of peer reviewed publications

☑ Clicking this box affirms you will continue to collect data on these items and report the data in the Annual Report of Accomplishments and Results.

V(H). State Defined Outputs

1. Output Measure

- Competitive Grants Awarded
- Undergraduate Researchers
- M.S. and Ph.D Students
- Post-doctoral Researchers
- Refereed Journal Articles
- Books and Book Chapters
- Extension Bulletins and Fact Sheets
- Webpage views/downloads
- Workshops and regional, national, and international levels

☑ Clicking this box affirms you will continue to collect data on these items and report the data in the Annual Report of Accomplishments and Results.

V(I). State Defined Outcome

O. No	Outcome Name
1	Science, Technology, Engineering, and Math: 1) Increased knowledge of STEM content areas resulting in increased critical thinking and scientific inquiry. 2) Increased numbers of youth pursuing education and careers in science and in contributing to society using science skills.
2	Volunteer Leadership Development: 1) Increased knowledge of leadership skills and apply of these skills volunteering and leadership within the community. 2) Augmentation of Cooperative Extension program and resources through volunteer leaders providing education in communities and groups.
3	Farm, Small Business, and Family Resource management: 1) Increased knowledge, increased awareness of skills to use, and adoption of best practices in financial management. 2) Increased knowledge, increased awareness and adoption of skills to use and evaluate and enhance business and marketing plans.

Outcome # 1

1. Outcome Target

Science, Technology, Engineering, and Math:
1) Increased knowledge of STEM content areas resulting in increased critical thinking and scientific inquiry.
2) Increased numbers of youth pursuing education and careers in science and in contributing to society using science skills.

2. Outcome Type : Change in Knowledge Outcome Measure

3. Associated Knowledge Area(s)

- 803 - Sociological and Technological Change Affecting Individuals, Families, and Communities
- 806 - Youth Development
- 901 - Program and Project Design, and Statistics

4. Associated Institute Type(s)

- 1862 Extension
- 1890 Extension

Outcome # 2

1. Outcome Target

Volunteer Leadership Development:
1) Increased knowledge of leadership skills and apply of these skills volunteering and leadership within the community.
2) Augmentation of Cooperative Extension program and resources through volunteer leaders providing education in communities and groups.

2. Outcome Type : Change in Knowledge Outcome Measure

3. Associated Knowledge Area(s)

- 801 - Individual and Family Resource Management
- 803 - Sociological and Technological Change Affecting Individuals, Families, and Communities
- 806 - Youth Development
- 901 - Program and Project Design, and Statistics

4. Associated Institute Type(s)

- 1862 Extension
- 1890 Extension

Outcome # 3

1. Outcome Target

Farm, Small Business, and Family Resource management:
1) Increased knowledge, increased awareness of skills to use, and adoption of best practices in financial management.
2) Increased knowledge, increased awareness and adoption of skills to use and evaluate and enhance business and marketing plans.

2. Outcome Type : Change in Knowledge Outcome Measure

3. Associated Knowledge Area(s)

- 601 - Economics of Agricultural Production and Farm Management
- 801 - Individual and Family Resource Management
- 806 - Youth Development
- 901 - Program and Project Design, and Statistics

4. Associated Institute Type(s)

- 1862 Extension
- 1890 Extension

V(J). Planned Program (External Factors)

1. External Factors which may affect 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.)

Description

{NO DATA ENTERED}

V(K). Planned Program - Planned Evaluation Studies

Description of Planned Evaluation Studies

We will use both formative and summative evaluation studies for all programs developed for the

Plan of Work. Extension will collect outcome data statewide in the New England Consortium Planning and Reporting Web tool to provide both output and outcome data and narrative information systematically across the state. During this 5-year period, we will conduct both periodic needs assessments of clientele and regular evaluations at workshops, training sessions, and education programs. Also, we will periodically survey our stakeholders for input on the appropriateness of our research and extension programs relative to their needs. We will also conduct a retrospective evaluation at the end of this 5-year period to assess the performance of our research and extension programs relative to the Outputs and Outcomes provided in the Plan of Work.

V(A). Planned Program (Summary)

Program # 4

1. Name of the Planned Program

ENVIRONMENTAL STEWARDSHIP IN A CHANGING CLIMATE

2. Brief summary about Planned Program

The focus of research and extension activities in this planned program will be (1) improving our fundamental understanding of why and how a changing climate affects animal and plant physiological processes related to health and productivity, (2) 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 (3)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. A fourth focus includes improving our understanding and skills in best management practices to protect and improve soil, air, and water quality that ensure ecosystem integrity and enhance biodiversity.

3. Program existence : Mature (More then five years)

4. Program duration : Long-Term (More than five years)

5. Expending formula funds or state-matching funds : Yes

6. Expending other than formula funds or state-matching funds : Yes

V(B). Program Knowledge Area(s)

1. Program Knowledge Areas and Percentage

KA Code	Knowledge Area	%1862 Extension	%1890 Extension	%1862 Research	%1890 Research
111	Conservation and Efficient Use of Water	10%	10%	10%	10%
112	Watershed Protection and Management	10%	10%	10%	10%
124	Urban Forestry	5%	5%	5%	5%
132	Weather and Climate	10%	10%	10%	10%
135	Aquatic and Terrestrial Wildlife	15%	15%	15%	15%
136	Conservation of Biological Diversity	10%	10%	10%	10%
216	Integrated Pest Management Systems	20%	20%	20%	20%
302	Nutrient Utilization in Animals	5%	5%	5%	5%
806	Youth Development	10%	10%	10%	10%
903	Communication, Education, and Information Delivery	5%	5%	5%	5%
	Total	100%	100%	100%	100%

V(C). Planned Program (Situation and Scope)

1. Situation and priorities

Delaware's rich terrestrial and coastal ecosystems have helped develop two main industries, agriculture and tourism, which for many years have partially defined the state's economic landscape. However, prosperity and economic diversification have improved the state's appeal, increasing both human population growth and the subsequent demand for land. Competition for land has not only affected agriculture by reducing area farmed and increasing the need to achieve higher crop yields, but it has also impacted the terrestrial and coastal environments by destroying natural areas, marshes and degrading water quality. It seems certain today that land use changes will lead to an increasingly fragmented landscape in Delaware, with less open space and more urban/suburban environments. Farmland area will decrease and remaining farms will slowly change their cropping systems to introduce new, value-added crops (e.g., vegetables, herbs, biofuels), some of which will be genetically modified. Public pressure to prevent ecological degradation will increase, resulting in the need for science-based management practices and policies for agriculture, forestry, suburbia, and natural areas that can sustain or restore ecosystems and provide suitable habitat for wildlife, fish, and endangered species.

Climate change will affect all sectors of Delaware agriculture, as well as natural ecosystems, water resources, and human health. In general, anticipated effects of climate change for Delaware are warmer temperatures, increasing by 3-4^{o}F by 2100, a greater frequency of extremely hot summer days, warmer winters, a 15-40% increase in annual precipitation, and more extreme weather events. Because Delaware is a low-lying coastal state, impacts of sea level rise on coastal ecosystems, ground waters used for irrigation, agricultural drainage, and cropland near coasts are also concerns. While a warmer climate and higher atmospheric concentrations of carbon dioxide may lead to yields of some crops, many negative

impacts are also expected. In particular, because most cropland is located in the sandy, coastal plain, greater rainfall extremes and more severe droughts are expected, accompanied by more severe heat stress for crops, and higher pressure from weeds, insects, and diseases. Higher pest pressure may result in greater pesticide use, increasing production costs and the risk of ground and surface water contamination.

Crops requiring extended periods of cooler weather for optimum flowering, fruit set and seed development may suffer. Irrigation needs are likely to increase and extend beyond current crops (corn, vegetables) to others such as barley, wheat, and soybeans. This may lead to increased conflicts between farmers and other water users, particularly given the rapid pace of urban development.

Animal agriculture, dominated by confined poultry production operations, may face greater challenges in maintaining healthy growing conditions for animals and greater incidences of disease and environmental stress. For example, studies show decreases in birth rates and lower milk yields in dairy cows due to rising temperatures. Animal manures provide valuable plant nutrients and reduce fertilizer costs. However, warmer, wetter conditions may accelerate manure decomposition, releasing more nitrate and phosphate, beneficial from a fertilizer value perspective, but problematic for water quality due to our shallow ground waters and already frequent, plentiful rainfall. Climate change will create challenges for natural resource areas, for similar reasons as agriculture (e.g., insects, disease, water stress) and also foster growth and distribution of invasive plants that now plague many forests, wetlands, and meadows. Warmer conditions may lead to shifts in forest species as native trees adapted to cooler conditions are replaced by those suited to warmer climates.

Delaware's natural ecosystems are becoming increasingly fragmented as urbanization converts farmland and forests into homes, businesses, roadways, and other suburban land uses. 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. Changes in these ecosystems reflect new cropping systems, the growing presence of invasive plants in natural areas, loss of wetlands, and the impacts of nonpoint pollution associated with urbanization of adjacent lands (e.g., air pollution, erosion).

2. Scope of the Program

- In-State Extension
- In-State Research
- Multistate Research
- Multistate Extension
- Integrated Research and Extension
- Multistate Integrated Research and Extension

V(D). Planned Program (Assumptions and Goals)

1. Assumptions made for the Program

Our planned program assumes that climate change will occur and that those involved in sustaining Delaware's agriculture and natural resource areas must be prepared for the deleterious effects of a

warmer and more extreme climate. We assume that the current growing season will become longer, droughts will be more frequent, sea level rise will impact crop production and coastal ecosystems, extreme weather events will periodically disrupt key farming operations such as planting and harvesting, pressures from plant and animal pests (e.g., insects, diseases, weeds) will increase in frequency, duration, and diversity (i.e., new pests adapted to other, warmer regions will appear), and that our natural resource areas will be threatened by drought, diseases, insect, fire, and by both current and new species of invasive plants. In response, we expect to build integrated teams of research and extension scientists to work in close cooperation with farmers, natural resource managers, state and federal agencies, and not-for-profit organizations to develop research-based strategies to mitigate the pending negative effects of climate change. Delaware has developed a state "climate change action plan", now mainly focused on reducing greenhouse gas emissions, and we expect that strategies related to agriculture and forestry will become key components of this plan in the future. As with other successful programs we have developed in the past, we anticipate that external funding from competitive sources, often conducted with colleagues from other universities in the region, will provide the resources needed to conduct basic and applied research and develop extension teams to conduct educational programs and provide advice on new management strategies

2. Ultimate goal(s) of this Program

The ultimate goals of Planned Program #4 are greater understanding of the physiological and ecological effects of climate change on animal agriculture, crop production - including plants produced by Delaware's large and growing "Green Industry", and native and invasive plants found in our increasingly fragmented natural ecosystems. The development of management practices, systems, and technologies to mitigate the effects of climate change and enhance the environmental quality of agriculture and urban landscapes is another goal. In particular, this plan focuses on animal health, drought and irrigation management for agronomic and vegetable crops, pest pressure and integrated pest management practices, nutrient cycling and management, biodiversity and invasive plant control for natural resource areas. Goals also include investigating and proposing new economic policies (e.g., carbon trading) that provide farmers and others with resources to implement the management practices needed to mitigate problems associated with climate change and environmental impacts.

V(E). Planned Program (Inputs)

1. Estimated Number of professional FTE/SYs to be budgeted for this Program

Year	Extension		Research	
	1862	1890	1862	1890
2015	7.8	1.9	30.7	4.8
2016	7.8	1.9	30.7	4.8
2017	7.8	1.9	30.7	4.8
2018	7.8	1.9	30.7	4.8
2019	7.8	1.9	30.7	4.8

V(F). Planned Program (Activity)

1. Activity for the Program

I. Increased knowledge of and best management practices to mitigate the effects of climate change

a. 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. The latest research projects are focusing on animal care, management and environmental design to ensure animal well-being and raise awareness of environmental protection, law and legislation. These studies are on four fronts, including monitoring technologies for animal physiological and behavioral response, assessment of animal-environment interactions, quantitation of air quality and emissions from animal feeding operations, and assessment and development of best management practices aiming at mitigating air emissions based on their character, amount, and dispersion.

b. 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 groundwater 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; and new studies now underway on how changing temperature and rainfall patterns will affect phosphorous management and water quality impacts, using isotope geochemistry to identify how and why the phosphorous has been released from cropland to surface and ground waters. 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;

c. 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; and new studies using weather radar to quantify bird distributions and to track migratory birds. Understanding stopover ecology of migratory birds, including how they select the habitats where they stop and how that impacts their behavior and the success of their migrations is an important area of ecological research today. 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; 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; 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; 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. 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; new research focuses on the ecology and conservation of wild felids, the evaluation of wildlife behavioral response to human recreation, the development of new technologies in wildlife research, the application of hierarchical models, and monitoring bird and bat flight activity near wind turbines; Fisheries - population status, spawning areas, and management of Atlantic sturgeon in the Delaware River.

d. 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. Type(s) of methods to be used to reach direct and indirect contacts

Extension

Direct Methods	Indirect Methods
● Education Class	● Newsletters
● Workshop	● TV Media Programs
● Group Discussion	● eXtension web sites
● One-on-One Intervention	● Web sites other than eXtension
● Demonstrations	● Other 1 (Social Media, Newspapers)
	● Other 2 (Blogs, Online Courses)

3. Description of targeted audience

For animal agriculture, target audiences are 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, audiences include 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, 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. Train the trainer programs will develop volunteers in Master Gardeners and Forest Stewards to augment program outreach.

V(G). Planned Program (Outputs)

NIFA no longer requires you to report target numbers for standard output measures in the Plan of Work. However, all institutions will report actual numbers for standard output measures in the Annual Report of Accomplishments and Results. The standard outputs for which you must continue to collect data are:

- Number of contacts
  - Direct Adult Contacts
  - Indirect Adult Contacts
  - Direct Youth Contacts
  - Indirect Youth Contact
- Number of patents submitted
- Number of peer reviewed publications

☑ Clicking this box affirms you will continue to collect data on these items and report the data in the Annual Report of Accomplishments and Results.

V(H). State Defined Outputs

1. Output Measure

- Competitive Grants Awarded
- Undergraduate Researchers
- M.S. and Ph.D. Students
- Post-doctoral Researchers
- Refereed Journal Articles
- Books and Book Chapters
- Extension Bulletins and Fact Sheets
- Webpage views/downloads
- Workshops at regional, national, and international levels

☑ Clicking this box affirms you will continue to collect data on these items and report the data in the Annual Report of Accomplishments and Results.

V(I). State Defined Outcome

O. No	Outcome Name
1	We anticipate an increase in knowledge of, an acquisition of skills, and/or an adoption of practices that: 1) mitigate the effects of climate change; 2) reduce greenhouse gas emissions and increase carbon sinks; 3) use energy efficiently; 4) protect and improve soil, air, and water quality; 5) promote biodiversity and sustainable landscapes; 6) reduce risks through Integrated Pest Management tactics

Outcome # 1

1. Outcome Target

We anticipate an increase in knowledge of, an acquisition of skills, and/or an adoption of practices that: 1) mitigate the effects of climate change; 2) reduce greenhouse gas emissions and increase carbon sinks; 3) use energy efficiently; 4) protect and improve soil, air, and water quality; 5) promote biodiversity and sustainable landscapes; 6) reduce risks through Integrated Pest Management tactics

2. Outcome Type : Change in Knowledge Outcome Measure

3. Associated Knowledge Area(s)

- 111 - Conservation and Efficient Use of Water
- 112 - Watershed Protection and Management
- 124 - Urban Forestry
- 132 - Weather and Climate
- 135 - Aquatic and Terrestrial Wildlife
- 136 - Conservation of Biological Diversity
- 216 - Integrated Pest Management Systems
- 302 - Nutrient Utilization in Animals
- 806 - Youth Development
- 903 - Communication, Education, and Information Delivery

4. Associated Institute Type(s)

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

V(J). Planned Program (External Factors)

1. External Factors which may affect 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.)

Description

{NO DATA ENTERED}

V(K). Planned Program - Planned Evaluation Studies

Description of Planned Evaluation Studies

We will use both formative and summative evaluation studies for all programs developed for the Plan of Work. Extension will conduct statewide collection of outcome data in the New England Consortium Planning and Reporting Web tool to provide both output and outcome data and narrative information systematically across the state. During this 5-year period we will conduct both periodic needs assessments of clientele and regular evaluations at workshops, training sessions, and education programs and also periodically survey our stakeholders for input on the appropriateness of our research and extension programs relative to their needs. We will also conduct a retrospective evaluation at the end of this 5-year period to assess the performance of our research and extension programs relative to the Outputs and Outcomes provided in the Plan of Work.